Editorial

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A recent three-year national strategic project (financed by the Italian Ministry of Education and Research) on the assessment of the economic impact of policy instruments devoted to promote business R&D, represents the motivation and scientific background of this special issue. During and after the project, the guest editors have had the opportunity of broadly discussing results and new research approaches for assessing the effects of R&D and innovation policies with many colleagues in national and international conferences and workshops. In the footsteps of this fruitful experience, this special issue has been thought for calling and gather a range of new good-quality contributions around the many questions which are still open in this field and that deserve further analysis and better understanding.

The special issue collects eight papers dealing with significant theoretical and empirical advances in the analysis of the effect of public incentives on firm R&D and innovation performance. So far, although several studies have provided sound evidence-based analyses on this subject, many aspects still needs to be explored, especially along three lines of inquiry demanding:

1 further exploration in terms of even more precise econometric techniques, especially those incorporating non-linearity and other complexities, and accounting for individual heterogeneity

2 more in-depth investigation of the processes through which policies take place in specific institutional contexts, with a specific focus on the relation between funding public agencies' and firms' interactive behaviours and strategies

3 better identification of the set of feasible and appropriate indicators required to perform sound evidence-based evaluation and policy guidance in a science, technology and innovation (STI) environment.

The papers forming this special issue broadly deal with these lines of research. Both theoretical and empirical works, taking on different approaches and theoretical perspectives, are herein presented. As such, this special issue aims at encouraging a board-spectrum discussion and a critical re-thinking of the subject.

What follows provides the reader with a very concise exposition of the collected papers, with the explicit purpose to point out for each paper: the main objective, a brief discussion of the methodology and some interesting findings. Although selected via an open and competitive call-for-paper (with a guest editors' pre-screening and a peer review process), these papers are striking for their mutual consistency and

complementarities. As such, we deem them able to serve as a valuable tool for all scholars interested in the subjects covered by this publication.

1   The opening paper by Cerulli and Potì discusses various aspects concerning the design of the ex-post effect assessment of R&D and innovation (RDI) policies. The authors review the literature, provide an original 'logical framework', and then critically list and discuss the basic elements needed for a reliable (ex-post) evaluation design of an RDI policy. As such, this paper may be taken as a preliminary reading of the papers that follow. The paper's main message is that agents' behaviours, factors affecting their decisions, and quantitative (econometric) methods, are to be jointly considered for an evaluation design to be reliable, effective, and thus useful to policymakers. The ending part of the paper pays particular attention to some 'open questions' concerning RDI policy ex-post assessment and it is thought of as a way for helping to improve, and better steer, future evaluation exercises in this field.

2   Antonioli and Marzucchi analyse critically the concept of 'behavioural additionality' (loosely defined as changes in beneficiaries' behaviours resulting from the policy intervention) in the light of the evolutionary theory of 'system failure', as opposed to the 'market failure' approach of the mainstream literature. In particular, the authors review carefully some recent econometric and quantitative studies dealing with the measurement of the behavioural additionality at firm level, by stressing pros and cons of the main typologies of econometric strategies followed by various scholars. They conclude by supporting the need to jointly analyse input, output and behavioural additionality, as they are strictly linked and interdependent, and by stressing the importance of a better understanding and measurement of agents' 'interrelations' (within a systemic approach, looking also at welfare effects) via an integration of programme evaluation econometrics and sociological quantitative tools, such as – for instance – the network analysis.

3   The paper by Duch-Brown, García-Quevedo and Montolio deals with the selection process operated by a Catalan public agency to select suitable R&D projects of a number of Catalan innovative firms. As such, it assumes an 'ex-ante' perspective. The authors compare the projects' ranking from two different decision rules, one drawing upon the 'actual' process adopted by the public agency based on the 'peer review method' (i.e., experts' judgments), the other based on a more quantitative method, the data envelopment analysis (DEA), aimed at assigning higher scores to projects with higher outputs for given inputs (i.e., the most efficient projects). The latter is taken as one of the methods private firms actually use for ranking their portfolio projects, by assessing projects' value through their expected rate of return. The authors starts by comparing the rank of the peer review method with the simulated ranking obtained when the DEA is applied. They find that the difference in the score is not negligible, although a good deal of overlap also occurs. Interestingly, they then compare the ex-post R&D additionality of the two selection criteria and make use of the 'expected R&D performance' associated to the policy, as declared by the firms involved in their application questionnaire. They find, quite unexpectedly, that the DEA selection rule leads to higher additionality than the (actual) peer review rule. The authors conclude that the selection procedure matters for final policy success/failure, and that public agencies should take it into proper account. Nevertheless, these results draw upon two important assumptions: first, it is

supposed that the agency's primary aim is that of fostering input additionality, when an agency might also ponder 'welfare' (i.e., indirect) effects, such as employment growth, aid to firms in disadvantaged conditions, etc.; second, the use of firm expected R&D spending as a proper output indicator is correct only in the case in which expectations are formed independently of the selection rule adopted by the agency (that, in the case of the authors, is the peer review). Beyond these limitations, the paper is a first daring attempt to go into a rigorous exploration of the 'potential' policy effect under different selection criteria.

4 The contribution of Klette and Møen is an ambitious attempt to build a bridge between formal theory and empirical analysis in the field of R&D and innovation policy evaluation. The study considers a specific Norwegian support policy for high-tech firms taking the form of a 'matching grants', where firms are asked to contribute a fifty percent own risk capital to the subsidised projects. In the first part of the paper, the authors find neither crowding-out nor additionality for this instrument, thus suggesting a neutrality effect. Only large firms seemed to have been successful by getting – on average – a 25% of additionality. But the most innovative part of the paper is in its dynamic analysis. There, the authors find that lagged subsidies have a positive impact on current firm R&D activity, and suggest that this contradicts the predictions of the permanent inventory model – the traditional R&D investment model – according to which a positive R&D today should discourage the growth of future R&D. This approach does not seem appropriate to model R&D investment behaviour. To reconcile their finding with theory, the authors provide a model of R&D dynamic evolution based on a modified version of the permanent inventory incorporating company 'learning-by-doing'. They show that, in this case, it is possible to support that higher R&D today is consistent with higher R&D tomorrow. Why? By and large, the reason is as follows: suppose that a subsidy is effective and able to increase current R&D, then it feeds a larger present knowledge stock that in turn makes future costs of doing R&D less costly. This is a sufficient condition to create an incentive to perform higher R&D tomorrow, as this has become a cheaper activity than in the past. Finally, Klette and Møen apply a structural econometric model incorporating learning-by-doing, by exploiting a dedicated questionnaire on Norwegian companies. The results confirm the initial 'neutrality' outcome and suggest also that the matching-grant did not modify company marginal price of R&D (namely, beneficiary firms were not financially constrained); given this, no additionality was associated with subsidies in the period in which they were awarded.

5 The paper by Bloch and Graversen examines the effect of public funding on R&D performance in a sample of Danish firms from 1995 to 2005. It sets out important improvements compared with usual R&D input additionality studies mainly in two directions: first, it considers subsidies in level, an aspect that allows the authors to jointly model – within a system of simultaneous equations – the public agency selection, the agency's choice on the 'level of treatment' (subsidy intensity), and the firm R&D behaviour; second, it estimates the R&D equation by a dynamic panel data approach that allows for incorporating persistency in doing R&D. The authors find evidence of significant complementary effects, with a 1% increase in public funding yielding a 0.10% to 0.12% increase in privately funded R&D.

6   Also the paper by Papa deals with input additionality of R&D policies. The author applies a structural econometric model, but differently from that by Bloch and Graversen, he introduces the firm choice of doing (or not doing) a continuative R&D activity. This approach allows for studying the effect of a subsidy – taken here on a binary form – within a system of three related equations: one explaining the selection rule of the agency, one – as said – modelling firm choice to do or not to do a continuative R&D, and one accounting for the level of R&D to perform. In this way, the model assumes subsidy's endogeneity, where the identification of parameters is contingent to errors' joint normality assumption (*à la* Heckman). Compared to the traditional Heckman selection model (Heckit), the author tries to make the choice of doing R&D endogenously determined. The author estimates four sub-models: the first one is a standard OLS, where neither the selection nor the R&D choice equation is considered; the second is a Heckit model, where the choice of doing R&D is not considered; the third is a treatment model, where the selection equation is this time excluded; and the forth, finally, is the full model, where all the three equations are included. The author finds that, unlike the OLS, the subsidy binary variable has a positive coefficient, but not significant in the full model, thus suggesting high effect's dispersion around the mean. This leads the author to conclude that endogenising the choice of doing R&D changes the results, by suggesting that part of the significant effect found by the OLS should be explained by agency's strategy to 'pick' companies with higher propensity to do R&D in a continuative way. Although CIS data do not provide subsidy levels, and although results are based on strong distributional hypotheses, this paper represents an interesting and valuable attempt to improve on existing literature on structural models for R&D programme evaluation.

7   The study by Czarnitzki and Lopes Bento focuses on a cross-country comparison of the effect of public funding on firm internal R&D investment and total innovation intensity. The paper stresses the role of 'heterogeneity', by comparing five different countries characterised by different industrial structure and policy-mix. They use harmonised micro-data, based on the community innovation survey (CIS) structure. With the exception of one country (where probably an 'aiding the poor' strategy may be invoked), all the countries would benefit from an extension of their subsidy policies. The paper is a first interesting attempt to compare policy effects in different national contexts with harmonised data, although this comes at the cost of a reduced number of covariates and information (as, for instance, about the knowledge of subsidies' level).

8   The paper by Barbieri, Iorio and Lubrano-Lavadera, finally, by evaluating the effect of a specific Italian R&D and innovation policy instrument, the Law 46/82 (part I, FAR; and part II, FIT), aims at introducing an analysis of additionality for a 'policy mix'. The authors exploit an unusual long time series of data from 1995 to 2003 using the Capitalia/Unicredit surveys, and the difference-in-differences (DID) as estimation tool. One interesting advancement regards the application of a 'multiple treatment' through which the authors may consider simultaneously also the effect of 'other incentives' within their regression analysis. As for results, the study concludes that – on the overall sample – both parts of the Law 46/82 does not succeed, while only 'other incentives' have a positive and significant effect. Only for large firms the first part of the Law 46/82 (i.e., FAR) seems successful. Although the authors' construction of the two Law 46/82 binary indicators (one for FAR and the other

for FIT) should assume statistical independence between these two different sub-instruments, the paper shows that technical advancements in programme evaluation techniques (such as the use of multiple treatment) may be of great worth to overcome the limitations imposed by evaluation exercises in presence of policy interventions characterised by a complex and articulated design.

Acknowledgements