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Is Italian science declining?

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ABSTRACT

The paper analyses the Italian contribution to the world scientific production, its relative citation impact, its international collaborations and scientific productivity compared with the most productive EU countries over the period 1980–2009. It shows that despite the fact that the level of funding has been dramatically low during the past decades, Italian science has been able to increase its performance up to 2007. Italian science is a "cathedral in the desert". However, a recent reduction in the level of scientific production, the lagging behind in international scientific collaboration (highly correlated with the relative citation impact) and the great heterogeneity of researchers' productivity (absence of correlation of number of researchers with quality and quantity of scientific production) may mark the start of a decline of Italian science. The paper concludes that the increased funding must go hand-in-hand with reform of autonomy and governance and calling for a sound system of internal quality control and performance enhancement.

1. Introduction and research questions

Basic research carried out at universities and public research organizations is a crucial important driver for innovation, economic progress and social welfare (e.g. Adams, 1990; Griliches, 1998; Henderson et al., 1998; Mansfield, 1995; Rosenberg and Nelson, 1994) and could be managed in a recession period, like the current one, in an anti-cyclical perspective.

Both in the literature and in the political and public debate there is an increasing recognition of the role of universities as strategic actors in knowledge creation and diffusion (Etzkowitz et al., 2000; Bonaccorsi and Daraio, 2007). Universities' scientific production concerns especially basic research, but the results which are generated are not only long-term ones but produce spillovers that have short and medium term effects on industrial innovation (Mansfield, 1991).

Recent trends in the growth of international collaboration – as evidenced by co-publication, the emergence of international collaborative programs and increased mobility of scientists – and the growth of international comparison of scientific performance – as reflected in the frequent publication of benchmarking comparisons and ranking of scientific institutions (see Harvey, 2008) – give evidence of the growing internationalization of scientific activity.

The increasing use of economic rationales to support increased public funding for research has its natural corollary in the desire for evaluations to ascertain whether the promised benefits are actually being delivered.

Despite the methodological problems that may arise in estimating the economic returns to public investment in basic research, according to Martin et al. (1996), the main contributions that publicly funded research makes to economic growth are: increasing the stock of useful knowledge; training skilled graduates; creating new scientific instrumentation and methodologies; forming networks and stimulating social interaction; increasing the capacity for scientific and technological problem solving; and creating new firms.

Salter and Martin (2001) critically reviewed the three main methodological approaches adopted by the literature on the economic benefits of publicly funded basic research: econometric studies, surveys and case studies. Econometric studies are subject to certain methodological limitations, such as the assumption of a simple production function model of the science system, but they suggest that the economic benefits are very substantial. From the literature based on surveys and on case studies, it emerged that the benefits from public investment in basic research can take a variety of forms. The relative importance of these different forms of benefit apparently varies with scientific field, technology and industrial sector. Consequently, no simple model of the economic benefits from basic research is possible. They concluded their review stating that:

> "The literature available has shown that there are considerable differences across areas of research and across countries and

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that additional research is needed to better define and understand these differences. This limitation in current science policy research should not be seen as implying a need for less government funding of science. Rather, it indicates that public funding for basic research is, like many areas of government spending (e.g. defence), not easy to justify solely in terms of measurable economic benefits".

Carillo and Papagni (2006) put forward a model of basic research and long-run economic growth in which the incentives of social reward to scientific work may produce increasing returns and multiple equilibria.

Rich empirical evidence shows that the governance and design of research institutions matters for economic growth and development (see Guiso et al., 2004; Bennedsen et al., 2005; Persson and Tabellini, 2009; Bauwens et al., 2007).

Hanushek and Woessmann (2010), reviewing the role of education quality in promoting economic growth, conclude that there is strong evidence that cognitive skills are powerfully related to long-run economic growth. They found that the relationship between skills and growth proves extremely robust in empirical applications. They interestingly showed that the effect of skills is complementary to the quality of economic institutions. They concluded that the long-run rewards to educational quality are large but also require patience.

Aghion et al. (2009) consider that the increasing awareness of the intimate and multiple connections of technological change and innovation with advances in science, on the one hand, and of the set of socio-economic institutions operating in a given context, on the other, encourages the conceptualization of "science, technology, innovation and growth systems" as appropriate subjects for policy-oriented research. Policy complementarities should be hence pursued in a larger dynamic system perspective among education, competition, macroeconomics and labour market; see also Aghion et al. (2008).

In a system driven by public funding, evaluating research is a key preliminary requirement (see e.g. Georghiou, 1995; Geuna and Martin, 2003; OECD, 2006; Whitley and Gläser, 2008). This is becoming more and more important given the broader changes in public sector management and the needs for accountability required by stakeholders. In such a context, it is imperative to define and implement effective evaluation systems that, in support of the allocation processes, stimulate adoption of a strong strategy and practices for increased productivity, both in quality and quantity, by universities and public research organizations. Evaluation is fundamental to allocate incentives to scientific excellence and as instruments for strategic choices on the part of political decision-makers (Van Raan, 2004; Narin and Hamilton, 1996; Moed et al., 1995).

Compared to other sectors, the university sector in Italy has the largest public human capital employed to produce R&D. According to the data from the General Accounting Office of the State (Ragioneria Generale dello Stato), in 2008, 89% of R&D full time equivalent funded by the state, persons with a permanent position worked in universities as assistant professors, associate professors and full professors, whilst the remaining 11% work in public research centres.

The evaluation of the Italian R&D system has been analysed in the literature (see e.g. Silvani and Sirilli, 1995). In particular, Woolf (2003) studies previous attempts towards a university reform in Italy that proved dismal in the context of higher education policy in Western Europe, due to the pervasive power of academic mandarins, technocratic methods of reform, and the recurrent expectations that import of foreign models will resolve contradictions that are deeply rooted in Italian power relations.

Biggeri and Bini (2001) examine the relationships between the State (the Ministry of the Universities) and each university in Italy, and the evaluation system established in 1996 and revised by the law of 1999. They discuss the system of indicators to be used for the evaluation and for the allocation of specific funds in terms of incentives, and to their possible effects on the decisions of the universities' management.

In 2003 Italy started up its first national research evaluation, a Triennial Research Evaluation, which referred to the period 2001–2003, with the aim to evaluate, using the peer review method, the excellence of the national research production. The evaluation involved 20 disciplinary areas, 102 research structures, 18,500 research products and 6661 peer reviewers (1465 from abroad); it had a direct cost of 3.55 millions euros and a time length spanning over 18 months.

Using the data on the research assessment exercise of 2003, based on peer review, some papers have analysed them and compared with bibliometric evaluation (see Abramo et al., 2009; Franceschet and Costantini, 2009).

A second evaluation exercise, assessing the time period 2004–2008, is currently being prepared.

With the Decree no. 76 of the 1st February 2010 it has been approved the functioning and organizational structure of the Italian National Agency for the Evaluation of the University System and of Research (ANVUR, Agenzia Nazionale per la Valutazione del Sistema Universitario e della Ricerca) established 4 years ago with the law no. 286 of the 24 November 2006. According to the Decree no. 76/2010 the ANVUR is lead by a Committee (Consiglio Direttivo) composed of seven members with at least two men and two women, that are selected among experts, also foreigners, with an high and recognised experience in the research and higher education sectors, and in particular in the evaluation of these activities, coming from different disciplinary and professional fields.

The submission to a Selection Committee of proposals for experts was closed on 20 September 2010. Currently[2] the Selection Committee is examining the CVs of the proposed experts and will nominate between 10 and 15 experts to the Ministry of Education and Research that will be in charge of choosing among these names the seven members of the Board of Directors (Consiglio Direttivo) that will run the ANVUR. The Selection Committee applies the following criteria:

(a) consolidated experience in evaluation, at a national and/or international level;
(b) consolidated experience in the direction of structures with high complexity, at a national and/or international level;
(c) a high international scientific profile.[3]

The Italian government has decided to carry out a plan, according to which the budgets of all Italian universities will be reduced by 7% (this percentage has to be increased in the next years up to 30%). This 7% is put in one single basked, and re-distributed to universities on the basis of demonstrated research quality. Research quality is measured mainly on the basis of peer review, by external, mostly foreign reviewers who review the submitted "best" papers of each researcher.

There is a current debate in Italy on the university reform. Some of the recurrent points of view in the debate appeared also in the journal Nature. Some believe that the Italian university system is

[2] At the moment we submit the paper, 15 December 2010.

[3] The first document no. 1/2011 issued by the ANVUR approved the 22nd of June 2011 is about "Criteria and parameters for the evaluation of candidates and evaluators for the national scientific qualification" (available at www.anvur.org). This document states that the necessary criteria to access the qualifying examination are: 1. having the parameters of the quality of scientific production (normalized by the academic career) higher than the median of the associate or full professors in the same disciplinary field; 2. showing a reasonable continuing scientific activity. Interestingly, the same necessary criteria are required for the evaluators.