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Quarterly R&I literature review 2020/Q3

Investing in R&I for the recovery



R&I PAPER SERIES
LITERATURE REVIEW



Research and
Innovation

Investing in R&I for the recovery

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Literature review

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INTRODUCTION

This 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: Lukas Borunsky, Ana Correia, Roberto Martino, Ruzica Rakic (coordinator for the review), Julien Ravet (team leader).

This edition of the review presents recent papers that highlight the multifaceted role, dynamics and policies related to R&I investments in times of crisis, but also in the aftermath of a crisis, as key drivers of prosperity, sustainability and wellbeing.

With R&I investments likely to be affected by the current economic downturn, possibly intensifying financial constraints for companies, the role of public R&I efforts to support an effective recovery is critical and deserves proper attention.

A wide range of instruments can support public interventions on R&I and several papers in this review show interesting insights on those, such as: the effectiveness of both direct funding and R&D tax incentives in increasing business

R&D, and the complementarity between these two approaches; the spatial perspective on the relationship between innovation and wellbeing; how social sciences can provide evidence for policy making around the European Green Deal; or the importance to consider R&D in light of education subsidies.

There is also a need to continue improving our understanding of R&I efforts. This implies for instance the decomposition into structural and intrinsic effects of the R&D intensity, a flagship indicator for monitoring EU's investment effort. We also need to continue strengthening the overall approach to modelling R&I-related issues, in particular through macroeconomic models, based on high-quality data.



THE MULTIPLE ROLES OF R&I IN THE COVID-19 CRISIS

Borunsky, L., Correia, A., Martino, R., Rakic, R. and Ravet. J. (2020), [Can R&I Save the Day? A Fair, Green and Digital Recovery from COVID-19](#), *R&I Paper Series, Working Paper 2020/05*

Messages Policy should: 1. promote the coordination of the R&I response to COVID-19, 2. support businesses to cope with the crisis and create innovative solutions to tackle the direct and indirect consequences of the pandemic, 3. help workers and businesses adjust to new ways of working and operating, and 4. build system-wide resilience to address long-term threats such as climate change.

This paper analyses the dynamics and role of research and innovation in the short-term context of the sanitary crisis and economic contraction, as well as in the longer term and aftermath of the crisis, as a key driver of the recovery.

With R&I being at the core of the response to the spread of COVID-19, R&I actors turned their attention and resources to halt the spread of the virus, and a surge in R&I production in the health area (drug therapies, medical publications) can be observed since the beginning of the crisis. On the other hand, the outbreak magnifies the underinvestment of the private sector in R&I activities, traditionally justified by market failures, and the importance of also supporting digital and data-driven

solutions to fight the virus.

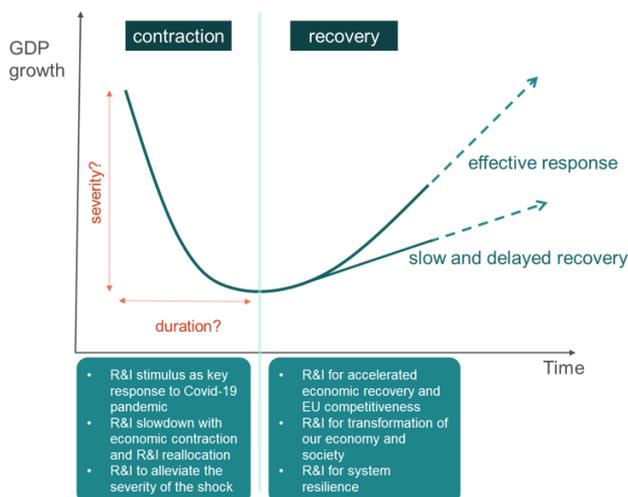
The impact of this crisis on overall R&I investment will depend on the type of economic downturn caused by the pandemic and the policy response to it. Experience from the last economic crisis shows that business R&D can slow down significantly with economic contraction. But there can be positive expectations due to supportive policy packages worldwide and the expansion of innovative responses in the business sector.

With the adaptation of economies and societies to the pandemic, there have been wide ranging changes to the organisation of workplaces or work in general and to ways businesses operate.

In broad terms, these adaptations have accelerated digital transformation but also have the potential to increase inequalities in the future.

Overall, policy action should also support measures that aim at building system-wide resilience to limit the impact of all such long-term threats. For a better future, creating greater resilience by design, not by disaster should be at the core of a coordinated recovery response to the COVID-19 outbreak.

Figure 1. R&I and the economic recovery from the COVID-19 crisis



FINANCING R&D INVESTMENTS DURING CRISES

Giebel, M. and Kraft, K. (2020), R&D investments under financing constraints, ZEW - Centre for European Economic Research Discussion Paper No. 20-018

Messages 1. Financing constraints significantly affect firms' R&D investments. 2. R&D investments of financially-constrained firms are even more affected in times of stress on financial markets. 3. The effect of financing constraints on R&D is also stronger for firms related to a bank with weaker balance sheet.

The authors analyse the impact of credit constraints for firms on their R&D investments when taking into account economic conditions (i.e. 2007-2009 financial crisis) in general and the impact of constraints of banks themselves (strength in terms of bank capital).

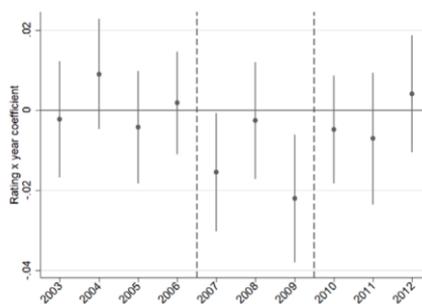
The role of banks is crucial for R&D investments in bank-based systems like Germany. A negative bank shock is likely to affect firm financing by increasing borrowing costs and lowering credit supply. As a result, firms with higher financing constraints face larger problems during a financial crisis and are likely to reduce their R&D spending to a greater extent than firms with lower financing constraints.

The analysis is based on firm-level data for 3,252 German companies (CIS data). The authors used the bank account information of companies to combine their firms' data with bank balance sheets (Bankscope). They identified financially-constrained firms by applying a credit rating index calculated by the largest German credit rating agency, Creditreform.

The results show that financial constraints matter for R&D in general and became more relevant during the financial crisis: financially-constrained firms reduced their R&D more than other firms during the crisis. Banks with weaker balance sheets also appear to transmit their problems to their corporate customers.

In terms of policy implications, the authors stress the importance of considering bank capital as strengthening the bank balance sheet is an important device to achieve stability in times of turbulence on financial markets. They also highlight that access to finance is key in order to realise innovation activities, with two additional sources of external finance that need to be considered: subsidies and venture capital (VC). R&D subsidies are essential to support innovative firms in general, but they are even more valuable in times of financial crisis. Venture capital is also a very important source of funding for younger firms, even if VC opportunities may be sparse, as stressed by the authors for Germany.

Figure 3: Impact of firm financing constraints on R&D over time



LINKS BETWEEN WELLBEING AND INNOVATION

Lenzi, C. and Perucca, G. (2020), [The nexus between innovation and wellbeing across the EU space: What role for urbanisation?](#), *Urban Studies*, Vol 57, Issue 2

Messages

1. Technology-intensive innovation shows impact on wellbeing only in the most urbanised regions. 2. Less technology-intensive types of innovation spread the benefits more homogenously. 3. Innovations affect wellbeing also through spatial spillovers, which are particularly relevant in less urbanised regions.

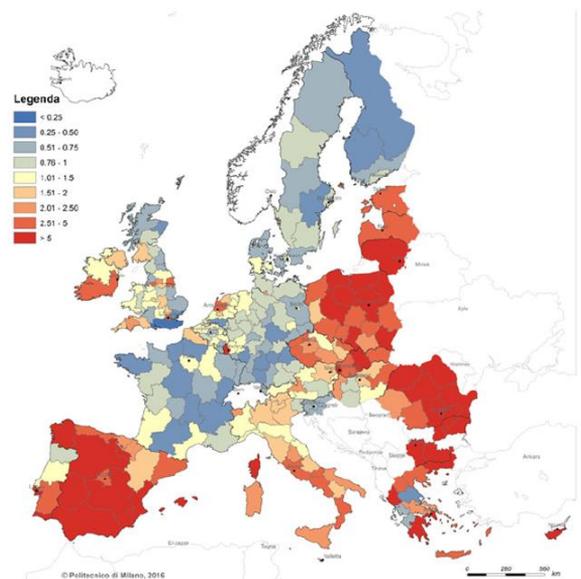
This paper investigates the relationship between types of innovation and subjective wellbeing in a spatial perspective. The initial argument suggests that the positive link between innovation and wellbeing can vary as different types of innovation and spatial setting are considered.

The authors map different types of innovative activities with technology-intensive ones represented by patents and less intensive represented by trademarks. Wellbeing is measured based on life satisfaction questions extracted from Eurobarometer surveys and spatial dimension is characterised by the degree of urbanisation. The analysis takes advantage of regionalised datasets on wellbeing derived from various waves of Eurobarometer data, patents and trademarks at the EU NUTS2 level.

The results indicate that different types of innovation have different impacts on wellbeing across space. Technology-intensive innovation demonstrated by patents yields its benefits in the most urbanised regions, which can be explained by the need for more sophisticated demand, more openness to radical innovations, etc. On the other hand, the impact of less technology-intensive innovation, such as trademarks, remains more homogenous

in space. As different innovation types deliver different effects on wellbeing, the design of local innovation-centred competitiveness strategies should reflect on that.

Local spillover effects also play an important role for individual wellbeing, across types of innovation and degrees of urbanisation in regions. Furthermore, the paper offers some reflections on regional innovation policies that are relevant for the ongoing debates on place-based regional policies.



LOCAL APPROACHES TO THE EUROPEAN GREEN DEAL

McCann, P. and Soete, L. (2020), [Place-based innovation for sustainability](#), Publications Office of the European Union, JRC121271

Messages

1. Social sciences are essential in providing evidence on policies related to the European Green Deal. 2. While Green Deal asks for a bottom up approach, policy-sharing and development have to go beyond local institutions. 3. The shift in Smart Specialisation Strategy (to 4+) requires improved guidance, along with new evidence and best-practice sharing.

This report explores how science for policy can support the implementation of the European Green Deal and the new EU policy for sustainable development. It presents reflections of the authors, backed up by a consultation with a broader academic community gathering expertise in both innovation policy and regional development policy.

The authors consider the new policy agenda with sustainability in the front seat an opportunity for the EU. To frame the opportunity in a policy context, they elaborate on experience from two experimental innovation policies in the EU: the smart specialisation policy, implemented through the European Regional Development Funds, and the mission-oriented policy, implemented through the upcoming Horizon Europe programme. In their view, the European Green Deal represents at the same time the European 21st century Moonshot mission and Europe's smart specialisation strategy at the global level.

Given the large scale of Green Deal and related policies, their design and implementation would benefit from a "science for policy". This could provide a platform reflecting on interaction of sustainability, competitiveness and inclusiveness and trade-offs between these three objectives. Therefore, an

updated place-based innovation policy for sustainability will require a solid multilevel governance and a policy, which opens up new opportunities in the EU, where a full use of subsidiarity is relevant for an effective innovation-driven policy.



While the authors consider Green Deal an innovation-driven initiative, they demonstrate the importance of local engagement and bottom-up decisions. In their view, place-based innovation for sustainability would support local actors and channel findings on local innovation barriers to the EU and national policy making. Although Smart Specialisation strategies have built the foundations, there is a need to close the gap between the bottom-up leadership and the new directionality of sustainability and inclusiveness. The authors speak about newly-focused S4+ Smart Specialisation agenda of the future.

GOVERNMENT AS A KEY PROMOTER OF INNOVATION

Ledley, F. D. (2020), Government as the First Investor in Biopharmaceutical Innovation: Evidence From New Drug Approvals, 2010–2019, Institute for New Economic Thinking, Working Papers.

Messages **1. Public sector has been a key contributor to basic research and innovation in the biopharmaceutical sector in the US. 2. The National Institutes of Health (NIH) funded research associated with every new drug approved between 2010 and 2019 in the US. 3. The funding also materialised into 22,000 new patents in the sector.**

The paper investigates the role of public sector-funded basic research in the approval of new drugs in the United States, as well as the magnitude and the different forms the funding took to promote basic research and (subsequently) innovation in the biopharmaceutical sector.

The authors start by identifying 365 new drugs approved by the US Food and Drug Administration related to the period 2010-2019. They then trace back the funding that the NIH has attributed to research publications related to each of these drugs, including their biological targets. The main finding illustrates the importance of public investments in research in biomedical sciences as “NIH funding contributed to research associated with every new drug approved from 2010-2019, totalling USD 230 billion”.

When assessing the character of the NIH funding allocated, the authors found that it took various forms- from support for investigator-initiated research projects,

cooperative agreements for government-led research on relevant topics, research program projects, to centers and training to improve research infrastructures. As the figure shows, research projects have received the most support, but it is possible to observe that the contribution of NIH funding goes beyond support to traditional research projects, encompassing as well support to capacity-building and infrastructures.

Moreover, the paper looks into NIH-funded patents associated with approved drugs as a measure of innovation in the sector. The main result is that NIH funding was related to 22,000 patents, including “marketing exclusivity for 27 (8.6%) of the drugs approved in 2010-2019”.

The authors conclude that more attention should be given to the role of the public sector in promoting research and innovation, and that we need to better factor in the public returns from that effort.

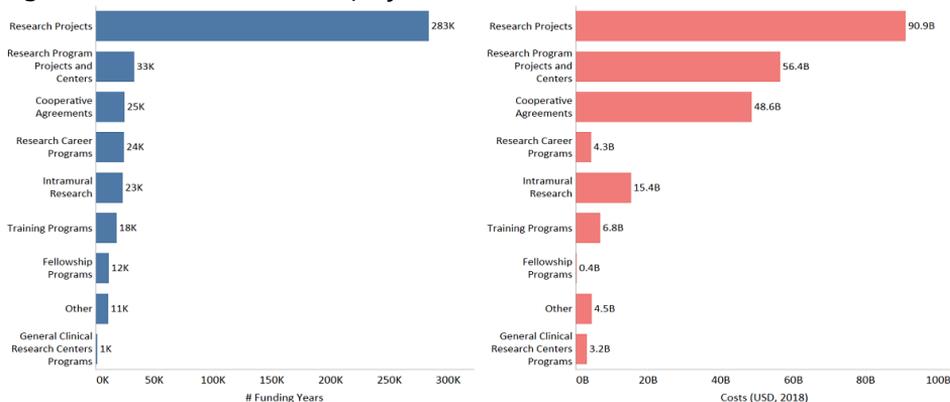


Figure 11. Funding Years (left panel) and Project Costs (right panel) associated with different forms of NIH funding since 2000.

INPUT ADDITIONALITY OF PUBLIC SUPPORT TO BUSINESS R&D EXPENDITURE

OECD (2020), *The effects of R&D tax incentives and their role in the innovation policy mix: Findings from the OECD microBeRD project, 2016-19*, OECD Science, Technology and Industry Policy Papers, No. 92, OECD Publishing, Paris

Report will be presented at the [EC-OECD Innovation and Growth Webinar Series](#)

Messages 1. R&D tax incentives and direct funding are effective in increasing business R&D investment. 2. Input additionality (the amount of R&D induced by one monetary unit of public funding) of R&D tax incentives is larger for firms that perform less R&D. 3. Tax incentives and direct funding complement each other in support of experimental development and research (basic and applied).

This report looks at the impact of R&D tax incentives across different types of firms and is trying to assess whether they are more or less effective than direct funding of BERD.

The authors use two analytical approaches: 1. cross-country analysis based on pooled, non-disclosive micro-aggregated data for 20 OECD countries. 2. Distributed country-specific analysis based on confidential firm-level data within 14 countries.

Some of the main findings from the cross-country analysis include: 1 EUR of either tax incentive or direct support translates into 1.4 EUR of business R&D investment. Direct support is more effective in inducing experimental development, while R&D tax incentives

are more effective in inducing research (basic and applied). The input additionality of R&D tax incentives is larger for small and medium-sized firms in comparison to large companies. This follows from the fact that smaller firms perform, on average, less R&D than larger firms. In addition, tax incentives have different impact on different sectors, the report finds less input additionality from tax incentives for firms in highly R&D-intensive industries (Pharma, ICT).

The firm-level analysis compares R&D-performing firms that start receiving tax relief or direct support with similar firms that do not depend on such support. This country-specific analysis of the effect of tax incentives and direct funding is consistent with the average effects found in the cross-country analysis. The results however reveal a substantial heterogeneity in input additionality across countries. In authors' view the reasons include differences in the uptake and distribution of indirect and direct support measures across different types of firms.



IMPACT OF PUBLIC PROCUREMENT FOR INNOVATION

Stojčić, N., Srhoj, S., & Coad, A. (2020), *Innovation procurement as capability-building: Evaluating innovation policies in eight Central and Eastern European countries*, *European Economic Review*.

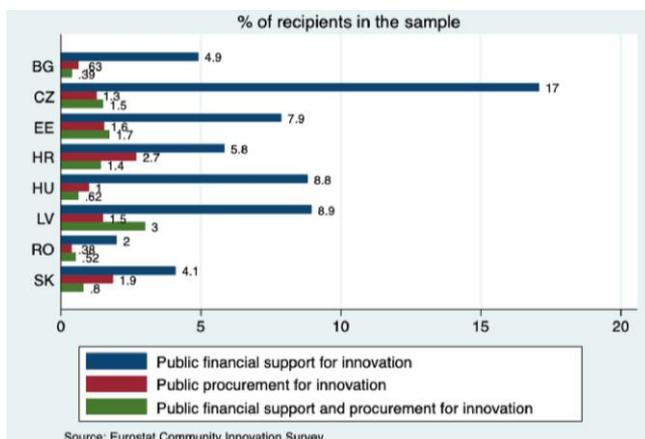
Messages **1. Public procurement for innovation (PPI) has a large effect on both innovation and output. 2. The additionality effect on firm performance is reinforced when there is both public financial support for innovation and PPI. 3. Innovation-led growth model in these catching-up economies should consider PPI to strengthen it.**

The paper discusses the transition in eight central and eastern European economies from an “imitation to (an) innovation-driven” model for competitiveness, notably focusing on how to best leverage public funding and PPI to boost firm performance and outcome additionality. As argued by the authors, public support for innovation can be an essential tool for catching-up economies that are “in transition from middle to high-income levels”, so the choice and the design of policy instruments matters, both on the supply (e.g. financial incentives) and demand side (e.g. public procurement).

In particular, the authors argue that, relative to more advanced economies, catching-up countries still need substantial efforts to boost the absorptive capacity of firms, including new innovation and management capabilities and skills, as well as more developed research and technology infrastructures. It is in this context that the authors find that grants or tax breaks would not be enough, but that combining that support with PPI can have a stimulating role to advance those capabilities and thus reap larger benefits from innovation. The authors use the Community and Innovation Survey (2012-2014) to get a database of 41,623 firms from Bulgaria, the Czechia, Estonia, Croatia, Latvia, Hungary, Romania, and the Slovakia. Out of those, 8135

have engaged in either product or process innovation. The figure shows that financial support remains the dominant type of support: “the share of firms receiving either PPI alone, or in combination with public financial support for innovation, is below 2%”. This shows that there is potential for the region to increase the use of PPI.

Overall, the paper concludes that in catching-up economies there are large and positive effects of “both public financial support and PPI on the introduction of innovations and the commercialisation of both radical and incremental innovations.” Moreover, the effects seem to be larger when the policy mix combines both financial incentives and PPI. This means that there are benefits for these countries from exploring both “push and pull” measures to drive firms’ innovation and competitiveness, rather than doing it in an isolated manner.



EDUCATION AND INNOVATION FOR ECONOMIC GROWTH

Akcigit, U., Pearce, J. and Prato, M. (2020), [Tapping into Talent: Coupling Education and Innovation](#), University of Chicago, Becker Friedman Institute for Economics Working Paper No. 2020-137

Report presented at the [1st Conference on Moving the Frontier of the Macroeconomic Modelling of R&I](#)

Messages 1. Innovation policy must tackle talent allocation, as talent cannot be substituted with other resources. 2. Innovation policies (e.g. R&D subsidies) are more efficient in the short run, while education policies (e.g. education subsidies) take longer time to transmit to the growth rate, but are the most effective policy tool in the long run.

This paper looks at the impact of education and innovation policies on individual career choice and aggregate productivity in Denmark between 2002 and 2013.

The authors use micro-level data from Denmark. The dataset provides detailed information on an innovation and education policy change implemented in 2002, which introduced new R&D subsidies and substantially increased funding to universities and the level of PhD enrollment.

The main policy implication of the paper is that innovation policy must tackle talent allocation, as talent cannot be substituted with other resources. Many policies targeted at growth fail due to talent allocation.

When having limited financial resources for innovation policy, the preference should focus rather on educational subsidies than on firms' subsidies. Nevertheless, the time span plays a role. Short-term considerations (next five years) favour subsidising

R&D. Long-term considerations (more than five years) favour investment in education as the optimal intervention.

Finally, the optimal policy will depend on the amount of parental income inequality in the society. In highly unequal societies, education policy is likely to be more effective than R&D policy given that the education policy can support credit-constrained people with talent. On the other hand, in equal societies, R&D subsidies are more likely to be effective. The reason behind is financial frictions in obtaining education will be limited, however R&D subsidies can increase the available resources for researchers and incentivise those who would have otherwise not worked in research to consider academic career.



CORPORATE R&D INTENSITY DECOMPOSITION

Moncada-Paterno-Castello, P., Amoroso, S. and Cincera, M. (2020), [Corporate R&D intensity decomposition: different data, different results?](#) *Science and Public Policy*, 2020, 1–16

Messages 1. Empirical studies sometimes lead to contradictory results when examining the causes of business R&D intensity gap, while relying on similar data and methodology. 2. BERD data are more accurate for territorial analysis of private R&D activities. 3. Global corporate R&D investment can be best analysed using EU R&D Scoreboard data.

Decomposition of the aggregate corporate R&D intensity can be used to explain the differences in R&D intensity between countries by determining whether they are the result of firms' underinvestment in R&D (intrinsic effect) or of differences across sectors (structural effect). However, empirical studies sometimes lead to contradictory conclusions, although using similar data. This paper examines how the use of different data sources and analytical methods affect R&D intensity decomposition results, and what the analytical and policy implications are.

The most widely used international data series on firms' R&D are (i) Eurostat statistics on Business Expenditure on R&D (BERD), (ii) JRC-IPTS statistics from the EU Industrial R&D Investment Scoreboard, (iii) OECD-STAN database and Analytical Business Enterprise Research and Development (ANBERD) database. The first provides aggregated data, at the national and regional level, and the second individual data at firm level.

The results suggest that studies that use BERD or ANBERD data identify sectoral composition as the main determinant of

the EU business R&D intensity gap when the industrial structure of the economies is taken into account. Otherwise, they indicate intrinsic effects as the main cause of the intensity gap. On the other hand, when using the EU R&D Scoreboard data, studies always show that structural differences across sectors can better explain business R&D intensity gap.

The paper suggests that the aforementioned datasets should be used for complementary purposes. EU R&D Scoreboard data are best suited for the analysis of global R&D performance and economic competitiveness of European multinationals at the level of firms. BERD data are more precise for territorial analysis of private R&D activities although they do not account for the outflow activities of the foreign-affiliated companies in a given country.



MACROECONOMIC MODELLING OF R&I

Annicchiarico, B., Licandro, O., Mohnen, P., Ortega, E. and Veugelers, R. (2020), [Moving the Frontier of Macroeconomic Modelling of Research and Innovation Policy](#), Luxembourg: Publications Office of the European Union.

Report presented at the [1st Conference on Moving the Frontier of the Macroeconomic Modelling of R&I](#)

Messages	1. There will never be one perfect or right model: “all models are wrong, but some are useful.” 2. When using macro-models for R&I, choices have to be made about which features and policies are more relevant, depending on the objectives and the policies being evaluated 3. There is a need to both strengthen incumbent models and develop new ones.
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This report aims at identifying characteristics and properties of R&I that should ideally be included in macro-models, notably to support R&I policy, as well as the main R&I policies used in practice that those that macro-models need to include in order to produce well-founded assessments.

The report also provides a review of the main macroeconomic models used today for assessing EU R&I policy. While these models all present a rich set of mechanisms and parameters, none of them appears to cover all of the key characteristics of R&I and R&I policy.

The authors highlight that no single macro model can simultaneously account for all features, enablers and policy instruments and still consistently produce the accurate quantitative figures needed for the macro-evaluation of all current R&I policies.

Hence, choices need to be made, depending on objectives and policies being evaluated. A few principles should be kept in mind when making these choices, such as: the inclusion (ideally) of heterogeneous firms and heterogeneous production and R&I technologies; a common core for results

when using different models to study different R&I features; the need to mimic a multi-country/region Europe trading with the rest of the world; heterogeneity across workers and households and associated dynamics (related to social inequalities); and environmental and climates issues.

In their recommendations, the authors call for helping incumbent models becoming more useful for R&I and R&I policy analysis, as well as helping the development of new models which are better able to assess R&I and R&I policy analysis.

There is also a need to improve data availability for modelling of the key R&I features and key R&I policy interventions. Transparency should be improved for all models to enable a more informed use of results by policy makers and to enable a more interactive mode of continuous development of the models.



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The “Quarterly R&I Literature Review” provides a brief summary of a selection of recent publications on R&I economics and policy.

The aim of the Review is to inform policymakers on the latest findings from the literature that links R&I economics to R&I policy.

This edition presents recent papers that highlight the multifaceted role, dynamics and policies related to R&I investments in times of crisis, and also in the aftermath of a crisis, as key drivers of prosperity, sustainability and wellbeing.

The Literature Review, together with the Working Papers and the Policy Briefs, is part of the “R&I Paper Series” which serves as a repository of analytical papers that supports an evidence-based EU policy, for R&I and beyond.

Studies and reports

