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Structural Comparison of Public Research Grants in Universities between Japan and the U.S.

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The initial application results for the 21st Century COE Program, which was highly publicized as "TOP30," were announced last autumn. As expected, national universities, especially the former imperial universities, predominated, with private universities being a minority. This program, led by the Ministry of Education, Culture, Sports, Science and Technology, aims to establish world-class research and education centers targeting doctoral programs. It considers approximately 30 universities, or about 5% of the total, to be research-focused institutions, and funds are preferentially distributed to the selected graduate schools after review. Being a first-time initiative, it has undergone various twists and turns since its announcement two years ago. Due to a reduction from the initially planned budget, about 20 universities were selected in each field this fiscal year. This system seems to clearly indicate the Ministry's intention to improve research and education levels through competitive measures. Some universities fear that the promotion of competitive measures might hinder traditional academic research (1). There are also concerns about universities being ranked (2), but national policies seem to be undergoing significant changes.

The shift in national policies towards a more competitive approach is strongly correlated with the Japanese economy. In the early 1990s, during the so-called "bubble economy," Japan's advanced industries were believed to possess sufficient international competitiveness, and large sums of research funds were being spent by companies. At that time, the United States, whose superiority in advanced technology was beginning to waver, strongly emphasized intellectual property protection, promoting the enclosure of patents and copyrights, and began to develop government-led strategic research and development in the civilian sector, as exemplified by SEMATECH in semiconductor development (3)(4). In Japan, on the other hand, corporate R&D expenditures have

decreased since the collapse of the bubble, with continued reductions in research funds and researchers to an extent that can be described as "the collapse of corporate research institutes." Research, broadly speaking, spans a wide spectrum from basic research to applied research closer to product development. Traditionally, Japanese companies were said to be strong in applied research but weak in basic research, often relying on Europe and the US for fundamental patents. Currently, the weakening of corporate research institutes is further diminishing Japan's overall research capabilities, casting a shadow over future technological development.

Originally, the probability of a basic research theme leading to an application and then to product development is small. Even researchers within companies engaged in basic research often lack a clear outlook on whether their current research will lead to product development. In the first place, anything with a clear image should be called development, not basic research, and companies do not need to worry much about risk, but on the other hand, the possibility of leading to major innovative research is low. In contrast, the advantage of basic research is that, albeit with a small probability, it has the potential to lead to products that can bring about significant paradigm shifts. To maintain national competitiveness, it is necessary to continuously generate impactful innovations, even if few in number, and some institution needs to financially support and conduct basic research.

In the United States, universities play a significant role in basic research, and university-centered venture companies are often the originators of new technologies. Furthermore, Japanese companies have deepened their collaboration with overseas universities, primarily in the US, since the 1990s (5). Currently, there is already a reality where Japanese companies' research expenditures to overseas universities are twice their expenditures to domestic universities (6). As a result, in a comparison between Japan and the US, the perception has emerged that the research role played by Japanese universities within the overall national framework is far too insufficient. However, there are significant differences between Japan and the US, both in the research systems of individual universities and in the national research system as a whole. Therefore, in the following, I would like to compare public research funding in universities in Japan and the US from the perspective of improving university research capabilities. Please note that "public research funding" here (research funds granted by national and local governments, such as through the NSF: National Science Foundation and NIH: National Institutes of Health in the US) primarily refers to competitive research funds, whose

flow of money is easier to track. Research funds regularly allocated to individual laboratories in Japanese national universities are not included in the following discussion.

Comparison of US Research Universities and Their Financial Structure

In the United States, universities are functionally divided into three tiers: Research Institutes (research universities) which have doctoral programs and primarily conduct advanced research, mass-type universities which have master's programs and primarily focus on undergraduate education, and universal-type universities which offer programs for progression to these universities, vocational technical programs, and liberal arts/lifelong learning programs. This three-tiered system was pioneered in California and is known as the California Master Plan (7). Research in the US is supported by these research universities. In Japan, the major research universities are a few national universities called the former imperial universities, and the total public research funding for national universities is five times that of private universities. In the US, on the other hand, private universities such as Harvard University and Stanford University are established as prominent research universities. Factors often cited for this include enormous assets and their management, patent income, and large donations. However, looking at the financial situation of private universities in the US, it is clear that public research funding, which accounts for as much as 30% of their expenditures, generates strong competitiveness in research (8).

Let's look at the Massachusetts Institute of Technology (hereinafter abbreviated as MIT) as a typical example of a US research university. MIT is a representative US research university, home to Professor Susumu Tonegawa, the first Japanese recipient of the Nobel Prize in Physiology or Medicine. Its annual financial situation is publicly available on its website (9), so interested parties can access it. MIT's total expenditure is $1.3 billion, which is about ¥150 billion in Japanese yen. This is smaller than the University of Tokyo's expenditure of ¥210 billion and roughly equivalent to Kyoto University's expenditure of ¥140 billion (in terms of university size, MIT has 10,000 students, while the University of Tokyo has 28,000 students). However, the characteristic difference lies in the amount of research funds. MIT's total research funds amount to $700 million, which is ¥80 billion. While the ratio of R&D expenses to sales is sometimes used as an indicator of a company's R&D capability, MIT's total research funds constitute over 50% of its expenditures. This shows that US research universities have an extremely research-oriented financial structure.

In contrast, the University of Tokyo's research funds are ¥32 billion, and Kyoto University's research funds are ¥16 billion, with research funds accounting for only 10-15% of their expenditures, and other former imperial universities are similar. In the US, public research funds account for about 70% of research funds, and it is estimated that about ¥56 billion of MIT's total research funds of ¥80 billion are public research funds. In Japan's former imperial universities, public research funds account for 90-96% of total research funds, indicating a high dependency on the government. Public research funding for private universities in Japan is even lower; for example, Waseda University's public research funding in 2001 was only ¥1.5 billion. Compared to MIT's public research funding, it is clear that Japanese private universities are far from reaching the economic scale of world-class research universities. While industry-academia collaboration immediately comes to mind when thinking of US research universities, the main source of research funding is actually public funds (8). Therefore, the biggest reason why Japanese universities have less research funding compared to the US is the disparity in public research funding.

Comparison of Public Research Funding at the National Level

The scale and distribution of public research funding at the national level also differ significantly. Public research funding for universities in the US amounts to approximately ¥2 trillion, whereas Japan's Grant-in-Aid for Scientific Research is about ¥180 billion. Even with competitive research funds from other ministries, the total is only about ¥350 billion, which is twice the Kakenhi amount. This ¥350 billion also includes research funds for national research institutes other than universities, so the funds allocated to universities are estimated to be about 1.3 times the Kakenhi, or about ¥240 billion (for the four former imperial universities and Tokyo Institute of Technology, if Kakenhi is 1, other public funds are about one-third) (10). Therefore, in terms of the total national amount of public research funding, there is an 8-fold difference between Japan and the US.

Last year, Japanese individuals won Nobel Prizes in both Physics and Chemistry, but the difference in the number of laureates is likely due to this economic disparity. In the natural sciences, the US has about 200 laureates, while Japan has fewer than 10. Looking more closely, the recipients for "research at Japanese universities" are Hideki Yukawa, Shinichiro Tomonaga, Kenichi Fukui, Hideki Shirakawa, Ryoji Noyori, and Masatoshi Koshiba, totaling six individuals. Leo Esaki and Koichi Tanaka's research for

their awards was conducted at companies, and Susumu Tonegawa conducted his research in Switzerland. Based on this large difference in the number of laureates, it is often argued that Japanese people lack originality. However, while research funds like Japan's Kakenhi have roughly tripled in the last decade, it is estimated that the difference between Japan and the US was more than 20 times before that. Therefore, the amount of investment in research should be considered first and foremost, rather than Japanese originality.

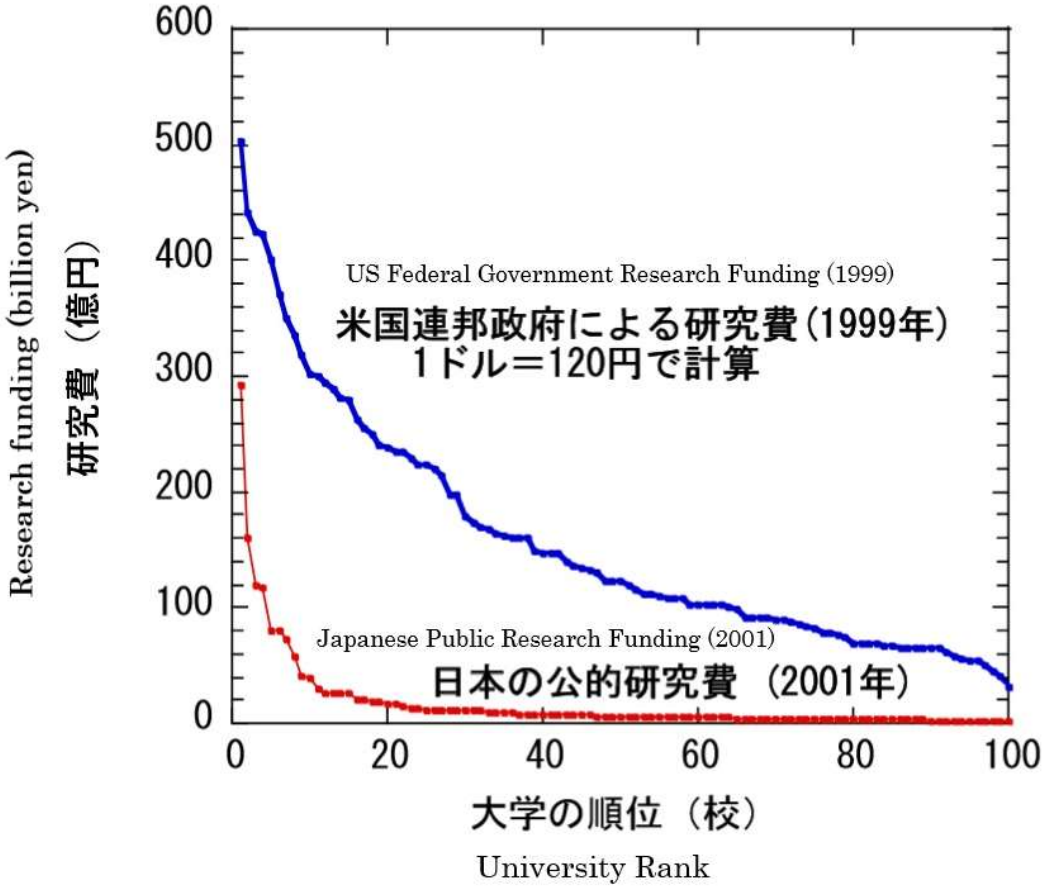

Figure 1. Japan-US Comparison of Public Research Funding by University Rank
(US data would be 1.1 times higher if state government funds were added.)
Calculated at 1 dollar = 120 yen

The allocation by university also differs significantly between Japan and the US. In Japan, only about four former imperial universities, such as the University of Tokyo and Kyoto University, receive over ¥10 billion in public research funding. However, according to 1999 US statistics, nearly 70 universities received over $80 million (approximately

¥10 billion) in public research funding. Figure 1 shows the university-specific allocation of public research funding: current Japanese public research funding is concentrated in a handful of universities and rapidly decreases as one goes down the ranks (11). For example, the top 10 universities for Kakenhi account for 50% of all Kakenhi, and the 10th-ranked university receives only 13% of what the top-ranked university receives. For US public research funding, the top 10 universities account for 20% of the total, and the 10th-ranked university receives 60% of what the top-ranked university receives. The 20th-ranked university still receives 47% of what the top-ranked university receives. As shown in the figure, US public research funding decreases much more gradually, forming a thick layer of research universities. For example, in the author's research field of semiconductor engineering, Shuji Nakamura, a renowned researcher in blue light-emitting diodes, was appointed professor at the University of California, Santa Barbara two years ago. Santa Barbara received two Nobel laureates in Physics and Chemistry in 2000. Its public research funding is $74 million, ranking 71st in the US. It should be noted that the high international research competitiveness of US universities is not supported by a handful of research universities, but by a cluster of nearly 100 research universities. Therefore, to provide Japanese universities with US-level competitiveness, approximately half of the US public research funding (around ¥1 trillion), considering GDP, is necessary, and a system should be implemented to allocate over ¥10 billion annually to the top 30-40 universities. In future increases in public research funding, strengthening the next tier of universities should be prioritized over financially supporting the former imperial universities, which are already on par with world-class universities in terms of university-specific research funding. The concentrated support for research universities through the 21st Century COE Program, which is considered to be just under ¥40 billion annually nationwide (¥18.2 billion in its first year), is much smaller in economic scale compared to US public research funding. Therefore, it is clear that unless a comprehensive policy shift, including Kakenhi and research funds from other ministries, is made in addition to the 21st Century COE Program, Japanese universities will not be able to achieve international competitiveness.

The Role of Private Universities in Research Universities

Currently, in the US, there is strong collaboration in research and development involving the NSF, universities, and corporations working as a unified entity. For example, last spring, a delegation comprising these three parties was dispatched to the author's research field of semiconductor spin engineering. The delegation, consisting of about 10 people, split into two groups and visited more than ten research institutions, primarily

universities, throughout Japan during their one-week stay. Having heard that the government and corporations in the US sometimes conflict, the author was curious about this point and asked why they were so unified. To his surprise, they responded with an unexpected look, "We are imitating Japan's (former) MITI." They conducted a comprehensive survey including research funds and academic output of each research institution, but they were particularly interested in asking why research funds for Japanese private universities were so low. In the US, 40% of research universities are private, and there is no significant difference in public research funding between private and public universities. Given the situation in the US, where many prominent research universities are private, they seemed perplexed by the current situation in Japan.

To improve Japan's research level, it is necessary not only to increase public research funding but also to allocate it considering human resources. In various layers and fields of society today, the contributions of private university graduates surpass those of national university graduates. This seems a natural consequence of the current situation where private university graduates account for three-quarters of all four-year university graduates. However, in academia, national university graduates still primarily play the leading role. This is due to the current situation where private university graduates in academia receive only one-fifth of the public research funding of national university researchers (12). Even in science and engineering fields, the number of private university students is twice that of national universities. The current concentration of public research funding in national universities means that the large number of human resources possessed by private universities are not being effectively utilized, resulting in a loss for the nation as a whole.

In the US, the NSF publishes an analytical report on "US scientific power" called Science and Engineering Indicators (13), which dedicates many pages to the analysis of human resources. In Japan, organizations equivalent to the NSF include the Japan Society for the Promotion of Science, but they are much smaller than the NSF in terms of personnel and budget, and their analytical capabilities regarding national scientific power, including human resource analysis, are insufficient. To ensure the efficient use of national funds, such organizations need to be strengthened.

Currently, the government has begun to implement competitive measures such as the 21st Century COE Program. However, as mentioned above, its budget is only 2% of US public research funding. Furthermore, it is mainly allocated to top-ranked universities

that traditionally receive high Kakenhi amounts, and it is not contributing to strengthening the next tier of universities. This program has also been criticized by various media for not publicly disclosing its review process. There are also issues such as the composition of reviewers being biased towards national university personnel, unlike the US review system which emphasizes diversity (14)(15). For example, looking at the committee members of the 21st Century COE, 14 out of 27 members had experience as faculty at former imperial universities, meaning more than half were affiliated with national universities. Private university representatives were a minority at 8 members. Given that private universities not only overwhelmingly outnumber national universities in terms of student population but also have 2.4 times their economic scale, the distribution ratio of these committee members is questionable for discussing a system that spans national, public, and private universities in this current situation.

While national policies are undergoing significant changes, it is believed that a broad discussion is needed in the future to determine whether various national systems, including the 21st Century COE Program, can truly contribute to improving the research capabilities of Japanese universities, and if so, how they should be improved.

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