Abstract. The H index attempts to measure both the number and impact of published work of scientists or specialists in a field. The index is based on a set composed of the most cited works of that author and number of citations appeared in other publications. Index can be used to assess the impact of work and the work of a group of scientists at the department, university or country. The index was introduced by physicist Jorge E. Hirsch as a tool for measuring the relative quality of scientific work of researchers in the science of physics and is called the Hirsch index or Hirsch number.

Keywords: Hirsch index - history, characteristics, method of calculation, effects, international understanding database (IDB).

1. Introduction to History

In early August 2005 in the prestigious journal Proceedings of the National Academy of Sciences (PNAS) - USA, published an article which aroused great interest in the world of science. It is the idea launched by Jorge Hirsch, a prominent physician in the Department of Physics, University of California, San Diego, USA. The idea was discussed worldwide research community, its purpose being to answer the question if you can find a method by which to assess as
accurately value the results of a scientist. Jorge Hirsch proposed an evaluation criterion, which can characterize the performance of a scientific researcher, and H-specific index (named after the man who proposed), calculated as the ratio between the number of citations of a researcher's work, within the While the total number of articles published by him at the same time. One of the main features that presents this index is that it has standing to highlight researchers who have made significant contributions in their field, but not yet earned the reputation that it deserves - as eg too young - from national and international scientific community. Of this situation, Professor Peter T. gave Frangopol interworking year Hirsch index is started, the following example: Dr. Manuel Cardona, Max Planck Institute for the Solid Research, Stuttgart, Germany, working in semiconductor have a h = 86. Few people would then be classified with Nobel laureates in physics, Philip Anderson (1977), with h = 91 Pierre-Gilles de Gennes or (1991) with h = 79.

2. Features index Hirsch

Hirsch index seems objective measure to compare the scientific performance of researchers entered the competition to recognize their value and / or obtaining research funds to continue their work performance. Thus, an author with an index N ha published works, each of which is cited in other publications by M times. Ratio N / M is the Hirsch index and reflects the number of articles published and number of citations in other works person. The index is designed to improve other forms of measurement such as total number of citations and number of papers published.

Index by comparing the relevant authorities within the same domain. Because only the articles cited often help set index, how his determination is relatively simple. Hirsch noted that h has a high predictive value if a scientist is a member of the National Academy and won a Nobel Prize. In physics, a specialist with an average publishing activities should take h equal to years of experience in the field, while biomedical researchers have a higher index in the same conditions. Hirsch index grows as citations accumulate and, therefore, depends on "academic age" of the researcher. Hirsch suggested with some reservations that if physicists, an index value of 12 would be typical for those who can advance the position of associate professor at most research universities, 18 would be equivalent to filling a position of professor, a value between 15 and 20 of the index would be a member of the American Physical Society and be 45 or over the index would Aveo a member of the American National Academy of Sciences.1

There are very few studies on the correlation between academic recognition and h index level institutions, industries or nations. Among the 22 scientific disciplines listed by Thomson Reuters Essential Science Indicators Citation, ranks second only physical space research. Between January 2000 and February 2010, a physicist to be quoted by 2.073 times to be among the top 1% most cited physicists in the world. Average citation threshold for space research is the 2236 citations, of clinical medicine is the 1390 citations, and molecular biology and genetics - the 1229 citations. Most scientific disciplines such as ecology or environmental science scholars were less, so less work and therefore fewer citations. Other disciplines, such as social sciences, computer science or some border have lower thresholds of citation.

3. The calculation of the Hirsch index

H index can be calculated using citation databases or using computational tools (software designed for this purpose and available on the Internet, clicked Google Hirsch index or Publish and Perish). International databases on subscription, and Scopus and Web of Knowledge provides automated software to determine the index. International Data Base (IDB) Publish or Perish Hirsch index calculated based on entries in Google Scholar, other BDI. In July 2011, Google experienced a program allowing a limited number of scientists to keep track of their citations and h index and the index I calculate 10. Each database generates a different h for the same author, because of varying degrees of coverage of the published work: Google Scholar has more citations than Scopus and Web of Science, but collections of citations tend to be less accurate.

This topic has been studied in detail by Lokman I. Meho and Yang Kiduk. BDI Web of Knowledge has better coverage at specialized scientific journals and less on high-level conferences. Scopus has better coverage on the conference, but at low coverage of publications prior to 1990, Google Scholar has the best coverage of conferences and most journals (though not all), but like Scopus has limited coverage of publications before 1990. Most of the BDI Google Scholar were criticized for producing "ghost citations", including so called "gray literature" ("gray literature") in calculating the citations and contrary to the rules of logic Boleene to combine search terms. Meho and Yang found that Google Scholar has identified 53 percent more citations than Scopus and Web of Knowledge together and showed that additional citations reported by Google

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2 *** Citation Thresholds, in Science Watch, may 1, 2010, on site http://www.sciencewatch.com/about/met/thresholds, accessed on 13 May 2010
3 idem
Scholar were from journals and conferences of minor importance which do not significantly change index Hirsch\(^4\).

4. Advantages and disadvantages

Jorge Hirsch index intended to put out more "problems" other bibliometric indicators such as total number of papers or total number of citations. But, as is known, the total number of papers do not provide information about the quality and number of citations may be disproportionately affected by participation in one / several high impact publications - methodological papers that propose new techniques, methods or approximations which can generate a large number of citations or publications with few having many citations each. H index aims to measure simultaneously both quality and quality of scientific production.

There are certain situations where the index \( h \) may provide misleading information about the work of a particular author. Here are some of these situations\(^5\):

- not keep track of when the works have multiple authors;
- disregard typical citations from various fields;
- Jorge Hirsch suggested dividing the citations between authors;
- disregard information about the author's position in a list of authors depending on the science covered, citations are different numbers or form;\(^6\)
- is related to the total number of publications. This means that lower career researchers are at a disadvantage, regardless of their discoveries. For example, Evariste Galois's Hirsch index is 2 and will remain so forever.

- When Albert Einstein died, after publication of Annu Mirabilis four revolutionary papers in 1905, H-index remained stuck at 4 or 5. This is also a problem for any action based on the number of publications. However, as indicated in the original work, Hirsch index is designed as a tool to evaluate researchers at the same stage of their careers. This is not meant as a tool for historical comparisons.

- H-index does not take into account the context of citations. For example, in a document are cited meanings with different meanings often simply an introduction to the context. H-index also does not resolve other contextual

\(^4\) idem

instances: citations made in a negative context and citations of works fraudulent or withdrawn. This is also a problem for the number of correct citations.

- H-index provides the same number of citations for both books and articles in the making comparison difficult for researchers in areas that are more oriented books such as the humanities.

- H-index ignores factors of confusion, such as "gratuity author", so-called Matthew effect, which are associated by default with favorable citations reviewed articles. Again, this is a problem for all other measurements using publications or citations.

- H-index was found to have greater precision than a prediction or a simple measurement of average citations per paper. However, this finding was contradicted by another study 7.

- H-index is an integer, which reduces the power of discrimination. Ruane Tol proposes therefore rational H-index, which involves an interpolation between H and H + 1 8.

- H-index can be manipulated by self-citations such as those that are generated by Google Scholar, even if the computer generates documentation for using such citation SCIgen 9.

5. Conclusions and proposals

JE Hirsch indicated in his first paper, 10, it launched index that bears his name, that it is intended to evaluate researchers are on the same stage of their career. Index h is not intended to be an historical comparisons, citation context not consider, given the same importance of books and articles, which is not correct and can be manipulated by self citation (citations of their work). Therefore, there have been other proposals to change the index h and thus highlight certain features of scientific authors:

- PD Batista and collaborators have introduced an index h which takes into account the average number of coauthors. They also found that the size of index h, although depending on the analysis, can be adapted to another domain by a scaling factor. For example, assuming standard h hs biology and math, math distribution of h is definitive, so if s = 3, and h for mathematics is 3, then

9 Cyril Labbe (2010), Ike Antkare one of the great stars in the scientific firmament, in Laboratoire d'Informatique de Grenoble RR-LIG-2008 (technical report), Joseph Fourier University
hs biology is 9. This method has not yet been adopted, probably because of its complexity. It would be easier to divide the number of citations to the number of authors, before the assigned work and get the h index, as originally suggested Hirsch.

• The index m is defined as $h / n$, where n is the number of years since the first paper of a scientist.

• A generalization of the H-index and other indices that provide information about the function of citations as the author (end weight, flat / climax, etc.) was proposed by M. Gągolewski and P. Grzegorzewski.

• Row index i, such Hirsch was introduced independently by M. Kosmulski and G. Prathap, who postulated that a scientific institution has a row index and the minimum and researchers from that institution have an index $h \geq i$.

• K. Dixit and his colleagues argue that "for an individual researcher, a measuring instrument that captures Erdos number of structural properties of that network research, while the h index captures the impact of citations of published works." Therefore, to determine the index relevant to the work of several authors who can be considered both tools to generate an acceptable state.

• Index c that takes into account the citations and their quality in terms of distance between citing authors who are cited. A scientist has index n of N c if citations are from authors who are at a distance of at least n collaboration and the other (Nn) citations are from authors remote collaboration are up n.

• L. Bornmann, Mutz RD and HD Daniel proposed in 2010, three categories of evaluation: h2lower, h2center and h2upper for a better representation of the shape of the distribution of values of h index. The three evaluation measures the relative area of distribution citations a scientist in the area of low impact (h2lower), the area actually captured by the index h (h2center) and area...

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13 M. Kosmulski (2006), I-a bibliometric index, in Forum Akademickie, vol. 11, nr. 31
publications more visible (upper h2). Scientists with h2upper are perfectionists, and those with h2lower produce more scientific literature\(^{17}\).

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