



European  
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Quarterly R&I literature review 2023/Q1

# Tax incentives for R&I



R&I PAPER SERIES  
LITERATURE REVIEW



*Research and  
Innovation*

## Tax incentives for R&I

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Literature review

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## INTRODUCTION

*This literature review is developed by the 'Economics of R&I' team of the Chief Economist unit of DG Research and Innovation. It provides a brief summary of a selection of recent publications on R&I economics and policy. Contributors for this edition: Valentina Di Girolamo, Luca Bollinger, Alessio Mitra (review coordinator), Elena-Raluca Pancu, Océane Peiffer-Smadja, Julien Ravet (team leader), Jan-Tjibbe Steeman.*

Tax incentives are a commonly used policy tool by governments worldwide to encourage firms to invest in research and innovation (R&I) activities. These incentives come in various forms, including tax credits, grants, and deductions, and their effectiveness in promoting R&I has been widely debated in the literature.

Understanding the impact of tax incentives on innovation is of great importance to policymakers and businesses alike, as innovation is widely recognized as a key driver of economic growth and competitiveness.

Supporters of tax incentives argue that they can provide a powerful stimulus for R&D investment by reducing the cost of R&I activities for innovative firms. This can lead to more investment in R&D, which can ultimately lead to the development of new products, services and technologies, and improved competitiveness in the marketplace. Additionally, tax incentives can help firms to attract and retain highly

skilled workers, which can enhance their innovation capacity.

However, not everyone is convinced of the effectiveness of tax incentives. Some critics argue that tax incentives are quite untargeted, not allowing for a directional approach, may not provide enough incentive for firms to invest in R&D, as the cost savings may not be significant enough to offset the risks and uncertainty associated with innovative activities. Additionally, some critics argue that tax incentives can lead to "crowding out" of private investment in R&D, as firms may choose to rely on government support rather than investing their own resources.

Overall, the debate surrounding the effectiveness of tax incentives for innovation is complex, and there are valid arguments on both sides. This literature review looks into recent papers that evaluated the impact of R&I tax incentives on a wide set of firm level outcomes.



# POLICY TOOLS FOR R&I

European Commission, Directorate-General for Research and Innovation, Teichgraeber, A., Van Reenen, J. (2022). A policy toolkit to increase research and innovation in the European Union, Publications Office of the European Union.

**Messages**      **1. We need a serious plan around innovation policy to rebuild Europe after the pandemic. 2. A mix of short-term and long-term policies as well as demand- and supply-side policies is required to stimulate innovation and make the European economy more sustainable and productive.**

What R&I policies should the EU adopt? While the authors acknowledge the increase in the budget for the EU Framework Programme over time as a step in the right direction, they suggest that theory and evidence support an even higher increase in resources. The budget should not solely be used as a short-term demand boost, but rather be designed to induce structural changes that will lead to long-lasting productivity increases. In this context, they discuss the rationale for state intervention in R&I and present a review of evidence on R&I policy tools.

The literature shows that research and development (R&D) tax credits and direct public funding (R&D grants) seem to be effective in the short run. A 1% fall in the tax-price of R&D causes at least a 1% increase in the volume of R&D, and there is an increasing body of work suggesting R&D grants can work in stimulating more innovative activity. In the long run, increasing the supply of human capital, for example, through expanding university STEM admissions, is more effective. Skilled immigration can also have significant effects in the short run. While competition and trade policies may have more modest benefits on innovation, they are cheap in financial terms.

(1) Policy	(2) Quality of evidence	(3) Conclusiveness of evidence	(4) Benefit-Cost	(5) Time frame
R&D tax credits	High	High		Short-Run
Direct R&D Grants	Medium	Medium		Medium-Run
Universities: STEM Supply	Medium	Medium		Long-Run
Universities: incentives	Medium	Low		Medium-Run
Opening up to Immigration	High	High		Short to Medium-Run
Increasing Inventor Quality	Medium	Low		Long-run
Greater competition and Trade Openness	High	Medium		Medium-Run

The paper stresses that to create an open labour market for researchers, the migration of researchers between EU countries should be made easier, and the EU could extend the European Research Area to attract researchers and innovators from outside its borders.

To identify and nurture talented individuals in math and science, we can adopt policies such as providing better educational support and implementing mentoring and internship programs. Additionally, leveraging Erasmus+ traineeships can increase interaction between innovators and underrepresented youth, opening doors to a future in invention.

# THE USE OF R&I TAX INCENTIVES WORLDWIDE

OECD R&D tax incentives database, 2022 edition. OECD R&D Tax Incentives Database, <http://oe.cd/rdtax>, February 2023

**Messages** 1. In 2021, 22 EU countries offer R&D tax incentives at central or subnational government level. 2. Countries have globally made efforts to enhance the generosity of their R&D tax relief measures over 2020-2021, with around one-third of these changes having been implemented as a direct result of the COVID-19 crisis.

Since 2007, the OECD has worked to extend the international evidence on R&D tax incentives. This report presents the latest evidence on the design of R&D tax incentives, the generosity of R&D tax incentives from the firm perspective, and the cost of R&D tax relief to governments, drawing on the data collected and validated by official contacts within countries.

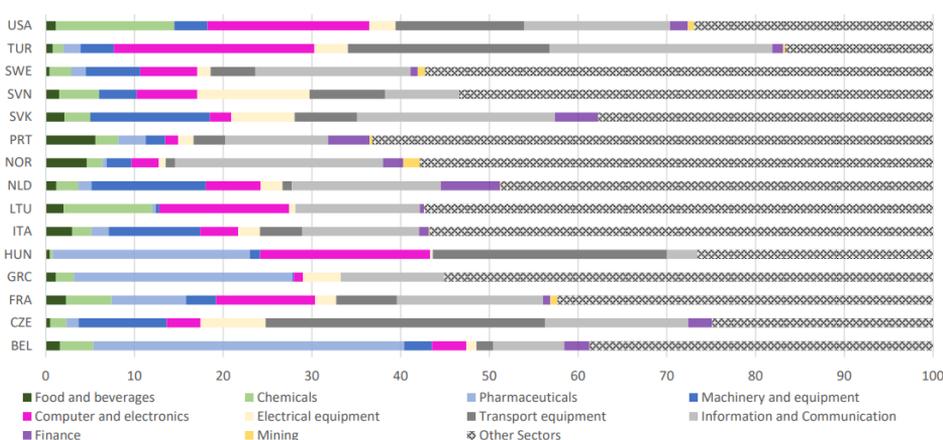
More countries currently rely on tax support to encourage business R&D than a decade ago. In 2021, 22 EU countries offer R&D tax incentives at central or subnational government level, with Germany introducing an R&D tax incentive for the first time in 2020, and Finland reintroducing R&D tax support in the form of a tax deduction for R&D-related research cooperation expenditures in 2021.

Although tax incentives are generally seen as the more market-based, non-discretionary alternative to direct support for R&D, a number of countries target R&D tax incentives to particular types of firms, industries or activities, such as green or energy-related R&D.

Figure 11 shows the distribution of government tax relief for R&D expenditure by industry, leveraging the more granular industry information collected for ten selected R&D-intensive industry sectors in 2021 and highlighting the country-sector specificity of the financing tool.

In conclusion, countries have globally made efforts to enhance the generosity of their R&D tax relief measures over 2020-2021, mainly as a direct result of the COVID-19 crisis.

Figure 11. Distribution of R&D tax incentive support by industry, 2019



# TAX CREDITS AND HUMAN CAPITAL

Alexandre Paredes, Joana Mendonça, Fernando Bação, Bruno Damásio, Does R&D tax credit impact firm behaviour? Micro evidence for Portugal, Research Evaluation, Volume 31, Issue 2, April 2022, Pages 226–235

**Messages** 1. R&D tax credit increases the number of PhD holders in companies with medium-high and high R&D intensity. 2. The design of R&D tax credits should be specific, rather than generic, focusing on targeting and identifying firms that are more proactive in performing R&D activities. 3. PhD holders' representation in firms is relevant as they are determinant in influencing the absorptive capacity within companies.

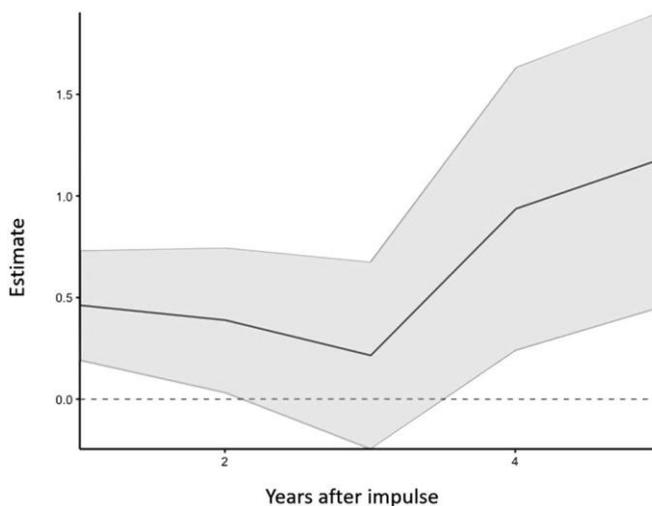
The paper analyses the impact of a Portuguese tax incentive scheme for corporate R&D on R&D personnel. To do so, the author employs a local projection approach to estimate the impulse-response functions (IRF) of the tax incentive scheme (SIFIDE) on different R&D personnel categories: persons employed, R&D personnel in FTE, and PhD holders.

The authors merge the Portuguese census survey of all firms that potentially performed R&D activities between 1995 and 2017 with administrative data on R&D tax incentives. The resulting dataset is an unbalanced panel of 7,710 firms containing firm-level variables such as the number of R&D personnel, the total full-time equivalent (FTE) staff, and the number of doctorates, current R&D expenditure, capital R&D expenditure, internal funds, external funds and the participation in the tax credit scheme.

The analysis shows that the tax incentive scheme had no significant impact on persons employed and R&D personnel in FTE, but had a positive impact on PhD holders. In the short run (1 year after the impulse), there is a positive impact on the cumulative addition of PhD holders in FTE (0.20), which becomes even more

substantial 3 years later (0.45). Furthermore, when focusing on firms with low R&D intensity, the effect is statistically insignificant, while for the medium-high and high R&D intensity firms, it is even larger (0.46 in the short run and 1.18 in the long run).

Given the findings presented, the authors call for tax incentives schemes that take into account the NACE sector and R&D intensity of the receiving companies. They also highlight how, regardless of the type of R&D performed (be it basic research, applied research, or experimental development), PhD holders play a determinant role within firms as researchers, contributing to the firms' absorptive capacity.



# TAX CREDITS AND SHORT-TERM FIRMS' FINANCIALS

Mellace, G., & Ventura, M. (2023). The short-run effects of public incentives for innovation in Italy. *Economic Modelling*, 120, [106178].

## Messages

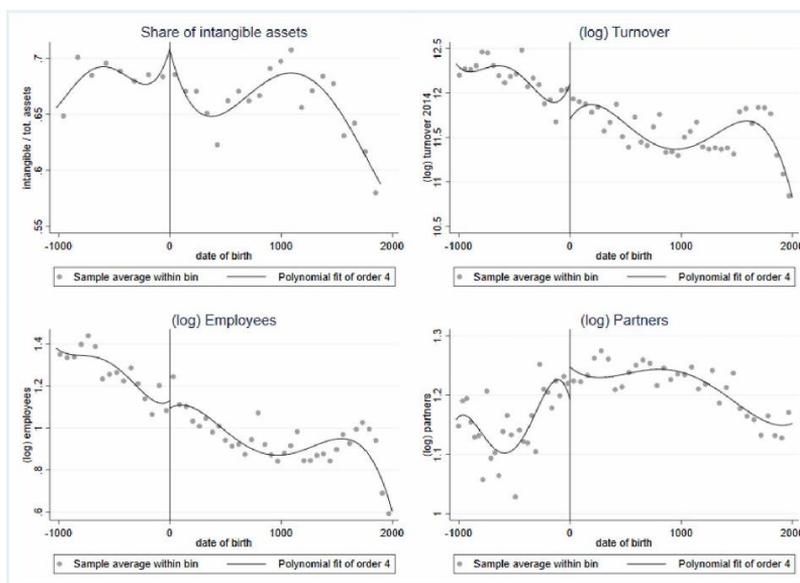
**1. Tax incentive policies that lack specific requirements for innovation-related activities may initially attract more partners and generate new investors. However, they do not have a significant impact on a firm's share of intangible assets, turnover, or the number of employees in the short term. 2. To effectively accomplish the goals set by policy makers, it is essential to implement a policy that ties tax cuts to actual investments in innovation.**

In 2012, the Italian government introduced a tax benefit scheme aimed at incentivising innovation in young firms. The tax benefit was substantial, targeted at firms that fulfilled a list of eligibility criteria, and with no specific requirements for innovation-related activities.

The paper analyses the short-term impact of this scheme. To do so, the authors use a regression discontinuity design, exploiting a discontinuity in the eligibility criteria of the scheme, and estimate the causal effects of the policy on the number of partners (the internal investors), the share of intangible assets, turnover, and the number of employees.

The authors collect data from the Archivio Statistico delle Imprese Attive (ASIA) and from the Chamber of Commerce.

The authors find that the generous tax benefits for investing in such firms attracted a substantial number of new partners. Yet, the policy had a very low take-up rate, and the increase in private investors did not translate into an increase



in innovative activities, as intended by the legislator. It is argued that this happened due to the lack of links between the tax cuts and the realisation of actual investments in innovation, making innovative firms use the programme as a tax shield instead of an innovation incentive.

Based on their findings, the authors advocate that a more effective policy would have linked tax cuts to actual investments in innovation, for instance, by introducing partial reimbursement of true investments made upon presentation of due documentation.

# TAX INCENTIVES AND SPILLOVER EFFECTS

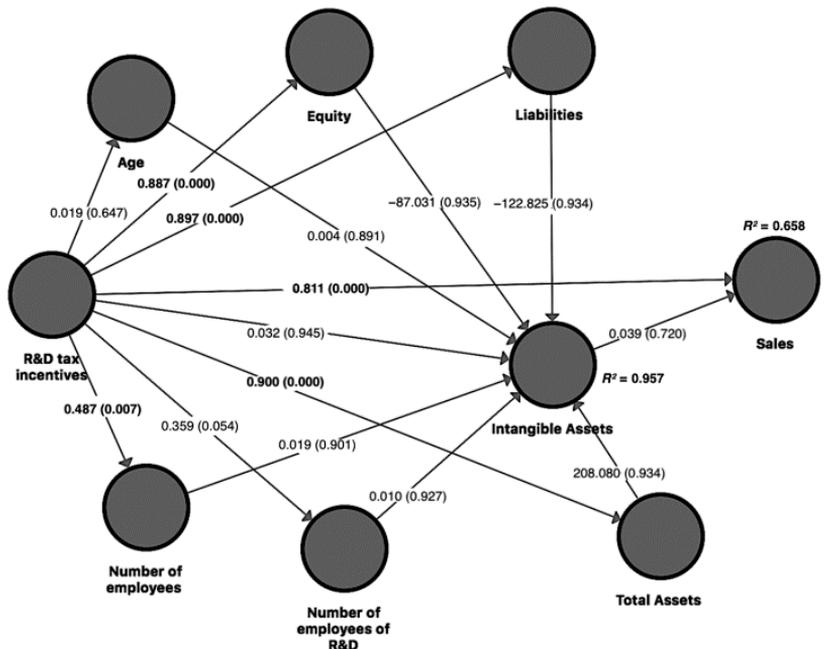
Walter, C.E., Au-Yong-Oliveira, M., Miranda Veloso, C. and Polónia, D.F. (2022), "R&D tax incentives and innovation: unveiling the mechanisms behind innovation capacity", Journal of Advances in Management Research, Vol. 19 No. 3, pp. 367-388.

**Messages** 1. Tax incentives play an important role in the creation of spillover effects for the construction and strengthening of organizational attributes, such as number of employees, total assets and sales, which may later on translate into innovation.

This paper investigates the influence of R&D tax incentives on organizational attributes in Portuguese firms and how they are later converted into innovation capacity. The authors argue that this type of tax incentive exerts a positive influence on both equity and liabilities, the number of employees in R&D, and on investment capacity.

The authors investigated 339 Portuguese companies that benefited consistently from the Fiscal Incentive System supporting R&D in Enterprises (SIFIDE) from 2013 to 2016 using partial least squares estimation modelling. The majority of firms (84%) analysed were medium and small enterprises with medium-high to medium-low technology profiles, with the majority offering knowledge-intensive services.

The results suggest that tax incentives cause direct spillover effects on organizational attributes such as total assets, the number of employees and sales.



While this kind of instrument plays an important spillover effect on organizational attributes that can spark innovation, no significant direct and indirect effects were found in the relationship between tax incentives and intangible assets. The authors conclude that the non-transformation of tax incentives into innovation may be related to managerial factors.

However, the paper highlights the fact that innovation is preceded by innovation capacity. The SIFIDE program has proven to be influential from an innovation-building perspective.

## TAX INCENTIVES AND CROSS-BORDER EFFECTS

B. Knoll, N. Riedel, T. Schwab, M. Todtenhaupt, J. Voget (2021), Cross-border effects of R&D tax incentives, Research Policy, Volume 50, Issue 9

### Messages

**1. R&D tax incentives lead MNEs to reallocate their R&D activities across borders, with R&D investments in different locations acting as substitutes. 2. R&D tax incentives have a small overall effect on MNEs' global R&D activity, but lower R&D tax costs result in lower effective tax rates at the MNE group level.**

The paper analyses the impact of R&D tax incentives on firms' R&D investments using patent data of European firms from the database PATSTAT, from 2000 to 2012. The dataset is linked to firm-level information in Bureau van Dijk's AMADEUS database and comprises both parent and subsidiary firms, including 2,793 companies from over 20 countries.

The analysis examines the R&D investments of multinational enterprises (MNEs) in a particular country and year using a fixed-effect PPML model. The study also tests for cross-border effects of R&D tax incentives by adding regressors for the average R&D tax costs of the MNE's other locations. The goal is to estimate the impact of tax incentives on the R&D investments of MNEs and to identify any cross-border effects that may arise within MNE groups.

The authors find that the effects of R&D tax incentives on MNEs' overall global R&D activity are small and statistically insignificant. However, the results indicate a negative effect of R&D tax costs on MNEs' investments in the host country. Furthermore, the results suggest that MNEs shift R&D activities across borders in response to changes

in R&D tax incentives in different countries where their group is located, implying that R&D investments at different locations act as substitutes.

Additionally, the analysis shows that direct government support for business R&D (i.e. support not granted through the tax system) has a similar effect. The level of support offered in different locations within the same MNE group affects R&D investment, indicating that direct subsidies for R&D lead to cross-country relocation of R&D operations.

In conclusion, despite the lack of evidence for positive effects of R&D tax incentives on MNEs' global R&D activity, the authors also suggest that R&D tax incentives for large MNEs might still be efficiency-enhancing, if the locations with a relative cost advantage in R&D in the global production process are the ones to introduce attractive tax incentives for R&D.



# TAX INCENTIVES AND START-UPS

Chen, Jun and Hshieh, Shenje, The Labor Effects of R&D Tax Incentives: Evidence from VC-Backed Startups (April 1, 2022). WP.

## Messages

**1. R&D tax incentives are effective in scaling up real R&D activities within start-ups through building up their skilled workforce 2. Increased skilled labour demand translates into the hiring of more R&D workers, with positive effects on both the quantity and quality of start-up innovation output.**

The paper analyses whether VC-backed start-ups respond to R&D tax incentives by attempting to scale R&D activities through hiring additional employees. Specifically, the authors focus on the impact of the US Protecting Americans from Tax Hikes (PATH) Act, adopted in 2015 and entered into force in 2016, which made the use of tax incentives for the hiring of R&D-related workers available to young start-ups in the US.

The authors use the VentureXpert database to retrieve information on different cohorts of VC-backed start-ups incorporated in the US. Skilled labour and recruitment of R&D workers are measured exploiting information from three datasets: the Burning Glass Technologies (BGT) job postings data, LinkedIn worker profiles, and inventor data extracted from patent filings.

The analysis employs a difference-in-differences (DID) framework to compare

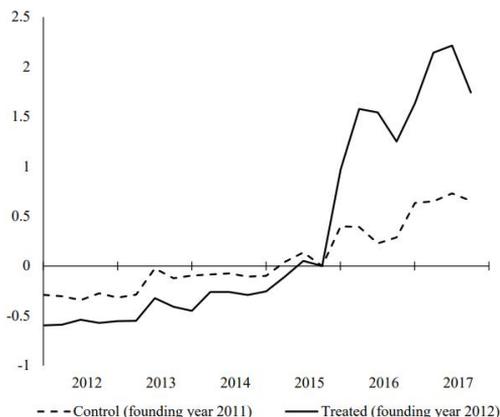
start-ups founded in 2011 (used as the control group) and start-ups qualifying for support under the PATH Act and founded in 2012 (treatment group).

The paper finds that start-ups likely qualifying for payroll tax credits, on average, increased their demand for labour in terms of quantity and quality in the quarters following the enactment of the PATH Act. Specifically, the results suggest that start-ups in the treatment group submitted, on average, 21% more job postings than the start-ups in the control group. Furthermore, when focusing on job postings requiring R&D skills, the magnitude of the results is even larger, with 33% more job postings in R&D occupations and 35% more job postings in STEM occupations submitted by the start-ups in the treatment group. The analysis also finds that these start-ups demand more employees with higher education (i.e., at least a master's or bachelor's degree) and longer work experience after the enactment of the PATH Act. In terms of employment effect, the impact is found to be positive and significant on both overall hiring (+8%) and the number of STEM-related hiring (+9%).

From a policy perspective, the paper provides direct positive evidence on the effectiveness of R&D tax incentives in scaling up real R&D activities within start-ups through building up their skilled workforce.

Figure 3: Trends of Job Postings Relative to the Fourth Quarter of 2015

This figure plots the average quarterly changes in the number of job postings relative to the fourth quarter of 2015 over the period 2012-2017. The solid and dashed lines are the average for VC-backed startups founded in 2012 (the treated group) and 2011 (the control group), respectively. The PATH Act went into effect in the first quarter of 2016.



## TAX INCENTIVES PERSISTENCY AND INNOVATION

José M. Labeaga, Ester Martínez-Ros, Amparo Sanchis, Juan A. Sanchis, Does persistence in using R&D tax credits help to achieve product innovations?, *Technological Forecasting and Social Change*, Volume 173, 2021, 121065

### Messages

**1. The reliance on R&D tax credits is a self-sustaining process, especially for firms regularly undertaking innovative activities. 2. The effect of R&D tax incentives on product innovation is positive and significant for SMEs, but not for large firms.**

The paper investigates the effects of tax incentives on firms' innovation in Spain to analyse whether a persistent reliance upon tax incentives increases the innovative performance of recipient firms (particularly in terms of product innovations).

The analysis is carried out using data on firms operating in the Spanish manufacturing sector, drawn from the annual survey ESEE, for the period 2001–2014. The final sample comprises 1,042 firms, including both large firms and SMEs. A 2-step empirical approach is adopted in the paper. First, duration model techniques are used to predict firms' persistence in using R&D tax credits and their drivers. The unit of measurement is the firm's R&D tax credit spell, defined as the number of consecutive years the firm benefits from R&D tax credits. Estimates from the first step are then used to analyze the effect of this persistence on the achievement of product innovations using a negative binomial model.

The findings from the econometric models point to the existence of persistence in the use of R&D tax credit by firms, suggesting that continuously benefiting from R&D tax credits is, in part, a self-sustaining process. In particular, the authors find that undertaking complementary R&D activities, operating in a high-tech industry and the availability of own financial resources are among the main factors

inducing continuity in the use of R&D tax credits for all firms. Furthermore, the results suggest that persistence in using R&D tax credits has a significant effect only on the innovative performance of SMEs and not on that of large firms.

A possible explanation for this result is that, compared to SMEs, large firms are more regular R&D performers and tax credit claimants, making it harder to detect effects with statistical techniques.

Given the self-sustaining nature of the tax credit claiming process, the paper suggests that any policy measure aiming to encourage firms to start claiming R&D tax credits is likely to have an impact on innovation in the long run, thereby increasing the effectiveness of fiscal incentives to R&D. At the same time, the analysis points to the need to implement fiscal policies that encourage firms to continuously use R&D tax credits to intensify the efficiency of R&D investments in terms of innovation results, especially in the case of SMEs. It is for SMEs indeed more challenging to benefit from this type of incentive due to several reasons such as unawareness, administrative costs or complexity in the application process. Therefore, the aforementioned policies should be complemented by actions intended to extend awareness of this fiscal instrument among these companies and facilitate and simplify the claiming procedures.

# TAX INCENTIVES AND CROWDING OUT

Dumont M. (2022). Public Support to Business Research and Development in Belgium Fourth evaluation. November 2022. Belgium Federal Planning Bureau.

**Messages**

**1. Regional subsidies and partial exemption from payment of the withholding tax on the wages of R&D personnel encourage companies to invest in R&D. 2. The innovation income deduction and the corporate income taxation incentives, except for the tax deduction for R&D investment, seem ineffective or may even result in crowding out. 3. There is substantial heterogeneity in the impact of public support among different types of firms and industries.**

This paper analyses public support for business R&D in Belgium, aiming to provide an indication of the extent to which direct support (regional subsidies) and indirect support (tax incentives) have contributed to R&D intensity.

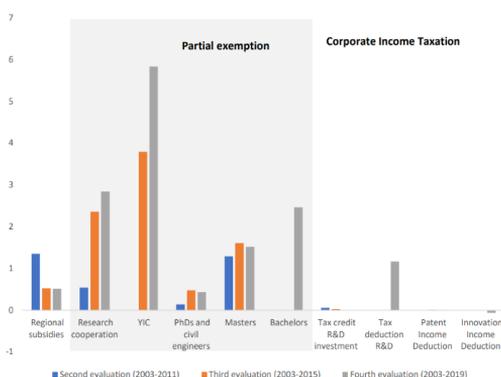
The Belgian federal government introduced several tax incentives in support of business R&D, starting from 2005, supplemented by substantial direct support (regional subsidies) and EU funding. The authors use panel data and multiple linear regressions to assess the impact of each scheme and type of public support. The evaluation provides robust indications that:

- Regional subsidies and the partial exemption from payment of the withholding tax on the wages of R&D personnel encourage companies to invest in R&D.
- The innovation income deduction is financing R&D expenditures that companies would finance themselves in the absence of tax support.

- The corporate income taxation incentives, except for the tax deduction for R&D investment, seem ineffective or may even result in crowding out.
- There is additionality for the innovation bonus but crowding out for EU funding.

The figure shows the "Bang for the Buck (BFTB)," defined as how much additional R&D expenditures result from one euro of support. The crowding out of some corporate income taxation incentives mainly applies to large and older firms, firms that are part of a multinational group, and firms operating in highly concentrated industries.

These results draw attention to the potentially negative impact of public support on market dynamism, as it may reinforce market concentration and winners-take-most effects. They also highlight the low efficiency of public support in highly concentrated industries. The results suggest that targeting specific industries or groups of firms may increase the effectiveness and efficiency of public support. However, such an approach requires a well-defined and evidence-based framework, and the conditionality of public support may conflict with EU state aid rules, which generally prohibit public support to specific companies or industries.



# TAX INCENTIVES PROS AND CONS

Evans, C., & Joseph, S. A. (2022). The Role of Tax Incentives in the Promotion of Innovation and Entrepreneurship: A Time and a Place. In *Government Incentives for Innovation and Entrepreneurship: An International Experience* (pp. 39-60). Cham: Springer International Publishing

**Messages** 1. The optimal policy mix of R&D&I incentives depends on countries' specific circumstances, preferences, and stage of innovation. 2. Non-tax incentives, such as grants, have the advantage, in general, of being more targeted. However, this comes with higher costs (administrative and application).

The paper explores the role of tax incentives in the promotion of innovation and entrepreneurship in recent years. By doing so, the study highlights the contrast between direct (non-tax) incentives, such as grants, soft loans, and business support, and indirect (tax-based) incentives.

The study points out that each type of incentive offers different advantages and disadvantages when applied to R&D, entrepreneurship, and innovation. The policy mix is, therefore, an important consideration when choosing the incentives to use, and the optimal mix depends on countries' specific circumstances, particular goals sought, and stage of innovation. This is also related to the fact that different incentives try to address different market failures.

The analysis looks at the heterogeneous policy mix across countries. The advantages and disadvantages between tax incentives and non-tax R&D&I incentives are explored. Non-tax incentives have the advantage, in general, of being more targeted. However, this comes with higher costs (administrative and application). See Table for the full comparison.

At the firm level, countries may use expenditure-based tax incentives that give advantageous treatment of R&D investments and income-based tax incentives that provide preferential treatment to income or gains attributable to R&D&I efforts. Yet, there is a lack of evidence on the effectiveness of the latter. Other tax incentives can be used to reduce the costs for R&D staff.

From a policy perspective, the study shows that there is no one-size-fits-all model for R&D incentives. Policymakers need to carefully design for purpose, depending, for example, on the beneficiary's maturity and size and the stage of innovation.

Type	Advantages	Disadvantages
Tax incentives	<ul style="list-style-type: none"> <li>Encourage an increase of R&amp;D across the whole spectrum of entities</li> <li>Can be used to target specific groups of entities, e.g., industry, size, location</li> <li>The private sector can decide what is the most productive way to invest</li> <li>Non-discriminatory nature in terms of research, technology fields, or industrial sectors</li> <li>Less risk of governmental failure in "picking winners" (choosing the wrong R&amp;D projects)</li> <li>Avoid an up-front budget since support is by means of forgone tax revenues</li> <li>Lower administrative costs of planning, allocation, and management</li> <li>Least burdensome way of increasing business R&amp;D</li> </ul>	<ul style="list-style-type: none"> <li>Poor budget control</li> <li>Greater risk of dead weight loss (supporting projects which would have been performed anyway)</li> <li>Less additionality in the case of very large companies</li> <li>Risk of entities relabeling other activities as R&amp;D</li> <li>Private organizations will choose R&amp;D projects with the highest private rates of return</li> <li>Risk that the globalization of R&amp;D may reduce local R&amp;D spill-overs to society</li> </ul>
Non-tax incentives	<ul style="list-style-type: none"> <li>Best suited to encourage high risk projects and to meet specific policy goals</li> <li>Adequate to target R&amp;D activities with the highest discrepancy between social and private returns</li> <li>Competition between firms ensures that public resources are directed to the best R&amp;D projects</li> <li>Can be used to target specific technologies or scientific areas to overcome cyclical or sectoral slowdowns</li> <li>Encourage cooperation and technology transfer</li> <li>Better budget control</li> </ul>	<ul style="list-style-type: none"> <li>High administrative costs</li> <li>High application/compliance costs</li> <li>Entities may not undertake R&amp;D projects not approved for public funding</li> <li>Highly bureaucratic approach</li> <li>Large volume of low value incentive</li> </ul>

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