THE EVALUATION OF SCIENTIFIC RESEARCH ON THE BASIS OF ESTIMATION PARAMETERS IN ECONOMICS

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Below are some considerations following on from a past Editorial entitled "The evaluation of scientific research: the result of merit-based or discretionary criteria?" published in issue No.11 (2011) of the historical-technical journal "Conservation Science in Cultural Heritage". The Editorial looked at various tools for evaluating scientific research and expressed some reservations about the bibliometric criteria:

- *Impact Factor (IF),* the most well-known bibliometric tool, owned by Thomson Reuters – Institute for Scientific Information (ISI), which collects data from over 14,000 journals in its web portal: an evaluation system that determines the frequency with which an article is cited in a given period;
- *Peer Review,* a quality indicator typically used in selecting articles for publication;
- *Open Linking,* a reference service offered by aggregators which transforms citations into hyperlinks and allows researchers to browse online from article to article regardless of the journal or publisher;
- *H Factor or H Index,* which aims to quantify the overall scientific contribution of a researcher.

The Editorial's objective was to provide a stimulus which was strictly for reflection only and devoid of any evaluative claims – a simple explanation of the mechanisms of evaluation used and given openly – in order to apply the said evaluation criteria not only to disciplines of a technical-experimental-naturalistic nature, but also to historical-humanistic and economic areas, in particular to research in the field of cultural and environmental heritage.

With the intent of connecting the key aspects and relevant tools characterizing this evaluation with the estimation parameters that measure the ills Europe is struggling with – a Europe that today is divided by a great many conflicting national interests – the question arises: "Why not call attention to the fact that conceptual terms, fundamental in economics and greatly favoured by economists, may be proposed again, with the necessary adaptations, in certain situations existing in the field of scientific production and research?"

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The specific terms are “growth”, “inflation” and “deflation”, in reference to which it is well-known that:

a) Economic growth in a macroeconomic environment is characterized by the long and short term increase in the development of society. It corresponds to a general increase in the level of variables such as wealth, consumption, production of goods, provision of services, employment, research and so on. Zero growth exists in a situation where the economy does not grow and remains stationary or when there is negative growth, as in the case of degrowth. These situations are also found in scientific contexts relating to trends characterized by: educational activities, scientific production, number of teaching staff, international mobility of students, research projects, consultancy, partnerships, awards, on the basis of meritocratic criteria established over the years, also at an international level; the trend highlights the growth of one scientific unit with respect to another that is stationary or has negative growth.

b) Inflation in economics, on the other hand, indicates a general increase in prices which continues over a period of time. The consumer price index (CPI) is a statistical tool that measures changes over a period of time in market basket prices, a sample of goods and services typical of a given country’s household consumption.
In a scientific context it could more specifically represent one of the parameters to be followed, as it is considered significant and emblematic of a growing reality: one example is the quality of publications in this field based on common objective criteria at an international level. Just as in economics the main objective of central banks is to maintain price stability, which is one of the basic conditions for raising the level of economic activity and employment, there is no doubt that in a scientific field too, a situation which responds to a level of significant though stable level of growth is obviously an acquisition of positive quality.

c) Deflation corresponds to a general drop in prices, in other words the opposite of inflation. It is often the result of a recessionary situation in the economy, that is, of negative growth, in which the demand for goods and services contracts. This is what was underlined earlier in the case of economic contraction, in other words, when there is a decline in scientific production or even when it is non-existent. Nationally and internationally, the resulting classification in the meritocratic elite of a scientific unit determines a position at a low level and is therefore negative.

To establish the top universities in Italy, several ‘indicators’ relating to education and research[1] are used for assessment. Below is the list compiled by experts from the newspaper “*Il Sole 24 Ore*”, with input from the *Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca* (ANVUR – the national agency which evaluates the quality of Italian universities and research institutes), following the VQR (*Valutazione della Qualità della Ricerca*) report for evaluating the quality of research: the following twelve indicators were used, divided into two fields - didactics and research. The final result in the national rankings is given below.

• Didactics

- ✓ ATTRACTIVENESS: percentage of student enrolment outside regional areas out of the total number of students enrolled;
- ✓ SUSTAINABILITY: average number of teaching staff engaged in basic activities with distinctive characteristics for each degree course;
- ✓ INTERNSHIPS: percentage of credits earned after completion of internship out of the total;
- ✓ INTERNATIONAL MOBILITY: percentage of credits earned abroad;
- ✓ GRANTS: percentage of successful candidates who have earned a grant;
- ✓ DISPERSION: percentage of matriculations registered in the second year at the same university;
- ✓ EFFICACY: percentage of matriculations registered in the second year at the same university;
- ✓ SATISFACTION: post-graduates' opinion of degree programmes;
- ✓ EMPLOYMENT: number of students seeking employment one year after graduation.

• Research

- ✓ EXTERNAL FUNDS: ability to attract resources for projects;
- ✓ RESEARCH: opinions obtained by research products in the ANVUR evaluation;
- ✓ HIGHER EDUCATION: opinions obtained by higher education in the ANVUR evaluation.

The final results obtained using these indicators have allowed the following classification to be compiled. Table 1 below shows the top 30 in the list.

Table 1. Ranking of Italian universities for 2014: prepared by Il Sole 24 Ore – ANVUR - VQR

POSIZIONE	ATENEO	PUNTI
1	Verona	84
2	Trento	84
3	Politecnico di Milano	79
4	Bologna	78
5	Padova	76
6	Politecnica delle Marche	75
7	Venezia Ca' Foscari	73
8	Milano Bicocca	73
9	Siena	73
10	Politecnico di Torino	73
11	Pavia	72
12	Piemonte Orientale	71
13	Milano Statale	70
14	Ferrara	68
15	Udine	66
16	Macerata	65
17	Firenze	63
18	Viterbo	62
19	Modena e Reggio Emilia	61
20	Venezia Iuav	60
21	Torino	59
22	Roma Foro Italico	58
23	Salerno	58
24	Pisa	56
25	Siena Stranieri	56
26	Trieste	55
27	Genova	55
28	Insubria	53
29	Roma La Sapienza	53
30	Chieti-Pescara	51

In the 2014-2015 QS World University Rankings, which classifies more than 800 universities by analyzing a total of over 3000, the first Italian university, the University of Bologna is ranked 182, while last year it was188th, followed by Sapienza University of Rome 202nd, the Polytechnic University of Milan 229th, the University of Pisa 245th and the University of Padua 262nd[2]. Out of the 800, the number of Italian universities in the rankings is 27.

The Academic Ranking of World Universities (ARWU) prepared by the Jiao Tong University of Shanghai, on the other hand, places the top Italian universities among the first 500 in the world between the 151st and 200th position[3]. Among them are the universities of Bologna, Milan, Padua, Pisa and the Sapienza University of Rome.

Other results are given in the Times Higher Education (THE) classification, in which there is only one Italian university, the Scuola Normale Superiore of Pisa, number 63 in the top 200 in the world. Successive universities are listed alphabetically in groups of 25. Other Italian universities in this classification are the University of Trieste, between 201-225; the University of Milan-Bicocca, between 226-250; University of Pavia, University of Salento, University of Trento, University of Turin, between 251-275; the University of Bologna and University of Milan between 276-300. In table 2 is the THE ranking of the top 30/31 universities in the world.[4]

Table 2. Times Higher Education 2014-2015 classification of the top 31 universities in the world

Rank ▲	Institution	Location	Overall score change criteria
1	California Institute of Technology (Caltech)	United States	94.3
2	Harvard University	United States	93.3
3	University of Oxford	United Kingdom	93.2
4	Stanford University	United States	92.9
5	University of Cambridge	United Kingdom	92.0
6	Massachusetts Institute of Technology (MIT)	United States	91.9
7	Princeton University	United States	90.9
8	University of California, Berkeley	United States	89.5
9	Imperial College London	United Kingdom	87.5
9	Yale University	United States	87.5
11	University of Chicago	United States	87.1
12	University of California, Los Angeles (UCLA)	United States	85.5
13	ETH Zürich – Swiss Federal Institute of Technology Zürich	Switzerland	84.6
14	Columbia University	United States	84.4
15	Johns Hopkins University	United States	83.0
16	University of Pennsylvania	United States	81.0

17	University of Michigan	United States	80.9
18	Duke University	United States	79.9
19	Cornell University	United States	79.4
20	University of Toronto	Canada	79.3
21	Northwestern University	United States	79.2
22	University College London (UCL)	United Kingdom	78.7
23	The University of Tokyo	Japan	76.1
24	Carnegie Mellon University	United States	74.3
25	National University of Singapore (NUS)	Singapore	73.3
26	University of Washington	United States	73.2
27	Georgia Institute of Technology (Georgia Tech)	United States	72.8
28	University of Texas at Austin	United States	72.3
29	University of Illinois at Urbana Champaign	United States	71.9
29	Ludwig-Maximilians-Universität München	Germany	71.9
29	University of Wisconsin-Madison	United States	71.9

These classifications are evidently discordant and demonstrate how the different indexes and criteria used can lead to different evaluations and rankings.

It is interesting to note, that in analyzing the 2014 QS World University Rankings, the top 10 include only British and American universities, while 11 universities out of the top twenty in the world, are American.

However, with the onset of the financial crisis in 2008, this American domination has been curtailed. Of the American universities included in the top 400, many moved down in the classification compared to 2007. A diametrically opposed situation for the Asian universities present among the top 400, which moved up in the classification for the same period. The top Asian university in the 2014-2015 QS rankings is the National University of Singapore, classified 22nd.

The connection between economics and the evaluation of universities thus leads back to what was said earlier in relation to the meaning of the terms 'growth', 'inflation' and 'deflation' all of which characterize situations and conditions in any given country. These are all aspects that can influence decisions made by central banks regarding economic policy, but can rightly be considered benchmarks with criteria for evaluating the quality of cultural academic and research units.

The connection between economics and evaluating universities is even more evident when one considers the reform wanted by the Minister of Education, University and Research, Stefania Giannini, based on 'meritocracy'. Economic rewards for the most deserving universities will carry more weight: the quota of state financing, based on rewards and incentives, of the *Fondo Finanziamento Ordinario* (FFO), in fact goes up from 13.5% to 18% (i.e. from 819 million to 1.3 billion). 'Meritocracy' is a form of government where administrative offices, public offices and any role requiring re-

sponsibility towards others is assigned on the basis of merit and not membership of a lobby, family (nepotism/favoritism and cronyism in a broader sense) or economic caste (oligarchy).

The term 'meritocracy' was first used by the British sociologist Michael Dunlop Young in the book "Rise of the Meritocracy" (1958). The term was intended to be used as a disparaging one and his book was the scenario for a dystopic future in which the social position of an individual was determined by their IQ and their efforts.

In the book, the existence of such a social system ultimately leads to a revolution; the masses overthrow the elite which has become arrogant and detached from the feelings of the people. Despite the originally negative connotation of the term, the meritocratic system is fairer and more productive than other systems, besides guaranteeing the end of discrimination based on arbitrary criteria such as gender, race and social origins (or membership).

However, the question arises: how is merit measured?

The clearest definition of what kind of merit should be rewarded is given in a recent publication by Roger Abravanel, "Meritocracy", which restates what Michael Young claimed "Merit = talent + effort." Hence the principle of merit based on talent and commitment replaces less efficient allocative criteria (length of service and the like).

Italy is somewhat behind in matters pertaining to measuring merit: there is no accepted system of evaluation for measuring the quality of didactic activities. At present the only certain parameter is related to research, which is a first step in the right direction towards evaluating universities and consequently for receiving funding, but which undoubtedly needs to be perfected.

Experts from the Ministry of Education, University and Research are studying a new system of calculating the base quota, focusing on so-called 'standard costs', so that the financing each university is entitled to is closely related to the number of degree programmes, the number of students and teachers, the relationship between them, and to merit.

"A fair assessment of the university system can only foster meritocracy". This is what Marco Mancini, the then President of the Conference of Italian University Rectors (CRUI), claimed in 2012, at the same time pointing out that: "the stricter the evaluation criteria are, the easier it will be to prioritize meritocracy and avoid waste". This meritocratic approach would help internationalization to grow and therefore be more competitive on the international market enabling Italian universities to increase the number of foreign students, researchers and teachers, and so attract private funding.

Notes

1 Source: http://www.ilsole24ore.com/speciali/classifiche_universita_2014

2 Source: http://www.topuniversities.com/university-rankings/world-university-rankings/2014

3 After the first 100, successive universities are shown in groups of 50 and simply listed in alphabetical order.

4 Source: http://www.timeshighereducation.co.uk/world-university-rankings/2014-15/world-ranking

Biographical notes

Salvatore Lorusso is Full Professor in "Chemistry of the Environment and Cultural Heritage" at the Department of Cultural Heritage of the University of Bologna. He founded and is Director of the Master in "Planning and promotion of artistic and cultural events". He founded and is Director of the two book series' "*I beni culturali e l'ambiente*" (Pitagora Edizioni, Bologna) and "*La formazione e la ricerca nel settore dei beni culturali e ambientali*" (Mimesis Edizioni, Milano-Udine) and the historical-technical Journal "Conservation Science in Cultural Heritage". He is the author of more than 380 publications in national and international journals and of 22 volumes covering various subjects and sectors, such as commodities, technology and environment, focusing in particular on the field of cultural and environmental heritage. He has been Vice-President and actually Councellor of the "Società Italiana per il Progresso delle Scienze (SIPS)", established in 1839. He is General Director of the Academy of Enogastronomic Culture. He is Foreign Member of Russian Academy of Natural Sciences.

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