

Impact Factor

Assoc. Prof. Violeta Tsakova, Ph.D.

Department of Intellectual Property, UNWE

Summary: Every scientist is acquainted, although to a different degree, with the impact factor and its application as a science metrics indicator. The reason for the attention and interest to this factor is its introduction and use as an important indicator in the scientific sphere. Nevertheless, the ongoing discussions and the polarization of opinions on the essence and usefulness of the impact factor are not coming to an end.

The present article can be regarded as part of such a discussion. It includes the analysis of issues related to the impact factor as: reasons for its appearance and application, its definition model, its field and limits of application, its advantages and limitations, the benefits of taking this factor into account, etc.

Special attention is paid to the fact that the impact factor is a numerical indicator of the rating of scientific journals. The mechanical broadening of its field of application – from journals to the qualities of papers published in them and the scientific competencies of the authors is dangerous and can lead to erroneous conclusions.

The article also discusses other issues related to the impact factor as: publishing of scientific papers in periodicals, the development of the world system of referencing and assessment

of scientific periodicals, the system of reviewing scientific papers, etc.

The conclusion is that the impact factor is a useful indicator; its application results in higher standards for scientific journals, as well as for papers published in them. The higher requirements can help overcoming some deficiencies of periodicals market – most of all mass scale publishing to the detriment of scientific content and value.

Key words: impact factor, referencing system, indexation and evaluation of scientific periodicals, science metrics indicators, quotation.

JEL: C13, D80, L82.

The impact factor is well known to the Bulgarian scientific community. It is largely discussed, especially during the period of 2004 – 2005, due to the intention to be used in estimating the achievements of the scientific workers in the country and to be included in the system of indicators for the procedure of scientific development. Since then any matters in relation to the impact factor and its application are discussed at random and viewed from different aspects on the pages of the scientific journals and scientific forum presentations. From the end of 2007, this index is a subject of increased attention again due to its intended use as a decisive factor in the awarding of the

academic titles Assistant Professor and Professor and for estimating the capacity of the scientific institutions. For the readers, well acquainted with the impact factor and the discussions surrounding it, this is hardly news. The importance of the subject however necessitates its discussion and the explanation of the aspects of its appearance, essence and significance, be it in short terms.

Publication of scientific materials

The impact factor relates to the **publication** of scientific research results in the periodicals and the feedback the publications in them receive. Publication is the main method for the realization of the scientific results, so striving towards publication is understandable. Publication itself has a multiplan effect:

- for **the scientific worker** it is a way to declare his presence and participation in the research world, a form of presenting the results of his research and a condition for his scientific development;
- for **the scientific institution** it is an indicator for the working capacity of its staff, a measure for its research activity and a factor for the compatibility of the institution as a whole;
- for **the scientific community** it is a form of circulation and exchange of science knowledge, thus helping to identify the trends and the actual problems of scientific research by a given date, to draw out reference points for scientific work and to identify useful ideas;
- for **the business and risk capital** it is an indicator for the forthcoming scientific news and related to them innovations, as well as for the specialists to be engaged in their realization;

- for **the state support and for the donors** it is a point of reference for the allocation of the scientific research funds.

The publication may be in an **individual release** – a monograph, a collection of articles, a textbook, etc., or in the **periodicals** – a journal, a bulletin and so on. As a rule, the big in volume scientific works, a result of many years striving, are published as an individual releases. Before their appearance however, some separate ideas, findings and results of the work find their place on the pages of specialized periodicals. This is a good method to inform the scientific community about the problems a researcher is working on, to acquaint it with the trends and the emphasis of the research and most of all – to look for its assessment and opinion on the results achieved. In this sense, the periodicals serve the purpose and have the significance of announcing first what is happening in the system of scientific knowledge and what is new in science.

We have to point out one more important difference between the two methods of publishing – from the standpoint of the author's motives and benefits.

The individual releases represent and are accepted as a whole product of the researcher's work during a given period of time. The author receives remuneration for the submission of his work to the consumer and for offering it on the market. This is an expected for the author income, considered a repayment for his efforts, and relied upon for the satisfaction of his economic needs and interests.

The publication in the periodicals is considered an **useful exchange of ideas in the community of creative individuals**, where a shared idea evokes regard, respect, popularity,

professional recognition and development. The strive for these consequences, rather than the remuneration, is the main motive of the authors to publish in periodicals. This is used as an argument by some publishing companies for not offering author's payment for the submitted and published materials. They hide behind the understanding that they fulfil a public function like a scientific forum, providing the conditions for giving publicity to the acquired scientific results, exchange of ideas, presentation of a point of view, problem discussion and generally – for scientific communication as a factor for the development of scientific knowledge. The fulfilment of this public function is made possible due to the mutual efforts of the periodicals and their authors. They need one another, while the readers need both of them as the main participants in the process of creating and circulating the scientific knowledge. To this meaning, the publication in the periodicals is considered a manifestation of nobleness and a gesture on behalf of both authors – sharing and offering for use the results of their work – and the publishing companies – popularizing these results.

Introduction of the Impact factor

The increase of employees in science, the rapid development of the scientific knowledge, the expansion of the scientific research field, the active international movements and other objective processes from the second half of last century have as a result the fast increase in the number of manuscripts, offered for publication in the periodicals. This in return causes the fast development of the market for scientific journals by increasing their number and specialization profile. The market expansion is accompanied by changes – not all of

them positive. The goals of some scientific journals have grown to a degree and in the directions that can be hardly associated with the development and circulation of scientific knowledge. The systems for assessment and selection of materials for publishing are liberalized to the point of lacking any selection. Such changes are supported by the authors' desire for publishing "at any cost, anywhere". The new situation is described half-jokingly and half-seriously by the sixth Parkinson's Law: "The progress in science is inversely proportional to the number of journals published".

Such reality brings the necessity for putting some **order in the scientific publication** and making searching easier. This necessity is "caught" as a commercial find by many companies, which are successfully using it. They create a different information database, such as bibliography information and/or annotation of articles in scientific journals and/or the full text of such articles, information for the publication activity of the authors, and determine the conditions for the use of any such information. Databases, like SCOPUS, EBSCO, Econ Lit, JSTOR, VINITI and many others, are already invaluable source of information for any scientific worker. The world system for the sorting of scientific journals is made complete with the introduction of an assessment element as well.

The initial idea for the assessment of the "values" of a scientific journal belongs to Eugene Garfield – Director of the Institute for Science Information in Philadelphia. He offers a scientometric index (**impact factor**) to be used in the working process and due to purely pragmatic reasons of the managed by him institute. The factor is intended to serve as an original filter in relation to the scientific journals to be

followed in the enormous flow of scientific information.

The calculation of the impact factor is based on the information for the publications in a given journal and their citation. The observation period for such information is three years, for example 2006 – 2008. The calculation of the impact factor (IF) is accomplished using the formula:

$$IF = A/B$$

where:

A is the number citations of articles during 2008, published in the journal during 2006 and 2007;

B is the number of articles, published in the journal during 2006 and 2007.

Thus determined, **the impact factor is a numerical index for the rating of the scientific journal**, but not for the articles in it or their significance, and even less – for the research abilities and achievements of their authors.

From the beginning of the sixties, the impact factor is calculated every year. Up till 1990 this is carried out by the Institute for Science Information, and after that – by Thomson Scientific¹. Based on this factor, the polythematic **Science Citation Index (SCI)** is issued. The index is a result of new index method for bibliographic reference, different to the traditional one for subject indexes. It allows not only operational and multi-aspect search, but the follow up of the adoption and the development of the scientific idea, without limitation to the sphere or the subject. Thus the **world**

system for reference, indexing and assessment of the scientific periodicals is completely formed. Today, nearly 80 000 scientific journals are included in the system for reference and indexing, and 10 % of these – in the system for assessment using the impact factor.

The publications inclusion in the system is achieved after application and inspection according to defined criteria. A major criterion among them is the application of a mechanism for anonymous review of the submitted material, based on the assessment of independent experts. Very often, the journals use the so-called review model of “double blind”² for the purpose of greater assessment objectivity for the quality of the reviewed materials. The requirements for the review are clear and unambiguous answer to matters such as: authenticity, actuality, availability of new ideas, continuity, clarity of presentation and other characteristics of the material, including the proposal for its publication, rejection for publication or publication after revision.

Soon after the SCI index issue, the data in it is used for the analytical research of science assessment.

The introduction of the term “impact factor” is related to the creation and the issue of Journal Citation Reports (**JCR**). This is a bibliometric reference book, containing statistical information for the citation of journals, and it is considered that it reflects the degree of their use and productivity³. Thus, from a private and insignificant bibliometric indicator, the impact factor is transformed into a major index for the quality of a jour-

¹ From 1990 the Institute for Scientific Information is under the ownership of Thomson Scientific Company.

² “double blind” – when the reviewer is made unaware of the author’s name and anything else in the material that may contribute to his identification.

³ JCR includes two databases: Journal Citation Reports – Science Edition and Journal Citation Reports – Social Sciences Edition.

nal and under certain conditions – for the quality of the included in it materials.

Today the impact factor is one of the standardized scientometric indexes, created by Garfield and other specialists⁴, used for the measuring of the influence/value of the scientific journals and their citing. Some of these indexes are:

- operational index – shows how quickly the published articles in a given journal become known in the scientific circles;
- “diachronic” impact factor – records the number of citations the articles in the journal receive during the specified year;
- period (number of years) during which half of the citations are made;
- coefficient of self-citing⁵ – the high values of the coefficient are an indicator for insufficient popularity of the journal;
- coefficient of self-citation⁶ – the high values of the coefficient are an indicator for isolation and narrow scope of the scientific field and matters included in the journal;
- impact factor by countries, etc.

Merits and limitations of the impact factor

The matter for the use of citation in the assessment of scientific productivity has always resulted in **disputes**. Garfield himself warns that the created by him system is not universally applicable, which explains its different reception by the scientific community. Even until now, the impact factor is a subject of discussions concerning

its positive and negative values. Its merits are considered to be:

- simplicity of use and understanding;
- wide range of the indexed scientific journals, already numbering around 8 000 issues of more than 3 300 publishing companies from 60 countries;
- allows the comparison of journals with different scientific problems by formal indicators;
- puts all scientific journals under equal conditions – the big ones (with bigger volume) alongside the small ones;
- availability of the calculation results to the public, etc.

The impact factor is under the influence of many sociological and statistical factors. The sociological factors include: subject sphere of the journal, its type, average numbers of authors per article and so on. The great number of factors, affecting the values and the dynamics of the impact factor, is the biggest contributor for its stated limitations, such as:

- inconclusiveness in relation to the quality of the cited articles (irrelevant of the strict review system, used by the journals with high impact factor, the number of the cited articles in them does not reflect the quality of the research and the published material);
- the influence of factors of different nature, such as type and sphere subject of the journal, average number of authors per article, period for the recording of the citations (it is considered that a two-year period is too short for articles about certain scientific areas, receiving response later);

⁴ Rousseau R. L. Journal Evaluation: Technical and Practical Issues // Library Trends 2002, Vol. 50, Iss. 3, p. 418-439.

⁵ Calculated as a ratio between the published articles cited in the journal and the total number of the cited articles from this journal in other journals.

⁶ Calculated as a ratio between the published articles cited in the journal and the total number of all citations, made in the same journal.

- different frequency in the publication of the results, typical for the different science research works and science spheres, which has a very strong effect on the calculation of the impact factor for the journal⁷;
- the belonging of the authors and the language the scientific journals are published in to the different language groups, which to a high degree predetermines the consumer group⁸;
- the difference in the national and international importance of the researched problems (the very important domestic problems of certain countries are of no importance or interest from scientific point of view to the researchers in other countries and respectively, they do not attract their attention.)
- protection of the presented results (the scientific research results, protected by a patent, as a rule are offered for publishing after the protection is received, but it costs money some scientific institutions and individual scientific workers in many countries can ill afford);
- the visits to the internet versions of some journals, which exceeds the traditional method of their use, is not taken into account, etc.

A perfect system for the formal assessment of creativity does not exist and cannot exist due to the incompatibility in their nature – creativity and qualification. That is why the stated merits and limitations of the impact factor as a scientometric index should not be put on the scales. It is more important to estimate – is it possible to receive some

benefit from the information it presents and is it possible to use this information reasonably, outside the absolute terms. Our categorical answer is YES. It is because the impact factor provides the rating for international recognition of journals, considered to be orientated towards the search for science, indicators of the scientific achievements and the power for the development of science as a whole⁹. These are the reasons, leading to the making of purely commercial decisions or decisions in connection with the scientific policy at different level, all of them based on the meaning of the impact factor. Under the conditions of popularization and influx of bureaucracy in scientific research, the impact factor is a good indicator for who needs financial support and what for, or who is to be involved in science work. It is because publishing in journals with high impact factor is an indicator and an original, although not an absolute guarantee for the quality of the published materials and the research abilities of their authors due to the applied strict review systems.

It is particularly important to bear in mind that **the impact factor is a scientometric index for the assessment of the scientific journals.** Its creator – Garfield has not intended the impact factor to be used for the assessment of the scientific qualities of the publications, and even less – for the scientific competence of the authors of such publications. Such extension of its field of application – from the journals to the authors of the articles in them – is mechanical and it should not be allowed due to many reasons, among which:

⁷ For example, during the last years, irrelevant of the variations, the average impact factor for the journals in the sphere of biology is more than twice higher in comparison with the journals in the sphere of organic chemistry and almost ten times as high in comparison with the journals in the sphere of mathematics. As a whole, journals orientated towards fundamental and theoretical scientific results are with a higher average impact factor in comparison with special and applied research orientated journals.

⁸ Even during the eighties Eugene Garfield points out that 80 % of the scientific literature is published in English.

⁹ To illustrate the said above, the first ten journals are enclosed according to their rating, in three spheres of science – economics, business and international relations.

- the high impact factor of a journal, where a scientific article is published, does not guarantee at all its use and the article may never be cited;
- many of the scientific results publications are made in individual releases and in collections of reports from scientific forums, which have no impact factor, as they are not part of periodicals;
- the publication of materials in releases without impact factor has nothing to do with the quality of the material, etc.

Still, a connection exists, but of different nature – what journals publish the works of a science worker. Because it is very difficult to publish in a high impact factor journal due to the bigger competition on behalf of the authors for them and due to the stricter rules for the review procedures. According to the principle “peer review”, authoritative international journals subject all materials to an uncompromising review by at least two leading specialists in the respective sphere of science. The information for the last years shows that between 2/3 and 3/4 of the manuscripts, submitted to high impact factor journals, are not published after their revision. But if a material is published after the strict revision by the independent reviewers, it is given the possibility to reach the international scientific community and stands a good chance to be noticed and valued. It is not by chance that journals, processed for the creation of JCR, are called “journals at source” for new, updated and useful scientific information. Nevertheless, in order to avoid formality in relation to the production of a researcher, a combination is recommended of the rating value of the

journal it is published in, and the expert assessment for its scientific value. This allows to overcome some of the limitations of the impact factor as well.

From the impact factor to other scientometric indexes

Having considered some of the limitations of the Garfield’s factor and at the same time, wishing to take the benefit of the achievements in the sphere of scientometrics, some countries with higher publishing activity but smaller use of the publications abroad due to language barriers and other objective reasons, create a national base for citation and introduce a **national index of citation**. National systems for citation are introduced in China, Japan, Russia and other countries¹⁰. Some go even further, by introducing an internal (for the organization) rating of publications¹¹.

The experience of other countries shows that the rating may contribute to an assessment of the scientific research on the next organizational level down to the individual scientific worker, by relating to, but not by mechanically transmitting the assessments and the indexes from one level to another – international, national, institutional and individual. On every level the indexes for assessment are different but at the same time they have to relate to one another. On working level – that of the scientific worker – the index for his productivity is the number of his publications for a specified period of time. Yet the index for the significance

¹⁰ As an example for the necessity for the introduction of such system China can be mentioned, where during the second half of the nineties are published approximately 440 thousand articles per annum and only 4.5 % of them reach SCI. During 1998, from the published 4 200 journals, SCI covers just 0.7 %. This creates the necessity for a national base for citations, which is developed and maintained by the Institute for Science and Technical Information in China.

¹¹ An example – the Siberian department of the Russian Science Academy.

and usefulness of the publications is the degree of their utilization and the back feed for them, which can be estimated by the number of citations, positive reviews and responses. The probability of achieving this is bigger when the publications are in journals of high rating. This is what gives the significance of the publishing journal – is it with high or low impact factor, is it included in the international system for reference, indexing and assessment or not. If not, it means that the journals themselves are unknown to the international scientific community and from there – that the authors of the published in them materials cannot be recognized as members of the global scientific community.

The citing is an index with individual and public aspects and modifications. In the purely individual aspect the citing points out the assessment and the recognition of the submitted by the author scientific research results, which is important for his confidence and development as a scientist. That is why each author has to know the number of citings received by his publications, as well as their character. Citing therefore may take the form of criticism, denial or disputing of a point of view.

In broader aspect, the citing has the function of a scientific barometer. It points out the current problems for research, their unresolved questions, the attractive and perspective lines of research and so on.

The information in both aspects – for the citing of the publications in the particular journals and the citing of the particular publications – is exceptionally useful. The subscription costs however, that can ensure

the citing, are not within the means of the separate scientific institutions and even less so within the means of the individual scientific workers.

In our country this problem is resolved by the provision of such **information services** by the Central Research and Technical Library with the National Centre for Information and Documentation (NACID)¹². The automated information service through access in foreign information centres and databases allows:

- to check for citations in SCI following a provided list for publications or of specified publication;
- to make a reference for citations in SCI;
- to make references for the impact factor of journals according to JCR information and others.

Conclusion

The publication at any cost, in whatever periodical is not the best way to declare participation in the world of research and to claim a place in the scientific community. The way journals are demanding towards the materials of their authors, the same way authors must carefully choose the periodical announcing the results of their research work. Based on mutually exchanged requirements, the market for scientific periodicals may overcome the accumulated shortcomings, and the major one of them – numbers against scientific content and quality. This will be to the benefit of both authors and consumers, but most of all – of the process for development of the scientific knowledge. The use of scientometric indexes and strict systems for review is only part of the mechanism for the achievement of this effect. **VIA**

¹² mail.nacid.bg/newdesign/bg/index.php?id = 54

Journals Ranked by Impact: Economics

Rank	2004 Impact Factor	Impact 2001-05	Impact 1981-2005
1	Quarterly J. Economics (4.41)	J. Economic Literature (10.11)	J. Economic Literature (57.59)
2	J. Economic Literature (4.40)	Quarterly J. Economics (10.11)	Econometrica (50.03)
3	J. Economic Geography (3.14)	J. Economic Perspectives (5.78)	J. Political Economy (45.24)
4	J. Economic Perspectives (2.95)	J. Political Economy (5.37)	Bell J. Economics (39.97)
5	J. Political Economy (2.62)	Econometrica (5.34)	J. Financial Economics (37.35)
6	J. Financial Economics (2.55)	J. Accounting & Econ. (5.18)	Quarterly J. Economics (37.34)
7	J. Health Economics (2.50)	J. Financial Economics (5.15)	American Economic Rev. (24.18)
8	J. Economic Growth (2.38)	J. Economic Growth (4.74)	Rev. Economic Studies (23.51)
9	NBER Macroecon. Ann. (2.33)	American Economic Rev. (4.50)	J. Economic Perspectives (23.35)
10	Economic Geography (2.33)	J. Health Economics (4.18)	J. Monetary Economics (22.12)

Journals Ranked by Impact: Business

Rank	2005 Impact Factor	Impact 2002-06	Impact 1981-2006
1	Acad. Manage. Rev. (4.25)	Admin. Science Quart. (10.41)	Admin. Science Quart. (74.80)
2	Journal of Marketing (4.13)	Acad. Manage. Rev. (7.79)	Acad. Manage. Rev. (55.80)
3	Marketing Science (3.79)	Acad. Manage. Journal (7.47)	Journal of Marketing (45.16)
4	Admin. Science Quart. (2.72)	Journal of Marketing (7.01)	Acad. Manage. Journal (41.78)
5	J. Marketing Research (2.61)	Marketing Science (5.12)	Strategic Manage. J. (36.40)
6	Acad. Manage. Journal (2.20)	Strategic Manage. J. (4.90)	J. Consumer Research (35.77)
7	J. Consumer Research (2.16)	J. Consumer Research (4.47)	J. Marketing Research (31.20)
8	Strategic Manage. J. (1.90)	Journal of Management (4.44)	Journal of Management (22.03)
9	J. Business Venturing (1.85)	J. Marketing Research (3.82)	Marketing Science (17.86)
10	Entrep. Theory Pract. (1.54)	J. Int. Business Stud. (3.44)	Sloan Manage. Rev. (16.37)

Journals Ranked by Impact:International Relations

Rank	2005 Impact Factor	Impact 2001-05	Impact 1981-2005
1	International Security (2.63)	Internat. Organization (5.46)	Internat. Organization (20.76)
2	Am. J. Internat. Law (2.15)	World Politics (3.68)	World Politics (17.57)
3	Internat. Organization (2.06)	J. Conflict Resolution (3.53)	Int. J. Geogr. Info. Sys. (13.28)
4	Foreign Affairs (2.06)	International Security (3.52)	J. Conflict Resolution (12.84)
5	Stanford J. Int. Law (1.81)	J. Common Market Studies (2.73)	Int. Studies Quarterly (9.82)
6	Eur. J. Int. Relations (1.50)	Alternatives-Soc. Trans. (2.60)	International Security (9.62)
7	Int. Studies Quarterly (1.42)	Int. Studies Quarterly (2.50)	Post-Soviet Affairs (6.29)
8	World Politics (1.31)	Am. J. Internat. Law (2.24)	Conflict Mgmt./Peace S. (5.05)
9	J. Peace Research (1.29)	J. Peace Research (2.20)	J. Peace Research (5.02)
10	Conflict Mgmt./Peace S. (1.29)	Eur. J. Int. Relations (2.12)	Internat. Interactions (4.98)

Source: *Journal Citation Reports, Journal Performance Indicators*