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Evaluation of current fiscal incentives for business R&D in Belgium

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1 Theoretical Foundation of S&T Policies and Fiscal Measures towards R&D

Europe has decided to make of innovation one of its top priorities. Indeed, the European Union is lagging behind in terms of research and development (R&D) expenditures; and the gap between it 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 an R&D intensity of 3% of GDP by 2010. Besides, it has set the target of boosting business-financed R&D to a proportion of 2/3 of all R&D expenditures. Belgium's efforts to achieve those results need to be further strengthened. Although the share of business-financed R&D is reasonable, the total R&D intensity is still weak compared to its European neighbours, and to the main international economic leaders. The business sector needs to engage in more R&D activities.

R&D that leads ultimately to 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 for the following reasons. First of all, R&D and innovation are characterised by externalities to the whole society. As a result, a company that performs R&D does not capture all the benefits of this process. It will therefore invest an amount of R&D that is below the socially optimal level. Second R&D is a risky activity, given that ultimately not all research or development leads to innovation. This might discourage performers of R&D from engaging in certain projects. The third reason is that uncertainty over the outcome of R&D makes it also difficult for enterprises to find financing, and they may well be confronted to credit rationing. All those arguments provide evidence that firms do indeed under-invest in R&D activities compared to what is socially desirable. Market failure may be corrected by public intervention.

Two main types of policies can be used by the government to stimulate business R&D: direct financial support (e.g. subsidies) and fiscal (or tax) incentives. This report focuses mainly on fiscal incentives to business R&D. In this section we underline the theoretical foundations of science & technology (S&T) policies towards business R&D. The advantages and drawbacks of the two main policies towards business R&D are presented and discussed. The next chapter summarizes the main findings of the empirical literature devoted to the evaluation of the effectiveness of fiscal incentives for business R&D. In section 3 the typology of fiscal measures for R&D are discussed. Section 4 moves on to the various design issues of a fiscal policy towards R&D.

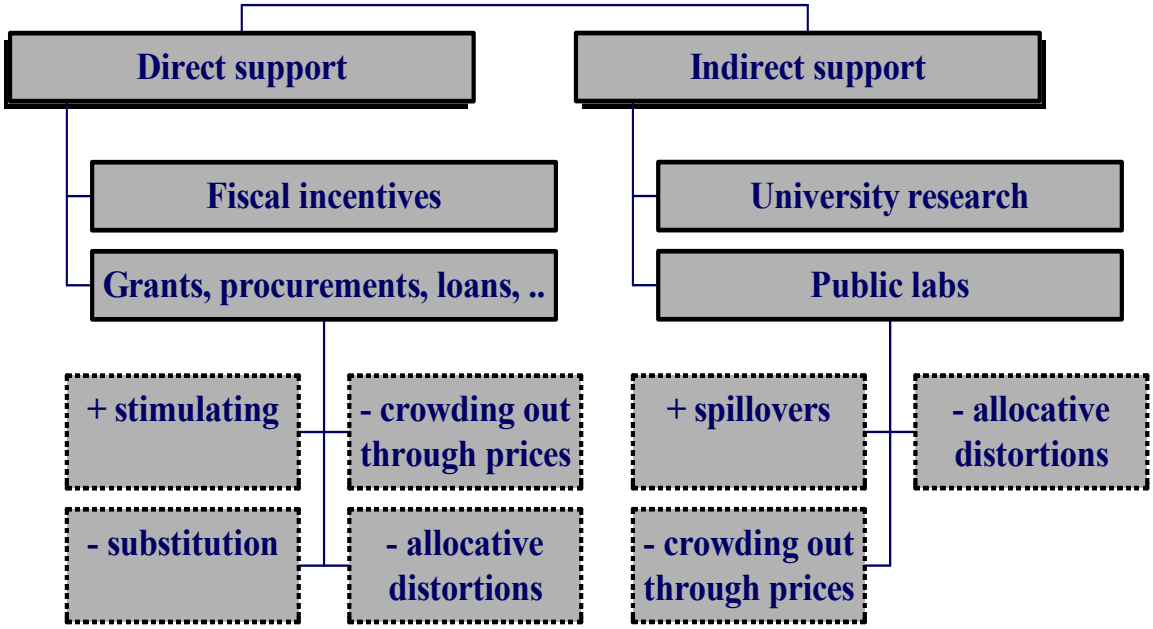
In section 5 case studies of two countries are presented with an extensive analysis of their innovative fiscal policy towards R&D. The recommendations from the European Commission Task Force are summarized in section 6. In section 7 the Belgian fiscal incentive system is presented and analysed in the light of the various design issues.

Section 8 presents four potential scenarios for improvement of the actual fiscal incentives for business R&D in Belgium, along with a preliminary evaluation of the maximum opportunity cost for the government.

1.1 Fiscal Incentives in a wider context

We will consider the different types of public intervention. Government support can be of two kinds, namely direct support and indirect support. Each category can be further detailed (see chart below).

Figure 1. Main policy tools towards business R&D, and their potential impact



a. The direct governmental support mechanisms to business R&D can be grouped into two categories. On the one hand there are (*1*) fiscal incentives, which stimulate business R&D through an alleviation of the corporate tax pressure. On the other, government can stimulate R&D even more directly through (*2*) financial support. In practice direct financial support mainly takes the form of grants, loans and subsidies given to selected companies in order to perform specific R&D activities. In analysing those direct support mechanisms some negative issues deserve attention. Hence the need to evaluate the net effect of these policies in order to test whether the potential negative effects of these policies are compensated by their stimulating impact. Firstly, there is a risk of substitution, i.e. financially rewarding business R&D that would have taken place even without the measure. Another important issue is the fact that the stimulating effect of direct measures on the total amount of business R&D is a gross volume effect. It is composed of the quantity of R&D times the unit price of R&D. The risk of crowding out through prices implies that there is a certain risk that the increase in gross R&D volume is partially explained by an increase of its unit price. In the worst case all the gross volume effect would go to increased salaries of R&D workers and to increased prices of suppliers of R&D equipment. A third possible issue concerns the impact of the

allocation of government support to certain specific projects. This can result in allocative distortions, i.e. the fact that some projects are supported by the government excludes others from being undertaken. This can be due to an inelastic supply of R&D, whereby the support measures offered by the government increase the price of non-supported R&D. It can also be due to unfair competition between similar projects, one of which receives support. This last risk concerns more subsidies than fiscal incentives.

However on the positive side, a vast body of literature finds that direct support measures to business R&D appear to be stimulating the net amount of business R&D.

b. Besides those direct measures, the government can also stimulate business R&D with indirect measures. First, through its funding of universities, the government aids academic research and this can further benefit the corporate world. Second, the research performed in public laboratories can be beneficial as well to the corporate world. This beneficial effect results from positive spillovers that are typically associated with R&D and that flow back to society. However as with the direct support mechanisms there is a risk of crowding out through prices. The more inelastic the supply of R&D, the more severe this effect will be. This can cause indirect support measures to have a perverse effect after all on the net amount of business R&D. In such a case increasing the amount of indirect support will generate positive knowledge spillovers to society, but it will as well increase the price of R&D, and this can negatively affect the amount of business R&D. A second issue concerns allocative distortions of the money flows to R&D. Beside the arguments described above, it has often been suggested that governments or universities are not necessarily as efficient as market forces to allocate money to specific R&D projects. As a result this can cause money to flow to R&D projects with lower expected value, away from projects that the market would have selected.

c. Besides those measures in figure 1 (fiscal incentives, grants, public and university research), the government can also stimulate business R&D by fostering the appropriate business environment. To this end the government can use the following policies[1]:

- Stimulate R&D cooperation between the corporate world and governmental organisations or between the corporate and the academic world. See for instance the recently adopted Danish policy (Bengtsson 2002).
- Enforce the patent protection so that the private benefits from R&D increase. All things being equal, this would lead to an increase in R&D expenditure as companies base their optimal R&D level on the expected private benefits of that R&D.
- Specifically stimulate venture capital oriented towards R&D intensive companies. This can be done through the creation of public venture capital funds or through public contribution to private venture capital funds.

d. A final option to the government affects the supply side of R&D. The government can try to stimulate via numerous actions technical and engineering studies so that the number of individuals apt to

[1] Adapted from Mohnen, P. (1999) Tax Incentives: Issue and Evidence, Cahier du CIRANO, 99s-32

engage in R&D activities increases on the market. This would make the supply of R&D less inelastic or even drive down the unit cost of R&D. However such a policy can only be fruitful in a long-term perspective.

1.2 Difference between fiscal and direct financial measures

There are many differences between fiscal measures and direct financial support to R&D. Some differences are clearly an advantage to one of the systems while others are more neutral and their importance depends on the government's policy pursued.

First, fiscal incentives are **more neutral** than direct R&D grants regarding the recipient companies and regarding the allocation of the R&D expenditure itself. R&D grants on the other hand are more targeted towards specific fields of research or towards specific companies.

- This can be a strong argument in favour of fiscal incentives if the government's resource allocation profile is put into question. Secondly, the government may not necessarily be more successful than the business world in "picking winners" to which R&D funding will be granted. In addition, fiscal incentives avoid misappropriation of funds and rent-seeking activities by government's civil servants. Lastly, fiscal incentives are more market friendly as they do not cause market distortions in the allocation of funds [1] between different fields of research or [2] between different companies by supporting some specific fields of research or some specific companies at the expense of others.
- Direct financial support may however be preferred to fiscal incentives in some cases. In fact the rationale behind government support to R&D is that the amount of R&D undertaken is not optimal from a societal perspective. This is the case because the social returns of R&D are higher than the private returns. As a result, it makes sense that the government targets its financial support towards R&D activities with the highest discrepancy 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.

Second, the **administrative cost** of running a fiscal incentive program can be lower than a financial one. This can be so because the government does not have to commit as much resources on the planning, the allocation and the management of the program (See also Sheehan, 2002). However some studies pass a more critical judgement with respect to the administrative costs involved (see OECD, 2001). The difference in cost is also difficult to measure as it depends heavily on factors like the degree of efficiency of the administration and the degree of control pursued.

Third, fiscal incentive schemes are **more accessible** than direct governmental support. 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 take full advantage of a fiscal policy. Moreover they will often already carry 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 reduces the present value of the tax credits that are carried forward. This can in turn reduce the effectiveness of the fiscal policy.

Fourth, fiscal incentives can be **more predictable** from a corporate perspective than direct grants. 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 has to be noted that in reality fiscal incentives can be far from predictable. For instance the tax credit system in the US changed the credit rate from 25% to 20% in 1987 and changed from a rolling base to a fixed base in 1990. Moreover the tax credit was never a permanent measure. Its duration was always granted during a fixed period, after which the tax credit expired. The American Congress always extended the tax credit retroactively, which caused much insecurity among participating companies. Hall (1993) showed on this subject that the impact of the US tax incentive increased when the policy became stable.

Fifth, contrary to direct R&D funding programmes, which are usually endowed with fixed annual resources, a fiscal incentive policy does not allow for an evenly tight **budget control.** .

Table 1 summarizes the main advantages of fiscal incentives versus direct financial support.

Table 1. Advantages of fiscal incentives versus direct financial support.

R&D Subisidies	Vs.	Fiscal Incentives
More targeted		**More neutral**
- Social return >>> Private return		- Business knows better - Avoid picking winners - Market friendly
Better budget control		**More predictable for companies**
		Wider reach
		Administrative cost can be very low
		More accessible

2 Evaluation of the Effectiveness of the Fiscal Generosity towards R&D

Given the importance to gain insight in the effectiveness of public spending, many academic and governmental studies were undertaken over the last two decades. The main problem with fiscal incentives is related to the relatively high costs of the policy for the government while the additional amount of R&D generated by the incentives is not exactly known. As the counterfactual can never be observed, most studies had to rely on model to estimate this additional amount of R&D generated by the policy. Ideally, studies on the effectiveness of fiscal tax incentives should perform a proper cost-benefit analysis on the societal level. However such an approach requires a lot of data, some of which is not always available. The main inputs needed are:

- The responsiveness of companies to fiscal incentives measured by the price-elasticity of R&D
- The amount of R&D that would be undertaken in the 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 drawbacks, the solution adopted in the literature has been to calculate the ratio between the amount of additional R&D expenditures generated by a marginal increase in foregone tax income. (The bang for a buck method) The tax incentive is considered to be efficient if the 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" analysis of the effectiveness of R&D tax credits have to be put forward:

- It does not account for the "relabelling" of activities to qualify for the credit. Such practice consists of fraudulent attempts by companies to include non-R&D activities into their declared R&D expenditure. This is done in order to increase the amount of tax credit that they are entitled to but those non-R&D activities have of course no positive externalities to the society.
- It only measures increases in the total R&D spending but does not properly distinguish between the volume and the price effect of the R&D (essentially the wages paid to researchers).

Overview of the current body of academic literature

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 anecdotic evidence. An overview of the most relevant empirical studies is provided in Table 2. The results can be summarised through the following highlights:

2.1 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 activities. In other words, the price-elasticity of R&D is negative. 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 figure, in absolute terms, comes from Mansfield and Switzer (1985) with a price-elasticity of –0.04 while Hall (1993) reports the highest price-elasticity with a figure of -2.7. Excluding some questionable figures, the median elasticity in Table 2 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 increase of business R&D expenses induced by those price changes. Hines (1993) also distinguishes the price-elasticity of R&D when R&D is considered as a stock and when it is considered as a flow. His finding of a greater price-elasticity of R&D flow compared to the price-elasticity of R&D stock is confirmed by the average elasticity for the flow approach (about -1) compared to the stock approach (about -0.7).

2.2 Preponderance of US and Canadian evaluation practices

A second observation from Table 2 is the fact that there is a preponderance of studies carried out in the US and in Canada. Out of a total of 18 studies, 8 focus on the US and 5 on Canada. Beside 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.

2.3 Diversity in data, methodology and scope

Table 2 also shows an enormous diversity in the data sources, the methodology, the time periods, and the scope underlying the different studies. Such diversity makes it difficult to compare the results and even more difficult to draw strong conclusions concerning the general effectiveness of tax incentives. Most studies collect data at the firm level while a few others use data at the industry or the country level. In five cases the data was obtained from surveys while in the other cases more formal sources of information and larger datasets were used, such as Compustat.

Beside the huge diversity in the data used, the methodology also strongly differs from one study to the other. Some “anecdotal” studies on 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 at 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 basis that surveying executives of companies 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 of 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 by the price reduction of R&D caused by the fiscal incentive. The second methodology uses a model with a dummy equation. In the case no incentive is available, the dummy equals "0", and else it equals "1". If the equation is well specified this model can, to a certain extent, eliminate all other factors that influence the amount of R&D in a given period.

Such econometric studies can be carried out at the microeconomic level, which is most common, or at the macroeconomic level. However the results of studies using microeconomic data cannot be generalised without caution. Indeed, using data from specific firms or from specific industries or using data that cover only a specific policy in one country does not allow inferring responsiveness of tax incentives to a broader context. Macroeconomic approaches bring additional evidence in this respect. Currently only two studies use aggregated data at the 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.

Table 2. Overview of studies into the effectiveness of fiscal R&D incentives.

	Authors	Year	Data	Approach	Price elasticity of R&D	R&D/$tax	Approach	Period of credit
1	Collins Eisner	1983	US survey 99 firms	event	Insignificant	<1,0		1981:2
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	0,4	Flow	1980-1983
4	Bernstein	1986	Canada firms	price elasticity	-0.13 (ST) -0.32 (LT)	0,8	Stock	1981-1988
5	Dagenais et al	1997	Canada 434 firms	R&D demand equation	-0.07 (ST) -1.09 (LT)	0.97	Stock	1975-1992
6	McFetridge & Warda	1983	Canada Aggregate	price elasticity	-0,6	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)	1,3	Flow	1981-1989
9	Hines	1993	US 116 firms	price elasticity	-1.2 (stock) -1.6 (flow)	1.2 (stock) 1.9 (flow)	Stock Flow	1984-1989
10	Hall	1993	US 800 firms	price elasticity	-0.8 to -1.5 (ST) -2.0 to -2.7 (LT)	2.0	Flow	1981-1991
11	Mamuneas & Nadiri	1996	US 15 industries	price elasticity	-0.9 to -1.0 (ST)	0,95	Stock	1981-1988
12	Berger	1993	US 263 firms		-1.0 to -1.5	1,74	Flow	1981-1988
13	Mansfield	1986	US 110 firms	survey	-0.35???	0.3 to 0.6		1981-1983
14	McCutchen	1993	US 20 drug firms	dummy equation	-0.28 to -10.0?	0.29 to 0.35		1982-1985
15	Asmussen & Berriot	1993	France 339 firms	dummy equation	-0.26	0,26	Flow	1985-1989
16	Bureau of Industry Economics	1993	Australia survey >1000 firms	dummy equation	-1.0	0.6 to 1.0	Flow	1984-1994
17	Bloom et al	1998	Panel of 8 countries aggregates	price elasticity	-0.16 (ST) -1.10 (LT)		Flow	1979-1994
18	Mansfield	1986	Sweden 40 firms	survey	small	0.3 to 0,4		1981-1983
19	Guellec & Van Pottelsberghe	2003	Panel of 17 OECD countries	price elasticity	-0.28 (ST) -0.31 (LT)	not relevant	Flow	1983-1996

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

3 Typology of Fiscal Measures for R&D Investment

In a broad context, fiscal measures for R&D investment aim to stimulate the level of business R&D by reducing the tax burden of companies in proportion to the amount of R&D undertaken. This is generally realized through a reduction of the corporate income tax, *i.e.* the tax due on positive corporate earnings. The exception to this rule is the Netherlands, where the fiscal measure reduces the wage taxes and the national insurance contributions.

Because fiscal measures reduce the amount of tax due, they do not lead to any out of pocket expense for the government but rather to a loss of revenue. This typology characteristic of fiscal measures implies that such a policy requires close monitoring in order to determine the real cost of the policy. This is the case because it is more difficult to keep track of foregone tax revenue than it is to keep track of real out of pocket expenses. Moreover, fiscal measures often allow companies to carry forward unused incentives to the subsequent fiscal periods. This inevitably makes it more difficult to determine the exact moment when the cost is supported by the government.

In practice there is a wide variety of fiscal measures in place to increase the amount of business R&D in a country. In the following part, all such measures will be discussed, starting with the most widely used measures.

3.1 Depreciation rate of current and capital R&D expenditure

Current expenses are expenditures that can be entirely deducted from the taxable income of the company in the year they are incurred, i.e. the depreciation rate is 100%. Such expenses mainly consist of the cost of goods sold, the cost of selling and general administration, the cost of rent and other kinds of expenses that are consumed within the fiscal year to which it relates. On the other hand, business expenditures that generate or that are expected to generate revenue in future years as well have to be capitalized. Each year, a portion related to the expected lifetime of such assets is then deducted as an expense. For instance if an asset has an expected lifetime of 5 years, each year one fifth of the initial value can be deducted and as a result the depreciation rate will be 20%.

It is clear that all the R&D-related expenditures are supposed to have an impact on the future revenues of the company and are less related to the everyday costs of keeping the business going. As such it is theoretically most appropriate to capitalize and depreciate that expenditure over several years. However in practice, almost all developed and even most of the developing countries allow the non-capital part of R&D-related expenditures to be expensed in the year it is incurred. This means that expenditure such as wages and consumables related to R&D can be fully deducted during that year. As a result, theoretically, this practice has to be seen as a sort of fiscal incentive for R&D. However given the fact that it is such a weak stimuli and such a widespread measure, full depreciation of current R&D expenditure is not considered as an important measure.

In addition to the expensing of current R&D expenditure, other specific measures allow for some accelerated depreciation on capital R&D expenditure. This makes it fiscally more attractive for companies to invest in R&D-related equipment.

3.2 Tax allowances on R&D expenditure

Beside the standard depreciation and expensing procedures, tax allowances allow companies to deduct eligible R&D expenditure at rates above 100% when calculating corporate income taxes. The effect of such measure is that the taxable income is reduced by an amount equal to the tax allowance rate times the amount of eligible R&D expenditure. The benefit for the company is that in the end it will be liable to pay less corporate income taxes because the taxable income is lower than the real income. The final cost reduction to a company equals (under the assumption of sufficient positive earnings in the relevant year):

$$\text{Cost reduction} = R\&D \times TA \times \tau$$

Where R&D = the total amount of eligible R&D expenditure for the tax allowance
TA = the applicable tax allowance rate in percentage
τ = the applicable corporate income tax rate

3.3 Tax credits on R&D expenditure

Similar to tax allowances are tax credits. However the fundamental difference is the fact that tax credits reduce the corporate income taxes directly instead of reducing the taxable income. In this case the final cost reduction to a company equals (under the assumption of sufficient positive earnings in the relevant year):

$$\text{Cost reduction} = R\&D \times TC$$

Where R&D = the total amount of eligible R&D expenditure for the tax allowance
TC = the applicable tax credit rate in percentage

Since the corporate income tax rate is necessarily below unity, a tax credit scheme using the same rate as a tax allowance scheme offers a higher cost reduction to companies.

3.4 Myriads of policies on the international scene

Table 3 shows the current fiscal treatment of R&D expenditure in EU member countries and in some other countries.

The first important observation is that all countries allow expensing, i.e. full depreciation, of current R&D expenditure in the year that they are incurred. Although such treatment reduces the cost of performing R&D, it is only a weak incentive. 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.
Second, the tax system in some EU and other industrialized countries allows an accelerated depreciation of equipment and machinery used for R&D.

Beside those standard treatments of R&D related expenditure, Austria, Australia and the UK have special depreciation allowances in place. As explained above, such allowances make it possible to expense R&D-related expenditure at rates above 100% of the real cost when calculating the corporate income taxes. The Austrian and the Australian policies are a mixture of both volume and incremental allowances. In Austria, expenditures related to the development or improvement of inventions that are valuable to the economy can be expensed at a rate of 125% for amounts below the previous three-year's average and at a rate of 135% for amounts above that average. In Australia, there is a 125% deduction on R&D-related expenditure and a 175% "premium" deduction for R&D that exceeds the three-year rolling average. In the UK, small and medium-sized companies are allowed to deduct 150% of qualifying current expenditures when calculating their corporate income taxes. For large firms this rate equals 125%.

One of the two Belgian policies to stimulate R&D can also be regarded as a special allowance. However it differs from other policies as it offers fixed amounts instead of percentages. For each additional employee used in scientific research in Belgium, the company is exempt from paying taxes on an amount of € 11.800 in the year of recruitment. This amount is annually indexed. For highly qualified researchers, *i.e.* employees holding a doctorate degree with 10 years of experience in scientific research, the exemption is equal to € 23.590. A detailed description of the Belgian policy can be found in section 7.1.

More generally used than those special depreciation allowances are R&D tax credits. In the sample of countries analysed, 9 countries currently offer tax credits. In 4 cases some kind of mixed scheme, with both volume and incremental tax credits is used. In three cases a volume tax credit is in place and in 2 cases an incremental scheme has been adopted.

Table 3 also shows that policy tools often focus primarily on small and medium-sized companies. This can be deduced from many indicators. Norway currently restricts the fiscal incentives specifically to small and medium-sized companies. Four other countries allow all companies to benefit from the incentives but have higher or special rates in place for small and medium-sized companies. Some countries like Australia and Canada, give refunds of the tax incentive to small and medium-sized companies only. France also has a more flexible refund policy for small and medium-sized companies than for large ones.

It is important to note that differences in the definition of small and medium-sized companies eligible for the tax incentive exist. For instance, in the case of the UK, small and medium-sized enterprises are

defined by the definition of the European Commission for State Aid purposes (See appendix 2), while Spain defines small companies as companies with a turnover under € 5 million. In the Netherlands, Small and medium-sized companies are defined as companies with less than 250 employees.

Besides those direct stimuli towards small and medium-sized companies many countries have upward limits on the total amount of fiscal incentives. Such limits are less of a disadvantage for small and medium-sized companies than for 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 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, where the ratio between the average qualified R&D expenditure and the average gross receipts for the period between 1984 and 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 case figures are not available for the period between 1984 and 1988, the base amount equals to 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 new employees compared to the previous year in order to be eligible for the tax exemption for scientific research.

Other differences that are not mentioned in table 1 include the location of R&D. Most countries limit tax incentives to expenditure incurred in the country in question (for instance Canada, France, the Netherlands and the US). The UK on the contrary allows overseas R&D expenditure to be eligible for their SME tax allowances.

In addition to this, some countries give tax incentives on the cost of subcontracting R&D. In the UK, a small and medium-sized company that subcontracts its R&D will be able to claim an R&D tax relief provided it retains the ownership rights to the knowledge. As a result, the subcontractor cannot claim the R&D tax relief. If the principal and the subcontractor are connected, the full amount is eligible. In case they are not, only 65% of the paid amount is eligible. This is similar to the system in the US where 65% of the contract research expenses qualifies. Other countries that also allow subcontracting of research include Canada and Portugal. However the UK excludes most subcontracting by large firms as the fiscal incentive can only be claimed by the conductor of the R&D.

In Denmark and Japan the fiscal incentives are (also) targeted to a certain type of research. In Denmark, companies (irrespective of their size) are allowed a tax deduction for participating in specific programs for basic research. In Japan, tax incentives are granted for basic research carried out by companies, in which case more generous provisions are given to small firms. 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 financially to independent research and development carried out by charities, universities and scientific research organizations, will be eligible for vaccines research relief on the full amount of their contributions. This is on top of the overall relief under the general tax relief schemes for small and medium-sized companies and large companies. A similar policy can be found in Belgium, where environment-friendly[2] R&D activities are encouraged through tax deductions on investments. Eligible investments are those that are depreciated over at least three years. On such investments, 14.5% of the value of the investment can be deducted from the taxable income. This rate is increased by 5 percent for innovative firms. In case the firm incurs a loss or has insufficient profit one year, the deduction can be carried forward. Firms also have the possibility to spread the deduction over many years: the deduction is then applied each year on the amount of depreciation of the investment. This is particularly attractive, as the deduction rate on environment-friendly R&D becomes 21.5%. A similar policy is available on investments in R&D that are patent-related.

Other countries reward collaboration between the industry and qualified research organizations. This is the case in the US where a special tax credit is available for payments to qualified organizations to conduct basic research. Furthermore, 75% of contract research expenditure is eligible for the tax credit, instead of 65%, in case the R&D is outsourced to a qualified research consortium. In Australia, only contracted research with a registered research agency is eligible for the tax incentive. On the other hand, the cost of acquiring an existing patent in Australia to facilitate R&D activities is also eligible.

Denmark has recently launched a new scheme that allows firms to deduct 150% of private investments in co-financed R&D[3]. The scheme aims at promoting 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 test. This test is scheduled to run for 2 years and will be evaluated at the end of the period.

Accession countries hardly use R&D tax incentives. There is a trend to either equalise tax incentives granted to domestic small and medium-sized companies and foreign investors, who often receive tax incentives not available to domestic firms, or to eliminate R&D tax incentives for greater neutrality. Hungary has a 100% tax deduction on total R&D expenses. Poland has abolished its tax allowances since 2000. Cyprus plans to introduce a 10-year tax relief on profits derived from the production of new products.

In the Czech Republic, a new law (2000) introduced tax incentives for existing companies planning expansion. Estonia and Slovenia have no R&D support program. In summary, tax incentives for R&D receive a low priority in these countries.[4]

[2] *i.e.* investments (in new products) that have no negative impact on the environment or that have an impact that is reduced to the maximum.

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

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

Table 3. Myriads of policies on the international scene

	Country	β-index		CITR	Target group		Qualifying R&D	Depreciation allowance				Tax credit		Base for incremental	Taxable	Maximum	Carry back/forward	Cash refund
		Large companies	SME's		All companies	Focus on SME's		Current expenditure	Machin. & equip.	Buildings	Special allowance	Volume	Incremental					
EUROPEAN UNION MEMBER STATES	Austria	0,869 (4)	0,869 (7)	34%	✓		C	100%			25% volume 35% incremental			3 Y Avg			?	?
	Belgium	1,012 (17)	1,008 (16)	40,17%	✓		W	100%	3 Y		€ 11.800 - 23,590 / extra researcher						None	
	Denmark	0,871 (6)	0,871 (8)	30%				100%	100%	100%								
	Finland	1,009 (15)	1,009 (17)	29%				100%										
	France	0,915 (8)	0,915 (11)	34,33%	✓		A	100%					50%	2 Y Avg	No	€ 6.100.000	3 Y carry forward, afterwards returned	Yes
	Germany	1,041 (23)	1,041 (23)	38,36%				100%										
	Greece	1,015 (18)	1,015 (19)	25/35%				100%										
	Ireland	0,937 (11)	0,937 (13)	16%				100%										
	Italy	1,027 (21)	0,552 (1)	40,25%	✓	✓	?	100%	Accelerated			10% - 30% depending on size & location	20%	n/r			?	?
	Luxemburg	?	?	30,38%				100%										
	Netherlands	0,904 (7)	0,642 (2)	29/34,5%	✓	✓	W	100%				60% for SME's 40% for the rest 13% > €90.756		n/r	n/r	€ 7.941.154	n/r	n/r
	Portugal	0,850 (3)	0,850 (6)	33%	✓		A	100%	4 Y			20%	50%	2 Y Avg		€ 498.798	6 Y carry forward	?
	Spain	0,687 (1)	0,687 (4)	30/35%	✓		A	100%	100%			30% on current exp. 10% on capital exp.	50%	2 Y Avg		35% of the tax bill	15 Y carry forward	?
	Sweden	1,015 (19)	1,015 (20)	28%				100%										
	United Kingdom	?	0,888 (9)	30%		✓	C	100%	100%	100%	50%			n/r		PAYE / nat. insurance liabilities	?	Yes
OTHER COUNTRIES	Australia	0,890 (6)	0,890 (10)	30%	✓	✓	A	100%?	3 Y		25% volume 75% incremental			3 Y Avg			?	Yes
	Canada	0,827 (2)	0,678 (3)	38,6%	✓	✓	A	100%	100%			35% < €1.322.489 20% for the rest		n/r	Yes		3 Y / 10 Y	Yes
	Japan	0,981 (13)	0,937 (14)	42%	✓	✓	C	100%				6% for SME's only	20%	Highest R&D expenditure of previous years		15% and 10% of the tax bill respectively	?	?
	Hungary	?	?	18%	✓		C	100%				100%?		n/r			?	?
	Norway	1,018 (20)	1,018 (21)	28%		✓	?	100%				25%		n/r		€ 540.124	?	?
	United States	0,934 (10)	0,934 (12)	40%	✓		C	100%					20%	Fixed base, 1984-88	Yes		3 Y / 15 Y	No

Abbreviations used

B-index: the index is defined below
CITR = Corporate Income Tax Rate;
SME's = Small and Medium-sized Enterprises;
W = Wages;
C = Current Expenditure;
A = All Types of Expenditure, both Current and Capital;
n/r = not relevant

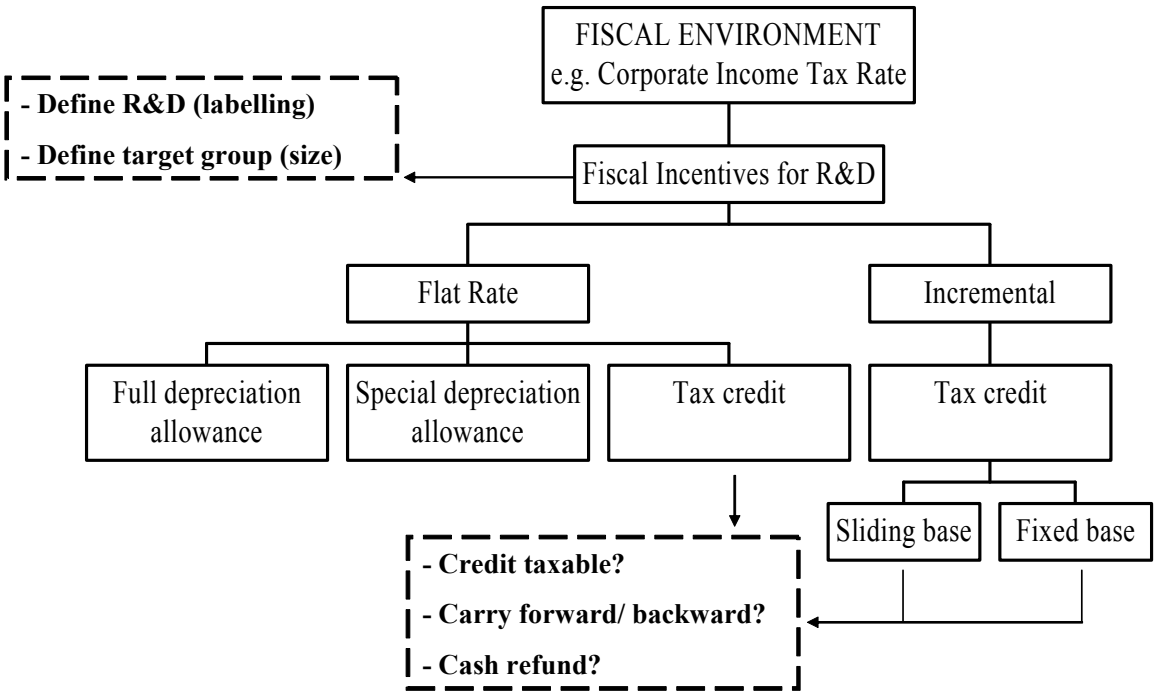
The OECD defines the *B*-index as follows: "the *B*-index is defined as the present value of before-tax income necessary to cover the initial cost of R&D investment and to pay corporate income tax, so that it becomes profitable to perform research activities. Algebraically, the *B*-index is equal to the after-tax cost of an expenditure of USD 1 on R&D divided by one minus the corporate income tax rate. The after-tax cost is the net cost of investing in R&D, taking into account all the available tax incentives.

The figure between brackets after the β-index indicates the position relevant to all other countries as reported in Warda (2002)

4 Design issues

There are many issues underlying the design of a good fiscal policy to business R&D (see figure 2). Beside the general fiscal environment (fiscal incentives are much less effective in a country with a low corporate income tax rate), the first choice to make is the selection of the target group (by firm size for instance) and the definition of the eligible expenses (current R&D expenses, R&D labour costs, total R&D expenses, innovation expenditures, collaborative or outsourced research…). Then a fundamental choice has to be made between a volume and an incremental policy.

Figure 2. Basic framework for the design of fiscal policies to business R&D



4.1 Target group

It is crucial for the government to decide what type of companies to support. However in order to take full advantage of the neutrality of a fiscal policy, neutrality is actually the main advantage compared to direct financial policies, targeting specific companies should be limited to the size criterion only. Either the policy is accessible to all companies, irrespective of their size, or it is limited to or more generous with small and medium-sized companies.

In putting into place this focus, the government has access to many different tools. First, it can limit the access to a certain group by tailoring the access conditions. Second, in order to target small and medium-sized companies, the government can also put in place upper limits on the amount of tax credit that can be claimed by a company. Such upper limits are much more likely to be attained by larger companies than

by small and medium-sized companies. Thirdly, the policy can be designed to be more generous with small and medium-sized companies. This can be achieved through a higher tax credit rate for small and medium-sized companies or by offering them more flexible features such as cash refunds of unused credits.

4.2 Definition of R&D

From a theoretical point of view, defining R&D does not pose major problems. In general the definition of R&D is based on the Frascati Manuel (OECD, 1993) (see appendix for the Frascati definition of R&D). This definition classifies R&D into three activities: basic research, applied research and development. In order for activities to qualify as R&D there also has to be an element of novelty and a resolution of scientific/technological uncertainty.

The most challenging task consists however in translating this definition into useful and accessible practical guidelines. Most countries have tried to fulfil this challenge by publishing non-exhaustive lists of types of R&D projects that qualify or not for the definition.[5]

Relabelling activities

It should be no surprise that some companies, in response to the introduction of R&D tax incentives, tried to "relabel" some expenditure in order to qualify for the credit. Unfortunately, the degree to which this happens in reality is unknown. Mansfield (1986) estimates, on the basis of a survey conducted in Canada, Sweden and the US that in the first years after the introduction of a tax credit, 13% to 14% of the increase in R&D expenditure is actually due to "relabelling". After this period "relabelling" stops. Mansfield also points out that the effect is facilitated if a broad definition of qualifying R&D is used. Similarly, the OECD (1998) recommends the definition of qualifying R&D expenditure to be unambiguous. In addition to the results of Mansfield, Hall (1996) finds the "relabelling" risk to be relatively small.

In case the threat of "relabelling" really becomes an issue, it can be interesting to look if this threat can be avoided by narrowing the definition of qualifying R&D expenditure to labour expenditures only. This could be an advantage if wages and salaries of R&D workers are easier to control than other, more vague, expenses such as overheads (See infra).

4.3 Eligible R&D expenditure

Countries also need to define the types of R&D expenditure that qualify for the fiscal incentive. There are mainly three options:

[5] See for example the guidance on the new definition of research and development published on the Internet site of the Inland Revenue (http://www.inlandrevenue.gov.uk/r&d/rdtaxcred.pdf) or the user manual of the Dutch WBSO policy published by SENTER (http://www.senter.nl/sites/wbso/contents/i000008/ wbsohandleiding2003.pdf)

- **R&D Wages**

The first option allows only expenditure on wages related to R&D to be eligible for the tax incentive. As mentioned supra in the country overview only the Netherlands currently limit their incentive to wages only. From a governmental point of view this can have two major advantages: first, social security and the waging taxes are diminished instead of the corporate income taxes (See infra). Second, an incentive on wages can stimulate the investment in human capital. This is very beneficial as human capital, considered much less mobile than plants or companies, remains in the country in the event of a delocalisation of a company or its production facilities.

- **Current R&D expenditure**

The second option allows current R&D expenditure to be eligible for the tax incentive. Current R&D expenditure mainly consists of wages and consumables that are directly used in the R&D projects and consumed within the year of purchase. The advantage of including all current R&D expenditures, and not only wages, is that it reflects better the real spending patterns of companies. As such it might be more stimulating for companies if they know that all current expenditure can be included.

- **Current and capital R&D expenditure**

The third option allows all kinds of R&D expenditures to be eligible for the tax incentive. This includes current R&D expenditure as well as capital R&D expenditure. The advantage of allowing all kinds of R&D expenditures compared to limiting eligibility to current expenditure only is that it reflects better the real spending patterns of companies. As such it might be more stimulating for companies if they know that all kinds of expenditure can be included. However, making all kinds of expenditure eligible may result in a high public cost of the policy.

Beside the basic choice between those three groups of eligible R&D expenditures, some specific types of expenditure can be included, to cope with specific deficiencies encountered by active R&D companies. For instance given the low propensity among companies in general and especially among small and medium-sized companies to patent their inventions, patent related expenditure can be included as well. This can cover both the cost of patenting inventions and the cost of patent enforcement. Furthermore, in order to stimulate collaboration between the industry and universities, the cost of outsourcing research to universities can also be included.

4.4 Volume versus incremental tax credit

One of the most fundamental choices that has to be made when designing an R&D tax credit is the option between a volume-based and an incremental tax credit. With a volume-based scheme, the tax credit is calculated on the entire amount of qualifying R&D expenditure. With an incremental scheme the tax credit is calculated on the additional amount of R&D expenditure that exceeds a certain base amount. Essentially this base amount can take two forms: [1] With a rolling average base, the base amount equals

the average R&D expenditure of the previous x years. [2] With a fixed base, the base amount equals the average R&D expenditure during a fixed reference period. This average is subsequently indexed to sales or to inflation in order to get an up-to-date figure.

The following table 4 summarizes the main disadvantages of each scheme.

Table 4. Disadvantages of volume-based and incremental schemes.

	Business Perspective	Governmental Perspective
Volume		More costly Least appropriate for rewarding additional R&D expenditure
Rolling Incremental	More complex Higher application costs Distorts the R&D planning process Nil when high but stable Too small to be stimulating Difficult for SME's	More complex Higher administrative costs Less appropriate for rewarding additional R&D expenditure Requires difficult to obtain info Marginal impact
Fixed Incremental	Even more complex Higher application costs Difficult for SME's	Even more complex Even higher administrative costs Marginal impact Requires difficult to obtain info

Disadvantages of volume-based schemes

From a business perspective, there are no real disadvantages related to volume-based schemes. Such schemes are simple, predictable and generous. From a governmental perspective however there are two important drawbacks. First, it is more costly for the government to run a volume scheme compared to an incremental scheme as the tax credit applies to the entire amount of R&D expenditure and not only to the increment. Second, companies may not be particularly encouraged to conduct additional R&D effort over and above the amount that would have been undertaken without the scheme for the simple reason that a volume scheme applies to the entire amount of R&D expenditure.

Disadvantages of rolling base incremental schemes

One important disadvantage of a rolling incremental scheme is that it is more complex to work with both from a business and from a governmental perspective. Records have to be kept concerning the R&D expenditure of the previous years and the base amount has to be calculated and updated each year.

On the corporate side, this complexity can seriously decrease the policy effect, as companies are highly averse to complex measures. This element surfaced consequently during our corporate meetings and during the intensive consultation rounds of the Inland Revenue in the UK.

Increased complexity results in higher application costs for companies. This might in turn reduce the willingness of companies to apply for the tax credit if the application costs outweigh the benefits. Moreover the benefits of such a policy for a company are already lower because the tax credit only applies to a small portion of the R&D expenditure.
Another important disadvantage of this scheme is that it creates distortions in the corporate planning of R&D expenditure. Increasing R&D expenditure one year inevitably increases the base amount for the years to come. Therefore the tax credit will become less efficient during those subsequent years. Since companies know and are able to calculate these effects, their R&D expenditure decisions will be at least partly influenced by it.

A rolling average base scheme is particular inconvenient for small and medium-sized companies. Such companies are even more sensitive towards complex measures since they often lack the required resources to comply with all procedures. Moreover, the budgets of small and medium-sized companies are highly unstable, and this results in important variances in R&D spending. In order to offer the much-needed support for small and medium-sized companies on a continuous basis a rolling average base scheme is indeed inappropriate.

Another major drawback of such a policy concerns companies with systematically high but stable levels of R&D expenditure. For such companies, the applicable base amount will also be high and stable so that a large portion of the R&D expenditure does not qualify for the tax credit.

Furthermore, the complexity of a rolling average base not only results in higher administrative costs for companies but for the government as well. The several major corporate drawbacks of this system imply that its impact is likely to be marginal so that the ultimate goal of stimulating business R&D will not be achieved.

A last point of criticism concerns the fact that a rolling average base scheme is not the most appropriate scheme for rewarding additional R&D effort above the amount that would have been undertaken without the scheme. The reason is that the eligible portion of R&D expenditure is calculated with regard to the average expenditure of the previous years, when the tax credit scheme was already in place.

Disadvantages of fixed base incremental schemes

The most important disadvantage of a fixed base incremental scheme is that it is complex to work with both from a business as from a governmental perspective. Records of the R&D expenditures during the reference period, together with sales or appropriate inflation figures of that period have to be kept in order to be able to calculate the reference base amount. Additionally, the reference base amount has to be updated each year using recent sales or appropriate inflation figures. Only then, the eligible portion of R&D expenditure can be calculated as the difference between the current R&D expenditure and the updated reference base amount.

On the corporate side, this complexity can result in a seriously reduced effect of the policy because companies are highly averse to complex measures and because complexity increases application costs. On the governmental side, the increased complexity will result in higher administrative costs.

4.5 Carry back / Carry forward provisions

In principle, a tax credit for R&D expenditure in a given fiscal year reduces the corporate income tax related to that year. In practice, however, companies will not always have sufficient corporate income taxes to offset the entire tax credit. This implies that a certain portion of the tax credit that the company is entitled to remains unused. In order not to reduce the effectiveness of the tax credit, it is essential that this unused portion that occurs in a given year can be carried forward to subsequent fiscal years. Additionally, it can also be considered to allow companies to carry back the unused portion of the tax credit to previous fiscal years.

Carrying back or forward provisions are extremely important tools to avoid inequality in the fiscal policy with respect to small and medium-sized companies. Such companies are typically already carrying forward accumulated fiscal losses from previous periods and/or have typically limited current corporate income taxes to offset the tax credit. However, it has to be noted that from a financial point of view, the time value of money has to be taken into account when carrying forward unused credits. This implies that carry forward facilities reduce the present value of the benefits of the policy, thereby also reducing its effectiveness and generosity. As a result, carry forward facilities are not the perfect measure to avoid inequality in the policy since it puts small and medium-sized companies at a disadvantage, as they are more likely to be subject to this effect.

This problem can be solved by offering different types of flexible facilities to companies in loss. The most common solution consists in cash refunds of the unused portion of the tax credit. But as mentioned for carry forward facilities, the time value of money needs to be also taken into account, especially for cash constrained small and medium-sized companies. This implies that the timing of the cash refund is as important as the refund itself. Monthly refunds are better than quarterly ones and quarterly refunds are better than refunds granted after the end of the fiscal year to which the R&D expenditure relates. At all cost, delays much beyond the end of the year should be avoided.

4.6 Minimum/maximum thresholds

Depending on the focus of the policy pursued by the government, it might also be justified to impose minimum and maximum thresholds on the amount of R&D expenditure that needs to be undertaken to qualify for the tax incentive. Imposing maximum thresholds can be effective to orient the policy towards a specific target group (See supra). However focusing on small and medium-sized companies should not exclude imposing minimum thresholds as well. This can be useful to increase the efficiency and cost-

effectiveness of the policy if the administrative costs to the government are judged to be too high for small applications.

4.7 Corporate income taxes versus wage taxes and contributions

Except for the Dutch R&D incentive, essentially all policies affected the corporate income taxes, i.e. the taxes due on positive corporate earnings. Typically such taxes are calculated at the end of the fiscal year, after the company has made its income tax return. Depending on the legislation, the efficiency of the fiscal authorities and other factors, the exact moment when corporate income taxes become due can be relatively long from the fiscal year to which it relates. This can be an important disadvantage for small and medium-sized companies because it affects the timing of the cash flows resulting from the policy (The tax credit and if any, the cash refunds).

By using the wage taxes and social security contributions this situation can be at least partially solved because those taxes are mostly due on a monthly or quarterly basis. Another advantage of such a system is the fact that every company, irrespective of whether it is in profit or loss, is liable to withhold wage taxes and pay social security contributions. This avoids situations where companies have unused tax credits and facilities that allow companies to carry forward those unused credits. Additionally it also reduces administrative costs since no records of unused tax credits have to be kept.

4.8 Claiming the tax credit

In order to claim the tax credit, three different options exist. Companies can be obliged to submit their R&D projects for approval before undertaking them. Alternatively, companies can claim the tax credit at the end of the year, after all R&D spending has been incurred. The third option is similar to the second with the difference that companies can obtain an upfront ruling on the eligibility of their R&D activities.

The main difference between requiring upfront versus ex post applications is a trade-off between certainty and flexibility. Mandatory upfront applications eliminate all possible uncertainty regarding what kind of R&D projects are eligible for the fiscal incentive. However, it lacks flexibility concerning unexpected changes in R&D expenditure during the year. Additionally an upfront ruling system is likely to require more workforces to deal with all the applications. For policies with ex-post applications companies do not need to plan and estimate their R&D activities in advance but can adjust the final amount of the application at the end of the year to meet economic reality. On the downside, there is a risk of uncertainty in case companies are not sure what kind of expenditures is eligible. However, some practical evidence indicates that there is a quick learning process among companies on this subject.

5 Case Studies

5.1 The Netherlands

Policy : WBSO	**Launch Date :** 1994	**Budget (2003) :** € 367 million
Main Target Group : SME's	**Level Rate :** 60%/40%/13%	**Incremental Rate :** n/a
β-index$_{\text{large companies}}$ **:** 0,904 (7)	**β-index**$_{\text{small companies}}$ **:** 0,642 (2)	**CITR:** 29%/34.5%

Summary: The Dutch incentive system is unique in two ways. First, it applies only to the wages paid to workers performing R&D and not to other current or capital expenditure. Second, it does not reduce the traditional corporate income taxes but the wage taxes and the national insurance contributions. It is a level incentive and, although available to all companies, it is more oriented towards SME's: [1] a higher rate applies for spending below a threshold, [2] there is an upper bound on the total credit amount, [3] technostarters enjoy an even higher rate, [4] there is an alternative for the self-employed. Contrary to most systems abroad, the R&D projects have to be approved by the government prior to undertake the R&D activities. The WBSO program accounts for about 70% of government support to business R&D.

Definition of Eligible Companies

R&D Tax Withholding Organisations

Employers who are liable to withhold wage tax and national insurance contributions and who operate a company as defined by legislation on income tax or corporate tax are eligible for a R&D rebate if they have employees who perform research and development work.

Employers who do not operate a company (such as universities) are eligible for a R&D rebate if they perform research and development work on the basis of a written agreement with, and for the account of a company, a group of co-operating companies, a commodity board or an industrial board. Additionally those entities have to be established in the Netherlands.

Option for the R&D tax-liable entrepreneurs

Self-employed persons who operate a company and who are entitled to an income tax deduction for self-employment may be eligible for an increase in this deduction if they perform R&D activities themselves for at least 625 hours per year.

Technostarters

Technostarters are defined as companies that are liable to withhold wage taxes and social security contributions for not more than 5 years and that have not used the WBSO facilities more than twice.

Definition of Eligible Research and Development

Eligible research and development has to meet the following criteria:

- For own account

- Systematically organised
- Performed in the Netherlands
- Directly and exclusively oriented towards technological and scientific research or
- Towards the development of (parts of) products, processes or software
- That are technically new for the applicant
- Including preliminary feasibility studies (excluded as from 2003)

Qualifying R&D Expenditure

In the Dutch system, the only qualifying expenditures for the R&D tax credit are the labour wages paid to workers performing R&D.

The Minimum/Maximum Amount of R&D Expenditure

In the Dutch system there is no minimum required amount of R&D expenditure in order to be eligible for the R&D tax relief. On the contrary, for the self-employed persons (Option for the R&D tax-liable entrepreneurs) there is a minimum amount of 625 hours of R&D activities per year to be undertaken before being eligible for a R&D tax relief.
However, the annual R&D tax credit cannot exceed a maximum set at € 7.941.154.

Claiming the R&D Tax Credit

The company or the self-employed person must claim R&D tax relief itself. The application has to be made 4 weeks before the start of the full or half calendar year to which the application relates. As a result applications for the full year must be made at the latest on the third of December of the preceding year and applications for the half year must be made at the latest on the second of June. Currently most of the applications are submitted in December and this for the R&D expenditure of the full fiscal year.

The company has to make a separate description for each project that it is considering to undertake. In practice, this consists of a short description of the project (about one page), containing also the planning in terms of man-hour. That description must allow SENTER to judge on the required element of novelty of the project.

The applications and all information contained therein are governed by the strict tax law. This safeguards confidentiality and guarantees that private information will never be provided to third parties without prior permission of the concerned company. According to people from SENTER, the disclosure of projects through those applications does not cause any reluctance among the companies regarding confidentiality. A recent study indicated that the amount of time required for submitting a WBSO project was perceived as low to average by companies. In other words, there are clear financial benefits for companies for submitting their R&D projects in order to receive fiscal R&D incentives.

Deductibility of Qualifying R&D Expenditure

In the Dutch system, the only qualifying expenses for the R&D tax credit are the labour wages paid to employees performing R&D. This system allows the employer to reduce the wage tax and national insurance contributions that it is liable to withhold by the following amounts:

- 40% on the first € 90.756 of the total R&D labour wages
- 13% on the remaining sum with an annual maximum of € 7.941.154

The self-employed persons who operate a company and perform at least 625 hours of R&D a year (the R&D tax-liable entrepreneurs) are entitled to a R&D tax deduction that is fixed annually. In 2001, this deduction amounted to € 4.990.

Additionally to those two measures applicable to all companies indifferently of their size, the Dutch system offers an extra impulse for technostarters. It allows the technostarter to reduce the wage tax and national insurance contributions that it is liable to withhold by 60% instead of the general 40% on the first € 90.756 of the total R&D labour wages. A similar system is in place for the self-employed. They are able to benefit from higher rates if they are liable to withhold wage taxes and social security contributions for not more than 5 years and have not used the WBSO facilities more than twice.

Cash Flow Timing

In order to obtain the Dutch tax credit, companies have two options. The first option is in practice mainly used by SME's while larger companies most often opt for the second option. With the first option companies are allowed to deduct the tax credit on a monthly basis when withholding the wage tax and social security contributions on the salaries of their employees for the government. In this case, the tax credit equals the total amount of approved R&D man-hour in proportion to the total period of the project that year. This facility is only preliminary. At the end of the year the difference between the expected and the real amount of R&D salaries is taken into account. In case the real amount was lower than the expected amount, the tax credit that was obtained on the difference has to be reimbursed. In case the real amount was higher, the company cannot obtain an additional tax credit on the difference. In other words the tax credit can never exceed the tax credit calculated on the expected R&D salaries as mentioned in the project applications. However, companies are not obliged to use the expected amount of R&D man-hours as stated in the project for their monthly tax credits. They can freely choose this amount to match real R&D man-hours as long as it does not exceed the expected amount.

With the second option, companies deduct annually at the end of the year the real amount of R&D salaries. This has the advantage that there is no correction needed to adjust for the difference between expected and real R&D expenditure. However this situation is less cash flow friendly because the reduction only happens once and at the end of the fiscal year, after all the R&D expenditure has been incurred. Obviously this explains why SME's typically prefer the first option.

Responsible Organisation

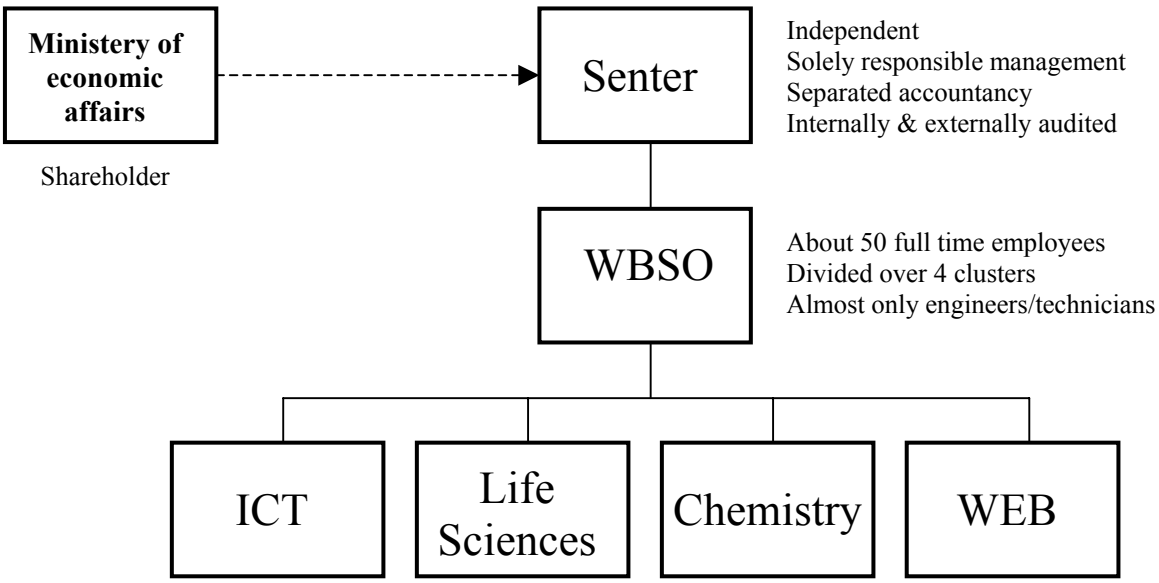
The Dutch R&D scheme is administered by SENTER, an agency of the Dutch ministry of economic affairs. SENTER is responsible for the execution of the national subsidies and fiscal schemes and the governmental programs in the field of technology, energy, environment, export and international collaboration. However SENTER is entirely independent and solely responsible in the execution of this program to guarantee optimal efficiency. In order to ensure proper accountability of its actions towards the government and the wider public, SENTER has a separate bookkeeping. Internal and external audits are in place to watch over the exactitude of this information.

The part of Senter that deals with the R&D scheme is organised in 4 clusters; ICT (information communication technology), life sciences, chemistry and WEB (Mechanical engineering, Energy and Construction). The projects submitted for the WBSO policy are subsequently assigned to the most relevant cluster. For new applicants, SENTER does in general a background research on the company, which mainly happens through the Internet. This is done in order to determine the actual state of the knowledge of the company. In case sufficient information to take a founded decision is lacking, SENTER can require additional information over the telephone or through the mail. They can also visit the company during the application period in order to obtain additional information before taking a decision to (partly) approve or disapprove a project. Once the application is complete SENTER has 9 weeks time to take its decision. Failure by SENTER to respect this deadline does not automatically imply the approval of the project. At first sight this timeframe can seem stringent given the fact that all applications occur together on the full year or half year deadline. In practice however it appears that there are no significant problems with the treatment of the applications because of 2 reasons: A fraction of about 20% of the applications was voluntary left incomplete by the companies when submitted. Companies are then given an extra delay to complete the application. During this delay the 9 weeks decision period for SENTER is not applicable. Secondly, in case SENTER requires additional information, the 9 weeks decision period only starts from the moment that the application is complete.
In total, approximately 85 % of the projects are partly or fully approved by SENTER. According to SENTER, the reason that this figure is so high reflects the fast learning process by companies of what projects will be eligible. The introduction of software related expenditure for the tax credit in 1997 can be used as an example. During the first year following this introduction many projects were submitted that did not meet the criteria of software development. As a result those projects were rejected by SENTER. During the subsequent years, the number of applications in the field of software sharply dropped while the quality of the applications increased, clearly indicating a learning process by companies of what projects are eligible. Currently about 2 % of the companies appeal to a decision by SENTER to disapprove their project and in a majority of the cases this appeal is settled in favour of SENTER.

SENTER employs in total about 50 full-time equivalents to execute the WBSO policy. About 35 of them are project advisors. Those project advisors are technicians or engineers of higher educational level (holding a bachelor or a master degree). This clearly highlights the underlying principle to focus the control of the Dutch policy more on the technical and content side of the applications and not so much on

the administrative side. The broad technical background of the project advisors must make it possible to understand the technical problem that is the object of the submitted projects.

Figure 3. Overview of the department responsible for the WBSO execution



The WBSO policy in figures

The annual budget of the WBSO program for 2003 is € 367 million, which corresponds to about 70 % of the total governmental support to R&D. The governmental cost of operating the program is estimated to be about € 12 million, or 3,2 % of the total budget.

Annually approximately 13.500 companies qualify for the WBSO program, 95 % of which are SME's and 52 % of which are recurring applicants. SME's account for 67 % of the total budget. Given the high penetration rate of the WBSO policy, it can be assumed with reasonable certainty that practically all innovative Dutch companies use the policy and that it must be easily accessible for companies.

According to people at SENTER banks, venture capitalists and business angels sometimes base their decision to finance companies on the decision of SENTER to approve the company's projects for the WBSO policy. This is even the case within larger companies where different departments and projects compete for limited internal funding: an initial selection is based on the approval of SENTER.

Monitoring

The ex-post control on the effective execution of R&D projects compared to what is claimed by the company is handled by two distinct entities in the Netherlands. On the one hand, fiscal authorities can exert investigations into the tax return of companies. As a result, such investigations are not specifically focussed on monitoring the WBSO tax credit program but happen more in a general context of the

financial aspects of the tax return. More direct control is executed by SENTER. To this end, SENTER performs hundreds of company visits each year. These visits are announced and are mainly intended to monitor the progress of the work from a technical and content side. Additionally it can also be checked whether the required administration is kept according to the requirements of the policy. According to people at SENTER, those controls are flexible, keeping into account the fact that the business reality often differs from what is planned in advance. The following elements are typically taken into account during those company visits: the project administration, schematic drawings, prototypes, test results… Still according to people from SENTER, the results of those controls are positive but exact figures are kept internal.

Unique features of the Dutch policy

The following four features are unique for the Dutch tax incentive policy and they differentiate this policy from other measures abroad.

1. Only wages are eligible

The main reasons put forward by people from SENTER to defend this position are that:

- It is easier to control "who" did "what"
- It stimulates investments in human capital, which again according to people from SENTER is a valuable option since human capital is less mobile and more durable than the companies that perform the R&D and the findings that might result from it. In case the company delocalizes or disappears, at least most of the people and their knowledge remain in the Netherlands.
- Administratively simple as wage administration already exists
- Labour costs make up a large fraction of the total R&D costs, especially for SME's.

2. It reduces the wage taxes and the social security contributions

- This system is less complicated towards non-profitable companies in the sense that not all companies make profit but all companies are liable to withhold and pay wage taxes and social security contributions. Hence there is no need to complicate the policy by introducing carry forward and cash refund facilities.
- Moreover such a system can be easy to administer since wage administration already exists. However this argument depends on the structure of the current administration and on how well the existing infrastructure is suited for use with the fiscal policy.
- Despite existing control mechanisms, corporate profit is more easily manipulated between different years, between different countries and especially within groups of companies. Using wage taxes avoids stimulating this distortive effect further.
- Cost reduction is linked more directly to the R&D project (it influences at the decision level)
- Wage costs were perceived as high in the Netherlands compared to E.U. average
- A monthly settlement offers the best timing for cash-constraint start-ups

3. R&D has to be technically new from the applicant's point of view only

- It is too difficult to know what is new from a societal point of view. This argument is valid both for the companies that apply for the incentive as for the governmental department that is charged with analysing the applications.
- A policy where the R&D has to be technically new from the applicant's viewpoint only makes it is easier to keep track of what a company already did in the past. For new applicants, the responsible governmental department needs to perform a background research on the previous R&D activities of the company. Once this is done, a decision as to approval of the current project can be made. This information can be stored and consulted during a later stage. For future applications of the same company, this permits to determine in an easy way what is technically new for that company by looking at the previous state of knowledge.
- Another advantage of the fact that R&D has to be technically new from the applicant's viewpoint only is that it spreads the risk and avoids picking only one winner. The following example supports this argument: If R&D has to be new from a national or international viewpoint it would only be possible to approve one research project in speech technology. In case this research was not successful because of firm specific reasons or in case the firm went bankrupt or delocalized, all the potential benefit to the Dutch society would disappear as well. By approving multiple projects in the same field but from different companies, the risk of failure, bankruptcy or delocalization is spread over different companies. Additionally, it also encompasses the difficulty of picking winner by approving the project of the first applicant only in a set of similar R&D projects. The following saying of "not to put all your eggs in one basket" was used by the people from SENTER during the interview to summarize that idea.
- Another and final argument to require that has R&D to be new from the viewpoint of the company only is that redoing the same research already undertaken by another company can still result in improvements. This can be the discovering of new, cheaper or better processes and technologies. Since by the definition, the outcome of a research is not determined from the outset, it is perfectly possible that different research teams reach different findings when doing the same research. In order not to exclude this possibility it make sense to accept projects for the fiscal incentive as long as those projects are new to the company.

4. Companies have to apply beforehand

- Eliminates uncertainty among companies whether its projects are eligible.
- Higher stimulating effect as companies know what they are going to get in advance. Only this can effectively influence decision making.
- There is also and educational effect towards SME's. It forces them to plan R&D projects in advance before being entitled to the tax credit.
- The drawback of reduced flexibility is countered by permitting to switch hours within approved projects. Additionally a company is allowed to apply two times each year (see supra). This makes it possible to adjust their application during the year to changes in their R&D spending. Finally a

company can submit projects that it will probably undertake or even projects that it is unsure to undertake.

5.2 The United Kingdom

Policy : UK R&D tax allowances	**Launch Date :** 01/04/2000	**Annual Budget :**
Main Target Group : SME's	**Level Rate :** 50%	**Incremental Rate :** n/a
β-index$_{\text{large companies}}$ **:**	**β-index**$_{\text{small companies}}$ **:** 0,888 (9)	**CITR:** 0%/19%/30%

According to the people of the Inland Revenue[6]: "What we feel strong about is that it is not our (the government) task of getting in the position of approving projects. Even if we did employ scientists, we could never have enough knowledge to second guess the company, to understand its commercial objectives and its area of technology better than it can. If the company thinks that spending money on some particular area of R&D is worthwhile, that is enough for us. As a result we do not want to get involved in recording, approving and second guessing R&D projects. The strength of a tax credit compared to a subsidy is its neutrality."

This resulted in the basic principle that the UK tax allowance is not any different from the other items in the corporate tax return. If you would treat it separately, it will look like a subsidy. The basic principle underlying the UK corporate tax system is the self-assessment of tax return. Companies are responsible for filing their own tax return and they are responsible for the correctness of the data contained therein. Since the R&D tax allowance is part of the corporate tax return, companies are responsible for the R&D tax allowance claims that they make. The corporate tax declaration can subsequently be reviewed by the Inland Revenue and inquiries into the correctness of the declaration can be carried out.

Building on those two basic principles, there seem to be no need for a separate department that treats the applications related to the tax allowance. The fact that this might create uncertainty concerning the eligibility of R&D projects among applicants is according to people from the Inland Revenue only temporarily. They rather expect a quick learning effect among companies regarding what type of R&D activities qualify for the incentive. In addition general advice, help and guidance can be obtained from the Inland Revenue to reduce any further uncertainty concerning the eligibility of R&D projects among applicants. However there is no possibility for pre-approvement of R&D projects through rulings. For the tax allowance for large companies this notion of advice and guidance is even reinforced by establishing close working relationships between those companies and the Inland Revenue. The same team of people from the Inland Revenue, consisting of more senior staff members, will be assigned to the same company each year.

[6] Interview in November 2002, London, England

Definition of Eligible Companies

Small and medium-sized companies

In order to claim R&D tax credits for small and medium-sized companies in the UK, the company must be an independent small or medium-sized enterprise (SME) as defined in article 1 of the European Commission Recommendation 96/280/EC.[7]

Large companies

Large companies are defined as companies that do not qualify as small and medium-sized companies

Definition of Eligible Research and Development

The Finance Act 2000 introduced a new definition of research and development in the UK.[8] The definition is based on two tests;[9]

- First, the activity in question must be one that is treated as R&D under Generally Accepted Accountancy Practice for companies in the UK, as set out in the Statement of Standard Accountancy Practice, SSAP13. This accounting standard is itself based on the definition developed by the OECD in the Frascati Manual.[10]
- Second, the activity must also fall within Guidelines issued by the Secretary of State for Trade and Industry. These Guidelines have been developed by the Department of Trade and Industry and the Inland Revenue.

"The key theme is that the activities must be

1. *creative or innovative work in the fields of science or technology and*
2. *undertaken with a view to the extension of knowledge.*

R&D is characterised by work that

1. *contains an appreciable element of innovation and*
2. *breaks new ground or aims to resolve scientific or technological uncertainties.*

Such work can range from

1. *"blue skies" research in areas that are purely theoretical, to*
2. *applied research and*
3. *experimental development directed towards a practical aim or product.*
4. *But commercial development without such scientific or technological investigation, or after the resolution of such uncertainty, is not R&D."*[11]

[7] The relevant extracts of this recommendation can be found in appendix 2
[8] Schedule 19 of the Finance Act 2000
[9] Adapted from "Guidance on the New Definition of Research and Development and R&D Tax Credits For Small and Medium-sized Companies" posted on the Inland Revenue web-site
[10] See for example: http://www1.oecd.org/dsti/sti/stat-ana/prod/e_94-84.pdf
[11] Source : "Guidance on the New Definition of Research and Development and R&D Tax Credits For Small and Medium-sized Companies" posted on the Inland Revenue web-site

Qualifying R&D Expenditure

The R&D tax relief is given on expenditure incurred during the relevant period on:

- *Qualifying Staff* are those staff directly and actively engaged in R&D. They are the people actually undertaking the R&D, staff providing technical support, and the managers who are planning and organising the programme of research. The costs of people more remote to the R&D, for example people providing clerical or general administrative services do not qualify. Staff may spend only part of their time on R&D. In these cases, the costs are apportioned to arrive at the qualifying staff costs. However, if the employee spends more than 80% of his or her time on R&D the whole cost qualifies. Conversely, if the employee spends less than 20% of his or her time on R&D none of the cost qualifies.
- *Consumable stores* are materials and equipment that are used up in the R&D activity.

Beside those two types of expenditure that are applicable for both the SME as the large company's tax relief, the R&D tax relief for SME's also allows to include:

- *Payments to Subcontractors for R&D* A company that subcontracts its R&D will be able to claim R&D tax relief provided it retains the ownership rights to the knowledge. The subcontractor cannot claim the R&D tax relief. The treatment depends on whether the principal and the subcontractor are connected.

Principal and Subcontractor are Connected

If the principal and the subcontractor are connected persons (as defined in Section 839 ICTA 1988), the principal can claim the R&D tax relief on each subcontractor payment based on the lower of:

- the amount payable to the subcontractor; and
- the subcontractor's expenditure on R&D wages and consumable stores carrying out the work relating to the payment, calculated as if the subcontractor qualified for the R&D tax relief on the work carried out.

In addition, the subcontractor must include

- the amount payable by the principal for the R&D, and
- its expenses of carrying out the work represented by the principal's payment, in the computation of the profit and loss in its accounts for a period ending not more than 12 months after end of the accounting period in which the principal included its payment in its profit and loss.

Principal and Subcontractor are not Connected

If the principal and the subcontractor are not connected, the principal may claim 65% of the amount it pays for the subcontracted R&D. Alternatively, the parties may make a joint election for the connected persons' treatment described above. The election must be made within 2 years of the end of the principal company's accounting period.

In summary, a large company may claim the R&D tax relief for research carried out by it on behalf of another large company, a charity, a government agency or a company resident overseas. It cannot claim the relief for research carried out on behalf of an SME because the SME can claim the R&D tax relief itself as explained above (payment to subcontractors).

The Minimum/Maximum Amount of R&D Expenditure

A company must spend at least £25,000 in an accounting period on qualifying R&D before it can claim R&D tax relief. This amount increases or decreases proportionally if the accounting period is longer or shorter than 12 months. The main reason for this threshold is to exclude a large number of small claims. In the initial proposal of the policy this level was even set at £ 50,000 but it was reduced to £ 25,000 after the industry consultation round, where it was rejected as being too high for SME's.

Claiming the R&D Tax Credit

A company must claim the R&D tax relief. The claim must be made within 6 years from the end of the accounting period to which it relates. It must be made, so far as possible, in the Corporation Tax Self-Assessment Return for the relevant accounting period. The whole procedure is relatively straightforward in the sense that at the time of claiming the tax relief the company only has to declare how much it spent on R&D.

For the claimant company there is no obligation to keep records of the R&D activity on a project basis. The only records that need to be kept are the ones required by general legislation on the tax return. This obliges the claimant company to keep any records that are appropriate to support that claim. No extra specific requirements are in place for the R&D tax credit.

Deductibility of Qualifying R&D Expenditure

The UK tax relief allows companies to deduct its current R&D expenditure that meets the aforementioned definition, at rates above the standard 100% when computing its corporate income tax liabilities. For SME's this deduction amounts to 150%, which thus reduces the taxable income by an additional 50% of the qualifying R&D expenditure. Large companies are allowed to deduct only 125% instead of 150% of their qualifying R&D expenditure.

The final impact of the UK R&D tax relief is that the applicant company is liable to pay less corporate taxes on its profit than it would without the tax relief. The real cost reduction of R&D spending depends however on the corporate income tax rate that is applicable. Currently, the UK applies three different rates of 0%, 19% and 30% depending on the total amount of taxable income. For SME's that are eligible for the 0% rate or that are loss making, the effect of the tax credit would be nil. As a result, an SME can claim a payable R&D tax credit if it has made a loss in the trade in which the R&D is carried out. The loss attributable to the R&D may be surrendered to the Exchequer in return for a cash payment equal to 24% of the cash cost of the qualifying R&D. The 24% is only an arbitrary figure given the fact that the corporate income tax rate, and hence the real cost reduction of R&D spending varies in function of the total amount of taxable income. The 24% was chosen as a reasonable estimate of what the SME R&D tax

credit might be worth to a typical claimant SME. For any SME the cash refund can never exceed the PAYE/NIC payments. These payments correspond to the pension, social benefits and national insurance contributions that a company is liable to withhold on the salaries of its employees. This upper limit was set really only as a precaution and safeguard to avoid abusing the system. It is to make sure that real people are there in real companies and not paper companies that claim the R&D cash refund while not doing any R&D.

According to people at the Inland Revenue responsible for the policy, the main reason for adopting a volume scheme instead of an incremental scheme is simplicity. During industry consultation rounds that were held in order to take into account the viewpoint of companies, incremental schemes were clearly rejected as being too complex. It creates too much uncertainty about what a company will get as final tax relief. As a result such a policy will not enter the real R&D decision-making process but it will only be regarded as an extra when claimed afterwards. Secondly incremental schemes create extra complexity for corporate groups. It requires extra legislation and procedures to calculate the total group spending on R&D in order to determine the applicable base amount. More generally, since an incremental scheme is more complex than a volume scheme, extra legislation has to be written that has to be conveyed, describe and explained to companies.

A second reason for choosing a volume scheme that surfaced during the interview with people at the Inland Revenue responsible for the policy was the low position of the UK concerning R&D spending compared to other developed countries. This resulted in the conviction that maintaining the current level of R&D spending by rewarding the entire R&D volume was more a priority than stimulating only extra R&D spending through an incremental scheme.

Cash Flow Timing

Since the UK tax allowance is built in the corporate income tax system, the moment of the tax return is determining the timing of the cash refund. In practice companies have 12 months from the fiscal year end to file their tax return. The Inland Revenue aims to process the tax returns within 20 working days but there is no specific rule or timing in place.

Responsible Organisation

Contrary to the Dutch case there is no specific organization in place responsible for the execution of the R&D policy. All functions are carried out by the Inland Revenue. The Inland Revenue is responsible, under the overall direction of Treasury Ministers, for the administration of direct taxes plus tax credits, national insurance contributions and stamp duties together with the collection of student loans and National Minimum Wage enforcement. The structure of this organisation is decentralized with more than 400 independently functioning local offices. Those local offices are grouped in clusters called areas. The aim is to have one person in each area to specialize in R&D issues and to function as an expert for that area. The decision power is in hands of the local offices but in case of difficulties or uncertainty, support can be obtained from this person. However the Inland Revenue does not employ technicians or scientists

to determine the eligibility of R&D projects. Since the launch of the policy there were no extra employees hired by the Inland Revenue to deal with the R&D tax allowance applications in the local offices. There are 3 people employed in the headquarters to coordinate the policy nationwide.

The UK policy in figures

Given the fact that the UK policy has only been introduced recently, very little data is yet available. 4.500 SME's are expected to claim the credit in 2002 while this figure is expected to be situated somewhere between 500 and 600 for large companies in 2002. Additionally the people interviewed from the Inland Revenue estimate that more than half of the SME's claim the cash refund.

Monitoring

Since the R&D tax allowance is part of the tax return of companies and thus administered by the Inland Revenue, all ex post control will happen within the context of the general tax return. This leaves the possibility for two distinct inquiries. On the one hand, with a full inquiry all elements contained in the corporate tax return can be controlled. On the other hand, specific elements of the tax return of a company, like the valuation of stock or specific claims of a company, like the R&D tax allowance can be investigated by the Inland Revenue during an aspect inquiry. Here is becomes clear once more that R&D related claims are not treated differently than any other item of the tax return. The introduction of R&D tax allowances in the UK is for the Inland Revenue merely a new variable into the risk assessment process of the tax return. As put by the people interviewed of the Inland Revenue: "We recognize that claims will be made successfully that do not meet the requirements of the policy. You have to treat it as a risk through proper risk management. At one point the policy itself will be evaluated." Given the fact that the policy was only launched on the first of April 2000, it is still too early days to have a clear view on the existence of fraud in the policy.

Promoting the policy

In order to promote the policy among UK companies several activities were undertaken. A series of seminars were held to which R&D intensive companies and accountancy companies were invited. During those seminars the setup and the functioning of the policy was explained. The Inland Revenue also published advertising material in selected newspapers and magazines like "The Engineer" and "The Scientist". In those ads the story of a company that claimed and used the tax credit was highlighted. Furthermore "The Tax Bulletin", a publication of the Inland Revenue, also devoted a special edition to the tax credit. Finally the Inland Revenue held talks with large accountancy companies and specific interest groups in order to explain and promote the policy.

6 European Commission Task Force Recommendations

The following recommendations stem from the European Commission Task Force on fiscal incentives:

- Member States are recommended to review their current fiscal incentives for R&D, or design new instruments, in such a way as to conform to basic criteria of good practices. These criteria for good 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 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 **refundability** (cash refund) of tax credits or tax allowances in cases where companies make losses (and therefore would not be able to have a 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, especially for large firms were important budget allocations take place between research centres based in different countries. One possibility to improve the visibility can be reached by considering R&D tax credits as taxable income for the company, as is currently the practice in Canada. This has the advantage that it 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 model developed by the Dutch WBSO system, which provides cash flow to firms in the year R&D is conducted. Furthermore, the support can be directly linked to the R&D expenditure.

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

- There is a need for **formal evaluation practices** of the effectiveness of fiscal incentives, also in comparison 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 exclusively for a broad reach of a wide population of firms involved in R&D activities. On the other hand, direct government funding of business R&D should be targeted to fields of research where 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 coordination** mechanism between the public institutions (ministries and agencies) involved in the stimulation of business R&D.

- Fiscal incentives using personal income tax breaks, 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 breaks may induce potential distortions within the EU labour market.

7 Implementation of Best Policy Practices in Belgium

As it was put forward according to the recommendations of the European Commission task force on fiscal incentives, a fiscal incentive has to be tailored to the specificities of the country in question. In order to make this approach possible, the following subchapters are devoted to analysing some of the specific characteristics in Belgium.

7.1 Overview of the Belgium policies

As described above, the main Belgian policy[12] has to be classified as a special allowance even if it differs from similar policies implemented in other industrialized countries. The Belgian fiscal incentive offers fixed allowances instead of percentages. For each additional employee used in scientific research in Belgium, the company is exempt from paying taxes on an amount of € 11.800 **in the year of recruitment**. This amount is annually indexed. For highly qualified researchers, i.e. employees holding a doctorate degree with 10 years of experience in scientific research, the exemption is equal to € 23.590. This policy is nominative which implies that companies have to apply on the basis of each new researcher. This application has to be filed no more than three months after the end of the fiscal year to which the recruitment relates. It has to prove that the researcher has been involved in R&D activities **on a full time basis**. In addition, activities for the development of the technological potential of the company are also allowed for this allowance. In case the tax allowance is granted for that year it is important to notice that this relief is never permanently secured by the company. For each subsequent year, the company has to deliver an attestation that the researcher in question is still working on a full time basis in the research department of the same company. Failure to comply with the regulation results in the loss of the previously obtained exemption. This causes the taxable income of the company to increase proportionally so that the company is liable to pay taxes on the previously obtained exemption in the year that the researcher leaves.

7.2 Industry consultation

In order to design an efficient policy that strongly stimulates business R&D, it is important to understand the enterprise's rationale underlying its R&D decisions. This stretches from understanding how firms make their R&D decisions, how and when R&D expenditure is budgeted and what elements actually enter into the R&D decision process.

In order to form a clear view of business R&D, several firms active in R&D have been approached. Two meetings have been organized. About a dozen CEOs, financial directors and tax consultants took part

[12] It concerns the following policy: "Exonération fiscale pour les enterprises" – "Belastingvrijstelling voor ondernemingen"

during a series of "breakfast-debates" with the aim of stimulating discussions concerning the present system of government support to R&D and the need for a reform.[13]

Though the number of companies consulted is not large, the sample has been carefully selected to ensure a good representation of the business R&D sector. A balance has been achieved between multinationals on the one hand and small and medium-sized companies on the other. Furthermore, companies from the three regions of the country have been included. Moreover, the firms participating in the process were very different from one another in terms of financial situation. A questionnaire submitted to all participants showed a clear disparity among firms, although all of them are actually involved in R&D. The amount of R&D expenditures ranges between 2% and 50% of the sales. While some of them expect their R&D expenditures to grow by 25% annually in the next years, others expect no growth at all. Furthermore, the questionnaire results showed that no clear-cut picture could be drawn concerning the frequency at which decisions to undertake R&D projects were taken. While some companies set up their R&D budget in advance, others adapt it to the different opportunities, every month or twice a year. The results also showed that R&D project often span over multiple years, with a timeframe ranging from 3 to 10 years.

Although most companies appear to be aware of the different incentives offered by the government, very few actually use the support that the government has put in place, be it the tax allowance offered for the recruitment of new researchers or for investment in R&D. Furthermore, there appears to be a serious misunderstanding among Belgian firms regarding the current incentive system. It is thought that the allowance for hiring new researchers is permanently obtained during the first year so that it would be beneficial to hire excessively one year and abandon the newcomers the next one. Such misinterpretations may be due to the fact that the current policy is probably too complex to be effectively used. Other important questions that deserve attention are: Why is this policy so unpopular among firms? What could be done to ensure that government support actually stimulates R&D?

Looking more carefully at the results, it appears that most of the participants were actually aware of the different kinds of incentives offered by the government. Among these, only a few admit using such incentives (mainly tax allowances for recruiting new researchers and for investment). When asked about the proportion of R&D expenditures that were actually covered by those supports in this sub-sample, the answers ranged from 5% to 20%. However, one should bear in mind that there is a difference between asking for an aid and using it to generate more R&D. In the survey, the government support is almost never perceived as an "R&D stimulator": indeed, only one firm has declared that it had carried out an R&D project because the fiscal support was available.

The majority of participating firms deliberately choose not to use any kind of measures. The discussions with the companies revealed that this is due to the following reasons:

[13] Participants: BAXTER, BIOXPR, B&B Controls, the FEB, FEDICHEM, JANSEN Pharmaceutical, LABORELEC, OCTALIS, PRICEWATERHOUSECOOPERS, PROBIOX, ROBONETICS, SHELL Research and

- First of all many firms do not use the different measures because the associated administrative cost is too high compared to the potential benefit. The procedure to receive support is time-consuming, bureaucratic and lacking in transparency, while the aid itself is too unsubstantial. Firms have called for a simple, transparent and "user-friendly" system.
- Second, because R&D is a long-term process, any kind of government support should be available to the firm for many years, in a predictable and stable manner.
- Third, the support should be substantial enough to generate a change in the R&D expenditure. Indeed, the present incremental system in Belgium is described by all firms as too small to influence significantly the cost of R&D activities.

An overview of both the UK and the Dutch models has been presented to all participating firms as possible best policy examples. Subsequently the firms have been asked to describe what appealed most to them in each model. It appears that the ideal model is a mixture of both systems. The UK model, on the one hand, is attractive for not requiring firms to apply in advance for the government support since British firms are allowed to include their R&D expenditures directly into their income tax return. Next to this climate of general trust between the public authorities and the corporate world, another appealing element in the UK system is the eligibility of outsourced research for the SME tax incentive.

The Dutch system has several very interesting elements for firms as well. Indeed, by benefiting from a cut in the wage costs, companies are able to reduce quickly, significantly and automatically the cost of research. This is especially appealing to the Belgian research centres of multinationals which are competing directly with other European and international centres. Belgium, it appears, suffers significantly from high wage costs. Leaving this issue unsolved forms a serious barrier to entry for new R&D firms and leads to the exit of existing ones. For instance, decisions regarding where R&D projects are to be performed are taken by multinationals' headquarters and to be really attractive, Belgium needs to implement something "visible".

Firms have made it clear that a volume-based approach would be highly preferred to an incremental one. In addition to being too complex to be effective, an incremental system only rewards a firm for an increase in its R&D expenditures that may well be due to external reasons such as the economic environment or the result of a merger & acquisition. Firms would rather prefer to see their entire R&D expenditures rewarded during several years.

How should firms apply for government support? Some have argued that the Dutch system is beneficial because the firm knows before starting its R&D projects whether the fiscal support is granted or not. However, many prefer a system with no prior application, similar to the one available in the UK. Firms prefer to avoid a system whereby an administration decides what can be considered as "research" and who can qualify as a "researcher". Such a system looks "un-transparent" in the eyes of companies. Tax credits should be granted in an objective way on the basis of a regulatory framework. Departing from the

Technology Centre, SOLVAY, STEROP Laboratoire, UCB, UCB Pharma and VANDEPUTTE.

Dutch system, firms have argued that a "research-based" approach is preferable to a "project-based" one. Some have put forward the idea of granting enterprises, after a thorough examination, an "R&D label". This idea, which is a combination of both the UK and the Dutch system, would enable certain companies to qualify automatically for tax credits, thereby reducing administrative costs significantly for both the company and the government as well as eliminating uncertainty among companies. Furthermore, this would foster a climate of trust between firms and public authorities.

Many firms have argued that what may be most effective in encouraging firms to perform R&D is the complete elimination (or at least a drastic reduction) of the social contributions for R&D personnel. This measure should ideally be extended to at least 5 years after recruitment to have a significant impact. What appeared to be widely acceptable is the system of policy mix: tax credits should be coupled with a decrease in social contributions. The former measure would only reward firms that make profits, while the latter would benefit to all.

Another important element that surfaced during the corporate debates was that it is equally important to secure the current level of business R&D spending, as it is to stimulate additional spending. Firms have also stressed the importance of not taxing any kind of government support, be it tax credits or subsidies if the full impact of such support is targeted.

7.3 Evaluation of the Belgian policy

Based on a comparison with the fiscal incentives implemented in most countries, on the best policy practices and key recommendations of the European Commission, and taking into account the opinions formulated during the corporate consultation process, it appears that the current state of the Belgian fiscal incentives could be improved significantly. The following elements definitely appear to be putting the current Belgian policy at a disadvantage:

1. The exemption only relates to the first year of recruitment (incremental policies on a "rolling base" induce investment distortions and are not highly stimulating).
2. The amount of the exemption is not significant enough to be stimulating. The net cost saving is too small to have a real impact on business R&D decisions (the fiscal incentive is too weak)
3. In order to secure the exemption, the company has to deliver an attestation each year (it adds complexity and administrative costs to both the firm and the government)
4. In order to secure the exemption, the researcher in question has to remain working on a full time basis in the research department of the same company (adds complexity)
5. The tax allowance is nominative. This causes important administrative constraints on both the government and the firm (each year there is a need to track the employees who benefited previously from the fiscal incentive).

6. The conditions for highly qualified researchers are so severe that practically no researchers qualify (the definition of highly qualified personnel is too strict)
7. As the experience with the Austrian R&D tax allowance has shown, it is better to apply the internationally recognized definition of the Frascati Manuel (OECD, 1993). In this context, it seems better to restrict the tax allowance to R&D activities only and to eliminate the "development of the technological potential of the company" (it implicitly induces relabelling practices).
8. A better integration of the different governmental departments could result in substantial savings on the administrative cost of the policy. Currently some procedures include performing tasks that could be avoided by using information readily available in other departments.

7.4 Recommendations for Belgium

- The essential keywords for our recommendation are the search for stability, visibility, simplicity and reliability

- Implement a **level** based tax credit of 25% on all R&D expenses (total expenses) if the 3% GDP R&D objective has to be reached (see section 2 of Chapter 8 below: "Opportunity cost of each scenario")

- Investigate the possibility to make monthly deductions of social security taxes, as in the Netherlands.

- Limit the definition of eligible expenditures to the one in the Frascati manual. (See appendix 1 for the Frascati definitions). An in-depth company consultation process would allow refining the interpretation of the Frascati Manual

- Allow patent-related expenses to be deducted.

- Allow R&D expenditure from outsourced or subcontracted activities to universities, public labs and high schools to be deducted.

- Reduce most of the complexity associated with the current policy (full-time requirement, subsequent attestations in order to maintain the exemption, …..)

- Increase the coordination between the various government institutions and ministries involved in any type of government support to business R&D, such as grants, subsidies, procurement, …

- Allow cash refunds for loss-making SME's and carry back and forward provisions for all other firms

- Eliminate the requirement that R&D has to be technically new from a societal point of view. Firstly, it is almost impossible and costly for the government to control what is and what is not new from a societal point of view. Additionally it is relatively straightforward to keep track of what R&D the company previously did (by looking at the previous applications). Moreover, it is not excluded that redoing a similar research does not result in new findings.

- Offer the facility to apply beforehand as well as afterwards for the tax incentive. This avoids the dilemma between the equally important arguments of **certainty** and **flexibility** for companies. This facility also offers potential benefits to the government as it spreads the applications over the whole year so that fewer human resources are required to cope with peak periods.

- It is important to put a **consistent** policy in place. This has to be achieved at all levels of the policy: from the design, the communication, the application, the treatment of applications and the granting of the incentive to the monitoring itself.

- There should be an independent evaluation put in place in order to assess the effectiveness of the new fiscal incentives.

- In order to ensure a proper evaluation process, access to micro-level databases is indispensable.

8 Scenarios for a new R&D policy in Belgium

8.1 Description of four scenarios

The analysis of the current fiscal R&D policy in Belgium has led to a series of recommendations for improvement presented in point 7.4 above. These recommendations have been organized into four different scenarios, each scenario representing a different degree of fiscal generosity. This approach makes it possible to estimate quantitatively the impact of an R&D policy.

The introduction of a tax credit system of 25% on all business R&D expenditures has been presented as the best feasible policy to stimulate R&D. Indeed, such a policy is likely to enable Belgium to reach the European target of 3% of R&D intensity by 2010. Such a policy is the object of scenario number IV.

Three other scenarios have been drawn. The aim is to present various improvements of the current system, with scenario I being the nearest to the current system. All three scenarios focus on improvements of the two existing incentive measures: the "R&D personnel" measure (*1*) and the "R&D investments" measure (*2*) (while scenario IV considers all R&D expenditures at once).

(*1*) The first existing measure considered, by which the recruitment of an additional R&D employee entitles the company to a certificate from the SSTC, allowing it to qualify for a tax deduction of €11.800 has been modified in the three scenarios (see table 1 below).

- The **current policy**, which can be defined as a rolling incremental system (it applies to the additional R&D personnel with respect to the previous year, and is granted on the first year of recruitment) is modified in **scenario I** to allow companies to keep the deduction received, even if the employee does not fill its position anymore.

- **Scenario II** further modifies the current situation by replacing it with a fixed incremental scheme. In such a system, the reference base is fixed. This can for example correspond to the year of implementation of the scenario. As a result, the company benefits each year from the deduction on the number of employees that exceeds the reference base.

- **Scenario III** extends scenario II by allowing all R&D employees to benefit from the fiscal measure. It is thus not restricted to new R&D employees. Contrary to the previous cases, scenario III is a volume-based system and not an incremental one.

For all those scenarios, the allowance remains the same: € 11.800 and € 23.590 for highly qualified R&D researchers. However, the conditions for obtaining this "high allowance" should be broadened, with

respect to the number of years of experience for instance. Furthermore, the nominative character of the deduction should be removed, as the administrative burden is too high.

(*2*) The second measure stipulates that all environment-friendly R&D investments and patents can be deducted at the special rate of *13,5* %. Regional administrations, after examining each case, grant companies certificates that are then included in their annual fiscal report.

- This fiscal measure currently in place has not been modified in scenarios I, II and III, except that the policies of both carry forward for large firms and cash refund for small ones have been included to incite companies to keep on performing R&D even if the prospect of making profit seems uncertain.

- As far as **scenario IV** is concerned, the investment measure is very much modified. Indeed, the fact that all R&D expenditures are included in the tax credit policy means that all other R&D investments which do not have the environment-friendly implication, and which qualify for the standard 3% deduction under all other scenarios, are also eligible. Furthermore, current expenditures related to R&D activities also qualify for the tax credit of 25%.

As explained in the "typology" section above, tax credits differ from tax deductions, by directly reducing the corporate income taxes instead of reducing the taxable income. Hence, under the assumption that all companies are making profits, the gain of a tax credit system for the business sector would be:

Gain for the business sector = Total R&D expenditures × *25%*

Whereas the tax allowance of 13,5% on R&D investments only (as would be the case under scenarios I to III and in the current situation) would induce a gain equal to:

Gain for the business sector = R&D investments × *13,5%* × *33%*

Where 33% corresponds to the current Corporate Income tax rate in Belgium, 25% the tax credit rate under scenario IV and 13,5% the deduction rate on R&D investments under scenarios I, II and III. This is again true if all companies are making profits and if all eligible R&D expenditures are actually submitted to the fiscal authorities.

Table 5. Description of the four scenarios compared to the current situation

	Current situation	Scenario I	Scenario II	Scenario III	Scenario IV
Recruitment of R&D personnel					
	Rolling incremental scheme: deduction granted 1st year for additional R&D employee, not permanently granted	**New rolling incremental scheme**: granted 1st year for additional R&D employee, permanently granted	**Fixed incremental scheme**: granted every year for new R&D employees w.r.t reference year	**Volume scheme**: granted each year for all R&D employees	**Volume scheme:** granted each year for all R&D employees
Deduction per R&D employee	TA[14]= 11.800 €	TA = 11.800 €	TA = 11.800 €	TA = 11.800 €	TC[15]= 25%
Deduction per highly qualified R&D employee	TA = 23.590 €	TA = 23.590 € broad definition	TA = 23.590 € broad definition	TA = 23.590 € broad definition	TC = 25%
Nominative application	Yes	No	No	No	No
Current R&D expenditures (excluding personnel expenditures)					
R&D current expenditures	No	No	No	No	TC = 25%
Patent-related current expenditures	No	No	No	No	TC = 25%
R&D investments					
Environment-friendly R&D investments	TA = 13,5%	TA = 13,5%	TA = 13,5%	TA = 13,5%	TC = 25%
Patents	TA = 13,5%	TA = 13,5%	TA = 13,5%	TA = 13,5%	TC = 25%
Other R&D investments	TA = 3%	TA = 3%	TA = 3%	TA = 3%	TC = 25%
Carry forward for large firms	Not available for the recruitment of additional R&D employee	Yes	Yes	Yes	Yes
Cash refund for small firms	No	Yes	Yes	Yes	Yes

[14] T.A. stands for tax allowance, as explained above.
[15] T.C. stands for tax credit, as explained above.

8.2 Opportunity cost of each scenario

A gross estimation of the opportunity costs of each of the four scenarios described above has been made. Those estimations are based on the specificities of the designs of each scenario, relating to both the recruitment of R&D personnel measure and the R&D investments measure. The case whereby the current system is maintained serves as comparison. Otherwise mentioned, data are taken from the OECD and the SSTC. It is important to keep in mind that these evaluations are upper bounds. These figures should be used for comparison purposes and not for absolute values approximation. Finally, it is important to remember that these evaluations are gross opportunity costs, because the positive externalities and the creation of new jobs are not taken into account.

***A*. <u>The following assumptions have been made</u>:**

- Both the annual rate of growth of the Belgian R&D personnel and the annual rate of growth of business R&D expenditures vary with the policy implemented. If the **current system** is maintained, these variables are expected to grow at an optimistic **3%** average annual rate.

- The average annual growth rate of GDP and the average annual growth rate of non-business R&D expenditures are assumed to remain at 3%, independently of the policy implemented.

- Given the little modifications scenario I brings with respect to the current system, the additional impact on growth is expected to be negligible too. Therefore, in **scenario I**, all variables are expected to reach an average annual growth rate of **3%**.

- For **scenarios II** and **III**, we assume both policies to trigger further business R&D investments, and an increase in the total R&D personnel. The additional growth rates, for those two variables, are assumed to be respectively 1% and 2%. Hence, the average annual growth rates are respectively **4%** and **5%**.

- Contrary to all other scenarios, **scenario IV** represents a volume tax credit of 25% on all R&D expenditures. To evaluate the impact of such a policy, the *B*-index (see below the definition of the OECD[16]) has been used. The *B*-index for Belgium is estimated to be about 1 (see Guellec and Van Pottelsberghe (2002)). Introducing the policy suggested in the scenario IV would lead to a decrease in the *B*-index of approximately 20%. Indeed, an index of 0.8 prevails in countries that apply a tax credit rate of 20%-25%. Using the short-term elasticity rate, which is estimated to be approximately 0.28-0.3 in the OECD, we get that the impact amounts to more or less 6%. Hence, a policy that allows all business R&D expenditures to benefit from a 25% tax credit will in fact generate an average annual business R&D expenditures growth of **9%**.

[16] The OECD defines the *B*-index as follows: "the *B*-index is defined as the present value of before-tax income necessary to cover the initial cost of R&D investment and to pay corporate income tax, so that it becomes profitable to perform research activities. Algebraically, the *B*-index is equal to the after-tax cost of an expenditure of USD 1 on

- For simplifying purposes, the deduction for the recruitment of new R&D personnel is assumed to be €11.800, independently of the degree of qualification. Indeed, the share of highly qualified R&D employees (according to the definition of "highly qualified" used by the SSTC) in Belgium is negligible.

a) Assumptions and remarks related to the R&D investments measure:

- Business R&D expenditures in Belgium can be decomposed into three parts: R&D personnel expenditures, current R&D expenditures (excluding personnel expenditures) and R&D investments, each accounting for the respective shares 60%, 30% and 10%, according to the SSTC. (The total (100%) represented €3,6 billion in the year 2000). The current Belgian policy allows all (environment-friendly) R&D investments to be deducted at the special rate of 13,5%, upon showing a certificate. The three Belgian regions are responsible for delivering such a certificate to enterprises, which then include it in their annual fiscal report. According to the tax department of the Ministry of Finance however, up to one third of all business R&D expenditures in the year 2000 were in fact considered "R&D investments" and the special deduction rate of 13,5% has been applied on that amount (one third corresponded to €1,2 billion in the year 2000[17]).

  This considerable share could partly be due to the fact that the different regional administrations deliver certificate not only to R&D investments done in their respective regions, but to current R&D expenditures as well. Furthermore, though in theory the special deduction rate relates specifically to R&D investments that are environment-friendly, in practice this requirement is not necessarily observed by the administrations when granting the certificates. The exact amount of real R&D investments in Belgium is however impossible to obtain. The number given by the Ministry of Finance, which represents the total R&D investments (and probably some current expenditures) for which a regional certificate has been delivered, serves thus as a proxy.

- According to the Ministry of Finance officials, an application for the deduction rate of 13,5% is actually made for almost all R&D investments projects. Indeed, the measure being very well known by the companies and the deduction being quite substantial, the *participating share* is assumed to be **100%.**

b) Assumptions and remarks related to the R&D personnel measure:

- The share of newly recruited personnel for whom a certificate is actually delivered by the SSTC (allowing the company to deduct the annual amount of €11.800 for each additional R&D employee) was close to 30% in the year 2000. However, the number of certificates delivered in the year 2001 has heavily increased. If the total number of R&D personnel is indeed assumed to grow at the average annual rate of 3%, the *participating share* is then likely to increase from 30% to **90%** in the subsequent years. This seems, according to SSTC officials, a reasonable assumption given the recent publicity effect of the measure.

R&D divided by one minus the corporate income tax rate. The after-tax cost is the net cost of investing in R&D, taking into account all the available tax incentives.

[17] Part of those "R&D investments" that actually qualify for the special deduction rate represent investments for which the deduction is done at once, and part for which the deduction is spread over many years.

- In **scenarios II** and **III**, R&D personnel and R&D investments are assumed to grow at the respective average annual rates of 4% and 5%. In both cases however, the implementation of the measures accounts for respectively 1% and 2% (3% reflecting the average annual growth of R&D expenditures). Hence, the additional growth rates that both scenarios induce reflect the fact that additional R&D employees have been hired because of the policy implemented. Therefore, it can easily be assumed that the participating share of R&D personnel in this measure is equal to **100%** for the incremental growth component induced by the policy, and 90% for the general growth component not induced by the policy (3%).[18] The average annual growth rates induced by the policies (respectively 1% and 2%) is denoted by g^*, whereas the basic average annual growth rate which is common to all scenarios is denoted by g.

- The share of R&D employees who benefited from the deduction in period t but who do not fill the position anymore[19] in $t+1$, $t+2$, ... is more or less 25% in $t+1$ and 10% in $t+2$ (denoted here as the *return share*), according to the SSTC data. Under the **current policy**, the enterprise must return the deduction received in t when it cannot prove anymore that the position is filled by the same person. However, inter-enterprises movements by an employee cancel out as the deduction received in the new position compensates for the loss incurred by the former employer. Hence, the average annual growth rate of 3% in the current situation description takes those movements into account. **Scenarios I** and **II** do not.

  Indeed, deductions are granted permanently to the enterprise, there is thus no compensation at the macroeconomic level. This means that inter-enterprises do increase the number of certificates delivered annually. The *return share* ($r.s$) is assumed to be about **1/3** (for simplifying purposes, only the return share in ($t+1$) is taken into account and is thus approximated by 1/3): this means that one third of the deductions granted in period t are indeed returned after one year. If we further assume that all those who have quit their positions occupy another position as R&D employee in ($t+1$) and benefit from a new deduction, then the growth rate should then become **4%** in scenario I and **5%** in scenario II (one third of an average annual growth rate of 3% of the R&D personnel means an additional 1%). We further assume that the increase in employees due to the policy implemented (at the growth rate of g^*) is subject to a negligible return share ($r.s^*=0$).

- For **scenarios III** and **IV**, the certificates are granted to all R&D employees (volume-based rather than incremental-based system). Therefore, inter-enterprises movements do cancel out.

- Only profit-making firms are able to benefit from the policies launched. However, carry forward has been included in all four scenarios, meaning that for a significant share of the companies, there will be a gap between the year the R&D is effectively performed and the year the benefits are received. This *profit share*, denoted by $\pi.s$ is assumed to be **70%** of the participating expenditures.

[18] For R&D investments, the participating share is assumed to be always equal to 100%Indeed, the participating share for R&D investments is assumed to be 100% for the general growth component of 3%. It is *a fortiori* 100% for the incremental growth component that is triggered by the policy.

[19] Those numbers may also reflect the fact that some companies may have forgotten to reapply the following years.

B. **Formalization of the opportunity costs associated with the scenarios:**

The opportunity costs, which reflect the absence of revenue for the government, are computed by taking the gains for the business sector as a whole and applying the CITR (currently equal to 33%). Rates of growth and participating shares have not been replaced by the values estimated above to allow for a general case. Table 7 on the next page gives the estimations in euros using the data from the OECD, the SSTC and the Ministry of Finance and the estimations and assumptions made above.

The following abbreviations are used:

- G_t^P, G_t^I : before-tax gain in time *t* for the business sector for respectively the "R&D personnel" measure and the "R&D investment" measure. G_0^P and $\boldsymbol{G_0^I}$ refer to the before-tax gains in the year of implementation ($t=0$).
- P_0 : number of R&D personnel in Belgium in the reference year *0*
- I_0 : R&D investments in the year of implementation
- E_0 : R&D expenditures in the year of implementation
- g : average annual growth rate of R&D exp. and R&D personnel, independent of the policy pursued (%)
- $p.s$: participating shares as defined above.
- $\pi.s$: profit share as defined above.
- $r.s$: share of R&D personnel who received the deduction in ($t-1$) but who returned it after one year
- g^* : average annual additional growth rate of R&D exp. and R&D personnel (%), triggered by each policy:

$$g^* = \begin{cases} 0 \text{ for current situation and scenario I} \\ 1 \text{ for scenario II} \\ 2 \text{ for scenario III} \\ 6 \text{ for scenario IV} \end{cases}$$

Table 6. Formulas used in the computations of the opportunity costs of the scenarios

- Current situation

$$G_t^P \equiv 11.800 \times \left\{ g \times \mathrm{P}_0 (1+ g)^{\,t-1} \times p.s \right\}$$
$$G_t^I \equiv 13{,}5\% \times \left[\mathrm{I}_0 (1+ g)^{\,t-1} \times (1 + g) \right]$$

Opportunity Cost for public authorities $\equiv OC_t = 33\% \times \pi.s \times \left(G_t^P + G_t^I \right)$

- Scenario I

$$G_t^P \equiv 11.800 \times \left\{ (g + r.s) \times \mathrm{P}_0 (1+ g + r.s)^{\,t-1} \times p.s \right\}$$
$$G_t^I \equiv 13{,}5\% \times \left[\mathrm{I}_0 (1+ g)^{\,t-1} \times (1 + g) \right]$$

Opportunity Cost for public authorities $\equiv OC_t = 33\% \times \pi.s \times \left(G_t^P + G_t^I \right)$

- Scenario II

$$G_t^P \equiv 11.800 \times \left\{ \left[(g + r.s) \times p.s \times \Sigma_{i=1}^{t} \mathrm{P}_0 (1+ g + g^* + r.s)^{\,t-i} \right] + \left[g^* \times \Sigma_{i=1}^{t} \mathrm{P}_0 (1+ g + g^* + r.s)^{\,t-i} \right] \right\}$$
$$G_t^I \equiv 13{,}5\% \times \left[\mathrm{I}_0 (1+ g + g^*)^{\,t-1} \times (1 + g + g^*) \right]$$

Opportunity Cost for public authorities $\equiv OC_t = 33\% \times \pi.s \times \left(G_t^P + G_t^I \right)$

- Scenario III

$$G_t^P \equiv 11.800 \times \left\{ \left[(1 + g) \times \mathrm{P}_0 (1+ g + g^*)^{\,t-1} \times p.s \right] + \left[g^* \times \mathrm{P}_0 (1+ g + g^*)^{\,t-1} \times 1 \right] \right\}$$
$$G_t^I \equiv 13{,}5\% \times \left[\mathrm{I}_0 (1+ g + g^*)^{\,t-1} \times (1 + g + g^*) \right]$$

Opportunity Cost for public authorities $\equiv OC_t = 33\% \times \pi.s \times \left(G_t^P + G_t^I \right)$

- Scenario IV

$$G_t \equiv 25\% \times \left\{ \left[\mathrm{E}_0 \times (1 + g + g^*)^{\,t-1} \times (1 + g + g^*) \right] \right\}$$

Opportunity Cost for public authorities $\equiv OC_t = \pi.s \times G_t$

Table 7. Empirical application

An estimation of the four opportunity costs for the Belgian fiscal authorities can be derived using the information described above. The starting year is 2003, and a three-year analysis has been completed. Numbers are in million euros. This table should be used for comparative purposes only.

Current situation Million EUR

	2003	*2004*	*2005*
1. Total number of business R&D personnel	36 222	37 308	38 428
Number of certificates delivered	947	976	1 005
Benefit for business sector	11.2	11.5	11.8
2. Total R&D investment	1 317	1 357	1 398
Benefit for business sector	125	129	132
TOTAL OPPORTUNITY COST	**31.4**	**32.4**	**33.4**

Scenario I

	2003	*2004*	*2005*
1. Total number of business R&D personnel	36 222	37 308	38 428
Number of certificates delivered	1 263	1 314	1 366
Benefit for business sector	14.9	15.5	16.1
2. Total R&D investment	1 317	1 357	1 398
Benefit for business sector	125	129	132
TOTAL OPPORTUNITY COST	**32.3**	**33.3**	**34.4**

Scenario II

	2003	*2004*	*2005*
1. Total number of business R&D personnel	36 573	38 036	39 558
Number of certificates delivered	1 615	1 697	1 783
Benefit for business sector	19	39	60
2. Total R&D investment	1 330,3	1 383	1.439
Benefit for business sector	126	131	136
TOTAL OPPORTUNITY COST	**33.5**	**39.3**	**45.4**

Scenario III

	2003	*2004*	*2005*
1. Total number of business R&D personnel	36 925	38 771	40 710
Number of certificates delivered	33 230	34 892	36 636
Benefit for business sector	392	411.7	432.3
2. Total R&D investment	1 343	1 410	1 480
Benefit for business sector	127	134	140
TOTAL OPPORTUNITY COST	**120**	**126**	**132**

Scenario IV

	2003	*2004*	*2005*
1. Total number of business R&D personnel	38 332	39 865	41 460
2. Total R&D investment	1 394	1 450	1 508
3. Total business R&D expenditures	4 168	4 544	4 953
Benefit for business sector	1 042	1 136	1 238
TOTAL OPPORTUNITY COST	**729**	**795**	**866**

Point *1* refers to the "R&D business personnel" measure: row 1 is the expected total number of R&D employees in Belgium, row 2 is the expected total number of certificates delivered, and row 3 gives the number of certificates × €11800. Point *2* refers to the "R&D investments" measure: the first row gives the expected total R&D investment performed in Belgium, the second gives the amount which is actually deducted from that number (in practice, R&D investment is partly made at once and partly spread over several years).

The last row gives the opportunity cost of the scenario for the government. It is computed by taking all the benefits expected by the business sector and applying on it the CITR. The result should also take into account the share of enterprises that are not profit making during the period.

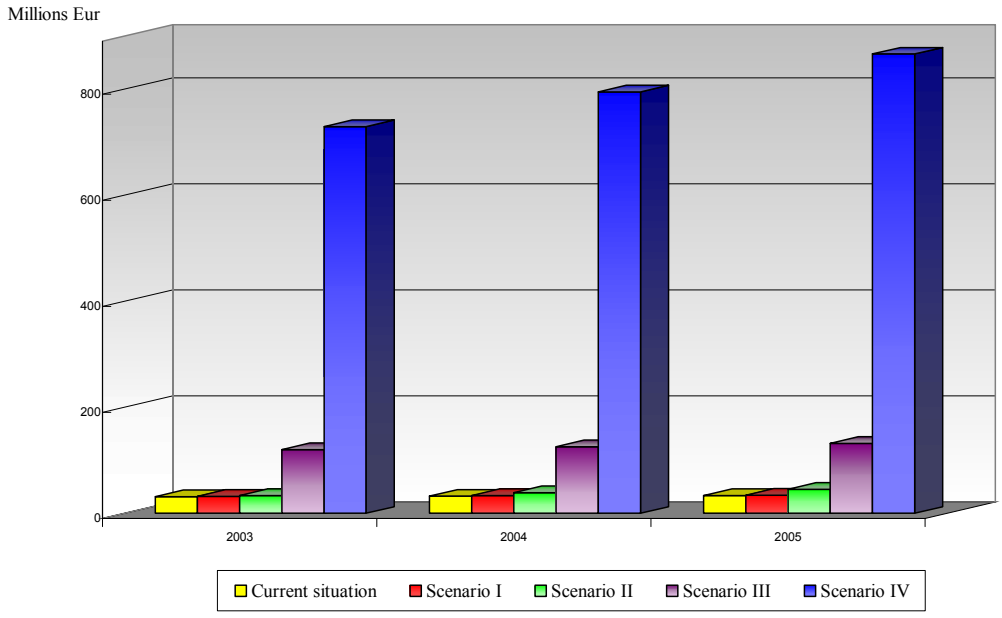
- Hence, opportunity cost = (sum of benefits) × 0,33 × 0,7
- Except for scenario IV, which is a tax credit system: opportunity cost = (sum of benefits) × 0,7

***C.* <u>Opportunity costs compared to the overall gains</u>:**

- **Scenario I**, being very similar to the current system, also has a very similar opportunity cost: the only difference is actually the share of personnel that quits its position without returning the deduction received.

- The opportunity cost in **scenario II** increases much from one year to the other. This is due to the fact that the deduction is granted every year to an employee who is recruited after the implementation year. Hence, costs are cumulated. This scenario differs much from scenario III: the former targets the additional employees with respect to the year of implementation, while the latter considers all R&D employees[20].

Graph 1. Expected opportunity cost of each scenario



[20] This is reflected in the formulas by the fact that in scenario II, the computations are made on the basis of (3%×P_{2002}) while scenario III uses the volume of employees: (103%× P_{2002}).

- **Scenario III** and **IV** may reflect a very high opportunity cost for the government, but this should be balanced with the fact that business R&D expenditures are expected to grow at a much higher rate. This matters much if the European target of achieving an R&D intensity of 3% by the year 2010 is targeted.

  R&D intensity is defined as: R&D intensity = [Gross Expenditures on R&D] / GDP

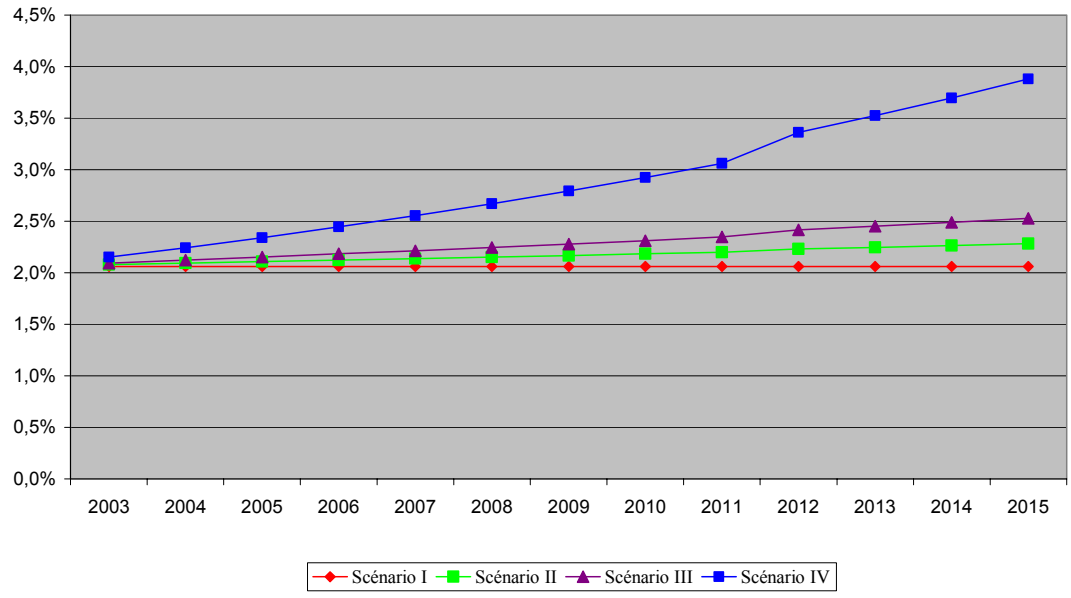
  This can be further decomposed into:

R&D intensity = {[Business Expenditures on R&D] + [non-Business Expenditures on R&D]} / GDP

- **Scenario III** expects the first term to grow at the average annual rate of (3% + 2%), while the second term (and the GDP[21]), not affected by the policy implemented, grows at the average annual rate of 3%. Hence, the R&D intensity, which was close to 2% in 2002, grows at a steady rate as the numerator grows more rapidly than the GDP. The ratio will eventually approximate the target rate of 3% by the year 2026.

- **Scenario IV**, on the other hand expects the business R&D expenditures term to grow at the average annual rate of (3% + 6%), while both other terms grow at 3%. In that case, the target rate of 3% R&D intensity is reached by the year 2010.

Graph 2. Expected evolution of the R&D intensity in the four scenarios



[21] The indirect effect of the increase of the first term on GDP is not taken into account for simplifying purposes.

References

- Asmussen, E., Berriot, C. (1993) Le Crédit-d'Impôt Recherche, Coût et Effet Incitatif, Ministère de l'Economie et de Finances, France 1993
- Australian Bureau of Industry Economics (1993) R&D, Innovation and Competitiveness: an Evaluation of the R&D Tax Concession
- Baily, M. N., Lawrence, R. Z. (1992) Tax Incentives for R&D: What Do the Data Tell Us?, Council on Research and Technology, 1992
- Bengtsson, C. (2002) Fiscal Measures to Stimulate R&D, a Danish Perspective, presented at the workshop "The use of fiscal measures to stimulate private investment in research and development, Brussels 22-23 January 2002
- Berger, P. (1993) Explicit and Implicit Tax Effects of the R&D Tax Credit, Journal of Accounting Research
- Bernstein, J.I., (1986) The effect of direct and indirect tax incentives on Canadian Industrial R&D Expenditures, Canadian Public Policy, 7, 438-448
- Bloom, N. et al (2001) Issues in the Design and Implementation of a R&D Tax Credit for UK Firms, The Institute for Fiscal Studies, Briefing Note N° 15
- Collins, E. (1983) An Early Assessment of Three R&D Tax Incentives Provided by the Economic Recovery Act of 1981
- Cordes, J.J. (1989) Tax Incentives and R&D Spending: A Review of the Evidence, Research Policy, 18, 119-133
- Dagenais, M., Mohnen, P., Thierrien, P. (1997) Do Canadian Firms Respond to Fiscal Incentives to Research and Development? Cahier du CIRANO 97s-34
- Grégoire, Pierre Ethienne (1995) Au-delà du mystère ou des préjugés: Jalons pour une évaluation des mesures fiscales à la R-D industrielle", Ministère de l'industrie, du commerce, de la science et de la technologie
- Grosfeld, T. () The R&D Tax Scheme in the Netherlands, Position and Performance, Ministry of Economic Affaires
- Guellec D., Van Pottelsberghe, B. (2003) The Impact of Public R&D expenditure on Business R&D, Economics of Innovation and New Technology, Forthcoming
- Hall, B.H. (1993) R&D tax policy during the eighties: success or failure? Tax Policy and the Economy 7, 1–36.1
- Hall, B.H. (1996) Fiscal Policy Towards R&D in the US, in Fiscal Measures to Promote R&D and Innovation, OCDE/GD(96)165, Paris
- Hall, B Van Reenen, J. (2000) How Effective are Fiscal Incentives for R&D, A Review of the Evidence, Research Policy, 29/4-5, 449-469
- Hines, J.R., Jr. (1993) On the sensitivity of R&D to delicate tax changes: the behavior of U.S. multinationals in the 1980s. In Giovannini, A., Hubbard, R.G., Slemrod, J. Eds. , Studies in International Taxation, Ill. University of Chicago Press, Chicago, 149–94

- Hutschenreiter, G (2002) Tax Incentives for Research and Development, Austrian Economic Quarterly, 2/2002
- Lebeau, D. (1996), "Les mesures d'aide fiscale à la R-D et les entreprises québécoises" dans L'efficacité des mesures d'aide fiscale à la R&D des entreprises du Canada et du Québec, M. Dagenais, D. Lebeau, P. Mohnen et P. Therrien, Conseil de la science et de la technologie, Gouvernement du Québec
- Mansfield, E. (1986) The R&D Tax Credit and Other Technology Policy Issues, The American Economic Review, 76/2, Papers and Proceedings of the Ninety-Eight Annual Meeting of the American Economic Association (May, 1986), 190-194
- Mansfield, E., Switzer, L. (1985) How effective are Canada's direct tax incentives for R&D?. Canadian Public Policy 11, 241–246
- McCutchen, W.M. Jr. (1993) Estimating the impact of the R&D tax credit on strategic groups in the pharmaceutical industry, Research Policy 22, 337–351
- McFetridge, D.G., Warda, J.P. (1983) Canadian R&D incentives: their adequacy and impact. Vol. Canadian Tax Paper No. 70, Canadian Tax Foundation
- Mohnen, P. (1999) Tax Incentives: Issue and Evidence, Cahier du CIRANO, 99s-32
- OECD (1996) Fiscal Measures to Promote R&D and Innovation, Paris 1996, OCDE/GD(96)165
- OECD (1998) Technology, Productivity and Job Creation, Best Policy Practices, Paris 1998
- Office of Technology Assessment USA (1995) The Effectiveness of Research and Experimentation Tax Credits
- Sheehan, J. (2002) Policy instrument for financing business R&D, finding an appropriate mix, presented at the workshop "The use of fiscal measures to stimulate private investment in research and development, Brussels 22-23 January 2002
- Swenson, C.W. (1992) Some tests of the incentive effects of the research and experimentation tax credit. Journal of Public Economics 49, 203–218

Appendix 1

Basic definitions and conventions used in the Frascati Manual

Research and experimental development (R&D)

(57) **Research and experimental development (R&D)** comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

(58) R&D is a term covering three activities: basic research, applied research, and experimental development.

(224) **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

(225) Basic research analyses properties, structures, and relationships with a view to formulating and testing hypotheses, theories or laws. The results of basic research are not generally sold but are usually published in scientific journals or circulated to interested colleagues. Occasionally, basic research may be "classified" for security reasons.

(229) **Applied research** is also original investigation undertaken in order to acquire new knowledge.
It is, however, directed primarily towards a specific practical aim or objective.

(231) The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods, or systems. Applied research develops ideas into operational form. The knowledge or information derived from it is often patented but may also be kept secret.

(233) **Experimental development** is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

(236) The following examples illustrate the general differences between basic and applied research and experimental development in the natural sciences and engineering and in the social sciences and humanities.

(237a) The study of a given class of polymerisation reactions under various conditions, of the yield of products, and of their chemical and physical properties is basic research. The attempt to optimise one of these reactions with respect to the production of polymers with given physical or mechanical properties (making it of particular utility) is applied research. Experimental development then consists of the "scaling up" of the process, which has been optimised at the laboratory level and the investigation and evaluation of potential methods of production of the polymer and perhaps of articles to be made from it.

(238a) Theoretical investigation of the factors determining regional variations in economic growth is basic research; however, such investigation performed for the purpose of developing government policy is applied research. The development of operational models, based upon laws revealed through research, aimed at modifying regional disparities is experimental development.

(239) *In softwar*e. Pure basic research includes the development of software for algebraic manipulations and numerical analysis. Oriented basic research includes investigation into the formalisation of human speech and of specific tasks *(e.g.* work in the field of man/machine communication using direct speech input and output, research into basic algorithms for possible information processing applications, and investigation into the possibility of formalising programming procedures). Applied research includes investigation into the application of information processing in new fields or in new ways *(e.g.* developing a new programming language, new operating systems, programme generators, etc.) and investigation into the application of information processing to develop such tools as geographical information and expert systems. Experimental development is the development of new applications software, substantial improvements to operating systems and application programmes, etc.

Appendix 2

Extract of article 1 of the European Commission Recommendation 96/280/EC on the definition of independent small and medium-sized enterprises.

The relevant parts of this recommendation for the SME R&D tax credit in the UK are as follows:

1. Small and medium-sized enterprises, hereinafter referred to as 'SMEs`, are defined as enterprises which:

- have fewer than 250 employees, and
- have either,

an annual turnover not exceeding € 40 million, or

an annual balance-sheet total not exceeding € 27 million,

2. Independent enterprises are those which are not owned as to 25 % or more of the capital or the voting rights by one enterprise, or jointly by several enterprises, falling outside the definition of an SME or a small enterprise, whichever may apply.

This threshold may be exceeded in the following two cases:

- if the enterprise is held by public investment corporations, venture capital companies or institutional investors, provided no control is exercised either individually or jointly,
- if the capital is spread in such a way that it is not possible to determine by whom it is held and if the enterprise declares that it can legitimately presume that it is not owned as to 25 % or more by one enterprise, or jointly by several enterprises, falling outside the definitions of an SME or a small enterprise, whichever may apply.

3. In calculating the thresholds referred to above, it is therefore necessary to cumulate the relevant figures for the beneficiary enterprise and for all the enterprises which it directly or indirectly controls through possession of 25 % or more of the capital or of the voting rights.
4. Where, at the final balance sheet date, an enterprise exceeds or falls below the employee thresholds or financial ceilings, this is to result in its acquiring or losing the status of 'SME` only if the phenomenon is repeated over two consecutive financial years.
5. The number of persons employed corresponds to the number of annual working units (AWU), that is to say, the number of full-time workers employed during one year with part-time and seasonal workers being fractions of AWU. The reference year to be considered is that of the last approved accounting period.
6. The turnover and balance sheet total thresholds are those of the last approved 12-month accounting period. In the case of newly-established enterprises whose accounts have not yet been approved, the thresholds to apply shall be derived from a reliable estimate made in the course of the financial year.