論説 Commentary

Three viewpoints for the reform of the competitive research funding system

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Role of the competitive research funding system

Historically, competitive research funding has not only fulfilled its direct function to support research activities at institutions such as universities, but has also changed the direction and nature of academic disciplines, and has significantly influenced the shaping of the research network spanning across organizations, as well as restructuring within universities. For example, it is a generally accepted fact that NIH and NSF funding programs have guided biology as a discipline to become more logical and quantitative, and for fields to become amalgamated[1]. The Rockefeller program, which is considered to be the precursor to the contemporary competitive research funding system, played a critical role in the 1930s in establishing molecular biology as a research discipline. I have heard from people with experience who served as Program Directors (PD) and Program Officers (PO) of NSF that their roles were not limited to simple support of the hubs of the discipline which they are in charge of, but that their responsibility also extended to deciding the future direction of each discipline, and carefully diverting funding in such a way as to guide research and resources in the chosen direction.

In December of last year, *Science* in the US published Breakthrough of the Year 2008 (top ten). There were two Japanese research achievements on the list: iPS cell discovery by Professor Yamanaka, and an Fe-based high temperature super-conductor discovered by Professor Hosono. These two research projects were initially funded by the Grant-in-Aid for Scientific Research (administered by the Japan Society for the Promotion of Science), and subsequently by the Core Research for Evolutional Science and Technology Project (CREST) run by the Japan Science and Technology Agency (JST). Support funding provided by two different funding programs had linked up agreeably, resulting in significant results.

As seen from the above example, by ingeniously combining multiple programs, rather than through individual application, competitive research funding programs can help not only to accelerate research, but also to lead to significant outcomes in generating knowledge and technologies that break the boundaries of organizations and disciplines, the creation of new human resources, and the formation of networks.

Since 2001, the competitive research funding system has undergone a significant reformation, including a doubling of budget, improvements in the assessment methodology, and the introduction of the PD/PO schemes. Forward ten years. In the Fourth Phase of the Science and Technology Basic Plan which begins in 2011, I believe that there is a need to carry out a qualitative reformation by taking past accomplishments into consideration. Below, I will state my opinion on the future shape of competitive research funding from the following three viewpoints: link-up between different funding sources; concentration of funding to specific universities; and creation of research networks.

Clarifying the position of competitive research funding system and link-up between different funding sources: "free basic research" and "target-oriented basic research"

In the Third Phase of the Basic Plan, basic research projects are classified mainly into two major types: "free basic research" and "target-oriented basic research." This imparts a strong message that the differences between these two types of researches should be fully taken into consideration when fulfilling the responsibilities at each of the three levels: policy making, funding, and research. In this article, I would like to focus on the role of the funding institution.

Firstly, "free basic research" is supported mainly by the Grant-in-Aid for Scientific Research, with an emphasis on creativity, diversity, and richness, with the primary objective of generating intellectual and cultural value. We could say that the Nobel Prize is the premier goal. On the other hand, in "target-oriented basic research," a strong emphasis is placed on ultimately generating socioeconomic values that match the needs of society, and various measures have been put into place to increase budgets and research frameworks, and to expand research networks in order to enhance the speed and probability with which value is generated [2].

Let us compare representative funding programs for the two types of basic research: Grants-in-Aid for Scientific Research and the CREST run by JST. The numbers of research projects funded by each program are annually in the tens of thousands for the former and hundreds for the latter, respectively. The average grant amount per project is in the millions of yen and the tens of millions of yen, respectively. In other words, the number of projects is reduced by a factor of 100, and the scale of the research budget is increased by ten to one-hundred fold, in transitioning from the former program to the latter.

In addition to these superficial differences, attention should also be given to differences in the manner in which research is conducted (for example, whether it is specialized and deepening

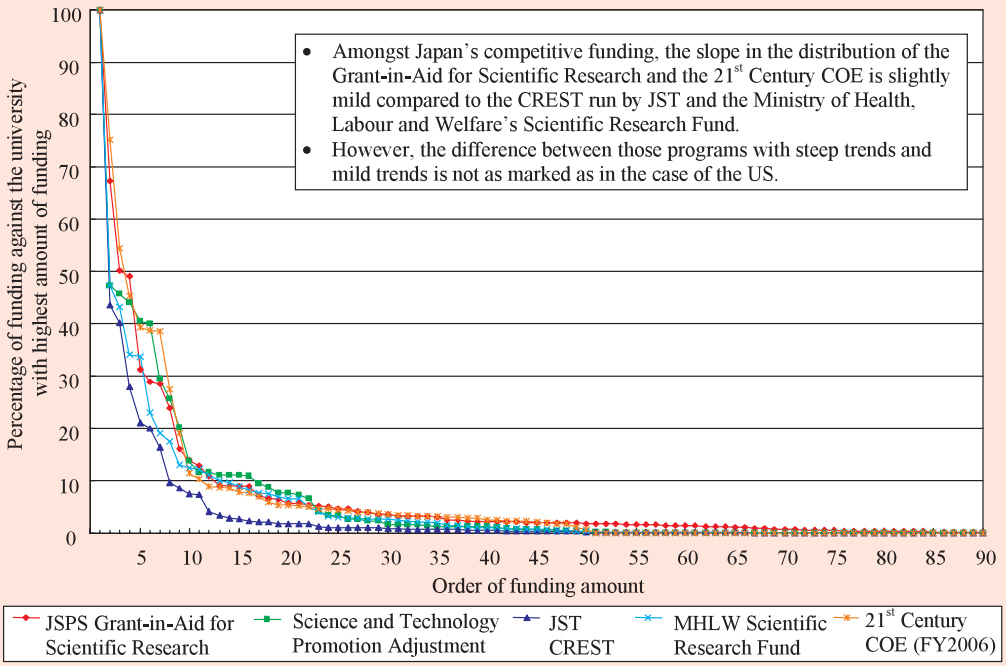

Figure 1 Trend in the distribution of competitive research funds to Japanese national universities, etc. (FY2007)

or interdisciplinary; and whether it is research-centric or network-oriented) and on the method of evaluation (for example, whether evaluation is made by expert colleagues or ramifications on socioeconomic factors are measured, in addition). It is not surprising that even within "target-oriented basic research," free basic research is often taking place, in practice. Breakthroughs could not be expected, if this were not the case. On the other hand, the investment efficiency would naturally worsen if the two schemes were operated in an identical manner.

With this viewpoint in the background, I believe that there is a need to perform a comprehensive inspection of the more than 40 competitive research funding programs in Japan from various perspectives, including the overall size of funding, orientation and size of individual programs, link-up between the programs, method for selecting research themes and evaluating outcomes, and authorities and responsibilities given to the PD and PO.

Concentration of competitive research funding to specific universities and the need for distribution—differentiating funding programs

Looking at the distribution of Grant-in-Aid Scientific Research funding and other competitive research funding across universities, the shape of the graph is almost identical for all of the programs, with funding being concentrated on the top ten universities **(Fig. 1)**. On the other hand, the distribution of research grants provided by the NSF, NIH, DOE, and NASA in the US can be classified into two broad groups. Specifically, in the case of NSF and NIH, the distribution continues moderately and extends to over 100 universities. On the other hand, in the case of DOE and NASA, in a fashion similar to Japan, research funding is concentrated on the top universities, and then declines rapidly thereafter **(Fig. 2)**[3].

Further, the correlation between funding from different programs granted to each university is not necessarily high in the US, whereas it is extremely high in Japan, at 0.9 or more. This suggests that in the US, the target universities for distributing funding differ for each program, whereas in Japan, all programs distribute their grants in a similar manner to the same universities.

As can be observed from the comparison between Japan and US, the fact that Grant-in-Aid Scientific Research funding, which should intrinsically emphasize both creativity and diversification, is being concentrated on specific universities consequently, suggests that there is a need for a reformation and expansion of the program and its operations. In attempting such a change, there is a need to consider expanding the total amount of Grant-in-Aid Scientific Research funding available, and to increase the categories of smaller funding, instead of simply aiming to average-out the distribution by cutting the funding previously granted to top universities and redistributing it to other universities in order for bottom universities to get the more amount of funding.(*)

In addition, an evaluation and administration method should be established for each competitive research funding program, to meet the objectives of the respective programs.

Formation of research networks

I believe that the competitive research funding of today has been designed and is being administered based on the concept of the Center of Excellence (COE) from the 1970s, with an emphasis on raising the acme of the research level and to create research hubs. Whilst the expansion of competitive research funding in recent years has helped to form a world-class COE within Japan on one hand, there is also a need to inspect whether or not this has led to the severance of research networks on the other.

While "free basic research" is an exception, with competitive research funding programs beyond "target-oriented basic research" that aim to meet the needs of the society, I believe that there is a need for an establishment of measures that place emphasis on the creation of research networks (Network of

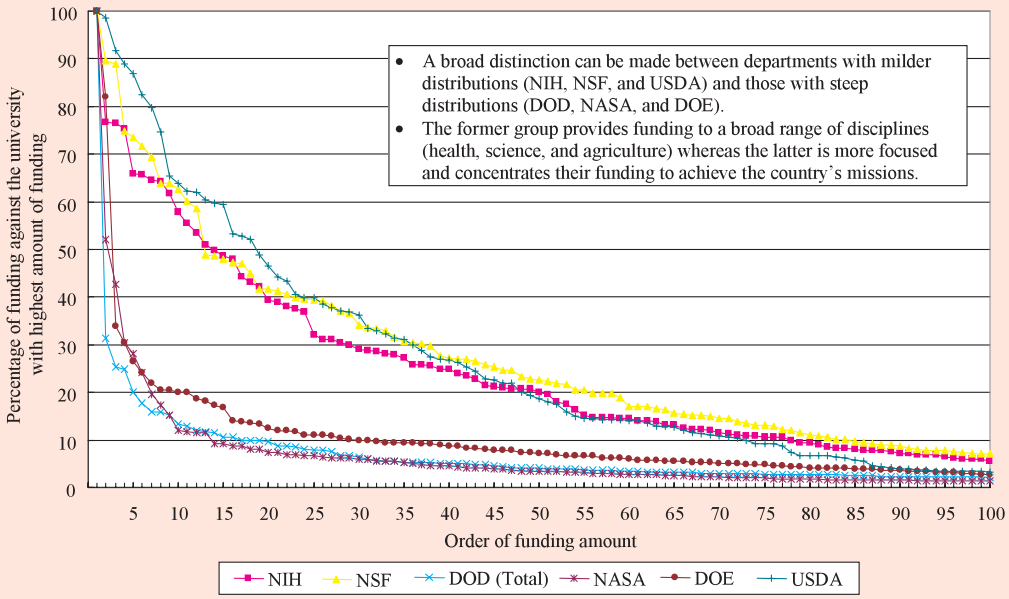

Figure 2 Trend in the distribution of science and engineering research grants from the US Federal Government to universities (FY2005)

Excellence, or NOE) that span across industries, academia, and the government, both domestic and overseas, in order to enhance the speed and probability of generating innovative value[4].

Concluding remarks—scientific culture in Japan and the US

For the first time since J. F. Kennedy, the US President, Barack Obama attended the annual meeting of the National Academy of Science in April this year, and gave a speech on science, technology, and energy and environmental government policies. It was an impressive speech that appealed to both general citizens and the science community to head in the right direction in order to overcome the risks associated with today's economy and global warming, and to attain sustainable development. A few days later, I had the opportunity to listen to a speech given by the Secretary of the Department of Energy, Steven Chu, a star of the Obama government, at the American Association for the Advancement of Science (AAAS)[5].

After talking about the new policies, such as the "Energy Frontier Center" and the "Advanced Research Projects Agency-Energy (ARPA-E)," he responded to questions, and called for the proactive participation of the scientist community, pointing out that it is indispensable to choose research themes and teams judiciously, in order to invest wisely in large budgets and research programs. In addition, in response to the question of whether target-oriented large scale programs will attract talented basic researchers, he responded positively, saying that such programs promote the fusion of different disciplines, and will become pioneers in science, and that many talented young scientists will definitely desire to participate. A sense of concord and unity overtook the crowd upon absorbing the intellectual and mild but confident words and demeanor coming from a person who is at the same time a Nobel Prize laureate in physics and someone with a proven track record in research management.

Returning to the topic of developing the Fourth Phase in the Basic Plan in Japan, I believe that we are at a stage where the related parties must share a recognition of the transitionary phase and the goals of the country, without being content with simple budget provisioning and institutional reform, and where there is a need to cultivate an arena and culture that makes intellectual arguments about the future shape of science and technology possible[6].

1) Yasushi Sato, "Historical Viewpoint to Policies in Science and Technology", *Science*, Iwanami Shoten, June **2009**.
2) Koichi Kitazawa, "2008—A Bonanza Year for Science in Japan", New Developments in JST Research Development, JST, January **2009**; Umakoshi et al., "Beyond Innovation," Maruzen Planet, May **2009**.
3) Yasumasa Watanabe, "Comparison of Research Funding from the Government to Universities Between Japan and the US", JST Center for Research and Development Strategy, July **2009**.
4) Hiroyuki Yoshikawa, "Network of Excellence for Innovation", the 8th CST International Salon, June 17, **2009**; Strategic Proposal "Policies for Promoting Emergent and Fusion of Science and Technology," Japan Science and Technology Agency, Center for Research and Development Strategy (to be issued in August **2009**).
5) Remarks by the President at the National Academy of Sciences Annual Meeting, April 27, **2009**; "US Energy Secretary Steven Chu calls on Scientists to Help Review Energy Applications", AAAS News Archives, May 1, **2009**.
6) Japan Science and Technology Agency, Research Institute of Science and Technology for Society (ed.), "Science, Technology and Spiritual Culture of Knowledge—Towards the Building of a New Civilization of Science and Technology", Maruzen Planet, March **2009**.

(*) The topic concerning the concentration of competitive research funding in specific universities is also covered from a different viewpoint in the Commentary of the July **2009** issue of this journal.

The commentary shown here is written by a commentator assigned by the Society and the author is basically responsible for the contents. The Society acknowledges that this is important and worth publishing. Opinions and comments of the readers are highly appreciated.
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