NON-H INDEX-BASED EMERGENT RESEARCH FUNDING ALLOCATION IN THE PHILIPPINE CONTEXT

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ABSTRACT

This paper identifies the consequences of research funding allocation based on Hirsch-Indices in the Philippines. It uses a descriptive design utilizing the data from the Google Scholar Rankings as of December 2016 for the top (51) members of the National Academy of Science and Technology of the Philippines (NAST) as well as the Editorial Boards of the Commission on Higher Educations' (CHED) accredited journals.To simulate what actually happens when the H-index is used as a funding criterion, the top 51 H-indices from NAST rooster of scientists were merged with the H-indices of randomly selected Filipino Editorial Board Members of Journal evaluated under the Journal Incubation Program (JIP) of the Commission on Higher Education. The results reveal that the use of H-index as a surrogate measure to determine an academician's capability to undertake a meaningful research study and, thereby, judge his/her worth on this account may have some unintended negative consequences to higher education research productivity such as monopoly in research grants and production of mediocre research. Thus, a new allocation scheme is suggested as an appropriate intervention of the research-granting government agencies to increase the number of qualified researchers in the Philippines resulting to the production of high quality research outputs. The suggested allocation scheme utilizes the principle of Self-Organizing Funding Allocation (SOFA) of Europe, but replaces the H-index as a criterion for the grant with either of two new measures of trust and influence T (A) and T (adj) of a researcher.

Keywords*: research funding allocation, h-index, self-organizing funding allocation, power-law probability model, fractal distribution*

1.0 Introduction

The increasing pressure to be more research productive has become more pronounced in this recent decade where academicians and research scientists compete for funding, academic positions and limited tenured items (Thor and Bornmann, 2011). Consequently, more reliable measures of scientist's research outputs are adopted to capture a scientist's lifetime citedness incorporating both productivity and citation impact. The *H-index* proposed by Jorge Hirsch (2005) enables the analysis of an author's productivity and the impact of his published works. It is calculated using the citation's rates of individual articles, in descending order by number of times cited (University of West England, 2011). The *H-index* allows an author's output to be ranked without being unduly influenced by articles which had been heavily cited or those which are yet to be cited. Its main drawback is that it cannot be used to compare across disciplines (University of West England, 2011).

Scientists invariably publish their important results in international journal literature. When such results are published, they are then positioned in relation to the results of others through a citation process (Gasparyan, 2010). Generally, every scientific paper has two main parameters of interest: (a) increment to the science, and (b) credit for its discovery (Greene, 2007). While the *H-index* has become the most used measure of a researcher's worth, it is not without its drawback. First, the *H-index* is field-dependent, so that it is not possible to compare *H-indices* across disciplines. Second, it is vulnerable to self-citation. Third, the *H-index* puts the newcomers at a disadvantaged position since their publication and citation rates are low (Bornmann. 2011). Schubert (2009) recommended the calculation of an H-index for the citations of one single publication, resulting into a "Single publication *H-index*". He justified his recommendation to wit: "Citation indicators usually measure the direct impact of publications. However, publications may exert influence also indirectly through a reference list."

In the Philippines, the Commission on Higher Education (CHED) very recently incorporated a research proponent's H-index as a decision criterion for the grant of research funding (CHED Call for Proposals, 2017). Since the fad to utilize the *H-index* as a surrogate measure of "capability to undertake a meaningful study" has apparently been implicitly adopted in this higher education, government agency, it is important that a scientific analysis be made in order to infer the consequences of such a policy. This paper is written specifically, for the purpose of providing policy advice to the research-granting agencies of the government using the H-index or contemplating the use of this measure.

2.0 Conceptual Framework

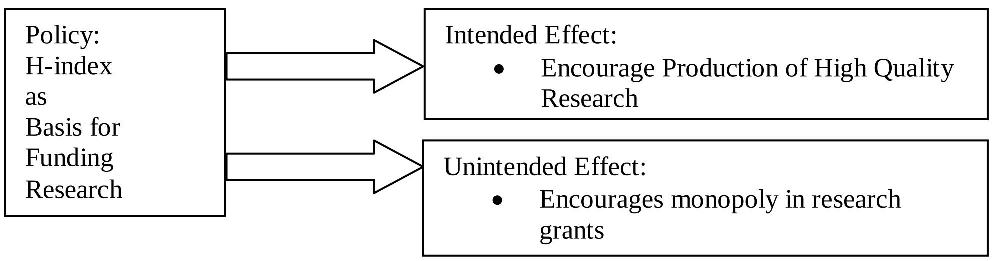
This present study claims that the use of *H-index* as a surrogate measure to determine an academician's capability to undertake a meaningful research study and, thereby, judge his/her worth on this account may have some unintended negative consequences to higher education research productivity. This *H-index*, a single-number indicator for evaluating the scientific achievement of a given researcher, has its drawbacks to consider. In measuring bibliometric, the *h-index* is dependent on the length of an academic career, and it should be used for comparing researchers of similar age. Likewise, the *h-index* value is dependent on subject category and should only be used within one discipline. These examples are just few of the many issues that should be considered when using *H-index* for evaluating scientific output (Bornmann and Marx, 2011).

However, when the H-index is used as a decision criterion at the national level, it is very likely that such indices will be ranked on the basis of their numerical values regardless of disciplines. Huang and Chi (2010) averred that papers written in the life and social sciences are more likely to be cited than papers in the hard sciences such as Mathematics and Physics because of the relatively fewer researchers in the latter fields than in the former. A funding agency may, of course, avoid this pitfall by maintaining huge data-basis for the H-indices of researchers by disciplines. Given the urgency of utilizing the H-index as a funding criterion, however, this does not seem possible.

Huang and Chi (2010) also looked into the distributional patterns of H-indices of 122,437 papers in 100 universities in Taiwan and found that the mean H-index of 19.86 already accounted for 90% of all H-indices viz. having an average H-index in this country implies that a scientist already belongs to the top 10% of his/her scientist-peers. This same observation was made six decades ago by V. Pareto (1948) when he introduced the power-law distribution as an alternative to the normal distribution. Thus, the use of the mean H-index value as the basis for funding grants encourages mediocrity rather than excellence in the system.

Finally, when used as a criterion for funding research, the H-index virtually shuts down the window of opportunity for brilliant but novice researchers in various disciplines. Hardy and Littlewood (1940) noted that the most brilliant mathematician of the 19th century, Srivasan Ramanujan, had serious difficulty in having his work published because of decision criteria based on track record.

The conceptual framework of the study is diagrammatically illustrated below:



3.0 Methods and Design

The data from the Google Scholar Rankings as of December 2016 were obtained from the top (51) members of the National Academy of Science and Technology of the Philippines (NAST). The data set contains information on both productivity and citation impact of the country's "cream-of-the-crop". The distributional pattern of these H-indices is analyzed and interpreted.

To simulate what will actually happen when the H-index is used as a funding criterion, the top 51 H-indices from NAST rooster of scientists were merged with the H-indices of randomly selected Filipino Editorial Board Members of Journal evaluated under the Journal Incubation Program (JIP) of the Commission on Higher Education. The distributional pattern of the H-indices for the entire Philippine can be gleaned from this merged list.

4.0 Results and Discussion

Table 1 shows the summary statistics for the H-indices of the top 51 NAST members in the Philippines.

Table 1. Descriptive Statistics of the H-Index of the Top (51) Members of the National Academy of Science and Technology of the Philippines

Variable	N	Mean	Median	TrMean	StDev	SE Mean
H-index	51	19.67	15.00	17.53	15.72	2.20
Citation	51	2772	990	1827	4933	691

Variable	Minimum	Maximum	Q1	Q3
H-index	3.00	71.00	9.00	24.00
Citation	34	25261	334	2256

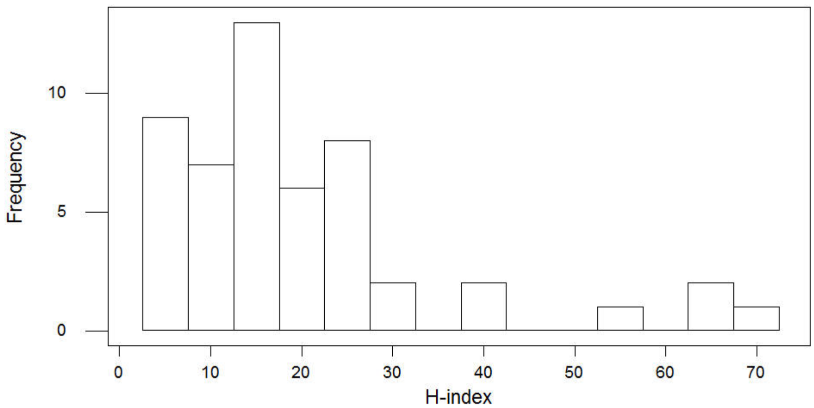


Figure 1. Histogram of the H-Index of the Top (51) Members of the National Academy of Science and Technology of the Philippines

The probability distribution of the H-indices shows a concentration of scores at the lower values. In fact, the mean H-index of 19% is greater than the median of 15.00. The average H-index of 19.86 or 20 is located at the 67.75th or 68th percentile implying that an average of H=20 surpasses 68% of the H-indices of the other top Philippine scientists. If the rule is to include only those with H-indices of 20 (average) or higher for funding consideration, then only about a third (32.20%) of the best scientists in the country would qualify.

On the other hand, if the median (H=15.00) is used as a reference point, then half of the top Philippine scientists would qualify. This increases the pool of qualified grantees by about 17%. The downside, however, is a significant reduction in the quality indicator utilized for screening purposes (from H=19 down to H=15.).

Consequently, adopting the average H-index as basis for grant inclusion ensures better quality research outputs but suppresses research productivity. Fewer research publications of better quality are to be expected. Meanwhile, utilizing the median as a basis for grant inclusion somewhat stimulate research productivity at the cost of lower quality publications.

In the Philippines, where research in higher education had been given serious attention only in the past two decades with CHED's leadership, productivity outweighs quality. Higher education research in the country is still at its infancy stage and the culture of research in the academe is yet to be established.

The aforementioned analysis considered only the top National Academy of Science and Technology (NAST) researchers, yet, the picture painted is not exactly inspiring. Table 2 summarizes the information when the Editorial Board Members of the accredited Journal Incubation Program (JIP) journals are included in the analysis. Note that none of the NAST members are members of these JIP journals.

Table 2. Descriptive Statistics of the H-Index of the 126 Top-Tiered Researchers in the Philippines

Variable	N	Mean	Median	TrMean	StDev	SE Mean
h-index	126	10.63	6.00	8.77	12.89	1.15

Variable	Minimum	Maximum	Q1	Q3
h-index	0.00	71.00	2.00	14.00

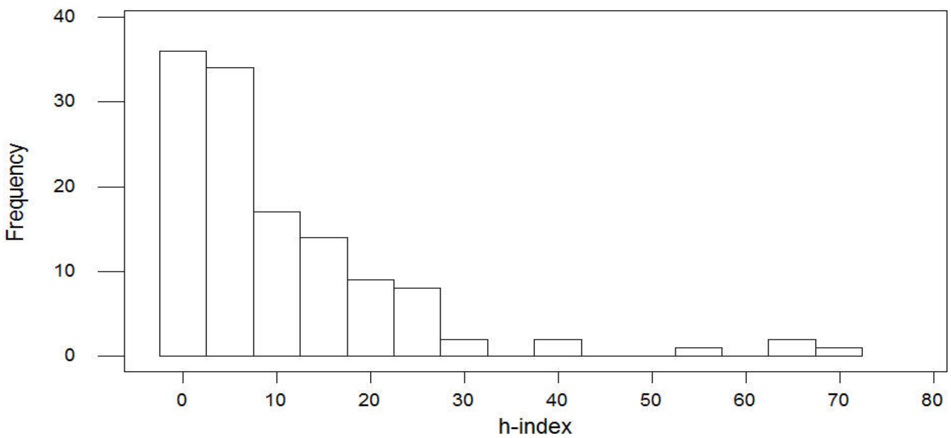


Figure 2. Histogram of the H-Index of the 126 Top-Tiered Researchers in the Philippines

A total of 126 researchers (NAST members and JIP Editorial Board Members) was included in the analysis. Tabular values show that the mean H index reduced to H=10.63 with a similar decrease for the median H-index (from H=15.00 to H=6.00). The probability distribution of the H indices reflected a more pronounced power law distribution with most scores clustering at the lower end of the spectrum. It may be noted that the probability distribution of the H-indices of a larger number of researchers in other countries manifested the same power law curve (rather than the normal curve) so that the phenomenon can be considered a global phenomenon (Huang and Chi, 2010; Schubert, 2009; Greene, 2007).

If the same funding rule is applied to this set of respondents, that is, consider only those with H-indices equal to or greater than the mean (H=10.63), then only 37% of the researchers would be included. This happens because the mean of H=10.63 falls on the 63rd percentile rank i.e. obtaining an H-index of 10.63 (or 11) means that the person surpassed 63% of his/her peers' H-indices. The situation is quite different from the previous case in the sense that more researchers (37%) get to avail of research grants yet quality may now be dubious (lower H-index of 10.63).

The situation gets worse when the mean is replaced by the median as a criterion. In this case, proliferation of more researches with questionable quality will become a huge issue.

SOURCES OF PROBLEM

The idea of using the H-index as a criterion for grant inclusion appears to be the main source of the issues that subsequently arise. In the first place, Schubert (2009) and Huang and Chi (2010) already warned that the H-index is inappropriate for comparing the researchers' capability across disciplines. Researchers in the social sciences generally get better citation values than those from the hard specialized sciences where very few people work (Huang and Chi, 2010).

Thus, one way to resolve the issue may be to compare the H-indices of researchers only in the same discipline. This is a more equitable and fair way of judging the worth of a researcher in his discipline. However, Pareto (1948) demonstrated that if the general distribution of the H-indices obeys a power law distribution, then the probability distribution remains the same at all scales. In layman's language, this means that the *H-indices of researchers in the same discipline would also obey the power-law distribution.*

The main inference that one could deduce from this is that the H-indices within the same discipline would be concentrated at the lower values with few observation at the higher end of the spectrum. Thus, there will be more grant-funded researches of questionable quality.

Finally, there is yet another issue that needs to be resolved relative to the use of H-indices by grant-funding agencies like CHED. How does one encourage new and promising scientists to publish? These scientists have no track record to speak of and may actually have no H-indices at all.

SELF-ORGANIZING FUNDING ALLOCATION (SOFA)

It is ironic that the intent of using the H-index as a criterion for incentivizing high quality research outputs may result into the exact opposite situation. This possibility was already anticipated by many Western research funding agencies (SOFA, 2014) which suggested an alternative mechanism for funding.

Self-Organizing Funding Allocation (SOFA) is a new system developed by Johan Bollen, a computer scientist, at Indiana University in Bloomington. In his system, scientists no longer have to apply for funding; instead, they all receive an equal share of the funding budget annually i.e. €30,000 in the Netherlands and $100,000 in the United States, however, they have to give a fixed percentage of donation to other scientists whose work they respect and find important (Vrieze, 2017).

Self-Organizing Funding Allocation (SOFA) works as follows: A fixed sum for research grants is allocated to the top-tiered scientists in a country. Each grantee is then instructed to collaborate with new or low H-index researchers. The grantee is responsible for ensuring that publishable research outputs are produced by the collaborators. Once the collaborators' H-indices are improved so that they qualify as main grantees, the SOFA taps a wider audience in the next funding cycle.

However, this kind of system is not applicable in the Philippine context for the following reasons: (a) the number of qualified researchers to receive a grant from the research-granting government agencies in the country is limited; (b) qualified researchers are mostly in the same field of disciplines, thus, it limits the funded research outputs to a few scientific disciplines; (c) donation to other researchers is limited to the qualified scientists' institutions and friends; (d) chances of getting funded for new researchers are very slim.

Trust Scores Compared with H-indices

Cross-comparability of the H-indices of scientists working in different disciplines is found to be the main weakness of this index for determining the impact of an author's work. Consequently, we propose a more flexible measure that allows for this comparison utilizing both the author's: (a) number of publications (P), and (b) number of citations (influence). In the construction of such an index, we considered how much trust his peers have on the author as well as the extent of his influence in the discipline.

The core quantity considered is the number of citations (Cp) which is a proxy for the "reach" of the author's body of work. When divided by the number of publications (P), we obtain the average influence of each individual publication of the author:

$$I_A = \frac{C_T}{P} \qquad (1)$$

We have shown in the earlier section that the number of citations C_T over a power law distribution:

$$C_T \text{ is distributed as } f(C) = (\lambda - 1)\, C^{-\lambda},\ \lambda > 1 \qquad (2)$$

while I_A obeys the same power law. Let

$$\lambda_A = 1 + \frac{1}{\log(I_A + 1)} \qquad (3)$$

(Padua and Borres, 2017). The trust index T_A for an author A is:

$$T_A = \ln(\lambda C_T) \qquad (4)$$

Alternatively, to be consistent with the power-law or fractal distribution of the core quantity, we can modify (4) into:

$$T_{Adj} = \ln(C_T)^{\lambda} = \lambda \ln(C_T) \qquad (5)$$

Note that the new measures (4) or (5) account for influential men of Science with hardly any publications like Sir Isaac Newton, (1683), P=1; Bernhardt Riemann (1859), P=1; and Evariste Galois (1830, P=5).

Figure 3 shows the histogram of the 51 scientists' citations-per-publication scores:

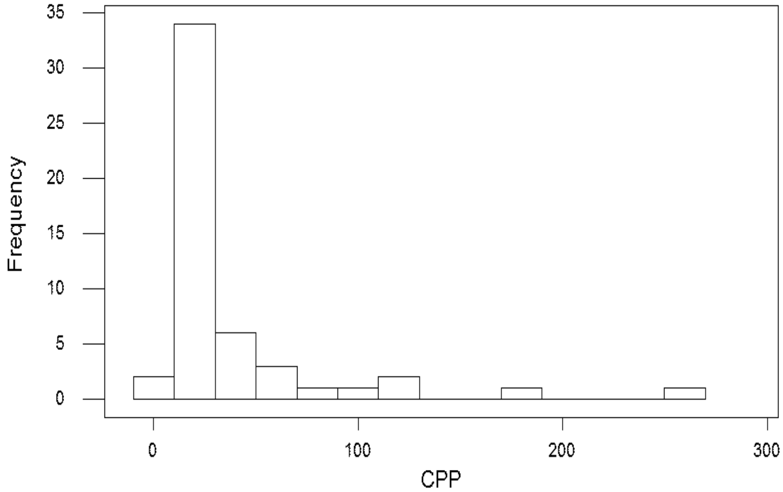


Figure 3: Distribution of the Citations-Per-Publication Scores(CPP)

Figure 4 shows the histogram of the Trust Score (T_A in Equation 4):

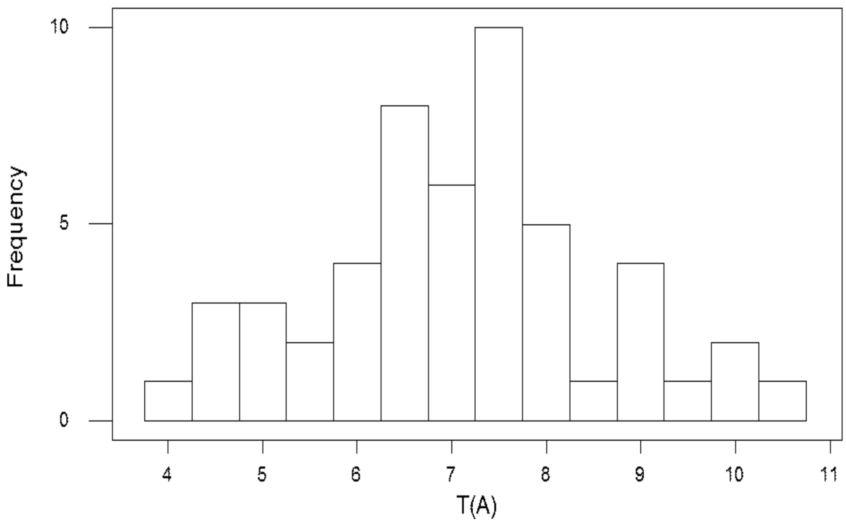


Figure 4: Distribution of the Trust Scores T_A , Kolmogorov-Smirnov =.074, p = .15

Figure 5 shows the distribution of the Adjusted Trust Scores:

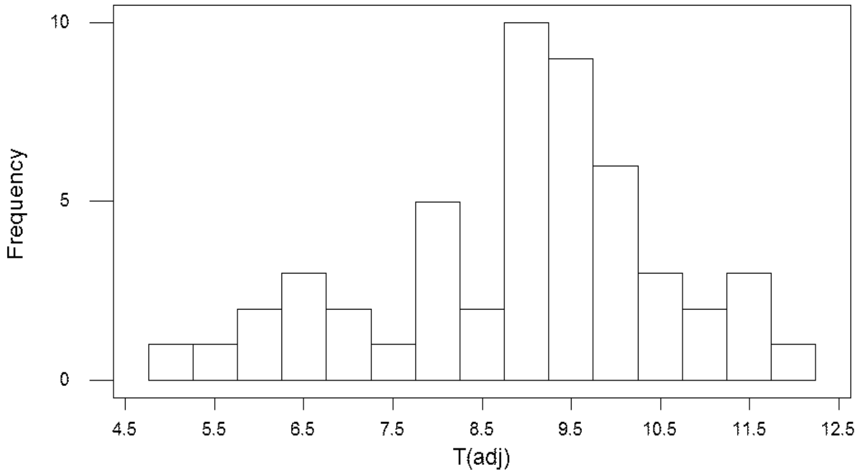


Figure 5: Distribution of the Adjusted Trust Scores, Kolmogorov-Smirnov=.123, p =.054

Comparison of the probability distributions of the trust indices (Figures 4 and 5) with the probability distribution of the original H-indices would show that the former two (2) have far more symmetrical distributions than the H-indices. This symmetry allows for cross-comparison of scientists in different fields.

5.0 Conclusion

The European model of Self-Organizing Funding Allocation for research grants can work in the Philippine context provided that the H-index is replaced with an alternative Trust Score for each of the individual Philippine authors. The trust scores are symmetrically distributed while the H-indices are power-law distributed. This allows for a more fair ranking of the author's influence in whatever discipline and of the trust that his peers have on him.

References

Bornmann, L. and Marx, W. (2011). The h index as a research performance indicator. European Science Editing. Retrieved from www.lutz-bornmann.de/icons/viewpoints.pdf.

CHED Call for Proposals (2017).

Gasparyan, A.Y. (2010). Thoughts on impact factors and editing of medical journals. Inflammation and Allergy – Drug Targets.

Greene, M. (2007). The demise of the lone author. Nature 2007.

Huang, M. and Pei-shan Chi. (2010). A Comparative Analysis of the Application of *H*-index, *G*-index, and *A*-index in Institutional-Level Research Evaluation. Journal of Library and Information Studies 8:2 p1-10. Retrieved from www.jlis.lis.ntu.edu.tw/article/v8-2-1.pdf.

Hirsch, J. E. (2005). "An index to quantify an individual's scientific research output". PNAS. ***102** (46): 16569–16572.* arXiv:physics/0508025

Padua, R.N. and Borres, Mark (2017) "From Fractal Geometry to Statistical Fractals" (Recoletos Multidisciplinary Research Journal, Vol.1 , Issue1), Retrieved from http://rmrj.usjr.edu.ph/index.php/RMRJ/article/view/80

Schubert, A. (2009). Using the h-index for assessing single publications. Scientometrics, 78(3), 559-565.

Thor, A. and Bornmann, L. (2011). The calculation of the single publication *h* index and related performances measures: A Web application based on Google Scholar data. Retrieved from https://dbs.uni-leipzig.de/file/Webhindex%20_accepted.pdf.

University of the West of England (2011). The H-index. Library Services. Retrieved from www.uwe.ac.uk/library.

Vrieze, J. (2017). With this new system, scientists never have to write a grant application again. Retrieved from www.sciencemag.org/news/2017/04/new-system-scientist-never-have-write-grant-application-again