Belitz, Heike

Article

Support for private research and development in OECD countries on the rise but increasingly inefficient

DIW Economic Bulletin

Provided in Cooperation with:
German Institute for Economic Research (DIW Berlin)

Suggested Citation: Belitz, Heike (2016) : Support for private research and development in OECD countries on the rise but increasingly inefficient, DIW Economic Bulletin, ISSN 2192-7219, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin, Vol. 6, Iss. 8, pp. 106-114

This Version is available at:
http://hdl.handle.net/10419/129759

Terms of use:
Documents in EconStor may be saved and copied for your personal and scholarly purposes.
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.
If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.
Support for Private Research and Development in OECD Countries on the Rise but Increasingly Inefficient

By Heike Belitz

The majority of OECD member states promote companies’ research and development (R&D) activities by providing project funding. Recently, in many countries, tax incentives have also begun to play an increasingly important role. The present study examines the level of R&D support in 18 OECD countries and explores how efficient the system of funding actually is. The main findings show that in the majority of the countries studied, the share of research and development expenditures funded by the government is on the increase. The system has become less efficient, however. Increasingly frequently, one euro of public funding fails to result in a corresponding increase in private R&D spending. In countries with high funding rates and substantial tax incentives (such as France and the UK), companies’ spending relative to economic output has not increased any faster than in countries with considerably lower funding rates and no tax incentives at all (such as Germany).

In developed economies, research and development (R&D) is one of the key determinants of productivity performance, international competitiveness, and economic growth. For the most part, R&D is conducted by private companies—in Germany, as in many other countries, the private sector accounts for around two-thirds of total R&D investment. The government supports these companies’ R&D activities by, for example, providing a research infrastructure comprising public education and research institutions as well as institutions for knowledge transfer, and by passing legislation to protect intellectual property rights. However, it also provides financial assistance for private R&D activities: on the one hand, directly, through grants and subsidies for selected R&D projects and through R&D contracts and, on the other hand, indirectly through tax breaks for R&D investment which is a mechanism that many countries have expanded considerably in recent years. The primary objective of incentives in this context is to reduce barriers to investment: for example, various forms of market failure can result in a situation where R&D development has a positive impact on innovation and growth from a macroeconomic perspective but where the companies actually conducting the research and development profit less.

Although, for purposes of international comparison, the OECD has already been providing national data on the level of direct R&D support, i.e., funding provided to subsidize R&D project costs and R&D contracts for each OECD country for some time now, it has only just started to collate additional data on the level of tax incentives relative to GDP, most recently for 2013. The resulting loss of tax revenue across all OECD countries is estimated at approx-

Germany’s funding rate is one of the lowest in the OECD.

Among the OECD countries where data for both direct and indirect R&D support are available, France, Canada, and Belgium have the highest funding rates: in each case, the government funds around one-quarter of companies’ R&D costs (see Table). In France, tax incentives account for a good two-thirds of all R&D funding, in Canada, the equivalent figure is as high as almost 84 percent, and in Belgium, it is still over half. In these three countries, the overall funding rate has increased dramatically in the last few years and the same applies to Austria, the Netherlands, Australia, and the UK. With the exception of Belgium and Canada where tax incentive levels were already very high, this form of support has been expanded particularly in countries where the overall funding rate increased most sharply. Along with Sweden, Switzerland, Finland, and Italy, Germany is one of the few countries which, up until 2013, either did not use tax incentives at all to promote R&D or only made marginal use of this mechanism. In these countries, the overall government funding rate is under seven percent and, with the exception of Sweden, this figure has even declined slightly in recent years.

**In an international comparison, countries with high funding rates ...**

Among the OECD countries where data for both direct and indirect R&D support are available, France, Canada, and Belgium have the highest funding rates: in each case, the government funds around one-quarter of companies’ R&D costs (see Table). In France, tax incentives account for a good two-thirds of all R&D funding, in Canada, the equivalent figure is as high as almost 84 percent, and in Belgium, it is still over half. In these three countries, the overall funding rate has increased dramatically in the last few years and the same applies to Austria, the Netherlands, Australia, and the UK. With the exception of Belgium and Canada where tax incentive levels were already very high, this form of support has been expanded particularly in countries where the overall funding rate increased most sharply. Along with Sweden, Switzerland, Finland, and Italy, Germany is one of the few countries which, up until 2013, either did not use tax incentives at all to promote R&D or only made marginal use of this mechanism. In these countries, the overall government funding rate is under seven percent and, with the exception of Sweden, this figure has even declined slightly in recent years.

---


---

<table>
<thead>
<tr>
<th>End year</th>
<th>Starting year</th>
<th>Share of funding in R&amp;D</th>
<th>Share of tax incentives in total funding</th>
<th>Private R&amp;D intensity (without funding)</th>
<th>Annual growth rate of R&amp;D without funding (constant PPP)</th>
<th>Difference in funding rate</th>
<th>Difference in private R&amp;D intensity</th>
<th>Change in the proportion of tax incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>End year</td>
<td>Period of time in total</td>
<td>End year compared to starting year</td>
<td>In percent</td>
<td>In percentage points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>2013</td>
<td>2006</td>
<td>26.1</td>
<td>84</td>
<td>0.63</td>
<td>−3.5</td>
<td>6.5</td>
<td>−0.26</td>
</tr>
<tr>
<td>France</td>
<td>2013</td>
<td>2004</td>
<td>26.1</td>
<td>69</td>
<td>1.07</td>
<td>0.3</td>
<td>12.4</td>
<td>−0.06</td>
</tr>
<tr>
<td>Belgium</td>
<td>2012</td>
<td>2007</td>
<td>25.0</td>
<td>52</td>
<td>1.26</td>
<td>3.8</td>
<td>8.4</td>
<td>0.19</td>
</tr>
<tr>
<td>Austria</td>
<td>2013</td>
<td>2006</td>
<td>18.4</td>
<td>32</td>
<td>1.71</td>
<td>3.5</td>
<td>4.6</td>
<td>0.27</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>2013</td>
<td>2006</td>
<td>17.3</td>
<td>33</td>
<td>0.85</td>
<td>6.2</td>
<td>−3.1</td>
<td>0.27</td>
</tr>
<tr>
<td>UK</td>
<td>2013</td>
<td>2006</td>
<td>16.6</td>
<td>46</td>
<td>0.89</td>
<td>0.6</td>
<td>4.1</td>
<td>−0.00</td>
</tr>
<tr>
<td>Spain</td>
<td>2012</td>
<td>2006</td>
<td>15.6</td>
<td>19</td>
<td>0.57</td>
<td>1.0</td>
<td>−3.4</td>
<td>0.05</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2013</td>
<td>2007</td>
<td>15.6</td>
<td>87</td>
<td>0.92</td>
<td>1.9</td>
<td>4.7</td>
<td>0.12</td>
</tr>
<tr>
<td>USA</td>
<td>2012</td>
<td>2006</td>
<td>13.9</td>
<td>27</td>
<td>1.61</td>
<td>1.3</td>
<td>1.3</td>
<td>0.05</td>
</tr>
<tr>
<td>South Korea</td>
<td>2013</td>
<td>2007</td>
<td>12.9</td>
<td>57</td>
<td>2.84</td>
<td>8.9</td>
<td>0.6</td>
<td>0.83</td>
</tr>
<tr>
<td>Australia</td>
<td>2011</td>
<td>2006</td>
<td>12.4</td>
<td>85</td>
<td>1.08</td>
<td>2.8</td>
<td>4.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Denmark</td>
<td>2013</td>
<td>2007</td>
<td>6.5</td>
<td>46</td>
<td>1.83</td>
<td>1.0</td>
<td>1.2</td>
<td>0.17</td>
</tr>
<tr>
<td>Italy</td>
<td>2013</td>
<td>2006</td>
<td>6.5</td>
<td>1</td>
<td>0.67</td>
<td>3.4</td>
<td>−1.6</td>
<td>0.18</td>
</tr>
<tr>
<td>Sweden</td>
<td>2013</td>
<td>2005</td>
<td>6.1</td>
<td>0</td>
<td>2.14</td>
<td>0.2</td>
<td>1.6</td>
<td>−0.21</td>
</tr>
<tr>
<td>Japan</td>
<td>2013</td>
<td>2006</td>
<td>6.0</td>
<td>82</td>
<td>2.49</td>
<td>0.4</td>
<td>0.4</td>
<td>0.00</td>
</tr>
<tr>
<td>Germany</td>
<td>2013</td>
<td>2006</td>
<td>3.4</td>
<td>0</td>
<td>1.84</td>
<td>2.6</td>
<td>−12</td>
<td>0.19</td>
</tr>
<tr>
<td>Finland</td>
<td>2013</td>
<td>2006</td>
<td>3.2</td>
<td>14</td>
<td>2.20</td>
<td>−0.6</td>
<td>−0.5</td>
<td>−0.09</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2012</td>
<td>2004</td>
<td>0.8</td>
<td>0</td>
<td>2.04</td>
<td>2.7</td>
<td>−0.7</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Sources: OECD; calculations and estimates by DIW Berlin.

© DIW Berlin 2016
Tax incentives for R&D in different European countries

Tax incentives for research and development (R&D) are provided through income tax for natural persons and/or corporation tax. They primarily consist of tax allowances that reduce the tax base, or tax credits that directly decrease the amount of tax payable. The tax credit may be offset against corporate taxes, or R&D personnel costs (income tax or social security payments). The subsidy is either based on volume, thus on the relevant R&D expenditure, or incremental, that is, related only to the growth of R&D expenditure compared to the previous period.

Tax incentives are not always granted to all companies but, for instance, restricted to companies of a particular size, specific age groups, regions, or fields of technology. The tax credit can be designed so that it would also be reimbursed in the event of companies operating at a loss (“negative tax”), in which case these companies would receive payments from the tax authorities.

The attractiveness of R&D tax incentives for companies is heavily dependent on the specific tax system of that particular country, tax rates, and tax bases. Finally, how attractive the tax breaks are depends on how difficult it is to make use of them from an administrative perspective.

France

France switched from incremental to completely volume-based tax incentives in 2008. As part of the Crédit d’Impôt Recherche (CIR) program, the government reimburses 30 percent of R&D expenditure by means of an input tax deduction up to a total of 100 million euros and five percent of expenditure exceeding that amount. In 2008, total government spending on R&D more than doubled compared to the previous year, increasing to 4.45 billion euros. Since 2010, annual expenditure has been over 5.2 billion euros and recently reached 5.5 billion euros. Young companies also receive support through a further tax measure called Le régime de la jeune entreprise innovante (J.E.I.).

Netherlands

Since 1994, companies in the Netherlands have been able to reduce their R&D costs through the tax measure known as Wet Bevordering Speur- en Ontwikkelingswerk (WBSO). At present, 35 percent of the R&D personnel costs up to a total of 250,000 euros and 14 percent of any personnel costs over this amount are reimbursed. Another program, RDA, was introduced in 2012 to foster additional investment in R&D equipment. The Dutch government spent just over a billion euros on the two measures combined in 2013.

UK

Tax incentives for R&D have been gradually expanded in the UK since 2000, first for small and medium-sized enterprises (SMEs) and then, in 2002, for large companies, too. At present, the increased deductions amount to 230 percent for SMEs and 130 percent for large companies.

4 OECD, Compendium.

... do not necessarily have high private R&D intensity

The primary aim of government support for research and development is to increase business investment in this area—both in absolute terms and relative to GDP (private R&D intensity). In 2013, private R&D intensity was even comparatively high in countries with relatively low funding rates—these included Switzerland, Finland, Germany, and Sweden (see Figure 1). Yet, in countries such as France, Canada, and Belgium which already had a high funding rate and at the same time attached particular significance to tax incentives, private R&D intensity was considerably lower. In the group of countries with moderate levels of R&D funding, South Korea stands out as having the highest private R&D intensity overall. In this group, the US and Austria also have relatively high R&D intensity but it is very low in countries such as the UK, the Netherlands, and Spain. When these countries are compared internationally, therefore, there is no dis-
cernible robust correlation between funding rate and private R&D intensity. Even increases in funding rates between 2006 and 2013 were not always accompanied by an increase in R&D intensity (see Figure 2).\(^5\) Relatively large increases in funding rates in France, Belgium, and Canada coincided with levels of self-financed business R&D spending which, relative to GDP, had either stagnated or were even declining. Finally, the average annu-

\(^5\) The observation period differs slightly among the selected countries since data are not available for every year.

Austria

The "research premium" was introduced in Austria in 2002 and initially amounted to only three percent of total research expenditure in a given financial year. It was gradually increased and has been 12 percent for large companies and SMEs since the beginning of 2016. The research premium is credited by the tax office and also benefits companies that have not reported any profits. It can also be claimed by companies commissioning external research worth a maximum of one million euros. The total amount paid out in research premiums in 2013 was 377 million euros (following just over 570 million in the previous year).


Increases in funding rates were not always accompanied by an increase in R&D intensity.
The growth rates of private business R&D are independent of the changes in funding rates.

France, the Netherlands, and Great Britain saw increases primarily in tax incentives for R&D.

Germany sees fall in share of private R&D investment funded by government...

The following section will examine the efficiency of direct and indirect R&D support in Germany and in four other research-intensive European countries, France, the UK, the Netherlands, and Austria, in more detail. Unlike the data used above which were based on two points in time and a large group of countries, this part of the study uses annual data for the period from 2002 to 2013 for a small number of countries. The data on R&D tax incentives were taken from national data sources.

If we add up the shares of overall business R&D expenditure accounted for by direct and indirect funding, in 2002, France and the Netherlands had the highest funding rates, each with around 12 percent, followed by the UK with eight percent, and Germany and Austria with around six percent (see Figure 4). Whereas in the Netherlands, tax incentives already played a central role in 2002, the share accounted for these incentives in France and the UK was still very low and Germany and Austria only provided direct support at this time.

The evaluation of the “research premium” and also the entire funding system for companies in Austria, which was called for by the government, may explain why this is the case. This evaluation is still pending however. See, inter alia, Response from the Austrian Minister of Finance, Dr. Hans Jörg Schelling, to written parliamentary question no. 5063/J regarding the increase in the “research premium” of May 20, 2015 by the member of parliament Dipl.-Ing. Gerhard Deimek and colleagues (Vienna: July 16, 2015).

Up until 2013, the share of business R&D expenditure which was funded by governments directly and indirectly increased in all the countries studied, with one exception. Germany was the only country where public subsidies fell to under four percent. France had the highest level of government funding with over 26 percent, followed by Austria with 18 percent, the Netherlands with 17 percent, and the UK with a good 16 percent. The discrepancy between government funding rates in Germany and in the other countries studied has therefore grown considerably since 2002 (see Figure 4). The expansion of tax incentives in France, Austria, and the UK (a mechanism which has not even been introduced in Germany) made a major contribution to this. In France, for example, as far back as 2013, 18 percent of business R&D expenditure was already funded through tax subsidies (see Box 1). However, the gap between Germany and Austria in terms of public funding did not only grow as a result of Austria introducing tax subsidies which already made up almost six percent of business R&D expenditure in 2013. An increase in direct funding that accounted for 12.5 percent of business R&D expenditure also contributed to the situation.

Whereas the share of R&D support contributed by public funding in Austria steadfastly increased from 2002 to 2013, the equivalent figure in France and the Netherlands rose sharply as both countries chose to address the consequences of the global financial and economic crisis. To address the consequences of the global economic crisis, France and the Netherlands relied primarily on the use of tax incentives for R&D.
R&D SUPPORT

Box 2

Firm-level studies on the efficiency of public funding

Numerous studies based on company data come to the conclusion that direct funding has a positive impact on companies’ R&D expenditure. The possibility that private funds might be completely replaced by government funding can generally be ruled out.1 However, only very few of the recent studies on companies in major EU countries conclude that R&D expenditure in companies (including public funding) grew more than the amount of the government subsidies received.2 In other words, the government funding mostly replaced some of the funds for R&D provided by the companies themselves (partial crowding out), but the total amount of private and government funding for R&D is ultimately higher than it would have been without the direct funding.

For tax incentives, too, there are a number of empirical analyses from different countries that use corporate data. Although findings on the input additionality vary, most studies show that companies tend to respond to tax incentives by increasing their research expenditure. Studies using more sophisticated econometrics show that a loss in tax revenue amounting to one euro results in growth in R&D spending of less than one euro,3 i.e., here, too, partial crowding out is normally observed. Recent meta-analyses attempt to verify and sum up the abundance of findings from econometric studies using statistical methods.4 Although they establish a bias in the publications towards positive effects (publication bias), they ultimately confirm robust, albeit moderate, effects of R&D tax incentives on increasing private R&D spending. However, there are variations in the effects for different groups of companies, for instance, in low- and high-tech sectors, or for SMEs. Additionality is higher in countries with incremental public funding.5 Moreover, recently published studies identify lower efficiency coefficients than older publications.6

---

2 Aristei, Sterlacchini, and Venturini, Effects of public supports.
5 Castellacci and Lie, Effects of R&D.
6 Gailllard-Ladinska et al., R&D with tax incentives.

---

crisis by promoting R&D activities more proactively (see Figure 5).9 Also in the UK, after a slight decline, the financial contribution of overall support increased again in 2008. Only in Germany has the funding rate been on a continuous downward trend since 2002, reaching 3.4 percent in 2013.

... but increase in efficiency of funding from macroeconomic perspective

From 2002 to 2013, private R&D intensity, i.e., the R&D expenditure funded by companies themselves, relative to GDP, experienced the strongest growth in Austria (0.41 percentage points). In Germany, private R&D intensity grew by 0.27 percentage points. The Netherlands recorded a smaller increase of 0.09 percentage points.10 In the UK and France, private R&D intensity even declined slightly (by 0.13 percentage points in each case). If we examine the growth of business-funded R&D spending, a similar picture emerges: in Austria, this increased by 54 percent between 2002 and 2013, in Germany the increase was 31 percent during the same period, and in the Netherlands, the corresponding figure was 23 percent. In the UK and France, however, business-funded R&D expenditure remained at its 2002 level. Consequently, growth in companies’ self-financed R&D spending was particularly low, both in absolute terms and relative to GDP, in countries where R&D tax incentives play a major and increasing role (see Figure 4).

---

9 In the Netherlands, the decline in the publicly funded share of overall funding in 2011 was largely the result of the break in the time series caused by the transition from a sample survey to a complete survey of companies’ R&D expenditure. See OECD (2016): Main Science and Technology Indicators. http://stats.oecd.org/index.aspx?r=85052.
10 Here, the increase in the Netherlands is slightly overestimated due to the break in the time series in 2011.
The efficiency of public spending on private R&D should primarily be measured on the basis of the direct effects of higher investment in business R&D (input additionality). Numerous studies have examined this at company level (see Box 2).

The following section examines the efficiency of funding at a macroeconomic level (see Box 3). For Germany, and the other four research-intensive countries, we were able to calculate funding efficiency, taking into account both direct and indirect funding for the period from 2002 to 2013. In terms of how efficient the funding was, strong fluctuations can be observed both between the countries and over time (see Figure 6). Over three-quarters of the annual funding efficiency scores are higher than zero but of these, a good half are lower than 0.5. Generally, this means that for every “euro of funding,” there is an increase in business-funded R&D spending of less than 50 euro cents. Only 22 percent of the efficiency scores are less than zero and these occur more frequently during the global financial crisis. The mean funding efficiency scores in the period preceding this crisis (2002 to 2007) are mainly higher than after it (2008 to 2013). This indicates declining funding efficiency coinciding with increased funding rates in the European countries compared in the present study. Germany is the exception since not only did this country achieve the highest funding efficiency from a macroeconomic perspective but also no decline was observed during the period following the crisis.

Conclusion

Using the most recent data available, the present study has not only examined the level of direct government support for research and development—for instance, in the form of project funding—but also indirect tax incentives. It was found that the overall funding rate in some OECD countries has increased dramatically in recent years and is now over ten percent in 11 out of 18 research-intensive countries studied. At the same time, tax incentives have become increasingly important in many places. There has been a decline in the efficiency of funding, however: in countries with high funding rates and some OECD countries has increased dramatically in recent years and is now over ten percent in 11 out of 18 research-intensive countries studied. At the same time, tax incentives have become increasingly important in many places. There has been a decline in the efficiency of funding, however: in countries with high funding rates and a strong emphasis on tax incentives, private R&D intensity has not increased any faster than in countries with considerably lower funding rates and limited tax incentives—or no tax breaks at all. An increase in the funding rate, on the one hand, and changes in private R&D intensity and growth in business R&D expenditure in real terms, on the other hand, are not positively correlated in the OECD countries included in the study. Ger-

---

**Box 3**

**Measuring the efficiency of government funding from a macroeconomic perspective**

Funding efficiency on the macroeconomic level can be measured by looking at the annual growth or decrease in the self-financed R&D expenditure of companies in a country (excluding public funding) relative to total government funding in a given year. The funding efficiency \( E \) in year \( t \) is measured using the ratio between the change in R&D self-financed by companies \( (RS) \) compared to the previous year and the volume of the total direct \( (DF) \) and indirect \( (IF) \) funding in year \( t \).

\[
E_t = \frac{(RS_t - RS_{t-1})}{(DF_t + IF_t)}
\]

1. A considerably more challenging approach is an estimation of the model to explain the annual changes in the self-financed R&D expenditure in companies where other factors are also taken into account in addition to public funding. This type of analysis was conducted for 17 OECD countries in the period between 1983 and 1996. See Guillec, D. and Van Pottelsbergh, B. (2003): The impact of public R&D expenditure on business R&D. Economics of Innovation and New Technologies, 12 (3), 225-244.

2. In the above-mentioned study by Guillec and Van Pottelsbergh, an additionality or, here, funding efficiency score of 0.7 for direct funding and 0.32 for indirect funding is estimated. Another finding is that an increase in one type of funding may have a negative impact on the other.