




BS index: incorporating R&D subsidies into B index

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Abstract

Motivation: The B index is a measure of the generosity of R&D tax incentives proposed by Warda in 2001 and is now widely used by the OECD. The author of this index already in 2001 indicated that developing it with measures of the availability of direct subsidies would improve the B index as a comprehensive measure of the attractiveness of R&D policies.

Aim: Extension of the B index, used by the OECD to measure the impact of tax incentives on the conditions of investing in R&D, to include direct funding, i.e. subsidies and grants.

Results: The study proposes several methods of including direct funding in the B index calculation. They depend on specific rules on which it is possible to combine the benefits of using tax incentives and direct subsidies in different countries: mutually exclusive in their use, grant funding reduces base of R&D tax credit/allowance, grant funding is part of taxable income, ceiling on total support (direct and tax), complementary in their use. The share of subsidies and direct grants in BERD in each country, broken down into SMEs and large enterprises, was adopted as the measure representing direct funding. The results show an increase in the expected subsidy rate in most of the surveyed countries in 2017. Increase is on average higher in the case of SMEs than in the case of large enterprises. The developed methods can be used for comprehensive in-depth analyzes and comparisons of R&D support policies applied in different countries. And after extending the calculations to historical data, they can be used as an important source material in modeling the impact of R&D support policies on R&D inputs and outputs.

Keywords: B index; R&D tax incentives; R&D subsidies; R&D policy

JEL: H25; H32; O38

1. Introduction and literature review

Numerous studies on the rationality and effectiveness of government support for R&D activities of enterprises have been published in contemporary economic literature. A substantial number of these studies focus on the analysis of the effectiveness of the use of two most popular forms of fiscal incentives for R&D in developed economies, i.e. grants and subsidies (direct funding), and tax incentives (indirect funding). The majority of papers examining the effectiveness of direct funding and tax incentives on R&D are studies at the micro level, examining the sensitivity of the inputs (less frequently outputs) of enterprises in a particular economy (or sector of the economy) to the use of specific fiscal incentives (usually one of them). The biggest problem of research at a firm level is the high discrepancy of results depending on the selection of companies for the study. The specific characteristics of individual economies, or even of individual sectors in economies, create difficulties in comparing the results of such studies (Becker, 2015, pp. 932–937; Zúñiga-Vicente et al., 2014, pp. 59–60). Relatively fewer published papers are studies comparing the effectiveness of different fiscal incentives in different countries or studies based on data from different countries. As pointed out by Castellacci & Lie (2015, pp. 819–820), international evaluations of the effectiveness of tax incentives are a type of research that has not received the necessary attention so far. This thesis is further confirmed in the report of the European Commission (2014, pp. 27–42), which draws particular attention to the fact that there are few studies that take into account both subsidies and tax incentives. Similar conclusions can be drawn by examining the works included in reviews of direct funding by Becker (2015, pp. 917–942) and Zúñiga-Vicente et al. (2014, pp. 36–67). Limitations in access to comparable data on tax incentives, grants and subsidies functioning in different countries may be the reason for such a situation.

The variables used to measure government support for business R&D activities in studies analyzing tax incentives and direct funding based on international data (Table 1) are highly diverse. The most commonly used variable representing tax incentives in various countries was the B index, which can be briefly defined as the pre-tax profit that a representative enterprise has to generate in order to invest one monetary unit in R&D after taking into account existing tax incentives. This indicator appeared in various forms (sometimes as a 1–B index) in nine papers operating data on three levels: firm (Ernst & Spengel, 2011, pp. 15–19; Ernst et al., 2014, pp. 698–703), industry (Bravo-Biosca et al., 2013, pp. 58–61; Jaumotte & Pain, 2005, pp. 26–50) and country (Buyse et al., 2019, pp. 191–193; Falk, 2006, pp. 538–542; Guellec & Van Pottelsberghe De La Potterie, 2003, pp. 225–243; Montmartin & Herrera, 2015, pp. 1068–1077; Westmore, 2013, pp. 15–18). In four studies from the 2000s working with data at the industry (Jaumotte & Pain, 2005, pp. 6–26), state (Wilson, 2009, pp. 431–434) and country level (Bloom et al., 2002, pp. 3–11; McKenzie & Ser-shun, 2010, pp. 312–313), the variable adopted by the authors was, “user cost

of R&D”, which is most often defined as the cost of investing a unit of capital in R&D and, apart from tax conditions, takes into account the cost of funding and depreciation. In two articles based on cross-sectional data at the firm level (Carboni, 2017, pp. 284–287; Lee, 2011, pp. 261–268), the authors adopted a binary variable taking the value of 0 or 1 depending on whether the enterprise used tax incentives in the examined period. Montmartin et al. (2018, pp. 2015–2021) were the only ones to use the amount of tax preferences connected with R&D tax incentives in the study on French regions.

On the other hand, the variable representing direct funding that was most often used by the authors was the amount of subsidies granted. This type of variable appeared in 6 papers that used data at the level of firm (Szucs, 2020, pp. 4–9), industry (Capron & Van Pottelsberghe De La Potterie, 1997, pp. 179–184), region (Montmartin et al., 2018, pp. 2015–2021) and country (Buyse et al., 2019, pp. 191–193; Guellec & Van Pottelsberghe De La Potterie, 2003, pp. 225–243; Westmore, 2013, pp. 15–18). Some authors have also used the relative amount of subsidies in proportion to GDP (Falk, 2006, pp. 538–542; Jaumotte & Pain, 2005, pp. 6–50) or business expenditure on R&D (Montmartin & Herrera, 2015, pp. 1068–1077; Wolff & Reinthaler, 2008, pp. 1406–1407). Also here, in the studies using cross-sectional data at the firm level, the authors usually used the binary variable stating only the fact of receiving a grant as a measure representing direct government funding of business R&D activities (Carboni, 2017, pp. 284–287; Czarnitzki & Lopes Bento, 2012, pp. 254–282; Hashi & Stojčić, 2013, pp. 356–359; Lee, 2011, pp. 261–268; Szucs, 2020, pp. 4–9).

All studies that analyze both tax incentives and direct funding on macro data (countries, regions and industries) reveal a significant discrepancy in the selection of variables representing these two types of public policies. Tax incentives are most often represented by the B index, which is a measure of the expected conditions in which a representative enterprise makes decisions about investing in R&D. Therefore, the 1–B index does not show the actual rate of tax subsidies received by individual companies, but the expected value of the tax subsidy rate for a representative enterprise as estimated under the tax law in a given country (OECD, 2013, pp. 1–2). In the case of direct funding, on the other hand, the authors usually use the absolute amount of the grants awarded or their relative amount in relation to GDP. Such a measure does not represent the conditions under which enterprises decide on investing in R&D activities. The amount of grants divided by the R&D expenditure of enterprises used by Montmartin & Herrera (2015, pp. 1068–1077) can be interpreted as the average direct subsidy rate in a given country. But in this case the variable represents the direct subsidy rate in isolation from the tax subsidy rate represented by the 1–B index.

One should bear in mind that enterprises hoping to benefit from direct subsidies tend to take the issue of tax incentives existing in a given country into account when further deciding where and how much to invest in R&D. This dependency also works the other way round — the company benefiting from tax

incentives continues to monitor the possibility of receiving direct government funding for its R&D project. At the same time, in different countries, the issue of combining the benefits of tax incentives and direct subsidies is regulated in a number of different ways. Therefore, analyzing tax incentives and direct funding separately does not provide a reliable indication of the fiscal conditions that a representative enterprise takes into account when making investment decisions at the stage of project planning, even if these variables are presented as subsidy rates. In order to achieve comparability of results in macro-level research, the total expected rate of direct and indirect subsidies should be included, also taking into account the legal conditions for combining both forms of government funding for private R&D projects. Companies make investment decisions based on the overall legal and financial conditions under which they can expect a certain rate of government subsidy for the project. Results suggesting the substitutive or complementary nature of the link between the two forms of funding (Montmartin & Herrera, 2015, pp. 1071–1077) may be the result of a legal provision prohibiting or permitting the combination of the two funding forms, rather than of the mere coexistence of different forms of government support. A similar strategy also seems reasonable when making transnational comparisons on the attractiveness of R&D support policies.

The B index is often used in empirical research and international comparisons. Its popularity is largely the result of the objectives that have been adopted by its authors from the very beginning: it should allow to isolate the impact of tax incentives on the return on a unit of expenditure on R&D; it should be based on a common and well-established economic theory; it should be simple to calculate and interpret and should serve as a tool for analyzing public policies (Warda, 2001, pp. 191). As noted by Warda (2001, pp. 202–203), despite the huge usefulness of this indicator as an analytical tool, in order to better reflect the attractiveness of public policies in a given country, it needs to be extended with measures representing also direct government funding and tax incentives for intellectual property revenues. A measure based on the B index methodology relating to patent related tax incentives was proposed by Warda (2006, pp. 20–29). As of now, the literature lacks analysis dealing with the extension of the B index to include direct grants, resulting in a significant research gap. For this reason, in this study, I intend to propose methods for extending the B index with the effect of direct funding specific to the conditions for combining these two forms of government support in different countries. The proposed methods will be used to calculate the value of the BS index and the size of changes in the expected total government subsidy rate in various OECD economies, resulting from the inclusion of direct subsidies in the B index calculation.

2. Methods

The B index can be calculated using a general equation (OECD, 2013, p. 1):

$$B \text{ index} \equiv \frac{1-A}{1-\tau}, \quad (1)$$

where:

A — total net present value of deductions and other tax preferences applicable to R&D expenditure;

τ — CIT rate.

It is important to remember that this is a basic formula which can be modified depending on conditions such as the type of tax incentives (income and tax deductions, reduction of SSCs, accelerated depreciation), refund and the possibility to carry over any unused deductions to subsequent tax years, etc¹. The index is calculated in four scenarios based on the size and financial performance of a representative company: large profitable, large unprofitable, profitable SMEs and unprofitable SMEs. The index calculated in this way should be understood as the pre-tax profit that the representative company for each scenario has to generate in order to cover the cost of investment of one monetary unit in R&D and pay the relevant taxes (Warda, 2001, pp. 191–195). The expected subsidy rate in each of the scenarios can be presented as $1-B$ index.

In his original article describing the B index methodology, Warda (2001, pp. 202–203) proposed a general method for extending the B index to include direct funding. He stressed, however, that at the time of the publication of the paper there was no generally available data allowing for this extension. Warda proposed the equation:

$$BS \text{ index} = B(1-PS), \quad (2)$$

where:

$BS \text{ index}$ — B index extended with direct subsidies;

B — B index;

PS — share of R&D expenditures of enterprises financed from government subsidies in a given country for a given B index scenario.

However, it is worth noting the significant problems arising in the application of the method of extension of the B index proposed by Warda. Firstly, the use of the share of government funding in BERD as an estimator of the expected direct funding rate for a representative company may seem to be a questionable issue. In reality, the direct subsidy programs available in different countries are highly diverse and come in many variants, which means that the subsidy rate can, in practice, be between 0 and 100% for different companies, even in the same government subsidy program. This is because the share of public

¹ For more information on possible modifications to the basic formula due to the specific characteristics of individual tax incentives, see OECD (2013).

funding is also usually determined individually for each project receiving such funding. Therefore, the subsidy rate for large enterprises and SMEs at the level of the entire economy, which is usually between a few and a dozen or so percent, seems to be a great simplification. On the other hand, however, it should be kept in mind that, in contrast to publicly available tax incentives, government subsidy programs are competition-based and only some companies applying for subsidies will ultimately receive them. Therefore, the expected subsidy rate for the representative company should take into account not only the maximum available public contribution to the project to receive government funding, but also the availability of this funding at the level of the entire economy. For this reason, in my opinion, the share of direct funding in BERD for SMEs and large enterprises proposed by Warda is a sufficient estimate of the expected rate of direct subsidies for the representative enterprise, which takes into account both the amount of subsidies and their availability.

Secondly, the primary equation consisting in multiplying the B index by the direct subsidy rate subtracted from 1 is only appropriate if in a given country it is possible to finance the same project from direct subsidies and tax incentives and the subsidy received reduces the tax credit/allowance amount. Although this solution is relatively common in OECD countries, there are several other methods of regulating the combination of benefits from direct government and tax funding of the same R&D project in national legislations of individual countries (Table 2). These could be: a ban on combining both forms of government support within the same R&D project, taxation of the amount of the subsidy received, an amount or percentage limit of cumulated government support and a combination of both forms of support without additional restrictions. It is therefore necessary to modify the equation to take account of these discrepancies.

Hence, for each of the principles of combining direct and tax funding, a different method of extending the B index with government subsidies has been created (Table 3). In case of a ban on combining both forms of support, the representative enterprise has a choice between two mutually exclusive subsidy rates: the tax subsidy rate represented by the $1-B$ index and the direct subsidy rate represented by the PS. The use of direct subsidies precludes the use of tax incentives and vice versa. In this situation, a measure with a higher expected subsidy rate was used as a measure representing the attractiveness of R&D support policies in a given country. Such an equation stems from the assumption that the representative company will be able to analyze the benefits and costs resulting from the use of any form of government funding and will be able to make a rational choice, always guided by the expected subsidy rate. Naturally, assuming that this is the only factor influencing the choice of a given form of funding is a great simplification, but taking into account more factors and calculation methods would result in deviating from one of the main objectives of the B index methodology, which is simplicity of calculation. In the most common version, i.e. the possibility of combining both forms of government funding while

reducing the base for calculating tax credit by the amount of direct funding, the original method proposed by Warda was used. In the absence of limitations on the combination of tax and direct funding and the absence of tax incentives, the B index is reduced by the PS. In case of taxation of direct subsidy when combining both forms of support, the PS is multiplied by the tax rate deducted from 1 and treated as in the previous case. With the limit of cumulated government funding, the method applied is the same as in the case of absence of limitations — if the limit is not exceeded, or the percentage of the limit — after the limit is exceeded. In the absence of detailed information on combining direct and tax funding in a given country, the BS index was not calculated.

The study covered 45 countries included in the OECD database for the B index (OECD, 2020a)². The BS index was calculated for 33 countries for which it was possible to obtain detailed information on combining the benefits of tax incentives with direct funding of private R&D activities. A detailed list of countries covered by the research and the values of individual indices in each country can be found in Table 4.

3. Results

Observing the differences between the tax subsidy rate established on the basis of the 1–B index and the direct subsidy rate established on the basis of the share of direct funding in BERD, several dependencies can be observed (Chart 1). Firstly, direct funding is a more widely used tool for supporting R&D activities. Out of 45 countries analyzed, all of them allocated any amount of money to subsidies for SMEs, while subsidies for large enterprises were not available in 2017 only in Cyprus, Greece and Latvia. On the other hand, tax incentives based on R&D expenditures were not available in 11 countries. Secondly, the fact that direct subsidies are more common does not mean that this is the tool used to fund more of the BERD. In most countries the tax subsidy rate was higher than the direct subsidy rate. Such dependence was observed in 30 countries for large companies and in 28 for SMEs for profitable firms (26 and 24 for loss-making companies respectively). Thirdly, the tax subsidy rate for SMEs in each country is higher or equal to the rate for large companies. On the other hand, in the case of direct funding in 11 countries it was large enterprises that had a higher subsidy rate.

Taking into account only the level of tax subsidies, the countries where the government funded the largest share of R&D expenditures, considering the representative large enterprise, in 2017 were (Table 4): France (43% profitable/35% unprofitable), Portugal (39%/31%), Spain (33%/26%), Latvia (31%/25%) and Lithuania (31%/25%). In Germany and New Zealand, the tax subsidy rate for large profitable enterprises was –2%, while in Croatia, Den-

² 47 countries are included in the OECD database, but Argentina was excluded due to the lack of information on the B index in 2017 and earlier. In the case of Colombia, there is no information on the amount of direct funding.

mark, Finland, Luxembourg, Switzerland and Cyprus -1% . For unprofitable companies, negative tax subsidy rates were recorded in Germany (-2%), New Zealand (-2%), Croatia (-1%), Denmark (-1%), Japan (1%), Luxembourg (-1%) and Switzerland (-1%). The situation has changed, however, after taking into account direct funding. The expected rate of direct and tax subsidies for large enterprises exceeding 30% was recorded in 2017 in as many as 8 countries: France (48% profitable/40% unprofitable), Portugal (40% or 41%/33%), Spain (37%/31%), Mexico (33%/33%), Norway (33%/33%), Ireland (32%/27%), Lithuania (32%/26%) and Latvia (31%/25%). After taking into account subsidies, only two countries reported negative expected subsidy rates: Switzerland (-1% / -1%) and Cyprus (-1% /0%).

The highest increase in the expected subsidy rate (Chart 2), after taking into account direct funding, was recorded in New Zealand (+28pp), Mexico (+27/+29pp), Turkey (+12pp) and the UK (+11pp). In 7 countries the BS index was at the same level as the B index, i.e. in: Switzerland, Slovakia, Estonia, Czech Republic, Poland, Latvia and Cyprus. The expected subsidy rates for large enterprises increased by 4 percentage points on average as a result of taking into account direct funding — in 33 countries for which the BS index was calculated.

As far as SMEs are concerned, the tax subsidy rates for the representative enterprise in a significant number of the countries analyzed were higher than for large companies (Table 4). The highest rates were recorded in France (43% profitable/43% unprofitable), Portugal (39%/31%), Spain (33%/26%), Canada (31%/31%), Lithuania (31%/25%) and Latvia (31%/25%). Negative tax subsidy rate for SMEs was recorded in the same countries where it was negative for large enterprises. Its amount also remained at the same level. Taking into account direct funding of private R&D activities of SMEs in the expected subsidy rates resulted in even more significant changes than in the case of large enterprises. In Hungary, a representative company from the SME sector could expect a subsidy rate exceeding half of the expenditures, amounting to 53% for profitable companies and 51% for unprofitable ones. The countries where the subsidy rate exceeded 30% were also France (47%/47%), Portugal (43% or 45%/35% or 37%), Spain (41%/34%), Canada (35%/35%), Iceland (35%/35%), Mexico (33%/33%), Ireland (32%/26%), Lithuania (32%/26%) and Latvia (31%/25%). After taking into account direct funding, no country analyzed recorded a negative subsidy rate, regardless of the company's profitability.

Inclusion of subsidies resulted in the highest increase in the subsidy rate (Chart 2) in Hungary (+31pp), Mexico (+26pp profitable, +27pp unprofitable), Germany (+17pp), New Zealand (+16pp), Poland (+13pp profitable/+15pp unprofitable) and Iceland (+11pp). Subsidies for SMEs were not high enough to reduce the BS index in relation to the B index only in Latvia and the Czech Republic. The expected subsidy rates for SMEs increased by 7 percentage points on average as a result of taking into account direct funding — in 33 countries for which the BS index was calculated.

4. Conclusion

Comparisons and analyses between countries in the scope of the existing R&D support policies provide necessary information for evaluation of their effectiveness in the past and planning their shape in the future. Therefore, it is extremely important to properly measure the generosity and invasiveness of support instruments used in different countries. One of the most frequently used measures of the impact of tax incentives on the conditions for investing in R&D is the B index. In order to comprehensively assess the impact of government funding on the fiscal environment of enterprises investing in R&D, one should also look at direct funding of R&D activities. However, this is a complex process as different countries have different rules governing the combination of direct government tax funding of private R&D projects.

This paper proposes to extend the B index to the BS index, which would also include the expected direct subsidy rate. Several methods of extending the B index to the BS index depending on how a given country regulates the issue of combining tax incentives and direct subsidies were also proposed. The BS index gives a comprehensive view of the expected rate of government subsidies in a given country and can be used as a useful tool for international analysis and comparison. After expanding the results from this article with historical data from before 2017, it is possible to create a panel database reflecting the general effect of government funding (direct and tax) on the conditions of investing in R&D. Such a database can be a particularly useful tool in modelling the impact of public policies on R&D inputs and outputs on the international scale, as well as other analyses of the effectiveness of R&D policies and dependencies between them.

One should remember, however, that the BS index is an estimation value for a representative enterprise, and thus is based on several assumptions. The quality of the share of direct funding in BERD as an estimator of the expected direct subsidy rate for additional R&D expenditure by a representative enterprise may be a contentious issue. In reality, the share of government funding is determined individually for each application for funding and is highly diversified in many government subsidy programs that often exist in one country. Another issue that is simplified in the calculation of the BS index is the methods of combining direct and tax funding in different countries, which in some cases are more complex. However, it should be taken into account that the primary goal of the BS index, like the B index, is to be useful as a universal tool for analyzing public policies. This can only be achieved by meeting the criteria of simplicity of calculation and interpretation, which, however, requires several simplifying assumptions.

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Appendix

Table 1.
Empirical studies analyzing R&D tax incentives and direct funding on international data

Year	Author(s)	Countries	Time	Data level	Tax incentives variable	Direct funding variable
Studies on tax incentives						
2002	Bloom et al.	9 OECD	1979–1997	countries (panel)	user cost of R&D	–
2009	Wilson	51 U.S. States	1981–2004	states (panel)	user cost of R&D	–
2010	McKenzie & Sershun	9 OECD	1979–1997	countries (panel)	user cost of R&D	–
2011	Ernst & Spengel	20 EPO	1998–2007	firms (panel)	B index	–
2013	Ernst et al.	24 EPO	1995–2007	firms (panel)	B index	–
2013	Bravo-Biosca et al.	10 OECD	2002–2005	industries (cross-sec.)	B index	–
Studies on direct funding						
1997	Capron & Van Pottelsberghe De La Potterie	7 OECD	1973–1990	industries (panel)	–	R&D subsidies
2008	Wolff & Reinthaler	15 OECD	1981–2002	countries (panel)	–	government funded BERD/BERD
2012	Czarnitzki & Lopes Bento	4 EU and South Africa	2002–2004	firms (cross-sec.)	–	dummy: 1: subsidy, 0: no subsidy
2013	Hashi & Stojčić	16 European	2004	firms (cross-sec.)	–	dummy: 1: subsidy, 0: no subsidy
2020	Szucs	55 World	2003–2017	firms (cross-sec.)	–	dummy: 1: subsidy, 0: no subsidy R&D subsidy
Studies on tax incentives and direct funding						
2003	Guellec & Van Pottelsberghe De La Potterie	17 OECD	1981–1996	countries (panel)	B index	R&D subsidies
2005	Jaumotte & Pain	20 OECD	1982–2001	industries (panel)	B index, user cost of R&D	R&D subsidies/GDP
2006	Falk	21 OECD	1975–2002	countries (panel)	B index	government funded BERD/GDP
2011	Lee	5 Asian and Canada	1997	firms (cross-sec.)	dummy: 1: tax incentive, 0: no tax incentive	dummy: 1: subsidy, 0: no subsidy
2013	Westmore	19 OECD	1982–2008	countries (panel)	B index	government funded BERD
2015	Montmartin & Herrera	25 OECD	1990–2009	countries (panel)	B index	government funded BERD/BERD



Year	Author(s)	Countries	Time	Data level	Tax incentives variable	Direct funding variable
2017	Carboni	7 EU	2007–2009	firms (cross-sec.)	dummy: 1: any support, 0: no support dummy: 1: tax incentive, 0: no tax incentive	–
2018	Montmartin et al.	94 French NUTS3 regions	2001–2011	regions (panel)	tax credit granted	R&D subsidies granted
2019	Buyse et al.	14 OECD	1981–2012	countries (panel)	B index	government funded BERD

Source: Own preparation.

Table 2.
Rules for combining the benefits of direct and tax support for business R&D in the countries studied in 2017

Mutually exclusive in their use Czech Republic, Latvia, Mexico, Poland, United Kingdom ¹ , United States
Grant funding reduces base of R&D tax credit/allowance Austria, Canada, France ² , Ireland, Lithuania, New Zealand, Portugal ³ , Slovak Republic ⁶ , South Africa, Spain ⁴ , United Kingdom ¹
Grant funding is part of taxable income Australia, Japan
Ceiling on total support (direct and tax) Iceland, Norway
Complementary in their use Hungary, Portugal ³ , Sweden, Turkey, United Kingdom ¹
No expenditure based tax incentives Bulgaria, Croatia, Cyprus, Denmark ⁵ , Estonia, Finland, Germany, Israel ⁵ , Luxembourg, New Zealand, Switzerland
No detailed information available Belgium, Brazil, Chile, China, Greece, Italy, Korea, Malta, Netherlands, Romania, Russian Federation, Slovenia

Notes:

¹ United Kingdom: the R&D tax allowance for SMEs is incompatible with direct funding if it is “state aid” recognized by the European Commission; reduces the tax base for other types of grants and subsidies. In the case of RDEC (Research and Development Expenditure Credit — large firms), there is no reduction for the grant or subsidy.

² France: public subsidies received by enterprises for operations that qualify for the CIR (Crédit d’Impôt Recherche — R&D tax credit) are deducted from the base for calculating the credit. Firms can accumulate the JEI (Le régime de la jeune entreprise innovante — SSC reduction) status with other innovation subsidies, but this tax incentive is not modelled in B index for France.

³ Portugal: support from the European Commission or Portuguese government reduces the tax base; support by ‘Measures of Support R&D’ under the Portugal 2020 and Horizon 2020 are eligible for relief.



⁴ Spain: all investment costs related to R&D activities are eligible for accelerated depreciation for R&D capital, regardless of the source of funding of these activities. But B index for Spain is based on R&D&I tax credit, where government subsidies are deducted from the base for calculating the credit.

⁵ Denmark: tax credit for deficit-related current R&D tax expenditures and accelerated depreciation of R&D capital assets are available, but the OECD estimate for implied tax subsidy rate is -0.1 . Israel: accelerated depreciation for R&D capital is available, but the OECD estimate for implied tax subsidy rate is 0 . Therefore, for calculations, these countries are treated as not having expenditure based tax incentives.

⁶ Slovak Republic: there is a maximum ceiling for total public support (direct and tax) when using the tax relief for incentive recipients, but this tax incentive is not modelled in B index for Slovak Republic.

Source: Own preparation based on OECD (2018; 2019; 2020b).

Table 3.
Methods for incorporating direct funding to B index

Rule for combining direct and tax support	BS index calculation method
mutually exclusive in their use	$BS\ index = \begin{cases} B & \text{if } B < 1 - PS \\ 1 - PS & \text{if } B \geq 1 - PS \end{cases}$
grant funding reduces base of R&D tax credit/allowance	$BS\ index = B(1 - PS)$
grant funding is part of taxable income	$BS\ index = B - (1 - T)PS$
ceiling on total support (direct and tax)	$BS\ index = \begin{cases} B - PS & \text{if } B - PS < C \\ C & \text{if } B - PS \geq C \end{cases}$
complementary in their use no expenditure based tax incentives	$BS\ index = B - PS$
no detailed information available	–

where:

B — B index;

PS — share of direct funding in BERD for large enterprises or SMEs depending on the scenario;

T — tax rate applicable for R&D subsidies;

C — percentage ceiling on total support (direct and tax); amount ceilings are assumed to be non binding, as in the B index methodology.

Source: Own preparation.



Table 4.
B index, share of direct funding in BERD and BS index in the countries studied in 2017: different firm sizes and scenarios

Country	Firm size	Scenario	B index	1-B index	PS	BS index	1-BS index	Change: 1-BS-1-B
Australia **	large	profitable	0.90	0.10	0.017	0.89	0.11	+0.01
	large	loss-making	0.93	0.07	0.017	0.92	0.08	+0.01
	SME	profitable	0.81	0.19	0.031	0.78	0.22	+0.03
	SME	loss-making	0.81	0.19	0.031	0.78	0.22	+0.03
Austria	large	profitable	0.85	0.15	0.015	0.84	0.16	+0.01
	large	loss-making	0.85	0.15	0.015	0.84	0.16	+0.01
	SME	profitable	0.85	0.15	0.089	0.77	0.23	+0.08
	SME	loss-making	0.85	0.15	0.089	0.77	0.23	+0.08
Belgium	large	profitable	0.84	0.16	0.015	–	–	–
	large	loss-making	0.86	0.14	0.015	–	–	–
	SME	profitable	0.84	0.16	0.064	–	–	–
	SME	loss-making	0.86	0.14	0.064	–	–	–
Brazil * **	large	profitable	0.73	0.27	0.143	–	–	–
	large	loss-making	1.01	–0.01	0.143	–	–	–
	SME	profitable	0.73	0.27	0.143	–	–	–
	SME	loss-making	1.01	–0.01	0.143	–	–	–
Bulgaria	large	profitable	1.00	0.00	0.013	0.99	0.01	+0.01
	large	loss-making	1.00	0.00	0.013	0.99	0.01	+0.01
	SME	loss-making	1.00	0.00	0.024	0.98	0.02	+0.02
	SME	profitable	1.00	0.00	0.024	0.98	0.02	+0.02
Canada **	large	profitable	0.87	0.13	0.054	0.82	0.18	+0.05
	large	loss-making	0.90	0.10	0.054	0.85	0.15	+0.05
	SME	profitable	0.69	0.31	0.058	0.65	0.35	+0.04
	SME	loss-making	0.69	0.31	0.058	0.65	0.35	+0.04
Chile **	large	profitable	0.66	0.34	0.034	–	–	–
	large	loss-making	0.73	0.27	0.034	–	–	–
	SME	profitable	0.66	0.34	0.245	–	–	–
	SME	loss-making	0.73	0.27	0.245	–	–	–
China*	large	profitable	0.85	0.15	0.034	–	–	–
	large	loss-making	0.88	0.12	0.034	–	–	–
	SME	profitable	0.77	0.23	0.034	–	–	–
	SME	loss-making	0.82	0.18	0.034	–	–	–
Croatia	large	profitable	1.01	–0.01	0.016	0.99	0.01	+0.02
	large	loss-making	1.01	–0.01	0.016	0.99	0.01	+0.02
	SME	profitable	1.01	–0.01	0.012	1.00	0.00	+0.01
	SME	loss-making	1.01	–0.01	0.012	1.00	0.00	+0.01
Cyprus	large	profitable	1.01	–0.01	0.000	1.01	–0.01	+0.00
	large	loss-making	1.00	0.00	0.000	1.00	0.00	+0.00
	SME	profitable	1.01	–0.01	0.023	0.99	0.01	+0.02
	SME	loss-making	1.00	0.00	0.023	0.98	0.02	+0.02



Country	Firm size	Scenario	B index	1-B index	PS	BS index	1-BS index	Change: 1-BS-1-B
Czech Republic	large	profitable	0.79	0.21	0.040	0.79	0.21	+0.00
	large	loss-making	0.85	0.15	0.040	0.85	0.15	+0.00
	SME	profitable	0.79	0.21	0.144	0.79	0.21	+0.00
	SME	loss-making	0.85	0.15	0.144	0.85	0.15	+0.00
Denmark	large	profitable	1.01	-0.01	0.019	0.99	0.01	+0.02
	large	loss-making	1.01	-0.01	0.019	0.99	0.01	+0.02
	SME	profitable	1.01	-0.01	0.023	0.99	0.01	+0.02
	SME	loss-making	1.01	-0.01	0.023	0.99	0.01	+0.02
Estonia	large	profitable	1.00	0.00	0.001	1.00	0.00	+0.00
	large	loss-making	1.00	0.00	0.001	1.00	0.00	+0.00
	SME	profitable	1.00	0.00	0.090	0.91	0.09	+0.09
	SME	loss-making	1.00	0.00	0.090	0.91	0.09	+0.09
Finland	large	profitable	1.01	-0.01	0.023	0.99	0.01	+0.02
	large	loss-making	1.00	0.00	0.023	0.98	0.02	+0.02
	SME	profitable	1.01	-0.01	0.047	0.96	0.04	+0.05
	SME	loss-making	1.00	0.00	0.047	0.95	0.05	+0.05
France	large	profitable	0.57	0.43	0.081	0.52	0.48	+0.05
	large	loss-making	0.65	0.35	0.081	0.60	0.40	+0.05
	SME	profitable	0.57	0.43	0.078	0.53	0.47	+0.04
	SME	loss-making	0.57	0.43	0.078	0.53	0.47	+0.04
Germany	large	profitable	1.02	-0.02	0.019	1.00	0.00	+0.02
	large	loss-making	1.02	-0.02	0.019	1.00	0.00	+0.02
	SME	loss-making	1.02	-0.02	0.169	0.85	0.15	+0.17
	SME	profitable	1.02	-0.02	0.169	0.85	0.15	+0.17
Greece	large	profitable	0.89	0.11	0.000	-	-	-
	large	loss-making	0.92	0.08	0.000	-	-	-
	SME	profitable	0.89	0.11	0.100	-	-	-
	SME	loss-making	0.92	0.08	0.100	-	-	-
Hungary	large	profitable	0.78	0.22	0.031	0.75	0.25	+0.03
	large	loss-making	0.79	0.21	0.031	0.76	0.24	+0.03
	SME	profitable	0.78	0.22	0.315	0.47	0.53	+0.31
	SME	loss-making	0.80	0.20	0.315	0.49	0.51	+0.31
Iceland	large	profitable	0.76	0.24	0.029	0.73	0.27	+0.03
	large	loss-making	0.76	0.24	0.029	0.73	0.27	+0.03
	SME	profitable	0.76	0.24	0.106	0.65	0.35	+0.11
	SME	loss-making	0.76	0.24	0.106	0.65	0.35	+0.11
Ireland	large	profitable	0.71	0.29	0.047	0.68	0.32	+0.03
	large	loss-making	0.77	0.23	0.047	0.73	0.27	+0.04
	SME	profitable	0.71	0.29	0.045	0.68	0.32	+0.03
	SME	loss-making	0.77	0.23	0.045	0.74	0.26	+0.03
Israel * **	large	profitable	1.00	0.00	0.029	0.97	0.03	+0.03
	large	loss-making	1.00	0.00	0.029	0.97	0.03	+0.03
	SME	profitable	1.00	0.00	0.029	0.97	0.03	+0.03
	SME	loss-making	1.00	0.00	0.029	0.97	0.03	+0.03



Country	Firm size	Scenario	B index	1-B index	PS	BS index	1-BS index	Change: 1-BS-1-B
Italy	large	profitable	0.91	0.09	0.033	-	-	-
	large	loss-making	0.91	0.09	0.033	-	-	-
	SME	profitable	0.91	0.09	0.038	-	-	-
	SME	loss-making	0.91	0.09	0.038	-	-	-
Japan	large	profitable	0.83	0.17	0.009	0.82	0.18	+0.01
	large	loss-making	1.01	-0.01	0.009	1.00	0.00	+0.01
	SME	profitable	0.80	0.20	0.017	0.79	0.21	+0.01
	SME	loss-making	1.01	-0.01	0.017	1.00	0.00	+0.01
Korea	large	profitable	0.97	0.03	0.023	-	-	-
	large	loss-making	0.98	0.02	0.023	-	-	-
	SME	profitable	0.74	0.26	0.133	-	-	-
	SME	loss-making	0.79	0.21	0.133	-	-	-
Latvia	large	profitable	0.69	0.31	0.000	0.69	0.31	+0.00
	large	loss-making	0.75	0.25	0.000	0.75	0.25	+0.00
	SME	profitable	0.69	0.31	0.090	0.69	0.31	+0.00
	SME	loss-making	0.75	0.25	0.090	0.75	0.25	+0.00
Lithuania	large	profitable	0.69	0.31	0.010	0.68	0.32	+0.01
	large	loss-making	0.75	0.25	0.010	0.74	0.26	+0.01
	SME	profitable	0.69	0.31	0.013	0.68	0.32	+0.01
	SME	loss-making	0.75	0.25	0.013	0.74	0.26	+0.01
Luxembourg	large	profitable	1.01	-0.01	0.061	0.95	0.05	+0.06
	large	loss-making	1.01	-0.01	0.061	0.95	0.05	+0.06
	SME	profitable	1.01	-0.01	0.078	0.93	0.07	+0.08
	SME	loss-making	1.01	-0.01	0.078	0.93	0.07	+0.08
Malta	large	profitable	0.78	0.22	0.061	-	-	-
	large	loss-making	0.83	0.17	0.061	-	-	-
	SME	profitable	0.78	0.22	0.017	-	-	-
	SME	loss-making	0.83	0.17	0.017	-	-	-
Mexico * **	large	profitable	0.94	0.06	0.332	0.67	0.33	+0.27
	large	loss-making	0.96	0.04	0.332	0.67	0.33	+0.29
	SME	profitable	0.93	0.07	0.332	0.67	0.33	+0.26
	SME	loss-making	0.94	0.06	0.332	0.67	0.33	+0.27
Netherlands	large	profitable	0.85	0.15	0.024	-	-	-
	large	loss-making	0.85	0.15	0.024	-	-	-
	SME	profitable	0.69	0.31	0.018	-	-	-
	SME	loss-making	0.70	0.30	0.018	-	-	-
New Zealand **	large	profitable	1.02	-0.02	0.283	0.74	0.26	+0.28
	large	loss-making	1.02	-0.02	0.283	0.74	0.26	+0.28
	SME	profitable	1.02	-0.02	0.165	0.86	0.14	+0.16
	SME	loss-making	1.02	-0.02	0.165	0.86	0.14	+0.16
Norway	large	profitable	0.79	0.21	0.121	0.67	0.33	+0.12
	large	loss-making	0.79	0.21	0.121	0.67	0.33	+0.12
	SME	profitable	0.77	0.23	0.072	0.70	0.30	+0.07
	SME	loss-making	0.76	0.24	0.072	0.69	0.31	+0.07



Country	Firm size	Scenario	B index	1-B index	PS	BS index	1-BS index	Change: 1-BS-1-B
Poland	large	profitable	0.91	0.09	0.084	0.91	0.09	+0.00
	large	loss-making	0.92	0.08	0.084	0.92	0.08	+0.00
	SME	profitable	0.89	0.11	0.242	0.76	0.24	+0.13
	SME	loss-making	0.91	0.09	0.242	0.76	0.24	+0.15
Portugal	large	profitable	0.61	0.39	0.024	0.60/0.59	0.40/0.41	+0.01
	large	loss-making	0.69	0.31	0.024	0.67/0.67	0.33/0.33	+0.02
	SME	profitable	0.61	0.39	0.064	0.57/0.55	0.43/0.45	+0.04
	SME	loss-making	0.69	0.31	0.064	0.65/0.63	0.35/0.37	+0.04
Romania	large	profitable	0.92	0.08	0.046	–	–	–
	large	loss-making	0.93	0.07	0.046	–	–	–
	SME	profitable	0.92	0.08	0.168	–	–	–
	SME	loss-making	0.93	0.07	0.168	–	–	–
Russian Federation **	large	profitable	0.89	0.11	0.605	–	–	–
	large	loss-making	1.00	0.00	0.605	–	–	–
	SME	profitable	0.89	0.11	0.389	–	–	–
	SME	loss-making	1.00	0.00	0.389	–	–	–
Slovak Republic	large	profitable	0.90	0.10	0.002	0.90	0.10	+0.00
	large	loss-making	0.92	0.08	0.002	0.92	0.08	+0.00
	SME	profitable	0.90	0.10	0.081	0.83	0.17	+0.07
	SME	loss-making	0.92	0.08	0.081	0.85	0.15	+0.07
Slovenia **	large	profitable	0.79	0.21	0.004	–	–	–
	large	loss-making	0.83	0.17	0.004	–	–	–
	SME	profitable	0.79	0.21	0.075	–	–	–
	SME	loss-making	0.83	0.17	0.075	–	–	–
South Africa * **	large	profitable	0.84	0.16	0.031	0.81	0.19	+0.03
	large	loss-making	0.87	0.13	0.031	0.84	0.16	+0.03
	SME	profitable	0.84	0.16	0.031	0.81	0.19	+0.03
	SME	loss-making	0.87	0.13	0.031	0.84	0.16	+0.03
Spain	large	profitable	0.67	0.33	0.065	0.63	0.37	+0.04
	large	loss-making	0.74	0.26	0.065	0.69	0.31	+0.05
	SME	loss-making	0.74	0.26	0.114	0.66	0.34	+0.08
	SME	profitable	0.67	0.33	0.114	0.59	0.41	+0.08
Sweden **	large	profitable	0.95	0.05	0.047	0.90	0.10	+0.05
	large	loss-making	0.95	0.05	0.047	0.90	0.10	+0.05
	SME	profitable	0.95	0.05	0.046	0.90	0.10	+0.05
	SME	loss-making	0.95	0.05	0.046	0.90	0.10	+0.05
Switzerland	large	profitable	1.01	-0.01	0.003	1.01	-0.01	+0.00
	large	loss-making	1.01	-0.01	0.003	1.01	-0.01	+0.00
	SME	loss-making	1.01	-0.01	0.029	0.98	0.02	+0.03
	SME	profitable	1.01	-0.01	0.029	0.98	0.02	+0.03
Turkey	large	profitable	0.94	0.06	0.113	0.83	0.17	+0.11
	large	loss-making	0.95	0.05	0.113	0.84	0.16	+0.11
	SME	profitable	0.94	0.06	0.047	0.89	0.11	+0.05
	SME	loss-making	0.95	0.05	0.047	0.90	0.10	+0.05



Country	Firm size	Scenario	B index	1–B index	PS	BS index	1–BS index	Change: 1-BS–1-B
United Kingdom	large	profitable	0.90	0.10	0.079	0.82	0.18	+0.08
	large	loss-making	0.90	0.10	0.079	0.82	0.18	+0.08
	SME	loss-making	0.73	0.27	0.066	0.73/0.68	0.27/0.32	+0.00
	SME	profitable	0.73	0.27	0.066	0.73/0.68	0.27/0.32	+0.00
United States **	large	profitable	0.96	0.04	0.063	0.94	0.06	+0.02
	large	loss-making	0.97	0.03	0.063	0.94	0.06	+0.03
	SME	loss-making	0.96	0.04	0.070	0.93	0.07	+0.03
	SME	profitable	0.96	0.04	0.070	0.93	0.07	+0.03

Notes:

* No breakdown into large enterprises and SMEs in the data on the share of direct funding in BERD.

** Detailed data on the share of direct funding in BERD for large enterprises and SMEs older than 2017. The share of direct funding in BERD in 2017 was estimated by the Author using the equations:

$$PS\ large_{2017} = PS\ large_{latest\ detailed\ data\ year} * \frac{PS(large + SME)_{2017}}{PS(large + SME)_{latest\ detailed\ data\ year}},$$

$$PS\ SME_{2017} = PS\ SME_{latest\ detailed\ data\ year} * \frac{PS(large + SME)_{2017}}{PS(large + SME)_{latest\ detailed\ data\ year}}.$$

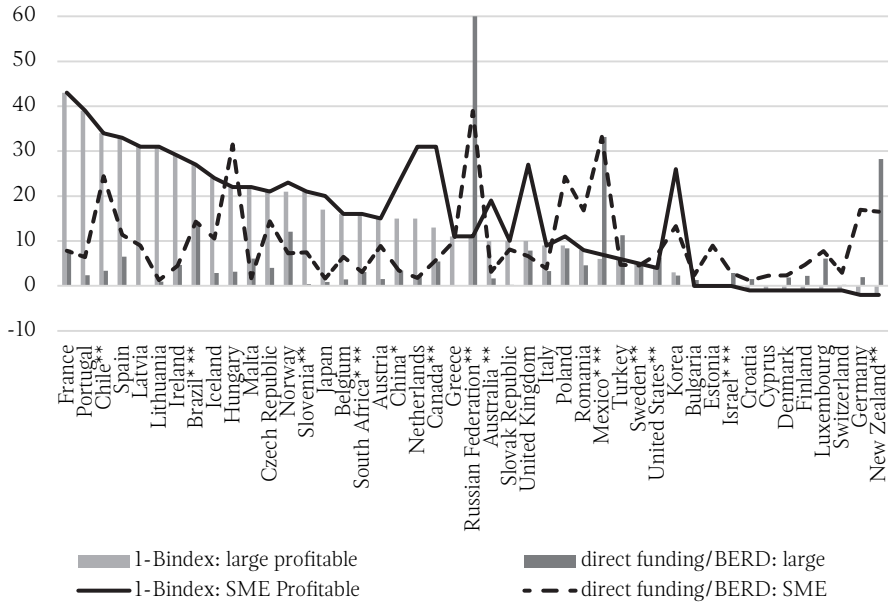
The purpose of the estimation was to take into account the difference in the direct funding of large companies and SMEs in different countries, while obtaining the latest data on the amount of direct funding in each of the countries studied. Years with the latest detailed data on the share of direct funding in BERD for large enterprises and SMEs in the countries where it was estimated for 2017: Australia (2011 – large and SMEs, 2015 – direct funding/BERD), Brazil (2014), Canada (2013), Chile (2016), Israel (2016), Mexico (2016), New Zealand (2015), Russian Federation (2016), Slovenia (2016), South Africa (2016), Sweden (2013), United States (2016).

Source: Own preparation based on Eurostat (2020), OECD (2020a; 2020c).



Chart 1.

Subsidy rates based on 1–B index and the share of direct funding in BERD in the surveyed countries in 2017 (in %)



Notes:

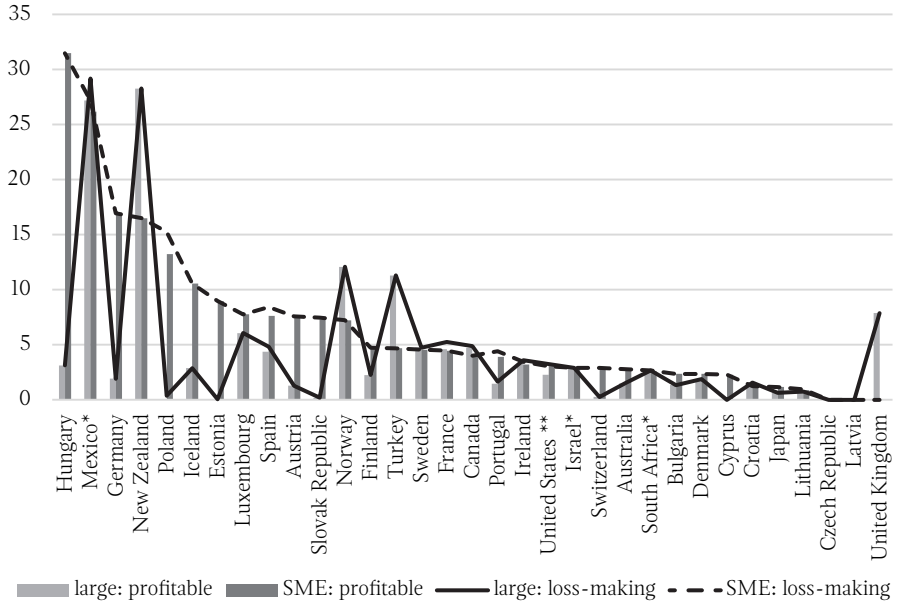
* No breakdown into large enterprises and SMEs in the data on the share of direct funding in BERD.

** Detailed data on the share of direct funding in BERD for large enterprises and SMEs older than 2017. The index for 2017 was estimated by the Author — details in Table 4.

Source: Own preparation based on Eurostat (2020), OECD (2020a; 2020c).

Chart 2.

Increase in the subsidy rate after incorporating direct subsidies into the B index (percentage points)



Notes:

* No breakdown into large enterprises and SMEs in the data on the share of direct funding in BERD.

** Detailed data on the share of direct funding in BERD for large enterprises and SMEs older than 2017. The index for 2017 was estimated by the Author — details in Table 4.

Source: Own preparation based on Eurostat (2020), OECD (2020a; 2020c).