Two New Simple Bibliometric Indexes to Better Evaluate Research in Economics

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Abstract

The paper proposes two new simple indexes - the k *and* w *indexes - to assess a scientist's publications record based on citations. The two indexes are superior to the widely used* h *index (Hirsch, 2005), as they preserve all its valuable characteristics and try to overcome one of its known major shortcomings, i.e. that it uses only a fraction of the information contained in a scientist's citations profile and, as a result, does not show a sufficiently fine 'granularity' (the* h *index is defined over the set of positive integers) to allow a fully satisfactory ranking of scientists. This problem is particularly acute in those disciplines, such as Economics, where scientific productivity and citation practices typically yield fewer citations per paper and, as a consequence, are characterized by 'structurally' lower values of the* h *indexes. Both the* k *and* w *indexes are defined over* R^+*, fall in the right-open interval* [h, h+1) *and their integer part is conveniently equal to the scientist's* h *index. While the* h *index is influenced only by part of the citations received by a scientist's most-cited publications, the* k *index takes into account all the citations received by her most-cited publications and the* w *index accounts for the citations received by the entire set of her publications. Variants of the* k *and* w *indexes are proposed which account for co-authorship. The* h *index and the new indexes proposed are calculated for 332 professors of economics in Italian universities and the results obtained are used to rank Italian university departments.*

Keywords: bibliometrics; citation statistics; h-index; evaluating research in Economics.

JEL Classification codes: A11.

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1. INTRODUCTION

Research performance is a multi-faceted endeavor and its evaluation should never be based on a single qualitative or quantitative indicator. Ideally, peer review should be the primary instrument for research evaluation[1] and bibliometric indexes should be used as support tools to make peer review more objective and transparent. Nevertheless, the use of quantitative indicators becomes unavoidable when the evaluation involves a very large number of individuals or institutions; however, even in such instances, one should never forget the evident limitations and risks of using quantitative indicators only.[2] Notwithstanding their limitations, bibliometric indexes are more and more extensively used and refining them in order to improve their capacity to measure, albeit imperfectly, research performances seems a goal worth pursuing.

This paper proposes two new simple indexes - the *k* and *w* indexes - to assess a scientist's publications record based on citations. The two indexes are superior to the widely used *h* index (Hirsch, 2005), as they not only preserve all its valuable characteristics but also try to overcome one of its known major shortcomings, i.e. that it uses only a fraction of the information contained in a scientist's citations profile and, as a result, does not show a sufficiently fine 'granularity' (the *h* index is defined over the set of positive integers) to allow a fully satisfactory ranking of scientists (many show the same value of the index). This problem is particularly acute in those disciplines, such as Economics, where scientific productivity and citation practices typically yield fewer citations per paper and, as a consequence, are characterized by 'structurally' lower values of scientists' *h* indexes. Both the *k* and *w* indexes are defined over R^+ , fall in the right-open interval [*h*, *h*+1), their integer part is equal to the scientist's *h* index and their fractional part is equal to the share of citations in excess of the minimum needed to hold her particular value of the *h* index. While the *h* index is influenced only by some of the citations received by the most-cited papers in a scientist's publication record, the *k* index takes into account all the citations received by her most-cited publications and the *w* index accounts for the citations received by her entire set of published contributions. Variants of the *k* and *w* indexes are introduced which account for co-authorship.

[1] In a non-ideal world, peer review too may have its limitations, including the possibility of highly subjective evaluations or conflicts of interest, and a bias against innovative ideas and approaches.

[2] A pertinent and thorough discussion of the use and misuse of citation statistics in quantitative indicators to assess scientific research performances is provided by Adler, Ewing and Taylor (2008).

The next section provides a brief review of the *h* index and some of its variants which have been proposed to try to overcome its limitations. Section 3 introduces the two new indexes. Section 4 shows the different indexes at work by comparing results obtained applying the *h* index and the two indexes proposed here to a group of 332 professors of economics in Italian universities and then using the results obtained to rank Italian university departments. Section 5 concludes.

2. THE H INDEX AND ITS VARIANTS

Among the indexes based on citations received by the publications of a specific scientist the one known as the *h* index, from the name of the author who introduced it (Hirsch, 2005), is certainly the most popular. A scientist has a value of the *h* index equal to s if s of his n publications received each at least s citations and the remaining (n-s) received each at most s citations. The *h* index has several valuable properties, including: that it can be easily computed, it combines in a single index information on both 'quantity' (the number of publications) and 'quality' (their impact, measured through the citations they received), and can be applied at different levels of aggregation (individuals, research institutions, countries). At the same time the *h* index shows some equally evident limitations, some pointed out by Hirsch himself, including the fact that it cannot be used to compare scientists in different disciplines (because the values it assumes are field-specific, due to systemic differences in productivity and citation patterns); moreover it does not take into account the number of co-authors of each publication, nor does it account for citations received in excess of their minimum number (h^2) given its value, it creates an incentive for self-citations, and, finally, depends, at least to a certain extent, on the length of a scientist's career.[3]

The two disadvantages of the *h* index which the indexes proposed in this paper try to address are:

(a) that it depends on a limited portion only of the relevant information contained in the citations profile of a scientist's publications, and

(b) that it does not account for the existence of co-authors.

For example, in the case of two scientists both with an *h* index equal to 10 it could happen that the publications cited at least 10 times for the first one received 2,500 citations in total, and those for the second one only 120; or that the publications of the first one which have been cited at least 10 times are each the result of collaboration with 10 co-authors, while those of the other scientist are all the result of her own work only. In both cases the *h* index does not do justice to the evident difference between the two scientists' publications record.

Many indexes have been proposed to overcome these specific limitations of the *h* index.

Among those proposed to take into account citations in excess of h^2 , i.e. those accounted for by the *h* index, are the *g* (Egghe, 2006), α[4] (Jin, 2006), *R* (Jin et al., 2007), *e* (Zhang, 2009), *h(2)*

[3] Alonso et al. (2009) and Todeschini (2011) provide a useful discussion of the pros and cons of using the *h* index and a review of variants to the index proposed to overcome some of its limitations.

[4] This is sometimes also referred to as the *A* index.

(Kosmulski, 2006), *m* (Bornmann, Mutz and Daniel, 2008), *hg* (Alonso et al., 2010), h_T (Anderson, Hankin and Killworth, 2008) and h^{Δ} (Ruane and Tol, 2008) indexes.[5]

The *g*, α, *R*, *e*, *h(2)*, *m* and *hg* indexes all give more weight than the *h* index to citations received by highly cited papers, i.e. those contained in the '*h* core'.[6] A researcher has an index *g* equal to z if, after ordering her publications in descending order with respect to the number of citations they received, z is the largest number such that the first z publications together received at least z^2 citations ($g \geq h$). The *e* index is defined as the square root of the citations received by the publications in the *h* core in excess of h^2 (*e* is a positive real number). The α index is the average number of citations received by the publications in the *h* core. *R* is the square root of the total number of citations received by publications in the *h* core (α and *R* are positive real numbers, $\alpha, R \geq h$; these three indexes are linked by the relation $R = \sqrt{h \cdot \alpha}$). The *m* index is the median number of citations received by papers in the *h* core ($m < h$). The *h(2)* index is defined as the highest natural number such that each of the h(2) most cited papers received at least $[h(2)]^2$ citations ($h(2) \leq h$). Finally, the *hg* index is given by the geometric average (the square root of the product) of the *h* and *g* indexes ($g \geq hg \geq h$).

The *e*, α and *R* indexes use information on the total number of citations received by publications in the h core; however, they are not considered by those who introduced them as possible replacements of the *h* index, rather they have been proposed as 'complements' to the *h* index, i.e. their use is suggested in conjunction with the *h* index, not instead of it. The *g*, *m*, *h(2)* and *hg* indexes are all computed using more information on the citations of publications in the *h* core than the *h* index, but do not use all of it.

Unlike the indexes mentioned above, the h_T (Anderson, Hankin and Killworth, 2008) and the h^{Δ} (Ruane and Tol, 2008) indexes consider citations received by publications outside the *h* core. The 'tapered *h* index' (h_T) proposed by Anderson, Hankin and Killworth (2008) uses a Ferrers graph to account for citations received by all publications ($h_T \geq h$). The h^{Δ} index considers part of the citations of the publications in the *h* core in excess of h^2 and those of the publication 'adjacent' to those in the *h* core; it is defined as (h +1) – m/(2h+1), where m is the number of additional citations the scientist needs in order to increase her *h* index by one, i.e. to make it become h+1 ($h \leq h^{\Delta} \leq$ h+1).

For all these indexes variants have been, or may easily be developed to take into account the existence of co-authors by normalizing, in one way or another, the number of citations received by each publication. For example, the *Normalized Individual h-index*, which is one of the bibliometric statistics offered by the Publish-Or-Perish software developed by Harzing (www.harzing.com/pop.htm), calculates the *h* index after having normalized citations received by each publication by dividing them by the number of the co-authors of that publication. Alternative proposals of indexes which take into account the number of co-authors include those by Batista et al. (2006) and Schreiber (2008).

[5] Many more additional variants of the *h* index have been proposed, including those by Garcìa-Pérez (2009), Panaretos and Chrisovaladis (2009), Todeschini (2011) and Tol (2009).

[6] For a scientist whose *h* index equals k the *h* core is defined as the subset of his publications, of dimension k, which received at least k citations.

3. THE INDEXES PROPOSED

We propose two new indexes, each of them in two versions, one based on the number of absolute citations received by each publication, the other based on the number of normalized citations, i.e. on the number of absolute citations received by each publication divided by the number of co-authors of that publication.

Both indexes use more information on the citations of a scientist's publications than the *h* index. The goal of the two indexes is to make use of the additional information to move from the discrete metric of the *h* index to a continuous metric, thus allowing for a ranking of those scientists who show the same value of the *h* index, while preserving the information provided by the *h* index untouched.

A distribution of scientists by their *h* index showing a high concentration in few (low) values of the index is common for those disciplines where publications typically receive fewer citations. The median impact factor of the journals by 'category' as listed in the 2010 ISI-WoK Journal Citation Reports can be used as a quick indicator of 'systemic' differences in citation patterns by discipline. Typically, journals in social sciences tend to show significantly lower median impact factors than those in 'hard sciences'. While, for example, journals in Anthropology, Economics, History, International Relations, Law, Linguistics, Political Sciences and Sociology all show a median impact factor lower than one, those in many categories in the area of medical research have a median impact factor above two, and for those in Chemistry or Physics, typically, this is well above 1.5 .[7] In disciplines where scientists usually show relatively low values of the *h* index, the possibility to use more of the information contained in their citation profiles to rank those with the same value of the *h* index, may turn out to be useful. This is the case, for example, when the need arises to comparatively evaluate individual publication records in the context of hiring or promotion decisions when the number of candidates exceeds the number of available posts and a choice has to be made. This is typically the case with the hiring and promotion process in the Italian university system. The nation-wide centralized rules governing hiring and promotions have been modified in recent years to impose on selection and promotion committees the requirement, '*for those disciplines for which their use is accepted by the international community*', to take into account in the comparative evaluation of candidates a list of bibliometric measures based on citation statistics, including the *h* index.[8] In this and similar frameworks, the possibility to exploit more of the information contained in the citations received by each candidate's publications in order to rank those with the same value of the *h* index seems a definite improvement.

The first of the two indexes – the *k* index – maintains all the desirable properties of the *h* index and takes into account the citations received by a scientist's most cited publications.

The second index – the *w* index – differs from *k* because it takes into account the citations received by the entire set of a scientist's publication record.

Let: *h* be a scientist's Hirsch index computed on the basis of the absolute citations received by her publications; the '*h* core' be the subset of her most cited publications, of dimension h, which

[7] However, the social sciences/'hard' sciences divide should not be taken as a rule. Journals in the ISI-WoK 'category' 'Business' have a median impact factor equal to 1.365, while, for those in 'Statistics and Probability', 'Mathematics' and 'Mathematics, Applied' this equals 0.948, 0.584 and 0.780, respectively.

[8] Italian Ministry of Education, University and Research, Ministerial Decree no. 89/2009, 28 July, 2009.

received at least h citations, while the remaining (n-h) received at the most each h citations; and cit_j be the number of absolute citations received by the *j*-th publication included in the *h* core. The *k* index is defined as:

$$k = h + [\, 1 - (h^2 / \Sigma_{j= 1, 2, ..., h}\ cit_j) \,] , \ \forall\ h > 0 \qquad (1a)$$

$$\text{and} \quad k = 0, \ \text{if} \ h = 0 . \qquad (1b)$$

The expression in (1a) in square brackets is nothing other than the share of absolute citations received by the scientist's publications contained in the *h* core in excess of their minimum number, h^2 , given the value of her *h* index. When *h* equals zero, *k* is set equal to zero; in fact, in this case the *h* core of the scientist's publications record is empty and, as a result, citations of these publications in excess of h^2 (zero under these circumstances) cannot exist.

Conveniently the *k* index varies between *h* and *h* + 1; it equals *h* when the number of citations received by the publications in the *h* core equals h^2 and tends to *h* + 1 as the number of citations of the publications in the *h* core increases.

The analogous index computed using normalized citations, i.e. the number of citations received by each publication divided by the number of co-authors of that publication, the *k-norm* index, is defined as:

$$k\text{-}norm = h\text{-}norm \ + \ [\, 1 - (h\text{-}norm^2 / \Sigma_{j= 1, 2, ..., h\text{-}norm}\ citnorm_j) \,] , \quad \forall\ h\text{-}norm \ > 0 \qquad (2a)$$

$$\text{and} \quad k\text{-}norm = 0 \ , \text{if} \ h\text{-}norm \ = 0 \ , \qquad (2b)$$

where $citnorm_j$ is the number of normalized citations received by the *j*-th publication included in the scientist's *h-norm* core. When *h-norm* equals zero, *k-norm* is set equal to zero, for the same reason given above for the *k* index.

The *k-norm* index varies between *h-norm* and *h-norm* + 1; it equals *h-norm* when the number of normalized citations received by the publications in the *h-norm* core equals $h\text{-}norm^2$ and tends to *h-norm* + 1 as the number of normalized citations of publications in the *h-norm* core increases.

Let *totcit* be the number of absolute citations received by the entire set of a scientist's publications record. The *w* index is defined as:

$$w = h \ + \ [\, 1 - \ h^2 / totcit] \ , \ \forall\ h > 0 \qquad (3a)$$

$$\text{and} \quad w \ = 0, \ \text{if} \ h = 0 . \qquad (3b)$$

The expression in (3a) in square brackets is the share of absolute citations received by a scientist's entire publications record in excess of their minimum number, h^2 , given the value of his *h* index.

The *w* index also varies between *h* and *h* + 1; it equals *h* when the overall number of absolute citations received by a scientist's entire publications record equals h^2 and tends to *h* + 1 as the number of absolute citations of his publications increases.

The analogous index based on normalized citations, the *w-norm* index, is defined as:

$$w\text{-}norm \ = \ h\text{-}norm \ + \ [\, 1 - \ h\text{-}norm^2 / totcit\text{-}norm \,] \ , \quad \forall\ h\text{-}norm \ > 0 \qquad (4a)$$

$$\text{and} \quad w\text{-}norm \ = \ totcit\text{-}norm \ / \ (1 + totcit\text{-}norm) \ , \ \text{if} \ h\text{-}norm = 0 \ , \qquad (4b)$$

where *totcit-norm* is the total number of normalized citations received by a scientist's publications. (4b) guarantees that for a scientist whose *h-norm* index equals zero and, nevertheless, is the co-author of publications which received citations, the *w-norm* index is greater than zero (giving credit for the citations received) and less than one.

The *w-norm* index varies between *h-norm* and *h-norm* + 1; it equals *h-norm* when the number of normalized citations received by a scientist's publications equals $h\text{-}norm^2$ and tends to *h-norm* + 1 as the number of normalized citations increases.

For any scientist the following relations hold: $h\text{-}norm \leq k\text{-}norm \leq w\text{-}norm$ and $h \leq k \leq w$.

To help understand the differences between the *h*, *k* and *w* indexes, in Figure 1 the citation profiles of two hypothetical scientists with the same *h* index are represented. Scientist A published 16 papers; the most cited one received 20 citations, the next most cited 16 citation, two papers received one citation each and two papers have not been cited yet. Scientist B published 12 papers; the most cited one received 9 citations, while, at the other extreme, two papers received one citation each and one no citation. For both scientists the *h* index equals 6, so their ranking would be the same in a comparative evaluation of their publication records solely based on this index. However, scientist A shows a larger number of citations for both the publications contained in her *h* core (91 vs. 45) and for the full set of her publications (117 vs. 54). The *k* and the *w* indexes take these differences into account, *k* by considering the relative weight of the citations received by the publications in the *h* core in excess of the minimum (36 citations, the area of the white square in each of the two profiles), *w* by considering the relative weight of the citations received by all publications in excess of the same minimum. The values of the *k* and *w* indexes for scientist A equal 6.60 and 6.69, respectively; those for scientist B 6.20 and 6.33. While both indexes provide more information than the *h* index, the choice between them depends on what the evaluator wants to base his assessment on: citations received by the most cited publications only, or by the entire publications record.[9]

The *k* and *w* indexes maintain all desirable properties of the *h* index and offer a few additional ones. In particular, as for the *h* index, they can be easily computed, they combine in a single index information on both 'quantity' (the number of publications) and 'quality' (their impact, measured through their citations), and can be applied at different levels of aggregation; in addition, they give credit for citations in excess of h^2, their interpretation is straightforward (the integer part equals the value of the *h* index and the fractional one is the proportion of citations in excess of h^2), they generate a quantitative assessment of a scientist's publications record which is continuous over the set of positive real numbers, thus allowing for the ranking of scientists with the same value of the *h* index, always increase with citations (of those in the *h* core in the case of *k*, of all publications in the case of *w*). At the same time, *k* and *w* suffer from some of the same drawbacks as the *h* index, including the fact that they cannot be used as such to compare scientists from different disciplines, create an incentive for self-citation and, possibly more than the *h* index, are to some extent biased in favor of scientists with a longer career. The *k-norm* and *w-norm* indexes provide a solution to the need to take into account the number of co-authors.

[9] If *w* is preferred, scientists with a career extending longer into the past may have been given an additional advantage.

4. AN APPLICATION

To show how results obtained using the indexes proposed in this paper compare with those obtained using the *h* and the *h-norm* indexes, in this section we use the different indexes to evaluate the publications record of a group of professors of economics in Italian universities. These are the 332 assistant, associate and full professors[10] of 'Economic Policy' - SECS-P/02, in the classification used by the Italian Ministry of Education, University and Research[11] (MIUR) - active in the 64 Italian - public and officially accredited by MIUR private - universities.[12] The set was extracted from the MIUR database[13] on 28th February, 2012. The choice of this particular set of scientists is motivated by the fact that, as mentioned above, publications in economics tend to receive a significantly lower number of citations than in other disciplines, such as physics or medicine, and, as a result, the distribution of economists by the value of their *h* index shows a large number of them holding the same (low) value of the index. When this is the case, the need arises to make a fuller use of the information associated with their citation profiles to obtain a ranking of those with the same value of the *h* index.

For each Italian professor of 'Economic Policy' the citational profile has been obtained from the Thomson-Reuters 'ISI Web of Knowledge' (ISI-WoK) data base, which was accessed between 13th and 17th March, 2012. ISI-WoK includes a large set of scientific journals, mostly in English, selected on criteria set and implemented by Thomson-Reuters itself. Although this data base remains the most widely used in quantitative evaluations of scientific research outputs, many would argue that the selection of journals it includes is biased. If this is true, both the identification of the papers published by each author and the number of citations each of these publications received would suffer from the same bias. However, because our aim is not to perform a comparative assessment, but only to provide evidence of the different results which could be obtained using the different indexes, the possible bias of the ISI-WoK data base does not constitute a problem here.

Publications by each author have been identified on the basis of the 'Social Sciences Citation Index' (SSCI) data base.[14] A very careful assessment of the results obtained has been performed with the aim of limiting as much as possible problems due to homonymy. The results of the search for each scientist have been analyzed making use of the 'refine results' option of the ISI-WoK

[10] They include 'ricercatori', 'ricercatori non confermati' and 'ricercatori a tempo determinato'; 'professori associati' 'confermati' e 'non confermati'; 'professori ordinari' e 'straordinari'. Three 'assistenti ordinari del ruolo ad esaurimento' have been excluded from the analysis.

[11] The Ministry classifies professors in Economics in six groups: 'Economics' , 'Economic Policy', 'Public Finance', 'History of Economic Theory', 'Econometrics' and 'Applied Economics' (coded SECS-P/01 to SECS-P/06, respectively).

[12] Studies related to the evaluation of the research performance of professors of economics in Italian universities using bibliometric indexes include Checchi and Jappelli (2009), Corsi and De Francesco (2012), Corsi, D'Ippoliti and Lucidi (2010, 2011), Lippi and Peracchi (2007), and Reichlin (2008). Checchi and Jappelli (2009) used the *h* index calculated using information from the Google Scholar data base to evaluate the 696 full professors of economics (SECS-P/01 through SECS-P/06). Corsi and De Francesco (2012) analyzed the publication records of the 311 full, associate and assistant professors of 'Agricultural Economics' (AGR-01) calculating the *h* and *g* indexes based on information from the SCOPUS, ISI-WoK and Google Scholar (via Publish or Perish) data bases.

[13] http://cercauniversita.cineca.it/php5/docenti/cerca.php.

[14] In addition to Economics, this data base includes other social science disciplines such as Anthropology, History, Philosophy, Law and Public Health.

web-based facility; this allows for a screening of the search results obtained for a specific author's name based on a number of filters, including discipline sub-sections ('categories'), 'subject areas', and author affiliation ('institutions'). The first refinement of the 'gross' results obtained was the exclusion of papers in a 'subject category' manifestly different from economics, such as geriatrics or psychiatry. Then each author's publications record was checked to ensure that the process had not failed to identify publications which were, without any doubt, authored by a different scientist bearing the same name.[15] Once the identification of the publications extracted from the ISI-WoK data base for each of the 332 scientists considered was completed, the 'create citation report' facility was used; this generates a report which includes a number of citation statistics for the specific author. This information constituted the base for calculating the values of indexes *h*, *k* and *w* and *h-norm*, *k-norm* and *w-norm* for each of the assistant, associate and full professors of 'Economic Policy' working in an Italian university.[16]

The distributions of the *h* and *h-norm* indexes are provided in Figure 2. Both distributions show a high number of professors with the same value of the index. 136 professors have an *h* index equal to zero (for 104 of them no publication in the ISI-WoK data base was found, while the publications of the remaining 32 have not been cited yet), 88 have an *h* index equal to one, 43 equal to two, 33 equal to three; only for 32 of them is the *h* index higher than three. The number of professors with an *h-norm* index equal to zero is 158; 95 have an *h-norm* index equal to one, 38 equal to 2 and only 41 have a value of the index equal to three or higher. These distributions signal that for this group of scientists the use of the *h* or the *h-norm* index is clearly unsatisfactory if one has to evaluate them comparatively and generate a rank.

Figure 3 offers the distribution of the *h* index along with those of the *k* and *w* indexes. When the scientist has a value of his *h* index equal to zero, the *k* and *w* indexes equal zero as well and no ranking can be generated based only on the available citation statistics. When the *k* index - the one which takes into account citations received by publications contained in the *h* core in excess of their minimum - is considered, the same is true for the 30 professors with the *h* and *k* indexes both equal to one (these are scientists whose single publication contained in the *h* core received only one citation). The *k* index allows ranking the remaining 57 professors with a *h* index equal to one as well as those with a larger *h* index. Analogously, when the use of the citations received by the entire set of an author's publications is found more appropriate, the *w* index ranks the 64 professors with a *h* index equal to one and a number of citations received by their scientific production greater than one, as well as those with a higher value of the *h* index.

Figure 4 presents the distributions of the *h-norm* index along with those of the *k-norm* and *w-norm* indexes. When the use, for each publication, of the number of citations normalized by the number of co-authors is preferred, again, the indexes proposed in this paper – one based on the total number of normalized citations received by the publications contained in the *h-norm* core (the *k-norm* index) and one based on the total number of citations received by all the scientist's

[15] No filtering based on the author's affiliation has been performed, as it is impossible to control for the mobility of an author from one institution to another.

[16] The data base with the publications record from ISI-WoK, the citational profile and the bibliometric indexes for each of the university professors of 'Economic Policy' (SECS-P/02) of Italian universities, and a table with the values of the six indexes calculated for each of them are available at http://www.ecostat.unical.it/anania/Anania&Caruso.htm .

publications (the *w-norm* index) - allow us to exploit citational information disregarded in the calculation of the *h-norm* index to rank individuals with the same value of this index. In the case of the *w-norm* index, it even ranks some of the professors with a *h-norm* index equal to zero; in fact, it returns a positive value for those 22 with co-authored publications which received citations, but not enough to yield them a *h-norm* index equal to one.

Bibliometric indexes based on citations are often used to rank research institutions. Most often rankings are based on the average value assumed for their members by the chosen citation index.[17] Table 1 provides the average values of the *h*, *k*, *w*, *h-norm*, *k-norm* and *w-norm* indexes for the 109 departments of the 64 Italian universities in which at least one professor of 'Economic Policy' is present, the rankings based on each of the six indexes and the differences between these rankings. This information enables the reader assess how the choice of a specific index may affect the ranking obtained.

Although this particular issue is outside the scope of this paper, it is interesting to note that the choice between using the *h* or the *h-norm* indexes, i.e. whether to account for the number of co-authors of each publication or not, does make a difference. The distribution of the differences, in absolute value, between the rankings obtained using these two indexes is presented in Figure 5. For 12 out of the 109 departments the two rankings differ by 20 positions or more, for 34 departments by 10 or more. At the other end of the distribution, rankings are equal or differ by 5 positions or less only for 21 departments.

Basing the comparative evaluation of research institutions on quantitative citation indexes which take into account more information contained in the publications citation profiles of their members than that used by the *h* and *h-norm* indexes can indeed make a difference. Figures 6 and 7 present the distribution of the difference, in absolute value, between rankings on the basis of the indexes using absolute and normalized citations, respectively. When rankings are based on the *k* index instead of the *h* index for 20 departments the ranking change by 10 positions or more; the same happens for 15 departments when the *w* index is used, while differences are much less pronounced when the rankings based on the *k* and *w* indexes are compared. Similar results emerge when rankings based on the indexes which use normalized citations are considered. If the *k-norm* index is used instead of the *h-norm* one, the ranking changes by 10 positions or more for 13 departments; the same is true for 9 departments if the *w-norm* index is used, while only two departments see their ranking change by 10 positions or more when those based on the *k-norm* and *w-norm* indexes are considered.

5. CONCLUSIONS

Despite their widely recognised limitations, quantitative indicators are more and more extensively used to measure and compare the research performances of individuals and research institutions. This paper introduces two indexes which try to improve on the *h* index, by far the most widely used bibliometric index. Two simple variants of the *h* index have been proposed: one – the *k* index – based on the assumption that in assessing a scientist's citation profile the total number of

[17] An alternative way of measuring the performance of research institutions is the one based on successive *h*-indexes (h_2) proposed by Schubert (2007). An institution has an index h_2 equal to s if s of its n researchers each have a *h* index at least equal to s, and the remaining (n-s) each have a *h* index which does not exceed s.

citations received by her most-cited contributions is relevant; the other – the *w* index – to be used when the evaluator believes that citations received by all the publications by a scientist should be considered to evaluate her performance.

Although substantially different from the *h* index in the assumptions made about what is important and should be considered to evaluate research performances using citations, the two indexes proposed are evident extensions of this index using more of the information contained in a scientist's citational profile. In fact, (a) the integer part of both indexes conveniently equals the value of his *h* index and (b) the fractional one equals the share of citations (of those in the *h* core for *k*, of citations received by any of the scientist's publications in the case of *w*) in excess of the minimum needed (h^2) for her to hold a value of the index equal to h; (c) they are both smaller than the value of the scientist's *h* index augmented by one, and (d) they strictly increase with the number of citations (of those in the *h* core for *k*, of citations received by any of the scientist's publications in the case of *w*). As for the *h* index, *k* and *w* are easy to compute and can be applied at different levels of aggregation.

k and *w* may be particularly useful when used to evaluate research performances comparatively in disciplines, such as Economics, where citations per paper tend to be lower, yielding lower values of the *h* index and a strong concentration of the scientists in very few low values of the index. In this case the use of the two indexes proposed in this paper allows us to exploit more of the information on the citations received by their papers than that contained in the *h* index and move from a discrete measure of their performance to a continuous one, thereby making a 'finer' ranking possible. This can be particularly useful when bibliometric indexes are used to comparatively evaluate individuals or research institutions in the framework of hiring selections, promotion decisions or funding allocation exercises.

Being extensions of the *h* index, the two indexes share some of its limitations, including their values being discipline-specific, which implies they cannot be used as such to make comparisons across different disciplines; they are influenced by self-citations, and are to some extent biased in favour of scientists with a longer career. However, to overcome these limitations, variants of the *k* and *w* indexes along the lines of those proposed for the *h* index can be easily developed.

Finally, whether we normalize or not citations to take into account co-authorship does make a difference. When bibliometric indexes are used, co-authorships should be accounted for, especially in the case of social sciences. A version of the two indexes which normalizes citations to take into account the number of co-authors of each publication has been proposed.

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Figure 1: Citation profiles for two hypothetical scientists with the same *h* index.

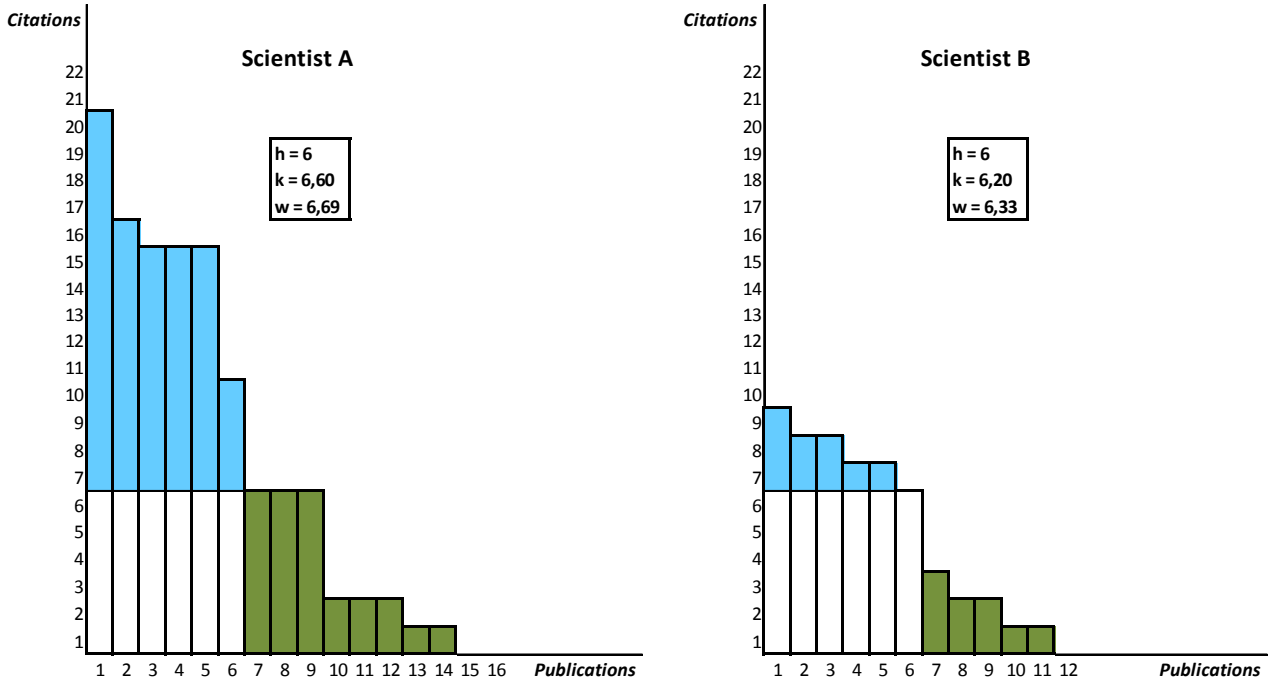


Figure 2: Distribution of the *h* and *h-norm* indexes for the professors of 'Economic Policy' of Italian universities.

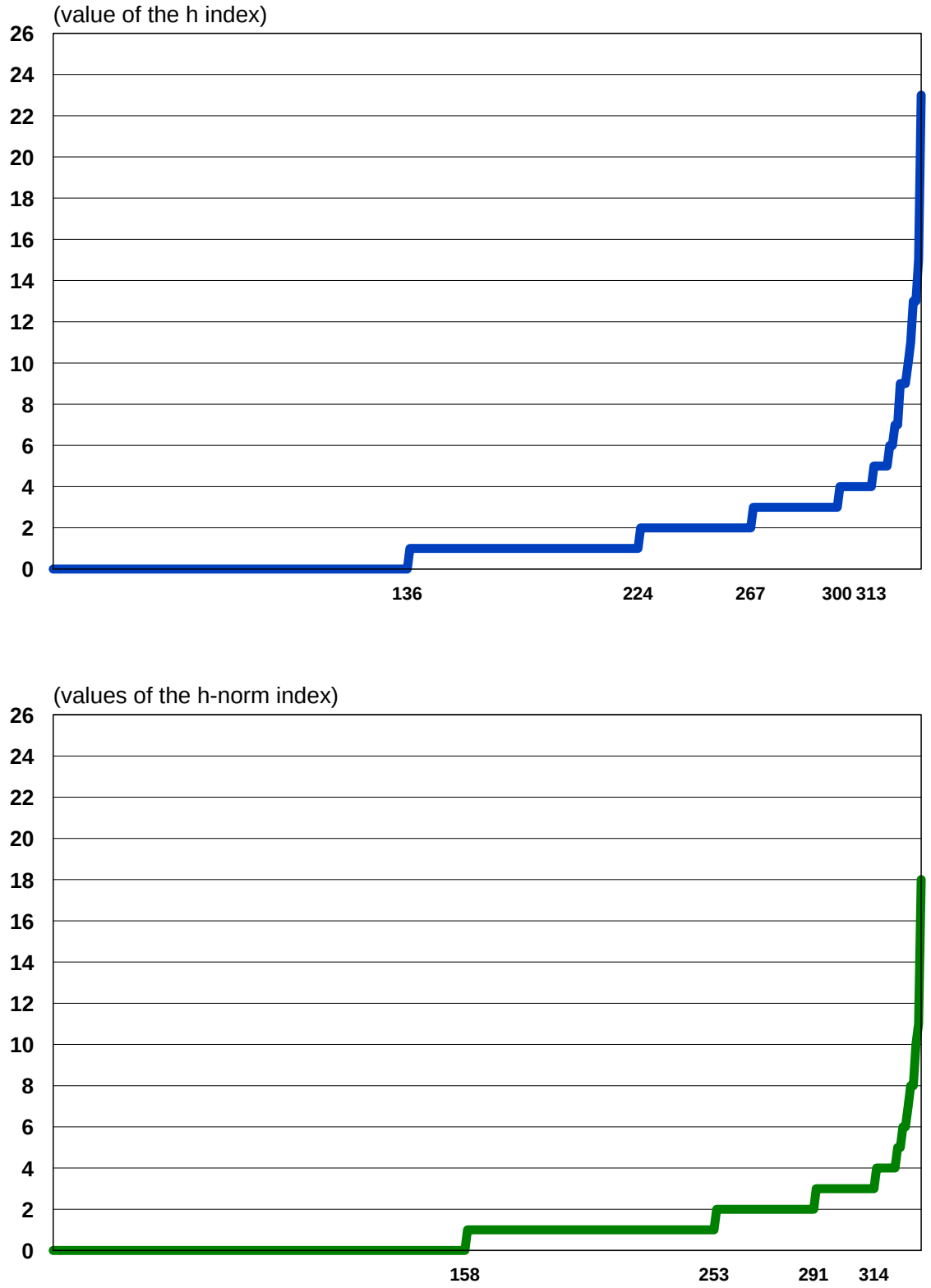
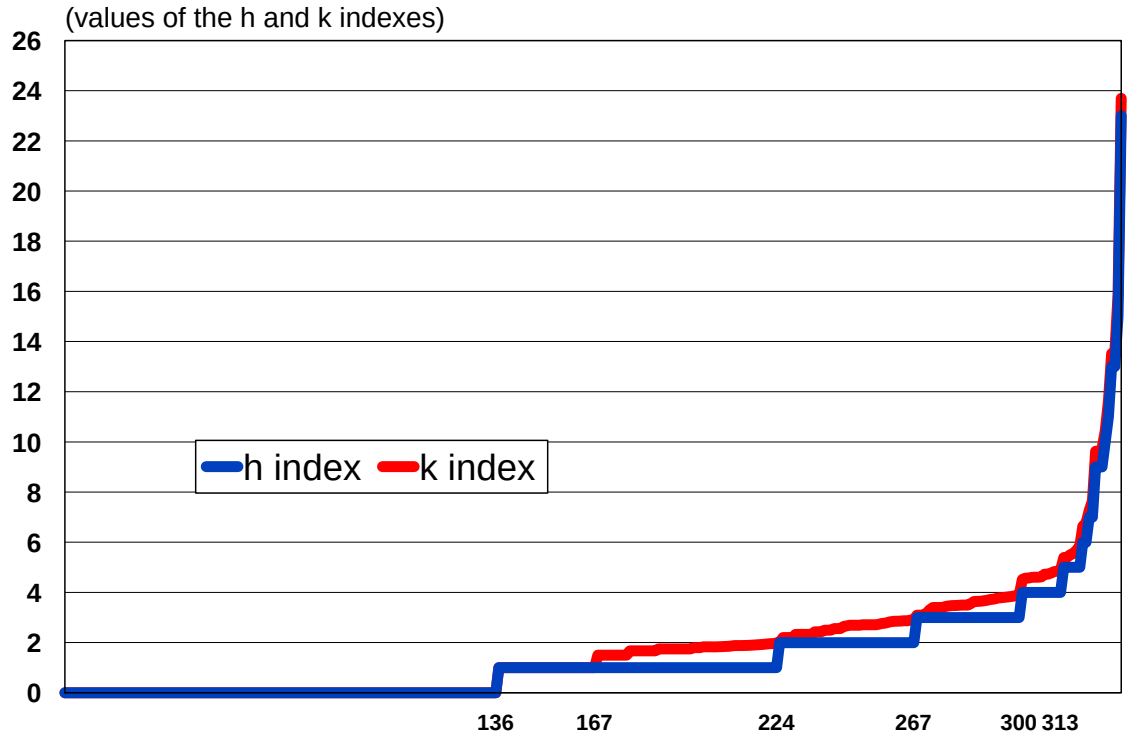


Figure 3: Distribution of the *h*, *k* and *w* indexes for the professors of 'Economic Policy' of Italian universities.



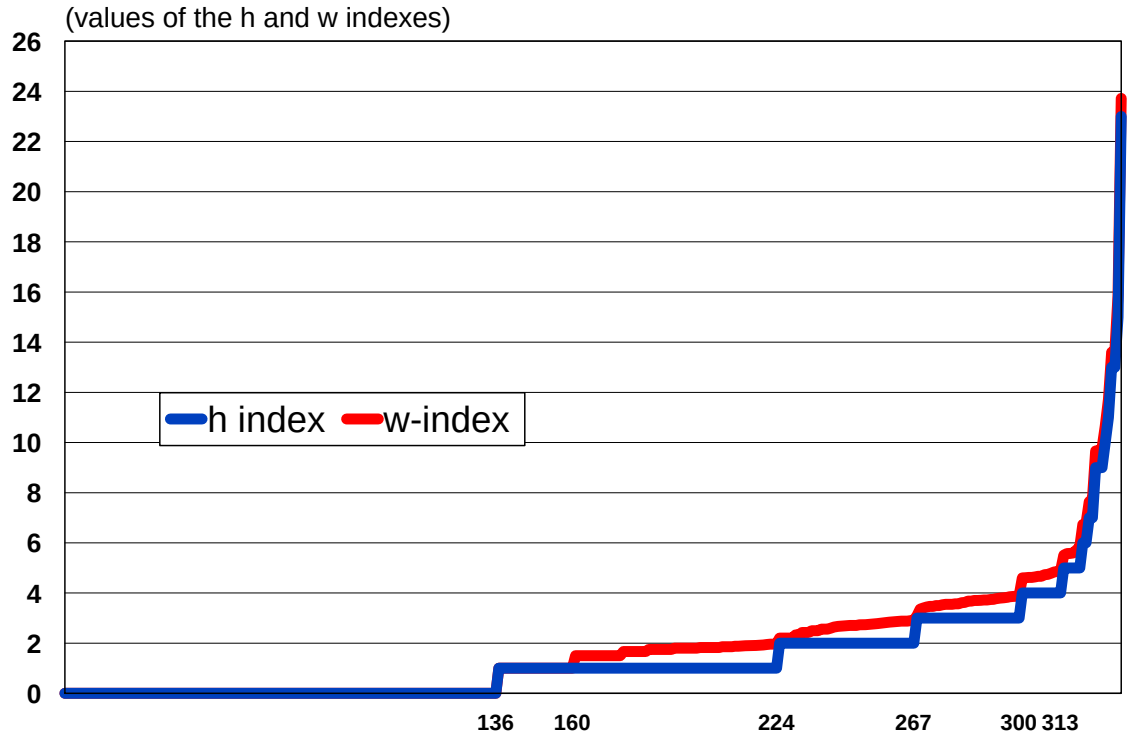
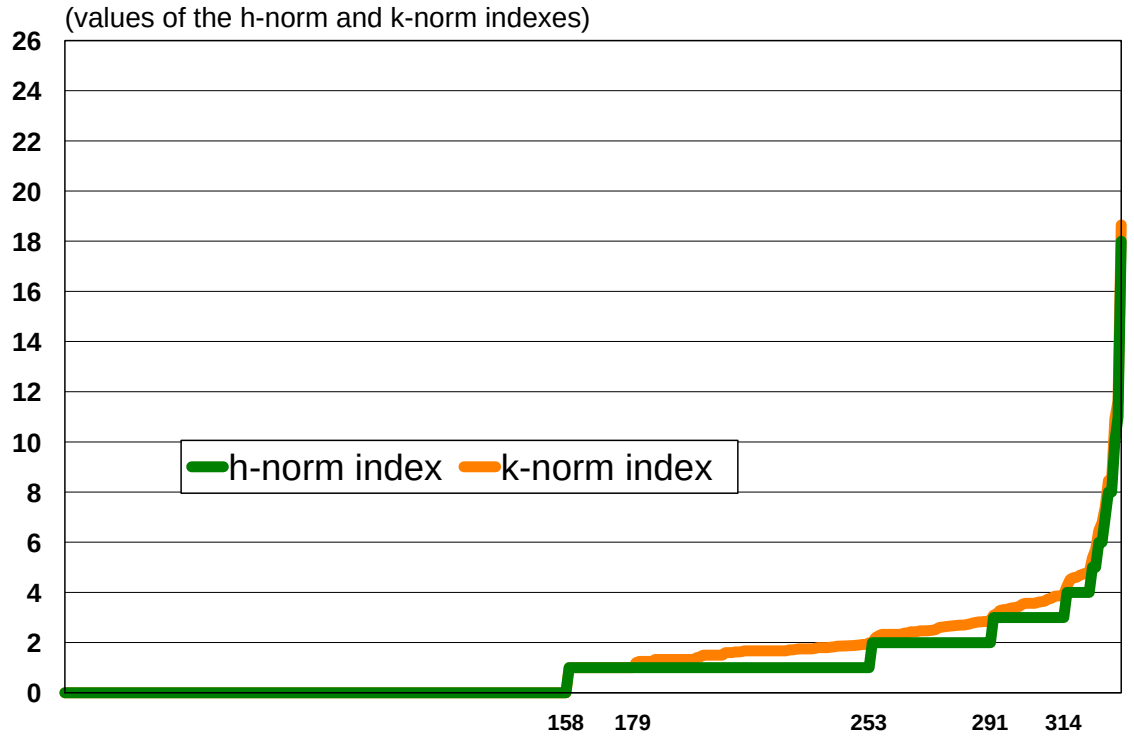


Figure 4: Distribution of the *h-norm*, *k-norm* and *w-norm* indexes for the professors of 'Economic Policy' of Italian universities.



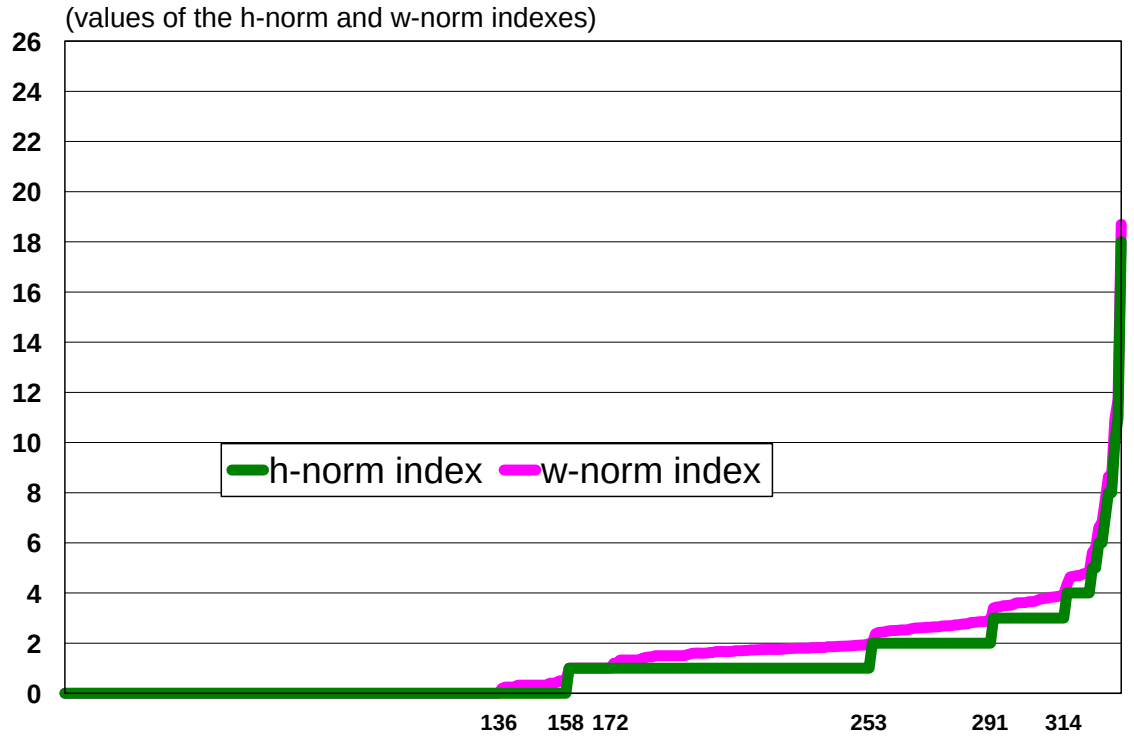


Figure 5: Distribution of the difference, in absolute value, between the rankings of Italian university departments based on the average *h* and *h-norm* indexes of members who are professors of 'Economic Policy'.

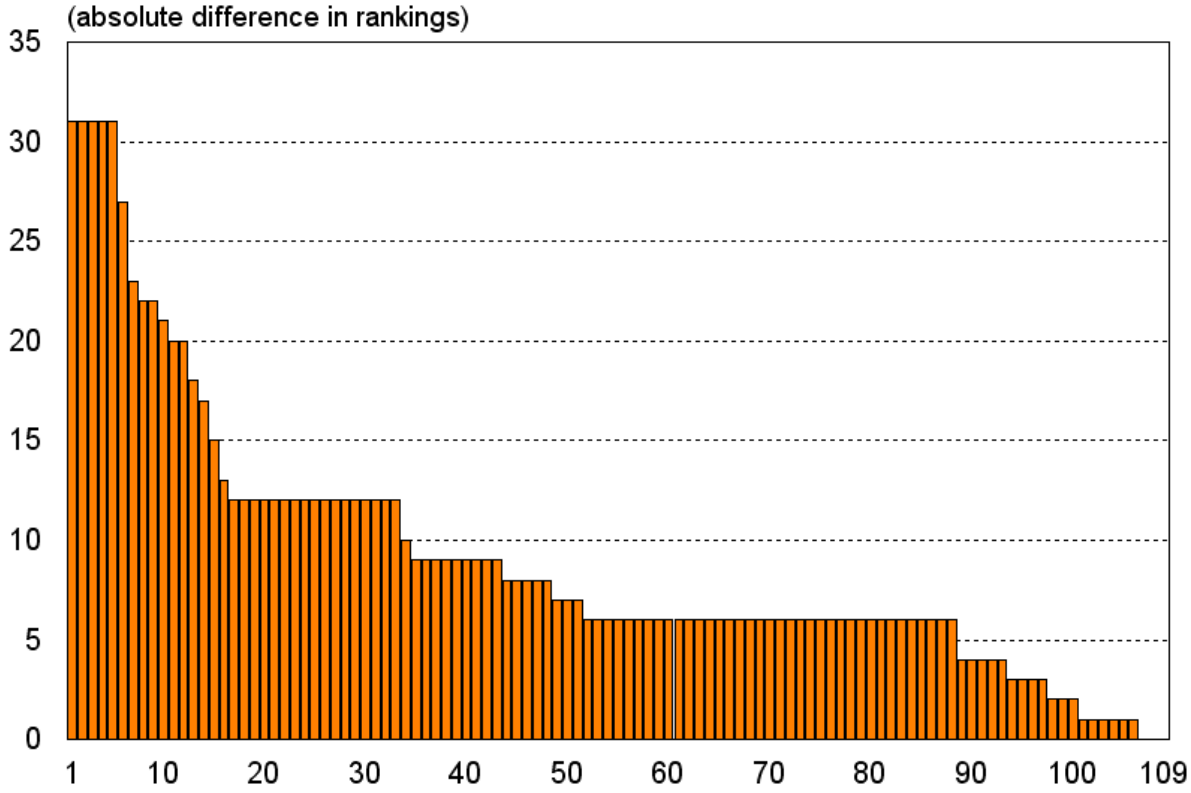


Figure 6: Distribution of the difference, in absolute value, between the rankings of Italian university departments based on the average *h*, *k* and *w* indexes of members who are professors of 'Economic Policy'.

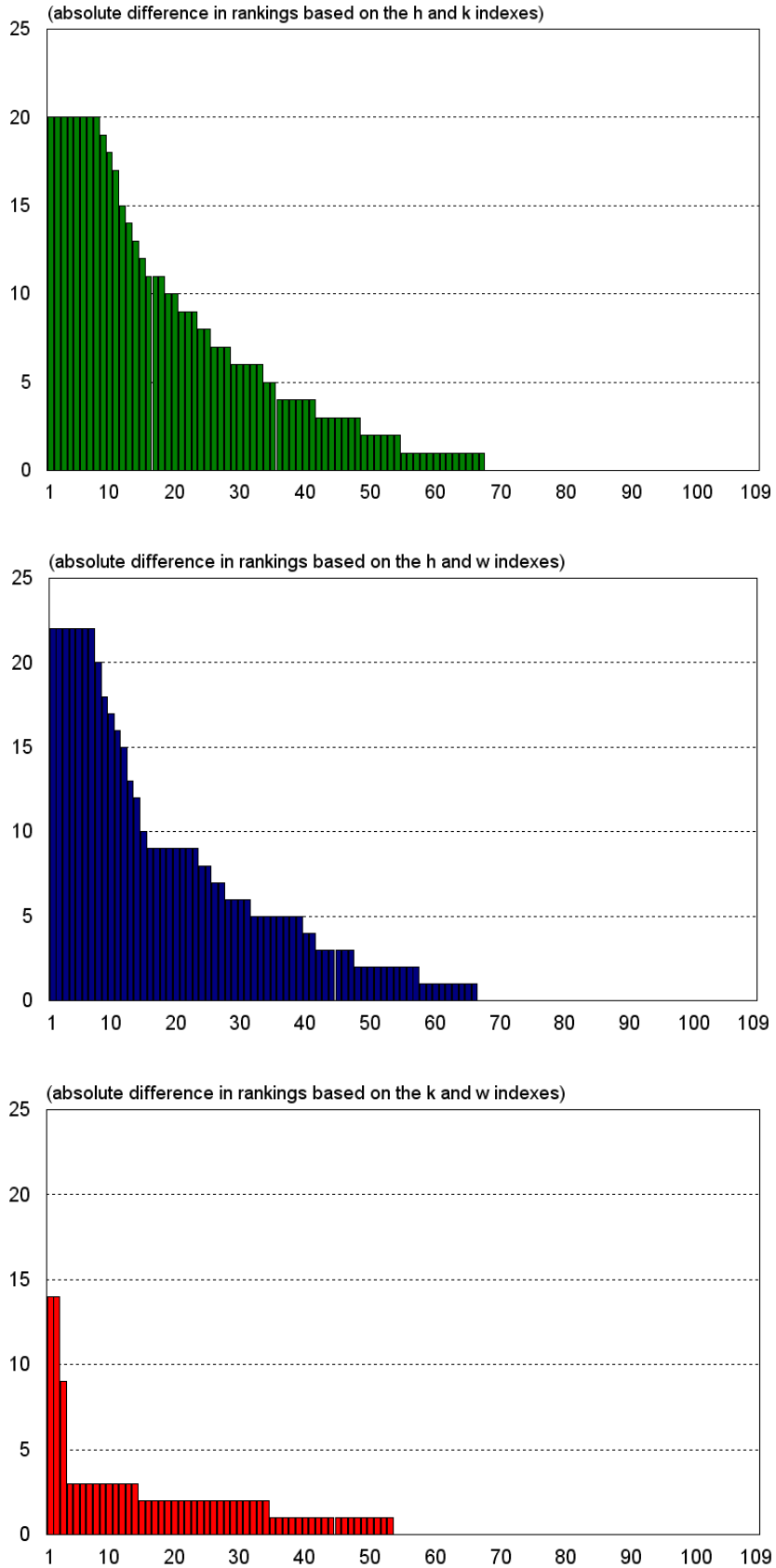


Figure 7: Distribution of the difference, in absolute value, between the rankings of Italian university departments based on the average *h-norm*, *k-norm* and *w-norm* indexes of members who are professors of 'Economic Policy'.

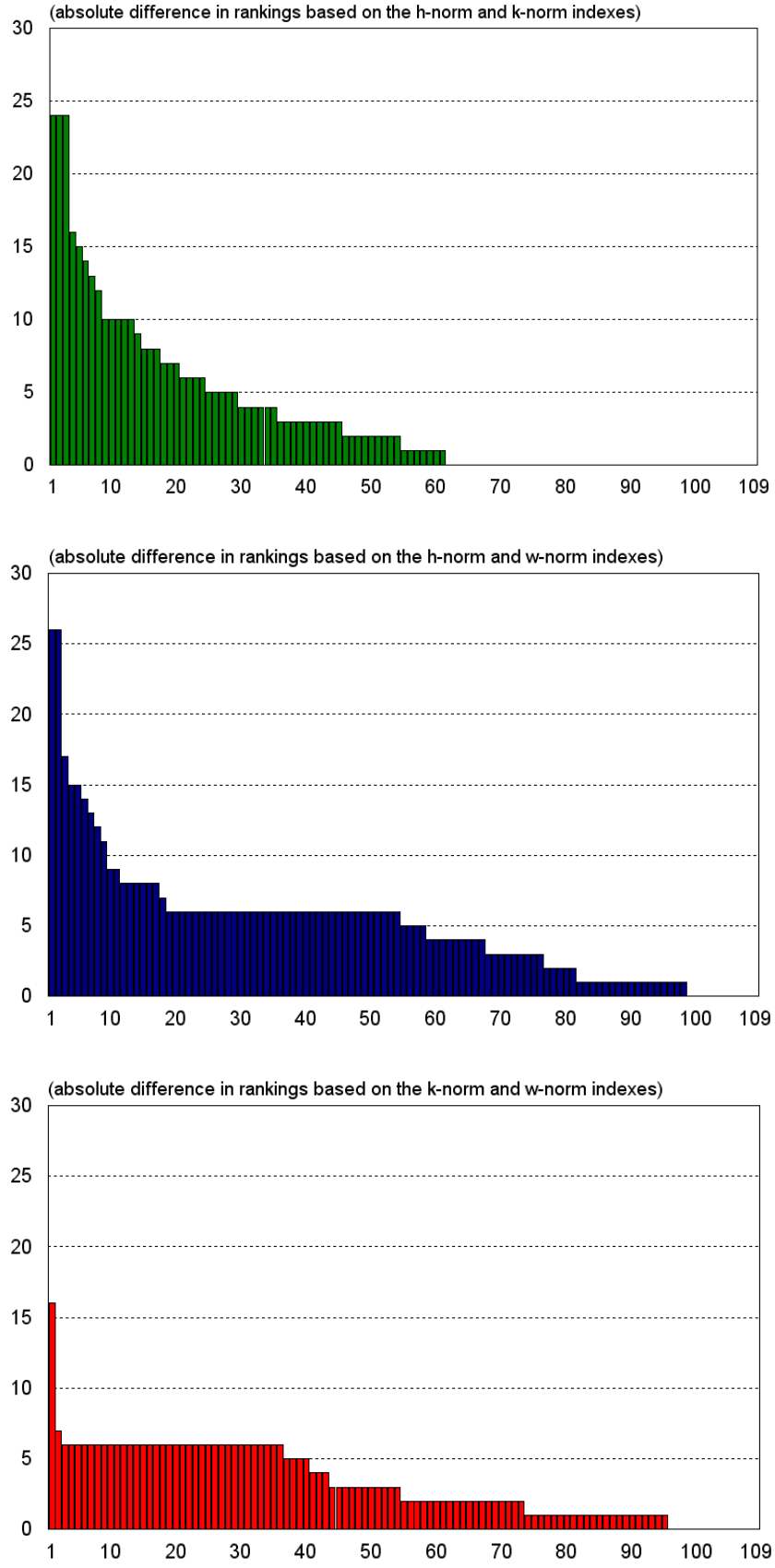


Table 1. Average values of the bibliometric indices based on absolute citations (*h*, *k* and *w*) and on normalized citations (*h-norm*, *k-norm* and *w-norm*)* for the professors of 'Economic Policy' (SECS-P/02) of Italian universities by department; department rankings based on each index and differences in rankings.

				average h and h-norm indexes				average k and k-norm indexes				average w and w-norm indexes				differences in rankings				
	University	Department	Number of professors of 'Economic Policy'	h-index	h ranking	h-norm index	h-norm ranking	k-index	k ranking	k-norm index	k-norm ranking	w-index	w ranking	w-norm index	w-norm ranking	Δ rankings h-norm - h	Δ rankings k - h	Δ rankings k-norm - h-norm	Δ rankings w - h	Δ rankings w-norm - h-norm
1	BARI	*Per lo Studio delle Società Mediterranee*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
2	BARI	*Scienze Economiche e Metodi Matematici*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
3	BERGAMO	*Scienze Economiche*	4	1	40	0,5	60	1,14	58	0,67	63	1,285	56	0,85	61	20	18	3	16	1
4	BOLOGNA	*Scienze Economiche*	15	3,13	6	2,13	9	3,64	7	2,51	11	3,69	7	2,62	11	3	1	2	1	2
5	BOLOGNA	*Scienze Statistiche*	3	1	40	0,67	55	1,46	46	1,11	45	1,46	49	1,14	50	15	6	-10	9	-5
6	BRESCIA	*Scienze Economiche*	5	1	40	0,8	49	1,416	49	1,09	48	1,452	52	1,216	48	9	9	-1	12	-1
7	CAGLIARI	*Economia*	2	0,5	69	0,5	60	0,5	72	0,5	65	0,75	71	0,6	65	-9	3	5	2	5
8	CAGLIARI	*Ricerche Economiche e Sociali*	2	0,5	69	0,5	60	0,5	72	0,5	65	0,5	74	0,5	68	-9	3	5	5	8
9	CALABRIA	*Economia e Statistica*	12	1,67	24	1,08	27	2,02	27	1,42	35	2,09	28	1,525	35	3	3	8	4	8
10	CAMERINO	*Scuola di Giurisprudenza*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
11	CASSINO e LAZIO MERIDIONALE	*Scienze Economiche*	1	1	40	1	28	1,86	34	1,86	24	1,86	35	1,86	27	-12	-6	-4	-5	-1
12	CATANIA	*Economia e Metodi Quantitativi*	3	1,33	32	1,33	24	1,77	37	1,69	29	1,82	37	1,74	30	-8	5	5	5	6
13	CATANIA	*Analisi dei Processi Politici, Sociali ed Istituzionali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
14	CATANIA	*Processi Formativi*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
15	CATANZARO	*Scienze Giuridiche, Storiche, Economiche e Sociali*	1	1	40	1	28	1	60	1	52	1	62	1	54	-12	20	24	22	26
16	Cattolica del Sacro Cuore	*Scienze Economiche e Sociali*	7	2,57	12	1,71	16	2,86	14	1,94	19	2,88	14	1,99	19	4	2	3	2	3
17	Cattolica del Sacro Cuore	*Economia Internazionale, delle Istituzioni e dello Sviluppo*	4	2	16	1,25	26	2,335	22	1,57	32	2,35	22	1,61	33	10	6	6	6	7
18	Cattolica del Sacro Cuore	*Economia e Finanza*	2	1	40	1	28	1,46	46	1,385	37	1,46	49	1,385	40	-12	6	9	9	12
19	Cattolica del Sacro Cuore	*Politica Economica*	7	1	40	0,71	53	1,21	57	0,92	56	1,21	60	0,98	57	13	17	3	20	4
20	CHIETI-PESCARA	*Economia e Storia del Territorio*	2	1	40	0,5	60	1,25	53	0,8	60	1,3	55	0,91	59	20	13	0	15	-1
21	CHIETI-PESCARA	*Metodi Quantitativi e Teoria Economica*	1	1	40	0	71	1	60	0	71	1	62	0,33	72	31	20	0	22	1
22	CHIETI-PESCARA	*Economia*	1	1	40	0	71	1	60	0	71	1	62	0,33	72	31	20	0	22	1
23	CHIETI-PESCARA	*Economia Aziendale*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
24	EUROPEA di ROMA	*Didattica e Ricerca in Scienze Umane*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
25	FERRARA	*Economia, Istituzioni, Territorio*	2	0,5	69	0	71	0,5	72	0	71	0,5	74	0,165	76	2	3	0	5	5
26	FIRENZE	*Scienze Economiche*	5	2,8	11	2,2	7	3,252	11	2,59	10	3,3	11	2,728	8	-4	0	3	0	1
27	FIRENZE	*Studi sullo Stato*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
28	FOGGIA	*Scienze Economiche, Matematiche e Statistiche*	3	0,67	67	0,67	55	1,22	55	1,11	45	1,22	58	1,11	51	-12	-12	-10	-9	-4
29	GENOVA	*Economia e Metodi Quantitativi*	7	1,29	36	0,71	53	1,54	45	1,01	51	1,55	45	1,1	52	17	9	-2	9	-1
30	GENOVA	*Diritto Privato, Internazionale e Commerciale "G. L. M. Casaregi"*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6

				average h and h-norm indexes				average k and k-norm indexes				average w and w-norm indexes				differences in rankings				
	University	Department	Number of professors of 'Economic Policy'	h-index	h ranking	h-norm index	h-norm ranking	k-index	k ranking	k-norm index	k-norm ranking	w-index	w ranking	w-norm index	w-norm ranking	Δ rankings h-norm - h	Δ rankings k - h	Δ rankings k-norm - h-norm	Δ rankings w - h	Δ rankings w-norm - h-norm
31	GUGLIELMO MARCONI Univ. Telematica	*Scienze Economiche e Aziendali*	3	0,33	76	0,33	67	0,5	72	0,5	65	0,5	74	0,5	68	-9	-4	-2	-2	1
32	INSUBRIA	*Economia*	2	2,5	13	2	10	3,15	12	2,633	9	3,15	12	2,718	9	-3	-1	-1	-1	-1
33	INSUBRIA	*Diritto, Economia e Culture*	1	3	7	2	10	3,5	9	2,27	15	3,57	9	2,52	13	3	2	5	2	3
34	IULM - MILANO	*Arti, Culture e Letterature Comparate*	1	2	16	2	10	2,67	19	2,33	14	2,79	18	2,61	12	-6	3	4	2	2
35	L' AQUILA	*Sistemi e Istituzioni per l'Economia*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
36	LIUC - CASTELLANZA	*Economia*	2	0,5	69	0,5	60	0,915	68	0,835	59	0,915	68	0,835	62	-9	-1	-1	-1	2
37	LUSPIO	*PIO V*	1	1	40	1	28	1	60	1	52	1	62	1	54	-12	20	24	22	26
38	MACERATA	*Istituzioni Economiche e Finanziarie*	1	1	40	1	28	1	60	1	52	1,5	46	1,5	36	-12	20	24	6	8
39	MACERATA	*Studi sullo Sviluppo Economico*	5	1	40	0,6	58	1,23	54	0,884	57	1,24	57	0,996	56	18	14	-1	17	-2
40	Mediterranea di REGGIO CALABRIA	*Scienze Storiche, Giuridiche, Economiche e Sociali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
41	Mediterranea di REGGIO CALABRIA	*Patrimonio Architettonico e Urbanistico*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
42	MESSINA	*Economia, Statistica, Matematica e Sociologia "Pareto"*	5	0,4	75	0,4	66	0,466	76	0,466	69	0,546	73	0,53	67	-9	1	3	-2	1
43	MESSINA	*Scienze Economiche, Finanziarie, Sociali, Ambientali, Statistiche del Territorio*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
44	MILANO	*Sanità Pubblica-Microbiologia-Virologia*	1	2	16	2	10	2,78	18	2,69	7	2,78	19	2,69	10	-6	2	-3	3	0
45	MILANO	*Economia, Diritto del Lavoro e Diritto Tributario*	2	2	16	1,5	20	2,545	20	1,845	27	2,545	20	1,97	20	4	4	7	4	0
46	MILANO	*Scienze Economiche, Aziendali e Statistiche*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
47	MILANO "Bocconi"	*Analisi delle Politiche e Management Pubblico (PAM)*	4	1,5	29	0,75	51	1,87	33	1,1	47	1,875	34	1,23	47	22	4	-4	5	-4
48	MILANO BICOCCA	*Sociologia e Ricerca Sociale*	1	1	40	1	28	1,67	41	1,33	38	1,8	39	1,6	34	-12	1	10	-1	6
49	MILANO BICOCCA	*Economia Politica*	1	1	40	0	71	1	60	0	71	1,5	46	0,43	70	31	20	0	6	-1
50	MODENA e REGGIO EMILIA	*Economia Politica*	7	1,57	28	1,57	19	2,24	24	2,03	16	2,26	25	2,05	18	-9	-4	-3	-3	-1
51	MODENA e REGGIO EMILIA	*Scienze Sociali, Cognitive e Quantitative*	1	1	40	0	71	1	60	0	71	1	62	0,33	72	31	20	0	22	1
52	MODENA e REGGIO EMILIA	*Scienze Giuridiche*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
53	MOLISE	*Scienze Economiche, Gestionali e Sociali*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
54	NAPOLI "L'Orientale"	*Scienze Umane e Sociali*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
55	NAPOLI "Federico II"	*Economia*	3	7,67	2	6	1	7,9	2	6,22	1	7,91	2	6,23	1	-1	0	0	0	0
56	NAPOLI "Federico II"	*Teorie e Metodi delle Scienze Umane e Sociali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
57	NAPOLI "Parthenope"	*Studi Economici*	14	0,86	66	0,57	59	1,11	59	0,68	62	1,14	61	0,81	63	-7	-7	3	-5	4
58	NAPOLI Seconda Università	*Strategie Aziendali e Metodologie Quantitative*	3	1,67	24	1,67	17	2,1	26	1,86	24	2,11	27	1,87	26	-7	2	7	3	9
59	NAPOLI Seconda Università	*Studi Europei e Mediterranei*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
60	PADOVA	*Scienze Economiche "Marco Fanno"*	5	3,6	5	2,2	7	4,064	5	2,646	8	4,126	5	2,798	7	2	0	1	0	0

				average h and h-norm indexes				average k and k-norm indexes				average w and w-norm indexes				differences in rankings				
	University	Department	Number of professors of 'Economic Policy'	h-index	h ranking	h-norm index	h-norm ranking	k-index	k ranking	k-norm index	k-norm ranking	w-index	w ranking	w-norm index	w-norm ranking	Δ rankings h-norm - h	Δ rankings k - h	Δ rankings k-norm - h-norm	Δ rankings w - h	Δ rankings w-norm - h-norm
61	**PADOVA**	*Studi Internazionali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
62	**PADOVA**	*Sociologia*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
63	**PALERMO**	*Scienze Economiche, Aziendali e Finanziarie*	4	1,5	29	1	28	1,765	38	1,245	42	1,81	38	1,28	43	-1	9	14	9	15
64	**PARMA**	*Economia*	4	1,25	39	0,75	51	1,46	46	0,97	55	1,465	48	1,03	53	12	7	4	9	2
65	**PAVIA**	*Scienze Economiche e Aziendali*	3	1,33	32	1	28	1,9	31	1,27	40	1,91	32	1,29	42	-4	-1	12	0	14
66	**PAVIA**	*Scienze Pedriatiche e Patologia Umana ed Ereditaria*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
67	**PAVIA**	*Scienze Politiche e Sociali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
68	**PERUGIA**	*Economia, Finanza e Statistica*	3	1,33	32	0,67	55	1,37	51	0,78	61	1,37	54	0,92	58	23	19	6	22	3
69	**PIEMONTE ORIENTALE**	*Studi per l'Economia e l'Impresa*	1	1	40	1	28	1,94	30	1,89	22	1,94	31	1,89	24	-12	-10	-6	-9	-4
70	**PIEMONTE ORIENTALE**	*Politiche Pubbliche e Scelte Collettive*	3	1	40	0,33	67	1,22	55	0,56	64	1,22	58	0,73	64	27	15	-3	18	-3
71	**PIEMONTE ORIENTALE**	*Scienze Economiche e Metodi Quantitativi*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
72	**PISA**	*Scienze Economiche*	2	0,5	69	0,5	60	0,875	69	0,875	58	0,875	69	0,875	60	-9	0	-2	0	0
73	**Politecnica delle MARCHE**	*Scienze Economiche e Sociali*	4	2,5	13	1,5	20	2,96	13	1,97	18	3,06	13	2,14	16	7	0	-2	0	-4
74	**ROMA "La Sapienza"**	*Economia e Diritto*	13	0,54	68	0,31	69	0,72	70	0,47	68	0,78	70	0,57	66	1	2	-1	2	-3
75	**ROMA "La Sapienza"**	*Scienze Sociali*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
76	**ROMA "La Sapienza"**	*Studi Europei, Americani e Interculturali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
77	**ROMA "Tor Vergata"**	*Diritto e Procedura Civile*	1	1	40	1	28	1,83	36	1,67	30	1,86	35	1,7	31	-12	-4	2	-5	3
78	**ROMA "Tor Vergata"**	*Studi Economico-Finanziari e Metodi Quantitativi*	5	1,6	27	0,8	49	1,958	28	1,05	50	1,98	29	1,234	46	22	1	1	2	-3
79	**ROMA "Tor Vergata"**	*Economia e Territorio*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
80	**ROMA TRE**	*Economia*	14	1,29	36	1	28	1,58	44	1,23	44	1,6	44	1,28	43	-8	8	16	8	15
81	**ROMA TRE**	*Istituzioni Pubbliche, Economia e Società*	2	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
82	**S.ANNA di PISA**	*Economia*	6	6,17	3	4,33	3	6,92	3	4,95	3	6,95	3	5,04	3	0	0	0	0	0
83	**S.ANNA di PISA**	*Diritto, Politica, Sviluppo (DIRPOLIS)*	1	1	40	1	28	1,89	32	1,89	22	1,9	33	1,9	23	-12	-8	-6	-7	-5
84	**SALENTO**	*Scienze Economiche e Matematico-Statistiche*	2	1,5	29	1,5	20	1,855	35	1,75	28	2,125	26	1,78	29	-9	6	8	-3	9
85	**SALERNO**	*Scienze Economiche e Statistiche (DISES)*	9	0,44	74	0,22	70	0,58	71	0,32	70	0,61	72	0,38	71	-4	-3	0	-2	1
86	**SASSARI**	*Economia, Impresa e Regolamentazione*	1	2	16	1	28	2,33	23	1,25	41	2,33	23	1,5	36	12	7	13	7	8
87	**Scuola IMT - LUCCA**	*Economics and Institutional Change*	3	1	40	1	28	1,4	50	1,24	43	1,41	53	1,24	45	-12	10	15	13	17
88	**SIENA**	*Politica Economica, Finanza e Sviluppo (DEPFID)*	1	9	1	5	2	9,63	1	5,71	2	9,66	1	5,79	2	1	0	0	0	0
89	**SIENA**	*Economia Politica e Statistica*	6	2,33	15	1,83	15	2,85	16	2,34	13	2,86	15	2,35	15	0	1	-2	0	0
90	**SIENA**	*Scienze Giuridiche, Economiche e di Governo*	1	2	16	1	28	2,85	16	1,91	21	2,85	17	1,92	22	12	0	-7	1	-6

				average h and h-norm indexes				average k and k-norm indexes				average w and w-norm indexes				differences in rankings				
	University	Department	Number of professors of 'Economic Policy'	h-index	h ranking	h-norm index	h-norm ranking	k-index	k ranking	k-norm index	k-norm ranking	w-index	w ranking	w-norm index	w-norm ranking	Δ rankings h-norm - h	Δ rankings k - h	Δ rankings k-norm - h-norm	Δ rankings w - h	Δ rankings w-norm - h-norm
91	**TERAMO**	*Teoria e Politiche dello Sviluppo Sociale*	3	2	16	1,67	17	2,45	21	1,93	20	2,47	21	1,95	21	1	5	3	5	4
92	**TERAMO**	*Scienze della Comunicazione*	1	3	7	1	28	3,4	10	1,67	30	3,61	8	1,88	25	21	3	2	1	-3
93	**TERAMO**	*Scienze Giuridiche nella Società e nella Storia*	1	1	40	1	28	1,95	29	1,86	24	1,95	30	1,86	27	-12	-11	-4	-10	-1
94	**TERAMO**	*Studi Giuridici, Comparati, Internazionali ed Europei*	1	1	40	1	28	1,75	39	1,5	33	1,75	41	1,5	36	-12	-1	5	1	8
95	**TORINO**	*Economia*	12	3	7	2,42	6	3,51	8	2,89	6	3,53	10	2,94	6	-1	1	0	3	0
96	**TORINO**	*Scienze Economico-Sociali e Matematico-Statistiche*	3	1,33	32	1,33	24	1,59	43	1,48	34	1,77	40	1,68	32	-8	11	10	8	8
97	**TRENTO**	*Economia*	8	1,63	26	1,5	20	2,22	25	2,03	16	2,27	24	2,125	17	-6	-1	-4	-2	-3
98	**TRIESTE**	*Scienze Economiche, Aziendali, Matematiche e Statistiche*	4	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
99	**TRIESTE**	*Scienze Politiche e Sociali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
100	**TRIESTE**	*Economia e Tecniche Aziendali*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
101	**TUSCIA**	*Economia e Impresa (DEIM)*	1	1	40	0	71	1	60	0	71	1	62	0,25	75	31	20	0	22	4
102	**UDINE**	*Scienze Economiche e Statistiche (DIES)*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
103	**UKE - Università Kore di ENNA**	*Kore*	1	0	77	0	71	0	77	0	71	0	77	0	77	-6	0	0	0	6
104	**URBINO "Carlo BO"**	*Economia, Società, Politica (DESP)*	1	6	4	4	4	6,76	4	4,77	4	6,77	4	4,81	4	0	0	0	0	0
105	**VALLE D AOSTA**	*Valle d'Aosta*	1	3	7	3	5	3,85	6	3,842	5	3,86	6	3,845	5	-2	-1	0	-1	0
106	**VENEZIA "Ca Foscari"**	*Economia*	7	1,29	36	1	28	1,72	40	1,39	36	1,72	42	1,41	39	-8	4	8	6	11
107	**VENEZIA IUAV**	*IUAV per la Ricerca*	1	2	16	2	10	2,86	14	2,38	12	2,86	15	2,38	14	-6	-2	2	-1	4
108	**VENEZIA IUAV**	*Arti e Disegno Industriale*	1	1	40	1	28	1,67	41	1,33	38	1,67	43	1,33	41	-12	1	10	3	13
109	**VERONA**	*Scienze Economiche*	7	1	40	0,86	48	1,37	51	1,09	48	1,46	49	1,16	49	8	11	0	9	1

* : When for a scientist no publication was found in the ISI-WoK data base his/her indexes have been set equal zero.