

Analysis on the Age Distribution of Scientific Elites' Productivity: A study on Academicians of the Chinese Academy of Science

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Introduction

Is there any regularity in scientists' research activities? For example, does there exist a period when a scientist makes his most contributions? If so, which period is the most productive period? To answer the questions above, many scholars have been contributed their efforts on studying the relationships between productivity and age, such as: (1) age distribution of scientists' creativity or productivity (Liming et al., 1996; Bonacarsi & Daraio, 2003; Jones 2010); (2) the relationship between the longevity and scientist's outputs (Levin & Stephan, 1991; Jonesa & Weinberg 2011; Todorovsky, 2014); (3) the effects of age on researcher's productivity (Bonacarsi & Daraio Costas & van Leeuwen, 2010). However, the previous research still leave some gaps need to be filled. One of them is what about the age distribution of an individual researcher's achievements in his research career. Our research efforts in this paper would contribute to this topic. Particularly, the object of our study is Academicians of the Chinese Academy of Science. And we explore the age distribution of publication by these academicians.

Data and Method

The website of Academic Divisions of the Chinese Academy of Sciences provides academicians' brief introduction and research experience, which including their birth day and affiliated institutions. We choose total 139 Academicians in field of *Mathematics & Physics*, and total 85 Academicians in field of *Information Technical Science* as our research data. *Mathematics & Physics* is an ancient and classical subject, and *Information Technical Science* is a rapid development subject. In order to analyze the age distribution of these academicians' publication, the academician's name and affiliation were used as joined retrieval terms to get their publications both in China National Knowledge Infrastructure (CNKI) and web of science (SCI) database. CNKI is the largest authoritative digital publishing platform and knowledge services platform in China. To get their whole publication output, the repetitive or mistaken publication data of these academicians were deleted.

The average age of 224 academicians is 74 years old, and all of these academicians are now alive

until the retrieval day (11/2014). The number of the scientists' publications was selected as the scientific productivity indicator, but the co-author situation was equally considered. This paper considers age distribution of scientists' publication from the scientists' physiological age view.

Age distribution of academicians' publication

Firstly, we count the number of every individual academician's publication according to his physiological age. After that we sum the number of publication up according to the same physiological age of all academicians in the same field. So we can get the physiological age distribution of publication of total scientists in one field. We named papers indexed in SCI/CNKI as "SCI/CNKI" paper for short.

Age distribution of academicians' publication in Mathematics & Physics

The publication age distribution curve of CNKI paper and SCI paper of academicians in *Mathematics & Physics* are shown in Figure 1(a). The publication age distribution curve of total paper (sum of number of CNKI paper and SCI paper) is presented in Figure 1(b). Just as shown from the folder part of the two publication age distribution curves in Figure 1(a), we can see the period between the age of 50 and 65 is the same publication peak period of CNKI paper and SCI paper. Scientists published 61% of their total publications between the age of 50 and 71, the highest peak point is at the age of 68.

Age distribution of academicians' publication in Information Technical Sciences

The publication age distribution curve of CNKI paper and SCI paper of academicians in *Information Technical Sciences* are presented in Figure 2(a). The age period from 60 to 70 is the same publication peak period of CNKI paper and SCI paper. As Figure 2(b) is shown, scientists published 51% of their total publications between the age of 62 and 76, and the highest peak point is at the age of 67. In detail, there is a smaller publication peak period between the age of 45 to 51 before the higher one.

Significant differences test of academicians' productivity before and after tenure

Paired-Samples T Test was used to test if the scientists' productivity would be different before and after tenure. We sum up the number of publications for five years of every individual academician before and after tenure. Before testing, we assume that there is no significant difference of academicians' productivity before and after tenure, then we use the Paired-Samples T test to test the hypothesis. According to the analysis results, the assumption is rejected, which means that the number of publication is obviously different before and after tenure. After tenure, academicians are more productive than before in overall.

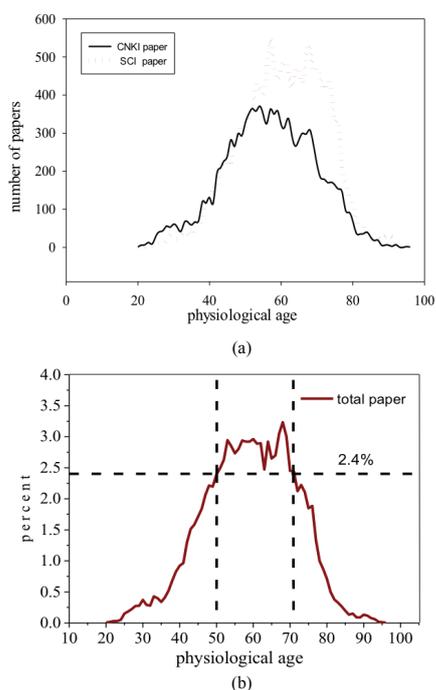


Figure 1. Publication age distribution of academicians in *Mathematics & Physics*.

Discussion and conclusion

The final results show that age distributions of academicians' publication have some regular features. The entire publication age curve of *Mathematics & Physics* shows a single peak distribution. The publication peak period is between the age of 50 and 71. However, publication peak period of academicians in *Information Technical Sciences* is between the age of 62 and 76. Moreover, it is different from *Mathematics & Physics*, which has a small publication peak period between 45 and 51 in publication age curve of *Information Technical Sciences'* academicians. Additionally, our results also reveal that there is significant difference of the scientists' productivity before and after tenure. The publication age distribution law on academicians of the Chinese Academy of Science brings us useful

enlightenment. We should pay more attention to middle-aged scientists to improve their research input-output ratio.

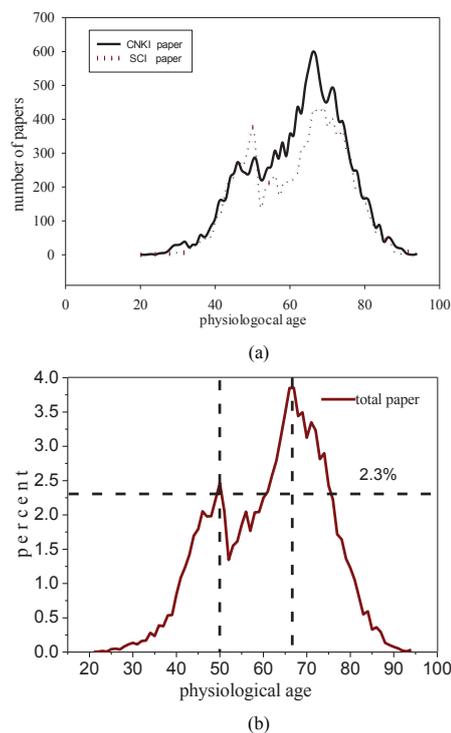


Figure 2. Publication age distribution of academicians in *Information Technical Sciences*.

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