Raising EU R&D Intensity

Improving the Effectiveness of Public Support Mechanisms for Private Sector Research and Development: **Fiscal Measures**

Report to the European Commission
by an Independent Expert Group

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Directorate-General for Research
Knowledge Based Society and Economy
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FOREWORD

The EU is currently lagging behind both the USA and Japan in terms of expenditure on R&D as a proportion of GDP, primarily due to slow relative growth in business R&D expenditure. The European Council in Barcelona set an overall target of 3% of GDP by the year 2010, with industry asked to contribute two thirds of this objective. To approach these levels, dramatic improvements are needed in the effectiveness of policies used to stimulate private sector R&D.

In order to review how progress could be made towards this goal, the Commission services set up four expert groups to explore and enhance the potential of different financial and fiscal policy instruments. These different expert groups investigated respectively: direct measures, fiscal measures, risk capital measures and loan and equity guarantee instruments. An overarching expert group, the policy mix group, was also charged with reviewing the relationships between the mechanisms dealt with by the four groups and considering how these measures might be combined most appropriately to stimulate private sector R&D.

The specific aim of this report is to offer suggestions and guidance concerning the design and implementation of fiscal measures to stimulate private investment in research. The report considers the importance of good design of fiscal measures and the role of framework conditions. After reviewing the use of these measures and the factors that affect their effectiveness, the report then presents a series of recommendations for policymakers across the EU.

I should like to thank all the experts who took part in the production of this timely report, particularly the Chairman of the expert group, Professor Van Pottelsberghe, and the Rapporteur, Dr Boekholt. Their work contributed significantly to the Commission's own thinking and to the preparation of the Communication from the Commission: 'Investing in Research: An Action Plan for Europe'. It contains much of value to all those concerned with the formulation and delivery of effective policy mixes. As such I trust that it will stimulate the process of mutual learning needed to realise not only the 3% target for R&D, but also the target set at Lisbon of becoming the most competitive and dynamic knowledge-based economy in the world.

This report, as well as the reports of the other Expert Groups, is available on the Commission Web site http://europa.eu/int/comm/research/ear/3pct.

Philippe Busquin
European Commissioner for Research

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EXECUTIVE SUMMARY

Today, most OECD/EU member countries apply a mix of direct and indirect measures to support R&D. Several countries have introduced or extended fiscal instruments to support R&D. Indirect Fiscal R&D incentives reduce the costs of R&D for a wide variety of firms, including SMEs. Fiscal incentives are recommended to be used to support private R&D because these schemes have the potential to address a wide range of firms, including SMEs, and leave the decision as to the content of the research to their discretion. If well designed, fiscal schemes can contribute to raising the overall level of investment in business R&D.

Fiscal R&D incentives allow companies to reduce their tax payments as a reward for carrying out innovative activities. Most EU-15 countries operate some form of tax measure to stimulate business enterprise R&D, as do Australia, Canada, Japan, the US and China. The use of fiscal incentives for R&D has increased in recent years (Chapter 2). Some examples of the types of schemes employed are given in the following table.

Overview of types of fiscal schemes

Corporation Tax Schemes Volume based	Italy: (only for firms in Objective 1,2 and 5b areas) United Kingdom: (separate schemes for SMEs and large firms) Canada (federal and state level schemes)
Corporation Tax Schemes Incremental	Belgium (per additional member R&D staff) France, United States, Japan, Korea
Corporation Tax Schemes Mixed systems	Austria (three parallel schemes), Portugal, Spain (national level and some regional fiscal schemes), Australia
Schemes based on employers' share of wage tax and social contributions	Netherlands
Fiscal schemes to attract foreign "key personnel' * through personal income tax	Finland, Sweden, Denmark, Netherlands (all have favourable income tax rates)

* These schemes are not exclusively for R&D staff but for all "key personnel" which could also include other staff e.g. management, engineers.

Schemes based on corporation tax are the most widely used type of schemes and the trend is that their use is increasing. Notable exceptions are Finland and Germany where this general trend is overruled by policy considerations to simplify or not further complicate the overall tax system.

The review of the fiscal incentives in place and the current use of tax schemes among the EU Member countries clearly shows a very high diversity. In this context there is

little room for recommending a uniform system of fiscal incentives for business R&D in Europe. Nevertheless, one clear conclusion of this report is that **fiscal incentives stimulate business R&D** and that the **design** of these fiscal incentives **is crucial to the effectiveness of these schemes.** In addition, since fiscal incentives are not the only financial instruments aimed at fostering business R&D, there is a strong **need for co-ordination** between the various institutions and ministries involved in the financing of business R&D.

What constitutes a "good" mix of direct and fiscal measures depends, to a high degree, on the specific conditions in member states, i.e. on framework conditions and, in particular, on the state of the respective national innovation system, its institutions and their strategies. There is evidence that the effectiveness of one instrument depends on the use of other instruments in the system of public support to R&D. At present co-ordination seems to be insufficient in many countries. Therefore co-ordination of instruments within the overall system of public support is essential. In addition to R&D related instruments there are of course many other policy areas that affect R&D, such as macroeconomic conditions, competition policy, an efficient internal market and entrepreneurship.

It follows that in order to realise the full potential of fiscal incentives – not least in view of contributing effectively to the European Union's goal to reach a ratio of R&D expenditure to GDP of 3% by 2010 – both the issues of the design of fiscal incentives and co-ordination with other policy instruments need to be addressed. This may be partly attributed to a lack of awareness of the interdependencies involved but may be also embedded in the departmentalised political process.

Generalisations concerning the efficacy of different types of R&D tax incentive schemes are difficult to make in the absence of extensive evaluation studies of fiscal schemes and the methodological difficulties associated with many of the econometric studies undertaken in this area (Chapter 3). Nevertheless, the following tentative conclusions can still be drawn:

- **If well designed, fiscal incentives can stimulate business R&D**. It has proven difficult, however, to evaluate the amount of additional R&D generated per unit of tax income forsaken by the public sector. The few tentative evaluations that exist show positive but moderate levels of leverage and additionality, and the possibility of externalities (R&D spillovers) strengthens the likelihood of fiscal incentives having positive impacts;
- **There is a clear need for more formal evaluations** to establish the effectiveness and impact of fiscal incentives, and for greater efforts to improve the methodological tools needed to conduct them;
- **Better micro-level data sets are needed** to understand the long-term impact of fiscal incentives on business R&D;
- Existing evaluations of fiscal R&D incentive schemes in different countries cannot be compared due to the use of different methodologies, incommensurable data sets and dissimilar time periods. **Coordinated, cross-country comparisons of the efficacy of different types of scheme using similar methodological approaches are needed**.

There are a number of clear design principles that Member States should use to review their current fiscal mechanisms and design new ones (Chapter 4):

- **Simplicity**. Schemes should be transparent and easily accessible to a broad spectrum of firms;
- **Low administrative and compliance costs**. For firms, it should not be complex and time consuming to apply for and receive a tax credit/allowance. For administrations, the auditing systems needed to check on the eligibility and validity of claims should be effective without being onerous for all concerned;
- **Reliability**. Firms should be able include fiscal allowances or credits in their forward plans with a fair degree of certainty. Receipt or non-receipt of tax incentives at any point in the future should not dependent on concurrent levels of profitability;
- **Stability**. The rules of the game should not be changed too often, since this reduces the ability of companies to budget for future tax benefits when making R&D investment decisions. Greater certainty in the long term allows firm to forecast the cost of their R&D projects more accurately.

Use of these design principles has implications for the choice of appropriate fiscal incentive schemes. In terms of the choice between volume-based and incremental schemes, for example, application of these principles favours the former over the latter. **Volume-based schemes are simpler to administer for both firms and public authorities**. They are also more predictable in that firms are still eligible for benefits even if there is no growth in annual R&D expenditure. Income streams are thus less volatile and forward planning less hazardous.

Arguably, volume-based schemes are also better at raising overall R&D expenditure levels. Incremental schemes might seem to offer greater incentives for individual firms to increase R&D spending, since they specifically reward firms for doing this, but the number of firms benefiting (i.e. those increasing R&D expenditure in any one year) is invariably less than the number that would benefit from volume-based schemes (i.e. all R&D performing firms), and if these benefits – spread across the total population of R&D performing firms – are subsequently translated into increased R&D expenditure in subsequent years, the macroeconomic implication is that volume-based schemes are more likely to stimulate greater increases in R&D expenditure levels than incremental schemes.

Hybrid combinations of volume-based and incremental incentives might seem to offer the best of both worlds, but again the principles of good design outlined above suggest that such schemes add too much complexity to the overall fiscal regime and thus undermine their effectiveness.

This report on the effectiveness of fiscal incentives towards business R&D leads to the following recommendations by the expert panel (Chapter 5):

Member States are recommended to review their current fiscal incentives for R&D or, if considering new instruments, design new instruments in such a way as to conform to the basic principles of good practice in policy design. These principles for good policy design require: **simplicity, low administrative and compliance costs, reliability and long term stability**.

It would be more powerful if the above "principles of good design" were complemented by a **concrete checklist** that policy makers could apply to assess the tax incentives available/planned in their country. This checklist would incorporate the following four recommendations on design issues**.**

In the light of the 'principles of good design' we recommend that tax incentive schemes **should be volume-based** rather than increment-based if the main objective is to substantially stimulate business R&D.

Assure **re-fundability** (cash refund) of tax credits or tax allowances in cases where companies make losses (and, therefore, would not be able to benefit from a reduction of corporate income tax liabilities). For large firms this could be dealt with by using carry-forward / carry backward arrangements. For small firms a cash refund is preferable since it will have an immediate effect on their cash flow.

It is important to **improve the visibility and transparency** of fiscal incentives in such a way that they can be directly linked to R&D decision making. This is especially important for large firms where important budget allocations, also for R&D investment, take place at the corporate level rather than within the research units.

A **clear definition of R&D** is essential for deciding in a cost-effective manner what are the eligible R&D costs and which activities count as R&D. We recommend that the definition used in Member Countries should be based on the international standard defined in the **Frascati Manual** of the OECD.

There is a need for **formal evaluation practices** of the effectiveness of fiscal incentives, also in comparing fiscal incentives with other types of policy instruments. These evaluations should be made publicly available for policy learning purposes.

In order to perform effective evaluations there is an urgent **need for relevant databases** at the firm level.

There is a need for an **optimal policy mix** regarding business R&D. Tax incentives should be used when governments want to reach a broad range of firms involved in R&D activities. Direct government funding of business R&D should be targeted towards the fields of research were the gap between private and social rates of return is large.

Policy makers need to ensure that fiscal measures and direct government funding of business R&D complement each other. This would be achieved only through an

effective co-ordination mechanism between the public institutions (ministries and agencies) involved in the stimulation of business R&D.

Fiscal incentives using **personal income tax breaks**, if appropriately formulated, could effectively attract researchers from abroad. The expert panel finds that there is insufficient information to assess the consequences and effectiveness of these schemes at this stage. It is recognised that personal income tax break may induce potential distortions within the EU labour market.

1. INTRODUCTION

Europe has decided to make innovation one of its top priorities. Indeed, the European Union is lagging behind in terms of Research and Development (R&D) investments; and the gap between Europe and the US and Japan is widening. By setting concrete targets, the European Council aims at reversing this situation. It encourages its members to reach by 2010 an R&D intensity of 3% of Gross Domestic Product (GDP). Furthermore, it has set the target of boosting business-financed R&D to a level of two-thirds of all R&D investments.

Innovation is a difficult and risky process. Even if the business sector finances and performs most of the R&D, it will still perform less than what is optimal from a societal point of view, for a number of reasons. First, firms under-invest in R&D because they cannot capture all the benefits themselves - some of them 'spill over' to others (what economists call 'externalities'). Second, R&D is a high-risk activity - not all R&D leads ultimately to innovation. This high risk hinders R&D performers from engaging in certain projects. The third reason is that uncertainty over the outcome of R&D makes it also difficult for firms to find financial support; they may well be confronted to credit rationing. These market failures may be corrected by public intervention.

Government support to business R&D can take various forms. The most common policy instruments aim to provide firms either with technology and new knowledge or with financial incentives. Of these two types of policy instrument, the former involves performing public research in public laboratories and universities. The latter are provided through a myriad of supporting policies. The main types of financial measures that can be distinguished are:

- Direct Measures, i.e. measures involving the direct transfer of financial support from the public to the private sector via grants, loans etc.;
- Fiscal Measures, i.e. measures whereby the public sector foregoes tax income from the private sector in exchange for approved R&D investment behaviour;
- Risk Capital Measures, i.e. public measures affecting the flow and use of risk capital for innovation-related activities likely to increase R&D investment levels;
- Loan and Equity Guarantee Measures, i.e. measures whereby the public sector tries to encourage additional investment in R&D by offering to share part of the risk involved in the provision of support for innovation-related activities.

This report focuses essentially on the effectiveness of fiscal incentives to business R&D. Chapter 2 describes the current status of the use of fiscal incentives and provides some empirical data on the use of this policy instrument in several industrialised countries. Chapter 3 explores the effectiveness of fiscal incentives on the basis of multiple quantitative studies and analyses of the business perspective on the issue. It also discusses the use of evaluation as a systematic tool for assessing their effectiveness. Chapter 4 discusses good practice in the design of fiscal incentives because this is a key determinant of effectiveness. Chapter 5 sums up the conclusions and recommendations that can be drawn from this report.

2. THE CURRENT USE OF FISCAL INCENTIVES FOR R&D

Fiscal incentives for R&D can be designed in many different ways, using corporation income tax, the company's share of wage tax (and associated social security premiums), or personal income tax regimes as a basis. Comparing the current schemes in operation in the world, we can distinguish many **differences in their basic design**.

The first section (2.1) of this chapter briefly presents the main characteristics of fiscal incentives for business R&D. An overview of the various schemes that have been adopted in industrialised countries is provided in the second (2.2). The third section (2.3) presents other types of fiscal incentives that might also affect the propensity of firms to invest in R&D. The fourth section (2.4) concludes on the similarities and differences between existing R&D tax incentive schemes.

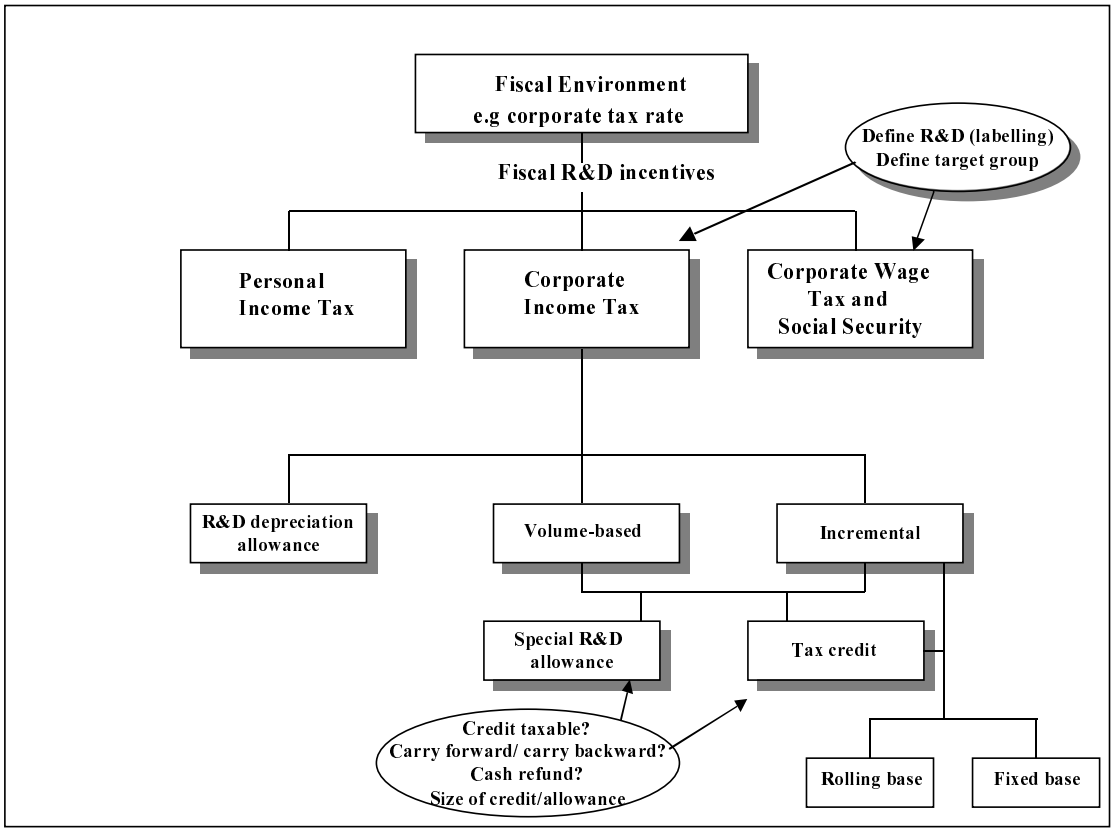
2.1 Policy options for fiscal incentives

There are many facets underlying the way in which a fiscal policy is designed to stimulate business R&D (see Figure 1). When governments chose to develop fiscal incentive schemes, there are a number of decisions to make on their design. The general fiscal environment will have a significant effect on which type of taxation regimes is most appropriate. For instance, other things being equal, the benefit from a tax allowance in a country with a low level of corporation tax, will be smaller compared to a country with high levels of corporation tax. Similarly, a fiscal incentive based on a company's share of the wage tax (and social security contributions), will only be relevant in countries where this share is relatively high.

The further choices to make are to select the target group (by firm size for instance), and the definition of the eligible R&D expenses (current R&D expenses, R&D labour costs, total R&D expenses, innovation expenditures, collaborative or outsourced research). In addition, the level of fiscal generosity has to be chosen. Figure 1 gives an overview of the types of fiscal R&D incentive schemes that are most widely used and the decision steps that can be taken when choosing a design.[1]

[1] The Expert Panel has not included in this report the use of VAT as a tax regime used as a basis for stimulating R&D.

Figure 1 The basic framework of fiscal incentives for R&D



Examples of policies that reduce the taxable income of a company are the accelerated depreciation schemes for investments (machinery, equipment, buildings, intangible investments), used for R&D activities. Another major decision concerns the question of whether the fiscal policy reduces the taxable income of the company (in the case of **allowances**), or whether it reduces the corporate tax liabilities (in the case of **tax credits**). A special R&D allowance makes it possible for a firm to deduct more than 100 per cent of its current eligible R&D expenditures from its taxable income. Tax credits, on the other hand, enable firms to deduct a percentage of their R&D expenses directly from their tax liabilities.

Allowances and credits can be calculated using either a flat rate or an incremental rate. Schemes using a flat rate - referred to as a volume-based tax scheme in the remainder of this report - allow a deduction corresponding to a share of the level of R&D expenditure in a given year. An incremental tax scheme involves a deduction equal to a share of the increase in R&D expenditure. This increase in R&D expenditure can be computed either with respect to a fixed reference base in the past (e.g. historical maximum level of R&D expenditure or R&D expenditure in a given period), or to a rolling base (i.e. increment over the average R&D expenditure of the last x years).

Firms not in profit cannot benefit from schemes based on the corporate income tax regime. Such a situation limits the generosity of these incentives. This situation can be compensated by allowing carry back and carry forward provisions (i.e. allowing firms

to carry the entitlement for a credit to a previous or later year), or by offering a direct cash refund.

The Dutch WBSO scheme is an exceptional case since it uses as its basis the employer's part of wage tax and social security contribution of R&D related personnel rather than the corporate income tax regime (see Text Box page 9).

2.2 An international overview of current practices

2.2.1 Myriads of design for fiscal incentives to business R&D

An international overview of fiscal incentives for business R&D illustrates **the wide diversity in terms of the types of measures** and levels of generosity. Table 1 shows which countries use different types of tax incentives. Over time, tax credits for R&D expenditures have become more popular than tax allowances.[2]

Table 1 Fiscal incentives for R&D: Classification and Geographical Application

Corporation Tax Schemes Volume based	Italy: (only for firms in Objective 1,2 and 5b areas) United Kingdom: (separate schemes for SMEs and large firms) Canada (federal and state level schemes)
Corporation Tax Schemes Incremental	Belgium (per additional member R&D staff) France, United States, Japan, Korea
Corporation Tax Schemes Mixed systems	Austria (three parallel schemes), Portugal, Spain (national level and some regional fiscal schemes), Australia
Schemes based on employers' share of wage tax and social contributions	Netherlands
Fiscal schemes to attract foreign "key personnel' * through personal income tax	Finland, Sweden, Denmark, Netherlands (all have favourable income tax rates)

* These schemes are not exclusively for R&D staff but for all "key personnel" which could also include other staff e.g. management, engineers.

Table 2 and Table 3 show in more detail the current fiscal treatment of R&D expenditure in corporation tax in EU member states and some countries outside the EU. Finland, Germany, Greece, Ireland, Luxembourg and Sweden are absent from Tables 2 and 3 because they currently do not have R&D fiscal incentives based on corporation tax.

[2] OECD, Tax Incentives for Research and Development: Trends and Issues, DSTI/IND/STP (2002)1, June 2002.

Table 2 Use of corporate R&D tax incentives, 2001/2002

	Volume base	Incremental	Combination of Volume based and Incremental
R&D tax credits	Canada Italy Korea Netherlands	France Japan Korea Mexico United States	Portugal Spain
R&D allowances	Denmark United Kingdom	Norway Belgium	Australia Austria Hungary

Source: Adapted from Warda (2002).

The first important observation is that all countries allow expensing, i.e. full depreciation of current R&D expenditure in the year incurred. Although such treatment reduces the cost of performing R&D it is only a weak incentive. This is because such expenditure would normally be fully deductible from the firm's taxable profits anyway on the grounds that it was incurred in the normal course of its business. There is currently a debate as to whether R&D should be treated as an intangible investment, rather than a cost, and, therefore, be included in the balance sheet rather than the profit and loss account. Moreover, the fact that this treatment is so widely accepted does not make it a differentiating factor to stimulate R&D in a specific country. The tax system in some EU and other industrialised countries allows an accelerated depreciation of equipment and machinery used for R&D. For example, Austria, Japan and the UK have adopted such a practice.

Besides those standard treatments of R&D related expenditures, Austria, Australia, Belgium and the UK have special allowances in place. These allowances make it possible to expense R&D-related expenditure at rates above 100% of the real cost when calculating corporate income taxes. The Austrian and the Australian policies are a mixture of volume-based and incremental allowances. In Austria, expenditures for the development or improvement of inventions that are "valuable to the economy" can be expensed at a rate of 125% for amounts up to the average over the previous three years and 135% for amounts above that average. In addition, there is also a 115% special allowance as well as a 5% "research premium" (direct payment for companies that do not make profits), both for R&D expenditure based on the Frascati Manual definition. In Australia, there is a 125% deduction for R&D-related expenditure and a 175% "premium" deduction for R&D expenditure that exceeds the three-year rolling average.

The **United Kingdom** Finance Act 2000 introduced a new tax relief for R&D for small and medium-sized enterprises (SMEs). From April 2000 relief for current spending on qualifying R&D was increased from 100% to 150% for these companies. So for every £100 a company spends on this R&D, it can claim £150 against its taxable income. An extra feature of the SME scheme is the payable R&D tax credit. This was designed to help SMEs overcome cash constraints that might prevent them from carrying out R&D. Small and medium-sized companies that are not yet in profit can take the relief up front and reduce the cash cost of their R&D by 24%. R&D tax

credits are also available to companies that have not yet started to trade. In 2002 the UK launched an additional large firm tax credit scheme. This is a simple volume based measure allowing a relief of 125% of R&D costs. This is not payable when companies are in a loss-making situation.

Spain uses a tax scheme based on a combination of both volume and incremental incentives. The definition of R&D in the Spanish fiscal incentive schemes is also much broader than in any other EU country: it includes expenditures on innovation (quality certificates, know-how acquisition, industrial design, production engineering), training and ICT investments by small firms. The rules of the fiscal incentive schemes have changed several times since the start of fiscal incentives already in 1979. In 2002 the credit was 30% on the volume of expenditure within a tax year and 50% on the expenditure amount exceeding the average expenditure of the last two years. An additional complexity in Spain is that some of the Spanish regions[3] have separate fiscal incentives for R&D.

The major fiscal incentive used in **France** is the Tax Credit for Research which is applied using an incremental system. A tax credit rate of 50% is levied on the difference between R&D expenditure for the year and the pre-determined baseline.[4] Currently France is considering to launch two new fiscal incentive schemes, one for new companies in the R&D intensive sectors (R&D investment should be > than 15% of turnover), providing them with a medium - term (planned is 8 years) tax exemption. The second plan is a tax relief for business angles investing start-up companies. Both plans are yet to be formally approved and launched.

The **Belgian** policy can also be looked at as a special allowance for incremental R&D, but it differs from other instruments in that it offers fixed allowances instead of percentages. For each additional full-time full-year employee conducting scientific research in Belgium, the company receives a credit against its income tax liability of €11.800 (in 2003). This amount is annually indexed. For highly qualified researchers (i.e. employees holding a Ph.D. with 10 years of experience in scientific research), the exemption is € 23.590 (for 2003).

It is important to note that the company receives the allowance only once, for the year during which the new employee enters the R&D department of the company. Each year thereafter the company must prove that the employee is still conducting R&D or otherwise the company will lose its right to exemption, and will have to pay the allowance back. As a result the taxable income for the year in which the researcher quits, will increase proportionally (with the amount received when the researcher entered the R&D department).

A more widely used type of instrument are R&D tax credits. Eleven industrialised countries currently offer tax credits based on corporation tax.

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[3] The Canary Islands, the Basque Country and Navarre

[4] European Commission, DG Enterprise, 2001.

Table 3 Overview characteristics corporation tax based fiscal incentives for R&D in EU and non-EU countries

Country	Target Group		Allowance	Tax credit		Basis for increment	Maximum	CF/ CB	Cash Refund
	All firms	SME		Volume	Incre mental				
Austria	x		Old scheme: 25 % volume, 35% incremental New scheme: 15% volume R&D premium: 5%			3Y Avg		Yes	Yes
Belgium	x		€11.800-23.590/ extra researcher					None	
Denmark	x		25% collaborative R&D						
France	x				50%	2Y Avg	€6.100.000	3Y CF	Yes
Italy	x	x		10-30% depending on size & location	20	na			
Netherlands	x	Start-ups		40% < €90.756, 13% for the rest			€7.941154		na
Portugal	x			20%	50%	2Y avg	€498.798	6Y CF	
Spain*	x			30%	50%	2Y Avg	35% of tax bill	15Y CF	
UK	x	x	50%						Yes
Australia	x	x		25%	75%	3YAvg.			Yes
Canada	x	x		35% <€1.322.489 20% for the rest				3Y 10Y	Yes
Japan	x	x		6% for SMEs only	20%	Highest R&D expend. of previous years	15% and 10% of tax bill		
Norway		x	25%				€540.124		
United States*	x				20%	Fixed base 1984-1988 Young firm exception		3Y 15Y	No

CF/CB = Carry Forward/ Carry Backward / Cash refund mostly for SMEs only

* Spain and the US have separate fiscal regimes in their regions / states which are not mentioned here

Table 3 also shows that fiscal incentives have specific **benefits for SMEs**. These take several forms. Norway currently restricts the fiscal incentives specifically to SMEs. Four other countries allow all companies to benefit from the incentives, but have higher or special rates in place for SMEs. Three countries: Australia, Canada and the UK, allow a refund of the tax incentive for SMEs while France has a more flexible refund policy for SMEs compared to more mature companies. The UK has separate schemes for SMEs and large firms.

It is important to note that there are differences in the definition of SMEs eligible for the tax incentive. For instance, in the case of the UK SMEs as defined by the European Commission for State Aid purposes, are eligible for the SME Tax Credit. While Spain defines small companies as companies with a turnover under €3 million.[5] In The Netherlands, SMEs are defined as companies with less than 250 employees. Besides those direct stimuli for SMEs, many countries have upward limits on the total amount of fiscal incentives. Such limits are less of a disadvantage for SMEs compared to other companies. In the case of Japan and Spain, the limit is set as a percentage of the corporate tax liabilities.

When incremental tax allowances or credits are in place, an appropriate calculation base has to be defined. In all but one case a rolling average base was adopted, using the average R&D expenditure of the previous two or three years. The only exception to this is the US. If available, the ratio between the average qualified R&D expenditure and the average gross receipts for the period covering 1984 until 1988 is calculated. In order to get the actual up-to-date base amount, this ratio is indexed by multiplying it with the average gross receipts of the last 4 years. As a result, the US uses a sales indexed fixed base. In cases where figures are not available for the period covering 1984 until 1988, the base amount equals 3% of the average gross receipts of the last 4 years. In Japan firms must exceed their previous historical "best performance" in R&D in order to qualify for the credit. This principle is simple, but it does not make the incentive particularly generous. In Belgium, companies must hire additional employees compared to last year in order to be eligible for the tax exemption for scientific research.

Other differences that are not presented in Table 3 include those relating to the place where the R&D is undertaken. Most countries limit tax incentives to expenditure incurred in the country in question (for instance France, the Netherlands and the US). However, the UK allows overseas R&D expenditure to be included their SME tax allowance.

In addition to this, some countries give (special) tax incentives on R&D contracted out to universities, public research institutions, R&D consortia or other firms. In the UK, a SME company that subcontracts its R&D will be able to claim R&D tax relief provided it retains the ownership of the knowledge. As a result, the subcontractor cannot claim the R&D tax relief.[6] If the principal and the subcontractor are connected, the full amount is eligible. In case where they are not connected only 65% of the paid amount is eligible. This is similar to the system in the US where 65% of the contract

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[5] European Commission (2001), *Corporation Tax and Innovation: issues at stake and review of European Union experiences in the nineties*, Luxembourg: DG Enterprise

[6] Source: The Inland Revenue (2000) Guidance on the R&D tax credit for small and medium-sized companies

research expenditure qualifies. Other countries that allow subcontracting of research include Canada and Portugal.

The Dutch WBSO scheme

The Dutch fiscal incentive scheme WBSO stands out from all others since it reduces the wage cost of R&D rather than the level of corporate income tax. It offers fiscal incentives to firms of all legal status, even smaller ones that are not registered as limited companies, and to self-employed entrepreneurs.

The R&D rebate entails a reduction of the total amount of wage tax and social security contributions that a company has to withhold on its employee's salaries. In a country with high income tax levels (up to 52% for the highest income groups), and high social security premiums, for both employees and employers, such an allowance has a direct impact by lowering the R&D labour costs.

The design of the Dutch programme (providing allowances on the employers part of the wage tax and social security contributions of R&D personnel), means that the cost reduction can be linked directly to the R&D activities and departments in the company, instead of to the overall tax burden at corporate level. Therefore, it allows better activity based costing. This has a greater chance of influencing R&D decisions since R&D managers can use the very predictable level of cost-reduction when arguing their case for R&D investments. Another advantage is that the allowance is administered monthly, when withholding taxes and contributions on salaries are paid, instead of yearly in the case of corporate income tax.

The 2002 evaluation of the WBSO found that the scheme is cost effective. According to the evaluation report[7], the WBSO makes a significant contribution towards increasing the R&D intensity of the Dutch private sector. In the near future, companies that receive tax incentives under the WBSO will spend on average slightly more than € 1 on extra R&D for each € 1 of wage tax deduction received. This conclusion is supported by both econometric evidence and extensive field study. This does not take into account the expected positive longer-term effects and the substantial social returns associated with extra investments in R&D activities. Small businesses appear to benefit more from the WBSO than large ones. This is related to the fact that the WBSO was designed primarily to promote R&D by SMEs: [1], a much higher rate applies to spending below a threshold of € 90.756; [2], there is an upper limit on the total credit amount; [3], companies younger than 5 years enjoy an even higher rate for their first two WBSO applications, [4] there is an alternative for the self-employed.

In some case fiscal incentives are (also) targeted at a **certain type** of research. In Japan, tax incentives are only given for *basic* research carried out by companies. More generous provisions are given to small firms. Several US states offer special tax credits for biotechnology research on top of the federal tax credit. A unique feature of the UK system is that it awards certain types of research with high social rewards. The vaccine research measure is in preparation. Companies which contribute to independent research and development carried out by charities, universities and scientific research organisations for the purpose of studying specified diseases will be eligible for vaccines research relief on the full amount of the contribution. This is on top of the overall relief under the general tax relief schemes for SMEs and large companies.

[7] Brouwer, E. et al. (2002), *Evaluating the WBSO: study of the effectiveness of the WBSO*,

Other countries reward **collaboration between industry** and qualified (public) research organisations. This is the case in the US where a special tax credit is available for payments to qualified organisations to conduct basic research. Furthermore, the percentage of contract research expenses eligible for tax credit increases from 65% to 75% in cases where the R&D is outsourced to a qualified research consortium. In Australia only contract research with a registered research agency is eligible for the tax incentive. On the other hand, Australia allows the cost of acquiring an existing patent, to facilitate R&D activities, to qualify for its fiscal incentives.

Denmark has recently launched a new scheme that allows firms to deduct 150% of private investments in co-financed R&D[8]. Companies (irrespective of their size), are allowed a tax deduction for participating in specific programmes of basic research. The scheme aims to promote public-private co-operation and the R&D projects have to be performed jointly by a public university or research institute and an industrial partner. So far the scheme has been launched as a pilot project and is scheduled to run for 2 years when it will then be evaluated.

Countries currently seeking accession to the European Union (hereafter "accession countries"), use R&D tax incentives to a limited extent. There is a trend towards equalising tax incentives for domestic SMEs and foreign investors (who often receive tax incentives not available for domestic firms), or to eliminating R&D tax incentives for greater neutrality.[9]

- Hungary has a 100% tax deduction on total R&D expenses.
- Poland has abolished its tax allowances as of 2000.
- Cyprus plans to introduce a 10-year tax relief on profits from the production of new products.
- In the Czech Republic, a law enacted in 2000 introduced tax incentives for already existing companies planning expansion.
- Estonia and Slovenia have no R&D tax incentives.

For many accession countries harmonising the overall tax system has greater priority than complicating it with R&D incentives. There is, however, an ongoing debate in these countries on the issue.

2.2.2 Countries not using fiscal incentives for companies

Not all countries are convinced that fiscal incentives are an effective instrument to overcome the negative impacts of knowledge externalities, or believe that fiscal incentives significantly stimulate private R&D investment. Contrary to the general tendency to increase the use of fiscal incentives, **Germany** and **Finland** are countries that used to have fiscal incentives (along with financial support), but decided to abolish these in the late eighties/early nineties.

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[8] Danish Ministry of Science, Technology and Innovation, Internal paper, 2002

[9] European Commission, 2001, *Innovation Policy Issues in Six Candidate Countries: The Challenges*. Pp.93-95.

The main reasons were related to the complication of the general tax system by introducing R&D tax incentives and the view that other policy tools would be more appropriate.

Governments as well as industry sometimes argue (as is the case in Germany), that a general reduction in corporate tax rates is a more appropriate instrument to foster the competitiveness of industry. The German tax system is considered to be highly complicated having a small tax base, high tax rates and myriads of tax exemptions for special industries and/or various types of investment (e.g. private housing). Hence, there is a need to make the tax system less complicated, lower tax rates and broaden the tax base. From this perspective, tax incentives for R&D are viewed as an instrument that makes the corporate income tax system even more complicated. In fighting for lower tax rates and an easier tax system it seems unwise to increase the complexity of policy discussion by suggesting a new tax incentive.

2.3 Other types of fiscal incentives

In order to overcome the shortage of researchers, a small number of countries (e.g. Sweden, Finland Denmark), have personal income tax allowances for foreign employees, including those employees devoted to R&D. In all cases the schemes are eligible to "key staff" which is a wider group than exclusively R&D personnel. This type of fiscal incentive does not directly reduce the tax liabilities of companies, but indirectly through the R&D employees who they might want to recruit.[10]

In **Sweden** this incentive is called the tax relief for foreign key personnel. This is not limited to scientists or researchers, but is also applicable to executives, technicians and specialists. The scheme is meant to provide an advantage to companies who need foreign expertise. Its main feature is the provision of a 25% reduction in the taxable income of a foreign key person for the first three years residence in Sweden. The person has to work for a Swedish company. Denmark, The Netherlands and Finland have similar tax relief facilities for foreign staff, which are not specifically focussed on scientists, but on key personnel with a very specific expertise. In Finland a Withholding Tax of 35% is levied for foreign key personnel instead of State income tax on earned income and communal tax. They must be working in the private sector, have a wage of at least €5800 per month and perform tasks which require specific expertise. For researchers working in the higher education sector or performing non-for-profit research these two latter rules do not apply.[11] The employer or the employees apply to the tax authorities to establish whether they are considered key personnel.

In **Denmark** a similar scheme, which fixes the personal income tax at 25% for foreign experts, has been in operation for a number of years. The employer may be a Danish with business premises in Denmark, or a foreign company with operations in Denmark. Highly paid foreigners, with a monthly gross salary of 55.400 DKK

[10] Some members of the Panel had difficulty understanding the rationale for such intervention, which has the potential to distorting labour market behaviour without being effective at increasing the overall levels of R&D investments

[11] Finland's Ministry of Finance, Taxation in Finland 2001, EDITA, Helsinki, 2001

(currently € 7475) can remain within the country at the favourable taxation period for up to 3 years. Again this is not exclusively for research personnel, managerial staff are also included. If the tax reduction is requested for research purposes, the qualifications of the researcher must be approved in advance. There are different approval procedures depending on whether the employer is a research institution or not. If the employer is a company or a non-research institution, the National Research Council must authorise the qualifications.

These type of incentives are typically used by countries with high personal income tax levels which could dissuade foreign researchers (particularly those used to much lower levels of income tax), from locating in those countries. However, this could lead to a distortion of labour markets within the country applying it and competition between countries of the European Union for the limited number of skilled researchers.

2.4 Concluding remarks on the actual use of fiscal incentives for business R&D

The most important issue that is underlined in this chapter is that there are no common views about fiscal incentives for R&D among the OECD countries, though there is a general trend towards greater use of them. Some countries use these facilities extensively and others do not or have abolished R&D tax incentives. Among the countries that use such incentives a wide range of different designs are employed. Some favour volume-based schemes, others rely more on incremental-based ones and many countries use a combination of approaches. There seems to be a trend that tax credits have become more popular than allowances.
Major differences can further be found in the way R&D activities are defined, in the existence of carry-back/forward provisions or cash refund practices and in the tax base (corporate income tax liabilities or company wage tax combined with social security contributions).

3. THE EFFECTIVENESS OF FISCAL MEASURES

A major question in the choice of fiscal measures is whether they have proven to be **effective** so far? The analysis of the effectiveness of fiscal instruments can be tackled through two major avenues of evaluation.

The first avenue is the performance of **ex-ante evaluation** before launching a fiscal scheme. Ex-ante studies help to assess the potential benefits and possible negative effects of such a scheme. This has been done extensively in the United Kingdom when the government launched their fiscal schemes for SMEs and later for large firms (see Text Box). This included the consultation of the business sector's potential response to tax credit.

The UK ex-ante studies

Before designing the fiscal schemes introduced in the Finance Acts of 2000 and 2002, a number of steps were taken by the UK Government .

A small team of officials from HM Treasury and the Inland Revenue was brought together to consider the academic and international evidence of tax credits' effectiveness in stimulating investment and the case for a credit in the UK. The ex-ante activities included the following:

- Study of the design features of a number of existing fiscal incentive schemes in other countries around the world
- Study of the economic evidence that an R&D tax credit would lead to increased R&D spending and that increasing R&D spending would improve the productivity performance of the economy.
- Extensive consultation with the business community and other stakeholders which influenced decisions in favour of a volume-based design
- As with all major UK tax policy changes, regulatory impact assessments were made to assess costs and benefits of introducing R&D tax credits for both the business and the public sectors.

A second avenue is **ex-post** analysis of R&D investors' behaviour as a result of the fiscal incentive schemes. This type of study intends to establish the micro-economic and/or macro-economic effects of fiscal incentives schemes on the short, medium and long term.

Both types of analyses can bring useful insight into the effectiveness of tax incentives. Ex-post investigations use more quantitative tools (surveys, econometric evaluation of impact). The ex-post investigations yield insights into the broad economic impact of the tax incentives while the ex-ante evaluations provide insights into the specific design of a policy. Finally, the broader context of a fiscal incentive must be taken into account when its evaluation is performed. Indeed, if other types of policy instruments aim at the same objective, we might expect strong interactions between these incentives.

This chapter starts with an in-depth review of the existing literature on ex-post quantitative evaluation of the impact of fiscal incentives on business R&D. The second section summarises the business perspective on fiscal incentives. The last section considers the broader context that might affect the effectiveness of fiscal incentives.

The ex-ante and ex-post elements of evaluation complement each other and both types of evaluation should be essential parts of each tax incentive programme.

3.1 Quantitative 'ex post' evaluation

There are concerns about the effectiveness of fiscal incentives in increasing private research efforts. These concerns are related to the relatively high costs of fiscal incentives to government without exactly knowing the additional amount of R&D generated by the incentives. Many academic and governmental studies on the impact of fiscal incentives were undertaken over the last two decades. Some studies are performed at the aggregate macroeconomic level and rely mainly on quantitative tools. Other studies, much more numerous, are performed at the microeconomic level and rely on econometric techniques, surveys, or case study evidence. An overview of the most relevant empirical studies is provided in Table 3. The results are summarised below.

Tax incentives stimulate business R&D

Almost all the results indicate that a decline in the cost of performing R&D generates additional R&D investments. This effect of the decline of costs on investment is referred to in the literature as the **price-elasticity of R&D**, and the more negative this indicator is, the higher the effect on generating additional R&D investments. This implies that fiscal measures targeting business R&D stimulate the total amount of R&D undertaken as they reduce the price of performing research. However, in many cases the elasticity found is relatively low.

The lowest effect of a fiscal incentive scheme is reported in a study by Mansfield and Switzer (1985) with a price-elasticity of only –0.04, while Hall (1993) reported the highest price-elasticity with a figure of -2.7. Excluding some questionable figures, the median elasticity in Table 4 is –0.85 and the average elasticity is equal to –0.81.

Six studies report a different price-elasticity for the short-term and the long-term. In all cases the short-term elasticity is lower than the long term one (-1 on average). This indicates that there is a certain time lag between changes in the price of R&D and the amount of business R&D expenses induced by those price changes.

Preponderance of US and Canadian evaluation practices

A second obvious observation from Table 4 is the fact that there is a preponderance of studies carried out in the US and Canada. On a total of 20 studies, 8 focus on the US and 5 focus on Canada. Besides the US and Canada there is some, although limited, econometric evidence available for France, Sweden, The Netherlands and Australia. Additionally, two studies use aggregate data from different countries: Bloom et al (1998) use data on 8 countries while Guellec and Van Pottelsberghe (2003) extend this by using data on 17 OECD countries.

Diversity in data, methodology and scope

Table 4 also shows an enormous diversity in the **data sources, the methodology, the time periods** and the scope used in the different studies. Such diversity makes it difficult to compare different results and hinders the inference of strong conclusions as to the general effectiveness of tax incentives. Most studies collected data on a firm level while a few others used data on an industry or country level. In five cases the data were obtained from surveys while in the other cases more formal sources of information were used such as Compustat, which allows the user to rely on much larger datasets.

Besides the huge diversity in the data used the methodology also strongly differs from one study to another. Some case study based investigations into the effects of newly introduced fiscal incentives were made. They look at the amount of business R&D expenditure before and after the introduction of the tax incentive. The results of those studies indicate that business R&D is indeed responsive to changes in the fiscal treatment of R&D expenditure, but they fail to take into account other explanatory variables that might have affected the amount of business R&D as well.

Other studies use company surveys to gather data on the impact of fiscal incentives on the level of business R&D. In general, the results indicate only a weak response to fiscal incentives. For at least some of those studies this might be due to the fact that the analysis occurred too shortly after the introduction of the tax incentive. Indeed, as discussed above, the short-term price-elasticity of R&D is always lower than the long-term elasticity. Moreover such a survey approach can also be criticised on the grounds that surveying executives of companies targeted by the tax incentives leads to subjective and/or perceptual responses.

More satisfying answers as to the effectiveness of tax incentives can be found in the results of econometric studies. Two main methodologies are used in this respect. The first one consists in a model that estimates the price elasticity of R&D expenditure. The additional amount of R&D expenditure generated by the fiscal incentive can then be calculated by multiplying this elasticity with the price reduction of R&D caused by the fiscal incentive. The second methodology employs a model with a dummy equation. In the case no incentive is available, the dummy equals “0”, otherwise it equals “1”. If the equation is well specified then this model can eliminate all other factors that influence the amount of R&D undertaken in a given period.

Such econometric studies can be carried out on a microeconomic level – the most common - or on a macroeconomic level. The problem with results from studies using

microeconomic data is that they cannot be generalised without caution. Indeed, using data from specific firms or industries or using data that covers only a specific policy in one country does not allow inferences to be drawn as to the responsiveness of tax incentives in a broader context. Macroeconomic approaches bring additional evidence in this respect. Currently only two studies used aggregated data on a macroeconomic level in order to estimate the effectiveness of fiscal measures on business R&D expenditure. Bloom et al. (1998) rely on aggregated data from a panel of 8 countries while Guellec and Van Pottelsberghe (2003) extend this by using data on 17 OECD countries. The results of both studies show a negative price-elasticity for R&D expenditure.

Studies at the micro and aggregate level are of a complementary nature. Micro-level studies regularly fails to take into account the impact of spill-overs on the R&D decision. However, they allow more detailed precise observation of the use/non-use of tax incentives. Macro-studies also consider the impact of spill-overs, but introduce a larger problem of assigning direct impacts to R&D incentives.

Table 4 Overview of econometric evidence on the impact of fiscal incentives towards R&D

	Authors	Year	Data	Approach	Price elasticity of R&D	Period of credit
1	Collins Eisner	1983	US survey 99 firms	event	Insignificant	1981-1982
2	Eisner et al	1983	US 600 firms	dummy equation	Insignificant	1981-1982
3	Mansfield & Switzer	1985	Canada 55 firms	survey	-0.04 to -0.18	1980-1983
4	Bernstein	1986	Canada firms	price elasticity	-0.13 (ST) -0.32 (LT)	1981-1988
5	Dagenais et al	1997	Canada 434 firms	R&D demand equation	-0.07 (ST) -1.09 (LT)	1975-1992
6	McFetridge & Warda	1983	Canada Aggregate	price elasticity	-0.6	1962-1982
7	Bernstein	1998	Canada Manufacturing sector	price elasticity	-0.14 (ST) -0.30 (LT)	1964-1992
8	Baily & Lawrence	1992	US 12 industries	dummy equation	-0.95 (ST)	1981-1989
9	Hines	1993	US 116 firms	price elasticity	-1.2 (stock) -1.6 (flow)	1984-1989
10	Hall	1993	US 800 firms	price elasticity	-0.8 to -1.5 (ST) -2.0 to -2.7 (LT)	1981-1991
11	Mamuneas & Nadiri	1996	US 15 industries	price elasticity	-0.9 to -1.0 (ST)	1981-1988
12	Berger	1993	US 263 firms		-1.0 to -1.5	1981-1988
13	Mansfield	1986	US 110 firms	survey	-0.35	1981-1983
14	McCutchen	1993	US 20 drug firms	dummy equation	-0.28 to -10.0	1982-1985
15	Asmussen & Berriot	1993	France 339 firms	dummy equation	-0.26	1985-1989
16	Bureau of Industry Economics	1993	Australia survey >1000 firms	dummy equation	-1.0	1984-1994
17	Bloom et al	1998	Panel of 8 countries aggregates	price elasticity	-0.16 (ST) -1.10 (LT)	1979-1994
18	Mansfield	1986	Sweden 40 firms	survey	small	1981-1983
19	Mairesse & Mulkay	2002	France 765 frims	price elasticity	-2	1982-1996
20	Guellec & Van Pottelsberghe	2003	Panel of 17 OECD countries	price elasticity	-0.28 (ST) -0.31 (LT)	1983-1996

Source: Adapted from Hall & Van Reenen (2000) and from Dagenais et al (1997)

The use of evaluation tools for policy purposes

One important observation is that tax incentive schemes are not always evaluated either regularly or systematically by the responsible government departments or by external experts commissioned to undertake the evaluation. Although Austria, for instance, has provided tax incentives for R&D for many years the scheme has never been formally evaluated. Therefore, no information exists as to its effectiveness (Hutschenreiter, 2002). This applies to other countries as well. As a matter of fact, evaluations that are made publicly available are scarce. The following Table 5 gives an overview of available **evaluations of tax incentives commissioned by government**. It has already been noted in the previous section that there are numerous, mainly academic studies on the effects of tax incentives, particularly in the US. But, since these academic studies are not officially commissioned they often lack the data sets necessary for conducting micro-level analysis.

Table 5 Overview of public evaluations of fiscal incentives for R&D commissioned by government

Country	Year	Title
Australia	1997	Research and development fiscal incentives in Australia: impacts and policy lessons, Ralph Lattimore, Industry Commission
Canada	1997	The Federal system of income tax incentives for scientific research and experimental development: evaluation report, Department of Finance Canada and Revenue Canada
Netherlands	2002	Evaluatie van de WBSO, PricewaterhouseCoopers & Dialogic

Ideally studies on the effectiveness of fiscal incentives should perform a proper cost-benefit analysis on a societal level. Such an approach requires a wide variety of data which is not always available or cannot be used to reach conclusions, given the lack of counterfactual. The main inputs needed are:

- The responsiveness of companies to fiscal incentives as measured by the price-elasticity of R&D
- The amount of R&D that would be undertaken in absence of the incentive
- The social rate of return of the additional R&D
- The opportunity cost of the foregone corporate income taxes resulting from the tax incentive
- The administrative costs to the government as well as to the benefiting companies.

Faced with these significant requirements, the solution adopted in the literature has been to calculate the ratio between the additional amounts of R&D expenditure that are generated by a marginal increase in foregone tax income, and this marginal increase in foregone tax revenue itself ("The bang for a buck"). The tax incentive is considered to be efficient if this ratio equals or exceeds unity, i.e. for each € of forgone tax income at least one € of additional business R&D expenditure is

undertaken. However, some potential problems with a "bang-for-a-buck" approach to analysing of the effectiveness of R&D tax credits have to be put forward.
First, it does not account for "re-labelling" of activities to qualify for the credit. Such activities will less likely have externalities. Second, it only measures increases in the total R&D spending, but does not properly distinguish between the quantity effect of R&D and the price effect of the R&D (essentially the wages paid to researchers).

There is also a problem of how to measure the value of foregone taxes (in terms of opportunity costs), with regard to other types of intervention that could have been done with the same level of public expenditure. This problem would need to be addressed if we would want to compare the impact of tax incentives to other types of R&D subsidies, or to other subsidies to firms (subsidies for declining industries).

A good example of an evaluation using a mix of methods is the recent evaluation of the Dutch WBSO scheme. The evaluation used a combination of the following methods:

- **Econometric analysis**. One of the methodological findings of this analysis was that data restrictions made it difficult to quantify the effects of the WBSO. In this evaluation, an econometric analysis was performed, building on previous evaluation studies and on the basis of an improved data-sets on WBSO user profiles built up over a number of years. This made it possible to evaluate the primary and secondary effects of the WBSO[12]
- **Telephone survey.** In a detailed field study, companies that use or had used the WBSO facilities were asked about decision-making on R&D, the effects of using the WBSO scheme, experiences with the implementation of the WBSO scheme and potential improvements in its design. In the processing of the results, various dimensions are often distinguished such as size category, sector, R&D intensity, WBSO intensity, type of WBSO user (e.g. structural, occasional, newcomer), type of project, use of an intermediary/subsidy advisor and whether or not the company is a high-tech start-up.
- **Desk research**. The most recent scientific insights and policy studies in the field of quantitative evaluation research and the use of tax credit schemes were listed and included in the design of the evaluation and analysis of the results.
- **Interviews**. Semi-structured interviews were conducted with representatives of a limited number of companies and research institutes.

The outcome of this evaluation was that the fiscal incentive scheme has a significant contribution to increasing the R&D intensity of the Dutch economy: for each €1 reduction in company wage tax from WBSO, companies spend slightly more than €1 on additional R&D.

[12] A method of this kind has not previously been used in evaluations of Dutch innovation policy and has only been developed to a modest extent at the international level. In that sense, this evaluation was also largely a survey of the possibilities for quantitative evaluation research. For various reasons, the tertiary effect cannot be determined reliably at present with econometric methods. See also the main report and Annex A.

3.2 The business perspective

Do R&D tax incentives really make a difference to the **business decision process** to invest in R&D? If the answer is yes, what would be its most appropriate design? The business communities in the countries that have tax incentive schemes are generally positive about this type of R&D incentive when they are simple and the benefits significant. This section reviews the perspectives from industry on the advantages and disadvantages of tax incentives and in particular certain types of design issues. In the case of the Netherlands for instance business arguments in favour of the WBSO tax scheme are:

- That it makes R&D effectively cheaper
- Given the design of the scheme, its effects are predictable at the level of R&D departments
- It causes much less overhead than direct R&D support
- There is no danger that the government 'picks the winners'
- It reaches a wider range of SMEs

In some OECD countries, however, the business community mainly argues against tax incentives for R&D. The German debate on this subject (see section 2) is a good example of where both the business community (mainly large firms), and the government have opted not to introduce R&D tax incentives. Instead, they choose for a simplification of tax regimes. The German business community stresses the need for additional measures to support industrial R&D in general - with an economy-wide impact, easy access and low administrative costs comparable to tax incentives, but without any complication of the tax system. Therefore, German industry often calls for general financial incentives involving more contract research conducted in collaboration with publicly financed research institutes and universities.

The following discussion summarise the viewpoint of the business sector regarding the conditions that would improve the effectiveness of tax incentives for business R&D. This highlights the importance of taking into account the business perspective before setting up new fiscal incentives.

Simplicity, certainty and long term framework

The **simplicity of the tax scheme** is an important feature, in order for the R&D managers to convince their executives how the scheme works and how it will benefit the firm. Simplicity reduces the cost of managing the R&D tax credits, from both the government and business perspectives.

Certainty about the outcome of an action aids decision-making. The following elements can help to reduce the uncertainty that surrounds a policy. This should in turn stimulate companies to apply for the policy.

- The type of expenditure that will qualify for credit has to be clearly defined
- The policy must be implemented in a long-term framework

- The time at which the credit will have an effect on the enterprise's cash flow and profit has to be known with certainty. Corporate uncertainty can arise if the enterprise is not in a tax-paying position. Allowing for mechanisms such as the trading of tax credits or cash refund can mitigate uncertainty. It gives the firm other options and hence mitigates its position if it is in loss
- Industry consultation is critical to any implementation of tax credit policy change for it to be effective.

The form in which an R&D tax credit is given is relevant to business decisions. The fact that a credit will be paid to the enterprise in the form of cash can be an important element in cash flow planning and can help persuade providers of finance to lend funds, perhaps with a right of first claim over the tax credit.

The UK consultation process

In 2000 the UK adapted its fiscal regime to introduce a new Research and Development relief for SMEs. In 2002 it decided to expand this facility in a different format for large firms, thus allowing all UK companies access to an R&D tax incentive. Before launching this, the government departments involved did quite a lot of homework in order to 'get it right'. First, they studied various tax incentive schemes already existing abroad, to see what could be learnt from their policy designs. Secondly, the departments engaged in an extensive consultation process with industry, to hear their views on what makes a good fiscal incentive. Both exercises had an influence on the final design of the UK tax facility.
When the exercise started the government's favoured approach for the scheme was to encourage an increase of R&D expenditure by targeting relief at additional spending by companies. With this in mind, the aim was to develop an incremental scheme that would explicitly encourage companies to increase their R&D investments, in comparison to a rolling baseline.

The consultation process with stakeholders was based on publication of a consultation document describing the policy options, published by HM Treasury and the Inland Revenue, to which written responses were sought. This was backed up by a series of meetings between officials from the Inland Revenue, HM Treasury, the Department of Trade and Industry and interested parties (companies, accountants, academics and regional development administrations), around the country. There were about 50 detailed responses from these interested parties.

As a result of the consultation round, the favoured approach changed from an incremental to a volume-based scheme. It became clear that incremental schemes have several disadvantages - in particular, uncertainty and complexity. A second consultation paper, therefore, put forward three possible options for a volume-based scheme: a simple volume-based scheme, a two-tiered volume-based scheme and a baseline volume-based scheme. During a further consultation process, views on the pros and cons of each design were collected. Two thirds of the respondents were in favour of the simplest design which is easy to comply with, both for companies and the government. Another advantage was its predictability that facilitates making R&D decisions. This led to a government decision in March 2002 to introduce a simple volume-based tax measure for large companies.

The amount of credit given

The **amount of credit** given will also be influenced by any cap imposed on the amount of the credit that can be claimed by one company or group. Imposition of such limitations may come from a policy decision to favour SMEs and to limit the total government expenditure on the scheme. The presence of cap might induce firms artificially to split their research activities into smaller and more independent units.

Care is needed in designing an R&D tax credit system to ensure that this does not penalise groups of companies with cost contribution agreements or cost sharing arrangements. Such agreements or arrangements typically provide that all members make a contribution to a central pool that is then used to fund the R&D activity. This enables economies of scale, central management of patents and other intellectual property by the group and allows the members to share the benefit of the intellectual property they have created together. If such funding reduces the expenditure eligible for credit in the research company and yet does not give rise to entitlement to credit in those companies contributing into the pool (which will normally be the case), the group gets no tax credit for that amount of R&D expenditure funded by the pool. The US system allows tax credits for costs shared through such an R&D cost sharing arrangement.

Impact on pre-tax results and the role of internal structures

Most R&D tax credit systems give rise to credits that reduce the enterprise's income tax liability. A manager of an R&D budget will typically be measured against a budget, whether that budget is for a notional profit centre or a cost centre.
Unless the R&D activity is managed in a self-contained legal entity and the management of that entity is judged on the performance after tax, the effect of R&D tax credits is not reflected in the measured results of the managers who take decisions on R&D expenditure. As well as possibly being bad for the businesses concerned, because it means decisions may not be taken in the best interests of the business, it means that legislators may be missing an opportunity to influence business decisions.

The Canadian SR&ED system and the Dutch WBSO schemes stand out among the R&D tax credit systems in larger countries in one important respect. Because the credit itself is taxable income of the recipient, it is considered appropriate, at least under some accounting standards, to account for the tax credit as a reduction in the R&D expenses above the operating profit line.
A factor that reduces the visibility of tax credits to those making decisions on R&D investment arises from the way large groups are structured and the manner in which their accounting systems are organised.

High-level R&D strategy is typically run from the centre. The activities of the group may be organised into divisions according to business segment. A division's activities may be spread over a number of different legal entities in different countries. Central decision-makers will typically look at ratios such as cost per R&D engineer when deciding into which country to put marginal activity. In order that they be influenced by the availability of R&D tax credits:

- The credit could be accounted for as a reduction in costs as described in the previous section, not as a reduction in tax payable; and
- The tax credit might be identified in the accounting systems as reducing the costs associated with R&D engineers. If it is accounted for as a "negative cost" against, say, all payroll costs, or against all of the legal entity's costs, the effect on average R&D engineer costs will be diluted. This factor is within the control of a large enterprise, in theory. In practice, it may be difficult to ensure that the accounting systems are set up in the appropriate way.

3.3 Fiscal incentives in a broader context

The most obvious framework conditions that affect the working of fiscal incentives are:

- ***The overall tax regime and its relative complexity*** (level of corporate tax and income tax, depreciation rules etc…) and the relative generosity of the tax allowances and credits.

Fiscal incentives schemes that have corporate taxation as their basis might have a stronger impact if the corporate income tax rate is high. The credit would compensate the additional compliance costs for entering the programme. Fiscal schemes working from the basis of reducing labour costs (social security) could be used more widely in countries with high labour and social costs.

There is an ongoing debate within the EU about the case for a common corporate tax base. At present, the debate has centred particularly on enterprises operating across borders within the internal market, where there is a need to reduce complexity and create the right tax environment so that investment decisions do not take second place to purely tax-driven decisions. The European Commission's October 2001 Communication (COM (2001) 582)[13] and accompanying study on company taxation is currently the focus of the debate. The Communication explains that the existence of 15 tax jurisdictions in the Internal Market lies at the root of the various tax obstacles to cross-border economic activity. The Communication advocates targeted solutions to deal with these obstacles in the short term, but a more comprehensive approach for the longer term, through providing companies with a consolidated corporate tax base for their EU-wide activities. In July 2002, in an orientation debate on the Commission's Communication, the ECOFIN Council agreed to invite the Commission to pursue its work on targeted measures. This work may in the future have consequences for the way Member States design fiscal incentive schemes for R&D, but at this stage it is impossible to comment further.

- ***The importance of other policy tools*** aimed at fostering business R&D or affecting the research environment will also influence the effectiveness of fiscal incentives for business R&D. The most important policy tools are: direct financial support, public research, university research, the intellectual property regime and cost, the development of relevant infrastructure, a high quality

[13] Communication from the Commission to the Council, the European Parliament and the Economic and Social Committee, 'Towards an Internal Market without tax obstacles', COM 2001, 582

educational system and appropriate framework condtions (e.g. competition policy, quality standards, entrpreneurship).

- ***Direct financial support to business R&D*** is probably the policy tool that would have the stronger interaction with fiscal incentives for R&D. Indeed, both policy tools have a similar impact: reducing the cost of doing R&D.

There are many differences between fiscal measures and direct support to R&D. Some differences are clearly an advantage to one or the other system while others are more neutral (less pronounced) and their importance depends on the specific design of the policy pursued. The advantages of each policy are summarised in Table 6.

Among the potential advantages of fiscal incentives vis-à-vis direct support instruments are the following [14]:

- First, fiscal incentives give less **distortion** regarding the allocation across companies and the allocation of the R&D expenditure itself, in comparison with direct R&D grants.

Fiscal incentives have potentially a wider reach over a large number of firms, regardless their size. In addition, the firms decide in which R&D areas to invest their fiscal allowance or credit. This can be a strong argument in favour of fiscal incentives if the government's resource allocation profile is called into question. In addition, the government may not be successful at "picking winners" to whom R&D funding will be granted. Furthermore, fiscal incentives are less sensitive to misappropriation of funds and "rent-seeking" activities. Fiscal incentives are therefore more market friendly as they do not cause distortions in the allocation of funds [1] between different fields of research or [2] between different companies. R&D grants on the other hand are, in general, more targeted towards specific fields of research or towards specific companies or technologies. Tax incentives can in principle be targeted at specific R&D areas or industries (which is done in the US and UK for instance), but this does add complexity to the policy's design.

The fact that direct R&D grants are more targeted than fiscal incentives has advantages as well as disadvantages. In fact, the rationale behind the financial support given by governments to private R&D is that the amount of private R&D undertaken is not necessarily optimal from a societal perspective. This is so because the social returns from R&D are generally higher than the private returns. Therefore, there are good reasons for governments to target its financial support towards R&D activities with the highest difference between social and private returns. It can be argued that this can be better achieved with R&D grants than through fiscal incentives. Indeed, if the allocation choice is left to the companies, only the private returns will be taken into account when deciding which R&D projects to undertake.

[14] see Hutschenreiter, G., Tax Incentives for Research and Development, Austrian Economic Quarterly, 2002 (2), pp. 74-85.

- Second, ***the administrative cost*** of running a fiscal incentive program can be lower compared to programs for direct R&D funding.

This can be so because the government does not have to devote resources to the planning, allocation and management of the program. However, some studies pass a more critical judgement with respect to the administrative costs involved (see OECD, 2001). The administrative costs of a tax incentive policy will clearly depend on the complexity of the design of the policy.

- Third, fiscal incentive schemes are ***more accessible*** compared to direct governmental support.

The application procedures are usually easier compared to those of direct funding schemes. This should be an advantage for small and medium-sized companies. On the other hand this argument can be weakened by the fact that small and medium-sized companies are not always profitable enough to have sufficient corporate income taxes to benefit effectively from the tax incentive. Moreover, they will often already be carrying forward previous losses. The fact that the unused tax credits can be carried forward does not entirely solve this problem as the cost of capital (time value of money) reduces the effectiveness of tax credits that are carried forward and is irrelevant if the SME is facing cash flow problems. Cash refund provisions or allowing the trading of fiscal incentives would solve this issue.

- Fourth, fiscal incentives can be ***more predictable*** than direct grants from a company point of view.

This is a quite powerful argument as many authors have already stressed the importance of having a stable policy over time (See Guellec and Van Pottelsberghe, 2003). However, it must be noticed that in practice fiscal incentives can be far from predictable. The tax credit system in the US for instance went through substantial changes over its lifetime.

- A political argument in favour of fiscal incentives is that they should not be regarded as additional government expenditure, but as reduction in its revenues. With stringent rules on expanding public expenditures, it might be easier to find political support for boosting fiscal incentives than for increasing public expenditures.

Yet, fiscal measures also have a number of potential drawbacks:

1. They might reward investments that would have taken place even without the incentive and as such are likely to bring about unintended windfalls. This argument also holds true for direct financial support schemes. However, the fact that particularly in large companies, the decision on investing in additional R&D and the financial benefits coming from reduced tax payments, are often not directly connected in terms of management planning. At the moment there is insufficient empirical evidence to suggest which type of instrument has the highest risk of windfall effects.

Fiscal incentives do not allow for an evenly tight government budget control compared to direct R&D funding because direct R&D funding programmes are

usually endowed with fixed annual resources. In order to limit to the level of public expenditure governments could decide to define a ceiling for each individual firm applying.
They are generally less effective as instruments to support specific government priorities and focussing on research with high societal rewards.
Depending on the specific design they tend to only apply to companies that are in profit. Thus these incentives have no counter effect to a downward business cycle. However, provisions such as carry-forward carry-backward facilities and cash-refunds can be set up to make these incentives less dependent of profitability.
Tax incentives can be difficult to design and might add complexity to the overall fiscal regime.

Table 6 sums up the advantages and disadvantages of fiscal incentives in relation to direct financial support schemes.

Table 6 Advantages of fiscal incentives and direct support to R&D

Direct financial support	Vs.	Fiscal incentives
More targeted - Social return >>> Private return - Societal goals		Neutral, economy-wide impact - Business knows better - Avoid picking winners - Market friendly
Higher risk of closed networks		More accessible (business viewpoint) - If carry back/forward; or cash refund - Wider reach - Easier access to information
Administrative costs high		Administrative costs can be low - Depends on the design of the policy
Better budget control from government viewpoint		Better budget control from business viewpoint
High potential additionality		Positive additionality

Implementing an effective fiscal incentive requires that the ***various government bodies work together very effectively***. The design and management of these incentives should be built on an understanding of how companies manage their fiscal affairs **and** how to influence R&D decisions within companies. If a fiscal incentive is designed mainly with an eye to fitting the needs of the tax authorities, e.g. making compliance costs very high, or having unclear R&D definitions, many companies will be deterred from using such a scheme. Likewise if fiscal schemes are created with sophisticated R&D facilities which do not match the private sector's normal fiscal practices the scheme will have difficulties fitting into overall company strategy. In the design and implementation knowledge of 'good practice' in both fiscal regimes and in R&D incentives should be built in. This requires policy makers from both domains to work together.

There is also a ***strong need for co-ordination*** between the institutions that provide direct financial support to R&D (typically the Ministry of Industry, or the Ministry of Education and Science), and the institutions providing fiscal incentives (the Ministry of Finance and Tax Authorities). The co-existence of these schemes influence their joint impact. For instance, Guellec and van Pottelsberghe (1993) show that there is a strong interaction between the two types of policy instruments. This interaction is rather substitutive, which means that increasing one of the two policy instruments seems to reduce the effectiveness of the other.

Tax incentives are easier to implement and create less distortion in countries with one unified federal tax regime. In both Spain and Canada tax regimes and incentives at national and regional level work in parallel but not necessarily in co-ordination with each other. This creates inter-regional competition to attract the (re-)location of firms. Canada is an example where the R&D tax allowance rules are applied differently from one state to another. This makes the situation even less transparent and predictable for firms. On these policy levels co-ordination is also essential.

3.4 Concluding remarks on the effectiveness of fiscal incentives

This chapter has tackled the effectiveness of tax incentives to business R&D on the basis of ex-post quantitative evaluation methods, a more qualitative overview of the R&D investors' behaviour, and a more conceptual analysis of tax incentives compared with direct financial support to R&D.

In the absence of extensive evaluation studies, and taking into account the methodological difficulties attached to many of the econometric studies we can say with some caution that:

- ***Fiscal incentives stimulate business R&D***. However, it is difficult to evaluate the amount of additional R&D per unit of forgone public revenue. The few tentative evaluations show a positive, but moderate level of additionality. Nevertheless, the substantial amount of potential externalities (R&D spillovers) would strengthen the positive impact of tax credit.
- Methodological difficulties in establishing the effect of fiscal incentives leave us with a large unknown factor. There is a clear ***need for more formal evaluations*** that would use several alternative methods. So far, there is a preponderance of evaluations for the Canadian and US tax incentives.
- There is a need for better micro-level data sets to understand the long-term impact of fiscal incentives on business R&D.
- No evaluation has so far attempted to evaluate the ***impact of alternative designs of tax incentives***. The existing evaluations for different countries cannot be compared due to the use of different types of data, methodologies, scope and time periods.

The section on the business perspective provides more details on the various policy designs that would affect the R&D investors' potential reactions to fiscal incentives. The following factors seem to play an important role:

- The design of a fiscal incentive influences its effectiveness. In this respect, a very important factor is that fiscal incentives to business R&D must be set in a ***simple and long-term framework***.
- For large companies the tax incentive must be ***visible and tangible*** and avoid inducing firms to split large research units into several smaller research units.
- The design of fiscal incentives can be improved through an in-depth ***consultation of large and small firms***.
- *Strategic behaviour* of firms with respect to re-labelling of activities as R&D should be taken into account and the design of the tax incentive should minimise pitfalls resulting from strategic behaviour.
- Given its wide reach, the spill-over effects are considerable regardless of whether fiscal incentives support R&D that is 'business as usual' or completely new R&D. There is also a likelihood that the absorptive capacity of SMEs using the fiscal incentives will be improved as well.

The socio-economic impact of R&D tax credit policies will also depend on the broader context in which they are set up. There are at least two broader factors that must be taken into account: the overall tax regime and the importance of other science and technology (S&T) policy tools, especially direct financial support to business R&D.

- A broader ***tax regime system*** that is not too complex and characterized by a relatively high level of corporate income tax rate is an environment that would most probably be favourable for fiscal incentives to business R&D.
- The ***broader context of the national innovation systems*** (other financial policies, intellectual property rights, regulation, S&T infrastructure, public research, education and training programmes), must also be taken into account when implementing fiscal incentives to business R&D.
- Tax incentives have various potential advantages and drawbacks with respect to direct financial support to business R&D. In any case there is a need for ***coordination of the two policy tools***. The most important advantages of fiscal incentives are:
  - A higher neutrality (they potentially affect all companies)
  - Potentially small administrative costs if the tax scheme is not complex
  - Greater accessibility and visibility
  - More predictability from a business budget setting viewpoint

In a nutshell, it clearly appears that fiscal incentives can be highly effective in stimulating business R&D. **The specific design of a fiscal incentive seems to be a key factor underlying its effectiveness**. A badly designed fiscal incentive can destroy the potential advantages of these schemes. The issue of 'good practice' design is, therefore, tackled in the next chapter.

4. WHAT MAKES A GOOD DESIGN OF A FISCAL INCENTIVE?

One clear conclusion is that the way in which fiscal incentives are ***designed does matter*** in terms of their effect on boosting private R&D investments.

In order for fiscal incentives to have an impact on decisions to invest in R&D we conclude from the previous chapter that they should have a number of features:

- Clarity, consistency and predictability are essential to assist enterprises in making R&D investment decisions partly on the basis of tax incentives.
- The accounting treatment and impact on a company's cash flow should be such that the incentive has a maximum of visibility to decision-makers both at the budgeting stage and later on, when spending decisions are being made.
- Overly complex schemes -- or those that change frequently -- will act as a deterrent to R&D investments. High compliance costs will be a further deterrent to use these schemes.
- In order to have a substantial impact, an R&D tax credit policy should be sufficiently generous.

4.1 Volume-based or incremental?

There are two principle ways of defining the R&D cost base for tax reductions. Volume-based schemes, which base allowances on the volume of costs made in a given period, and incremental schemes, which base allowances on the increment in costs from one period to another. There are important advantages and disadvantages for both types of scheme, but the balance seems to tilt towards volume-based schemes.

- Volume-based schemes are ***simpler in terms of the implementation*** for both firms and governments and more predictable in terms of calculating prospective benefits. Their main drawback from a policy perspective is a larger potential 'windfall'.
- Incremental schemes can frustrate the ability of firms to factor the benefits of tax incentives into long-term R&D plans as well as penalise heavy R&D spenders for their stable high levels of research expenditures.

From a ***business perspective*** the incremental design seems to have several ***drawbacks***:

- A tax credit which rewards an increase in R&D investment does not offer any incentives when R&D expenditures remain at a stable, but high level. In addition, a rolling average base might create distortions in the planning of R&D expenditure of companies. Moreover, increasing the level of R&D expenditure in one year increases the base amount applicable to the following years, and, as a result, would reduce the long-term effectiveness of the tax incentive.
- It is more complicated to administer

However, incremental tax credits can be particularly **ineffective during the downward phase of the business cycle**. This is so because the base amount is composed of R&D expenditure of the previous (more optimistic) years. In fact, during an economic downturn companies could decide to reduce their current level of R&D expenditure. As a result the company might not be entitled to any tax credits.

From a policy point of view some of the advantages of an incremental scheme are:

- Rewarding additional effort and not 'business as usual'
- They are less costly in the overall budget, but more costly to administer since more information is needed to treat applications
- Incremental schemes are more effective per Euro spent since the leverage effect is higher

Table 7 lists the main drawbacks of tax credits based on volume or incremental R&D expenditure from a business and governmental perspective.

Table 7 Disadvantages of volume-based and incremental schemes from the business and government perspective

	Business perspective	Government perspective
Volume-based		More costly
Rolling Increment	More complex Higher application costs Distortive in dynamic planning environment No benefit when high, but stable Difficult for SMEs	More complex Higher administrative costs Requires difficult to obtain info Marginal impact
Fixed Increment	More complex Higher application costs Difficult for SMEs	More complex Even higher administration costs Marginal impact

This overview would suggest that:

- On balance a volume-based scheme seems to be a better practice than an incremental scheme. It avoids complexity and administrative burden.
- Especially for SMEs it seems more appropriate [1] to adopt a volume-based scheme and [2] to offer a higher tax credit rate compared to large companies
- Mixed schemes incorporate the negative characteristics of both types of incentives and add very much to the complexity of the tax regime.

4.2 Definition of R&D

There are substantial variations in the definition of R&D. It is advisable to use a standard definition of R&D, like the one offered by the Frascati Manual (OECD 1993), but nationally some modifications may be required. From a business point of view the wider the definition of eligible R&D costs, the better. From a policy point of view, the broader the definition, the higher the likelihood of supporting investments that would have been done anyway. Moreover, a broader definition of R&D also facilitates the "relabelling" of activities in order to qualify for the credit.

Some further issues are related to specific policy objectives or to the general generosity of fiscal incentives:

- R&D can be defined in such a way that it covers collaborative R&D or R&D out-sourced to other organisations (public research or even companies), like in the USA and the UK. Such a design is more generous and would foster collaborative R&D as well as industry-university relationships. In this respect it would be advisable to allow tax incentives only for the outsourcing to universities or public research institutions;
- R&D can be defined in such a way that it includes R&D performed abroad (like in the UK or Japan), making the fiscal incentive even more generous for multinationals. Nevertheless, it is less advisable since it would not help to foster domestic and, therefore, European R&D investments;
- The generosity of fiscal incentives can be further improved by allowing expenditures from R&D consortia to qualify for the tax credit;
- One possible option to make the implementation of the incentive easier would be to focus essentially on companies' wage tax (and social security) related to R&D, like in The Netherlands. This allows monthly tracking of the benefits from the scheme.

4.3 Making schemes more predictable and independent of profitability

Fiscal incentives based on corporate income tax, with no further facilities, only provide benefit if a company makes a profit. From the company perspective this limits the predictability of the schemes, since companies cannot incorporate future credits or allowances into their forward planning.

On a macro-economic level this means that fiscal incentive schemes do not have a counter-cyclical effect, helping to boost investment in research at a period of down-turn of the economy. There are, however, several mechanisms in place that help overcome this direct link to profitability. Mechanisms used in existing schemes are carry forward / carry backward facilities with varying years (e.g. in the case of the US fiscal scheme), or cash refunds in case of losses (e.g. in the Australian, Canadian, French and UK fiscal schemes).[15]

[15] In some US States tax credits can be traded to other companies. The Expert Panel has not looked into this facility in detail but the additional complexity to the overall tax regime raises some concern.

4.4 Compliance costs and user friendliness

From a business perspective, the lower the administrative burden to receive fiscal support, the better. In addition, the fiscal schemes need to be transparent and stable so that firms can incorporate the schemes into their financial planning.

From a 'tax payers' perspective there needs to be a proper check that:

- What is supported actually relates to R&D activities.
- The fiscal instrument actually makes a difference to the R&D decision.

This means we need to find a good balance between user friendliness and low thresholds for the companies to enter the scheme on the one side, and some level of control on the side of the public authorities on the other.

Evaluation studies attempt to answer the question whether the fiscal instruments actually make a difference to the R&D decision. There is little empirical evidence on this subject and the answer is most likely different for different types and sizes of firms. For large firms operating globally fiscal incentive schemes influence the height of the R&D investment, but less likely the geographical location of certain R&D investments.

Scarce empirical evidence suggests that administrative costs of fiscal incentives are much lower than for direct support schemes. An overview study comparing all innovation policy schemes in the Netherlands showed that the fiscal scheme had one of the lowest levels of administrative costs (4.1% of total budget).[16] Given the small number of formal evaluations that touch upon this question overall conclusions cannot be drawn easily.

With relation to compliance costs the empirical evidence is even scarcer. A study from Industry Canada on their tax incentive scheme concludes that despite the reputedly extensive financial and technical record keeping required to support an R&D fiscal claim, the compliance costs of these credits appear to be relatively low in aggregate. A figure of 0.7 percent of the credits was reported by the sample of respondents. Looking at the costs incurred by the private sector the Canadian fiscal incentive scheme seems cost-efficient. One finding, however, is that the compliance costs are substantially higher in firms with small R&D activities, as compared to firms with larger R&D efforts.[17]

[16] The Netherland's Ministry of Finance, Samenwerken en stroomlijnen, opties voor een effectief innovatiebeleid, Eindrapportage IBO Innovatiebeleid, Den Haag 2002.

[17] Industry Canada, Measuring the Compliance Cost of Tax Expenditures: The Case of Research and Development Incentives, Working Paper no. 6, 1996

5. CONCLUSIONS AND RECOMMENDATIONS

Fiscal incentives are recommended to be used to support private R&D because these schemes have the potential to address a wide range of firms, including SMEs, and leave the decision as to the content of the research to their discretion. Fiscal schemes can contribute to raising the overall level of investment in business R&D.

The review of the fiscal incentives in place and the current use of tax schemes among the EU Member countries clearly shows a very high diversity. In this context there is little room for recommending a uniform system of fiscal incentives for business R&D in Europe. Nevertheless, one clear conclusion of this report is that **fiscal incentives stimulate business R&D** and that the **design** of these fiscal incentives **is crucial to the effectiveness of these schemes.** In addition, since fiscal incentives are not the only financial instruments aimed at fostering business R&D, there is a strong **need for co-ordination** between the various institutions and ministries involved in the financing of business R&D.

Several recommendations concerning the design of fiscal incentives for R&D could be easily implemented. They can be grouped in three areas: design issues, evaluation issues and policy mix issues.

5.1 Design of fiscal incentives

Recommendation 1

Member States are recommended to review their current fiscal incentives for R&D or, if considering new instruments, design new instruments in such a way as to conform to the basic principles of good practice in policy design. These principles for good policy design require: **simplicity, low administrative and compliance costs, reliability and long term stability**.

In order for fiscal incentives to be effective, they should fulfil a number of 'principles of good design'. The key principles of a good design are:

- Simplicity: schemes should be transparent and broadly and easily accessible.
- Low administrative and compliance costs: For firms it should not be complex and time consuming to make an application for a tax credit/allowance and having it granted. For administrations the scheme should be manageable with sufficient checks to avoid ineligible use, but without a large overhead for auditing purposes.
- Reliability: firms must also be able to plan their fiscal allowance or credits in advance. Tax incentives should be independent of current profitability.
- Stability: the rules of the game should not be changed too often, since this reduces the trust of companies to use the scheme in their R&D investment

decisions. More certainty in the long term allows firms to forecast the cost of their R&D projects more accurately.

Recommendation 2

It would be more powerful if the above "principles of good design" were complemented by a **concrete checklist** that policy makers could apply to assess the tax incentives available/planned in their country. This checklist would incorporate the following four recommendations on design issues**.**

Recommendation 3

In the light of the 'principles of good design' we recommend that tax incentive schemes **should be volume-based** rather than increment-based if the main objective is to substantially stimulate business R&D.

Although incremental schemes can be more effective in terms of their 'leverage effect' (additional business R&D investment per forgone tax revenue for the government), their overall impact on total R&D investment would be much weaker than volume-based schemes. It must, however, be kept in mind that:

- Increment-based tax incentives designed on a rolling base invite 'strategic behaviour' of companies, timing and allocating their R&D expenditures to fit the scheme and might, therefore, induce allocative distortions;
- Incremental schemes need a very high generosity level to attract large firms, which account for more than 85 per cent of business R&D in most EU countries;
- Since business R&D investments are highly pro-cyclical, incremental schemes might not be appropriate to stimulate R&D in periods of economic downturn;
- Using a combination of both schemes adds to the complexity and reduces the transparency of the fiscal incentive scheme. This would be in breach of most of the principles of good design.

Recommendation 4

Assure **re-fundability** (cash refund) of tax credits or tax allowances in cases where companies make losses (and, therefore, would not be able to benefit from a reduction of corporate income tax liabilities). For large firms this could be dealt with by using carry-forward / carry backward arrangements. For small firms a cash refund is preferable since it will have an immediate effect on their cash flow.

Recommendation 5

It is important to **improve the visibility and transparency** of fiscal incentives in such a way that they can be directly linked to R&D decision making. This is especially important for large firms where important budget allocations, also for R&D investment, take place at the corporate level rather than within the research units. One possibility for improving visibility can be achieved by considering R&D tax credits as taxable income for the company, as is currently the practice in Canada. This has the advantage that the income from the fiscal incentives is visible in the company's profit and loss accounts. In this way the incentives stand a much greater chance of influencing the decisions of budget-makers and managers. A second option is to use the Dutch model, which provides cash flow to firms in the year R&D is conducted and can be directly linked to the R&D expenditure.

Recommendation 6

A **clear definition of R&D** is essential for deciding in a cost-effective manner what are the eligible R&D costs and which activities count as R&D. We recommend that the definition used in Member Countries should be based on the international standard defined in the **Frascati Manual** of the OECD.

It is necessary to reach a workable definition in a carefully designed consultation process involving relevant ministries, the tax administrations, as well as the private sector. This process is something which each country should do nationally. The UK consultation process and their definition of R&D based on the Frascati-Manual, can serve as a good practice example.

5.2 Evaluation

Recommendation 7

There is a need for **formal evaluation practices** of the effectiveness of fiscal incentives, also in comparing fiscal incentives with other types of policy instruments. These evaluations should be made publicly available for policy learning purposes.

In those few cases where an evaluation is performed, there is evidence of the effectiveness of fiscal incentives in raising the level of business R&D. However, current practice in the evaluation of fiscal incentives has three weaknesses. First, none of the existing evaluations tackle the impact of particular designs of fiscal incentives. Since no pair of countries have implemented similar fiscal incentives there is so far no evidence as to the impact of specific designs. Second, existing methodologies are neither robust nor coherent enough to give a reliable insight into the impact of these measures in the short, medium and long term. Third, many governments have chosen not to conduct an external and public evaluation of their schemes, which prevents the policy community learning from the good and bad experiences encountered with

different design models. The Netherlands, Australia, and Canada have performed insightful ex-post evaluations of their fiscal incentives. The UK has implemented a thorough ex-ante evaluation of its policy through in-depth consultation with the business sector and theoretical analysis.

Recommendation 8

In order to perform effective evaluations there is an urgent **need for relevant databases** at the firm level.

Lack of appropriate micro-level data is probably the most important factor underlying the few formal evaluations of the effectiveness of fiscal incentives.

5.3 The contribution of fiscal incentives in the Policy Mix

The expert panel would like to stress that the costs of raising the levels of R&D expenditure to the target level of 3% of GDP is going to be significant, both for the private and the public sector. This challenge will not be reached by only relying upon fiscal incentives. Direct government funding of business R&D and public research, the use of guarantee mechanisms and the mobilisation of venture capital will also play an important role in stimulating business R&D investment.

Recommendation 9

There is a need for an **optimal policy mix** regarding business R&D. Tax incentives should be used when governments want to reach a broad range of firms involved in R&D activities. Direct government funding of business R&D should be targeted towards the fields of research were the gap between private and social rates of return is large.

Since these policies all influence the cost of conducting R&D, their interactions must be taken into account. Finland, for instance, has set up a Research Council where all issues related to innovation efforts are tackled at the country level.

Recommendation 10

Policy makers need to ensure that fiscal measures and direct government funding of business R&D complement each other. This would be achieved only through an **effective co-ordination mechanism** between the public institutions (ministries and agencies) involved in the stimulation of business R&D.

While direct support schemes are usually developed under the auspices of ministries in charge of science and technology policy, fiscal instruments tend to be introduced in the course of tax reforms with the respective Ministry of Finance at the helm. Therefore, it seems reasonable to recommend to member states that they should implement a co-ordination mechanism to ensure consistency and effectiveness of the system of public support for R&D.

In order to avoid a situation where the targeted 3 per cent R&D intensity translates only into a wage increase, governments will have to ensure that the increase in R&D expenses will be followed by an increase in the number of researchers. In the long term the number of researchers can be increased through an effective education policy. However, in the short term it might be more difficult to generate or attract researchers.

The expert panel is aware of the debate on using personal income tax breaks for qualified researchers and scientists who take up employment within the EU. A few EU countries currently use these types of incentives to attract non-residents, including those from other EU Member States. However, merely encouraging relocation of researchers within the EU is unlikely to increase the overall levels of R&D investment within the EU, and may be inconsistent with a fair tax competition. Boosting the number of researchers and engineers in industry should go hand in hand with investing in universities that train them otherwise the pool of new talents will dry up quickly.

Recommendation 11

Fiscal incentives using **personal income tax breaks**, if appropriately formulated, could effectively attract researchers from abroad. The expert panel finds that there is insufficient information to assess the consequences and effectiveness of these schemes at this stage. It is recognised that personal income tax break may induce potential distortions within the EU labour market.

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SUMMARY

The European Council in Barcelona set an overall EU R&D investment target of 3% of GDP by the year 2010, with industry asked to contribute two thirds of this figure. To approach these levels, however, dramatic improvements are needed in the effectiveness of policies used to stimulate private sector R&D. The specific aim of this report is to offer suggestions and guidance concerning the design and implementation of fiscal measures to stimulate private investment in Research. The report considers the importance of good design of fiscal measures and the role of framework conditions. After reviewing the use of these measures and the factors that affect their effectiveness, the report then presents a series of recommendations for the consideration of policy makers across the EU.