CHAPTER 3

ROBERT KNELLER

PROSPECTIVE AND RETROSPECTIVE EVALUATION SYSTEMS IN CONTEXT: INSIGHTS FROM JAPAN

INTRODUCTION

Research evaluation in Japanese universities has relied upon prospective evaluation of competing research proposals until very recently. Over the past decade, the process for evaluating and selecting among competing research proposals, which I henceforth refer to as *prospective peer review*, has evolved so that in 2006 it is more transparent and based upon expert input than it was in the mid 1990s. However, because each program usually has its own peer review process and the number of government programs that might provide competitive funding is quite large, potential applicants face a variety of peer review systems.

Despite the improvements in prospective peer review, two troubling questions remain: First, does the Japanese system of research funding and prospective peer review still encourage young researchers to follow the leads of senior professors, and thus discourage innovative, pioneering research? Second, the distribution of competitive research and development (R&D) funding (which accounts for roughly half of total R&D support in universities) remains highly skewed in favour of a few elite universities, as shown in the Appendix. Does this reflect an equally skewed distribution of talent or a tendency for the peer review system to allocate funding on the basis of institutional status and reputation?

The inequality in funding is a central issue in the recent effort to implement a *retrospective* evaluation system. This system is aimed at providing objective measures of individual researchers' performance that might be used in promotion decisions and that would encourage individual researchers to be more productive. But another purpose is to differentiate between a group of approximately thirty *research oriented* universities that will continue to receive substantial government funding in the hope that they will become world class research centres, and a larger group of *education oriented* universities where research will be viewed as a subsidiary activity and will be funded accordingly. Such differentiation is a common aim of national research evaluation systems, most explicitly perhaps in Australia (see Gläser and Laudel, this volume) and the UK.

Japan is implementing its retrospective system slowly, and it is not expected to result in differentiated budget reductions until 2010. However, already second and third tier universities are complaining that they should not be judged by the same criteria as elite universities. A key question about this new retrospective system, then, is: Are its results pre-ordained by the skewed results of the prospective system and by equivalent discrepancies in the distribution of general purpose funding? Known as *unei koufu kin* (literal translation: *operational and administrative subsidies*), this Japanese equivalent of block grant funding is also skewed in favour of the same elite universities, particularly, as shown in the Appendix table 3, the seven state universities designated as *imperial universities* in the pre-war era. Only a portion of the general purpose funding supports research, but the table nevertheless shows the overall disparity in distribution. If the results of retrospective evaluation are indeed pre-ordained, what additional purpose does it serve?

In attempting to deal with these questions, it is crucial to understand how evaluation systems and processes function in their broader institutional context, especially the funding and control of academic systems and reward systems, as the contributions to this volume make clear (see also Whitley 2003). Accordingly, in this paper, I summarise the key features of the post-war Japanese research system and the role of prospective evaluation in it before considering the likely impact of retrospective evaluation on the direction and organisation of research in the future. Thus, the following section describes the Japanese university research system and the role of prospective peer review, including a detailed description of the prospective evaluation process and the principal funding sources. Next, I outline the retrospective review system that is in its first years of trial implementation, while the final section offers some tentative remarks about coordinated reforms that might improve the climate for innovative science in Japan and other countries.

UNIVERSITY RESEARCH AND PROSPECTIVE PEER REVIEW

The University Research System

In 2004, the Japanese system of higher education consisted of 87 national universities and 4 national academic research institutes under the Ministry of Education, Sports, Culture, Science and Technology (MEXT); 80 prefectural, municipal and local government universities; and 542 private universities. In total, the universities accounted for about 14% of Japanese R&D in 2002, with government research institutes (GRIs) contributing a further 9.5% (NSB 2006). National universities conducted about 75% of this research and graduated 78% of all science and engineering doctorates in 2004 (MEXT 2004). A significant proportion (55%) of the research activities carried out in the national universities is supported by ‘outside sources.’ This percentage is around 50 in the private universities that fund a larger proportion of research from tuition fees. The most important of these external sources is government competitive research funding but industry funding and overhead support are also important components.

Japanese national universities receive almost no funding from prefectural or local governments, except for some sponsored research, despite many being major contributors to regional economies. As the premier educational institution in many of the outlying prefectures, they have the potential to contribute substantially to local economic development. In the case of the wealthier prefectures, bureaucratic rivalry between the prefectural governments and the prefectural universities they support, on the one hand, and MEXT, on the other hand, have prevented cooperation on a regional level. In the case of poorer prefectures, local governments lack the means to support resident national universities.

The Japanese academic system is highly stratified with the older state universities, particularly the universities of Kyoto and Tokyo, being the most prestigious and controlling the most resources (see Appendix). It is trite but nevertheless true that most academically inclined high school students (or at least their parents) dream of entering the University of Tokyo or Kyoto University, and most academics dream of ending their careers there. Because of these strong regional and institutional preferences, the system of recruitment and promotion in a few highly regarded universities influences academic career strategies throughout the nation. The elite universities do try hard to recruit and promote able and productive researchers, but nevertheless the selection of lead candidates usually depends upon small internal committees in which a single professor often has a dominant voice. The committees' selection of a lead candidate is rarely questioned by the larger faculty and university. Open debate is also unusual and solicitation of outside opinions even more so.

The leading universities manage to recruit creative and capable persons using this system, because they attract interest from bright younger researchers throughout the country, but the need for patronage probably discourages young researchers from pursuing unorthodox themes or using unorthodox research approaches (Coleman 1999). The price of failure is not simply losing an opportunity to work in a prestigious university. Because funding is consistently skewed in favour of the same small number of universities, it may mean spending one's career in a university with scant research resources.[1]

1 It might be argued that, because the Tokyo, Nagoya, and Osaka-Kyoto-Kobe metropolitan regions (hereinafter, group A regions) account for a large proportion of Japan's population, it is appropriate for universities in these regions, as well as the four next most populace regions: Sapporo, Sendai, Hiroshima and Fukuoka (hereinafter, group B regions); to receive a large proportion of research support. However, assigning the universities that account for 95 percent of 2006 MEXT Grants-in-aid to standard-classification metropolitan regions shows that universities in group A regions receive 63 percent of grants-in-aid, although these regions account for only 43 percent of 2006 population. Including group A and B regions together, universities in these regions receive 83 percent of grants-in-aid, although they account for only 49 percent of population.

Even classifying universities and population according to *prefecture* rather than *metropolitan area* shows skewed funding in relation to population. Thus, if the Tokyo area is considered to include all of Chiba, Saitama and Kanagawa prefectures, and the Osaka-Kyoto-Kobe area to include all of Shiga, Nara and Hyogo prefectures (most of these prefectures include substantial rural areas distant from the main cities), the 63 percent of grants-in-aids received by group A region universities would still be attributed to only 49 percent of the national population. Also the 83 percent of grants-in-aid received by the combined group A and B regions would be attributed to only 58 percent of population.

In 2004, national universities became independent administrative organizations (officially university corporations) under MEXT. Previously they were simply branches of MEXT, and personnel and financial matters were all subject to MEXT control. As a result of incorporation, they now have legal authority over most key areas. They are free, in theory, to determine the number of permanent faculty positions and their allocation between existing or new departments, as well as being able, in principle, to raise funds from alumni, local governments and other sources, and to vary tuition charges, although not by more than 10% a year. In fact, however, they all remain dependent upon MEXT for infrastructure costs and salaries of permanent staff. These expenses are covered mainly by the *operating and administrative subsidies* mentioned above.[2]

In order to reduce government expenditures while encouraging more self-reliance, beginning in fiscal year (FY) 2005, subsidies for all national universities are being reduced by about 1 percent per year compared to the 2004 base. Beginning in FY 2010 these reductions are to increase to 2 percent annually for universities that are judged to be *education oriented*, while the rate of reduction will remain at 1 percent for approximately 30 universities judged to be *research and education oriented*. The annual data being collected on research performance are intended to play a key role in determining which universities fall into each category.

So far, the subsidy reductions have not lead to decreases in numbers of permanent faculty. Instead, cuts are being absorbed by shedding temporarily unfilled faculty positions that are still receiving subsidies. But as the cuts continue, reductions in faculty and other permanent staff are expected, especially in the education oriented universities. Also some of the weaker education oriented universities are expected to merge or be absorbed by stronger universities. In view of the large number of universities, many with meagre research resources, some consolidation is appropriate. Nevertheless, to suggest that world class research ought to be consolidated within approximately 30 institutions seems to assume that elitism, not broadly based competition, leads to scientific excellence. It also presumes that it is possible to teach higher level subjects effectively without doing research or having contact with research colleagues, and that the solution to Japan's low share of Nobel Prize level scientific research is even greater concentration of research resources.

The Organisation of University Research and the Academic Reward Systems

The basic organizational unit in Japanese universities is the *kouza,* modelled on the *professor chair* system in early 20th century German universities. A *kouza* typically consists of one full professor, the laboratory head, an assistant/associate professor (*jo kyouju*), who is usually the lead candidate to inherit laboratory leadership when the professor retires, and one assistant (*joshu*). There is usually one laboratory per *kouza*. Thus laboratory facilities are under the *kouza* head. Applications for research

2 Tuition and patient hospital charges are combined with the subsidies to form the main pool of funds out of which salaries and general infrastructure costs are paid.

funding from junior *kouza* members usually include the *kouza* head as a co-applicant, and of course must be coordinated with him/her.

Some *kouzas* contained an instructor (*koushi*) intermediate in rank between a *joshu* and the assistant/associate professor. A *koushi* was expected to emphasize mainly teaching and sometimes was not considered to be in line to fill a vacancy at the assistant/associate professor level. In 2007, these titles changed. Assistant professors became associate professors (*jun kyouju*). Assistants became assistant professors (*jokyou*).

Academic careers still depend upon patronage rather than a record of individual achievement (Coleman 1999). Well into the 1990s, it was still common for vacancies to be filled from within the *kouza*. The *kouza* represented a narrow career ladder where vacancies were usually filled by the person next below in the hierarchy, and the professor essentially picked his second generation successor when he selected a new joshu. Now internal promotions to the assistant professor level are discouraged, and joshus/jokyous usually find their first assistant/associate professorship in a different *kouza*, sometimes in a different university. Nevertheless, academic recruitment and promotions still depend mainly upon the recommendations of key senior professors. Open recruitment, in the sense of widely soliciting applications to fill vacancies and a commitment to select among applicants on the basis of merit, is still rare.[3] Rarer still is soliciting in-depth, objective evaluations of candidates' achievements from *outside* experts and giving considerable weight to these outside evaluations.[4]

The *kouza* system is, however, becoming more flexible. In a few departments, formal *kouza* affiliations have been abandoned and professors make real collective recruitment decisions based upon individual merit and the needs of the department, not upon applicants' past affiliations with members of the department or the closeness of their research interests to those of particular senior professors. Even in such departments, however, there is usually no objective outside input into the process.

Research Funding and Prospective Peer Review

Various Japanese government ministries have implemented a variety of programmes for funding research. Procedures for judging applications and awarding funds vary, reflecting the different missions of these ministries, their various *modus operandi*, and in some cases their rivalry. It is worthwhile summarizing some of the more important ones in order to contrast them with the procedures for retrospective research evaluation. The following summaries cover MEXT Basic Research Grants-

[3] I am familiar with recruitment and promotion practices in only a few Japanese universities, but these include two of the leading national universities and one leading private university. Within each of these three universities I know of one department that practices this form of open recruitment. But persons within these departments themselves say that they are pioneers within their universities. In other words, they are exceptions that prove the rule.

[4] Such steps are under consideration in a few departments, but I know of no department that has implemented such procedures.

in-Aid, the Strategically Promoted Creative Research Programme of the Japan Science and Technology Corporation (JST), MEXT Special Coordination Funds for Promoting Science and Technology, and the Centres of Excellence Programme.

The *MEXT Basic Research Grants-in-Aid* are the mainstay of support for R&D projects in Japanese universities. Although the applicant can name collaborators, one person should have main responsibility for carrying out the project. The applicant chooses among 276 subject categories covering most fields of humanities, social science, law, natural science, engineering, agriculture and medicine. Each category has a review committee consisting of six to fifteen persons, most of whom are university professors, who maintain their normal responsibilities. For example, there are 13 categories under 'chemistry,' one of which covers 'physical chemistry.'[5] The applicant does not know the names of the panel members who will review the current year's applications, but the names and affiliations of panel members two years before are listed on the Japan Society for the Promotion of Science's (JSPS) website.[6] For example, an applicant under physical chemistry in 2004 would know that there were twelve members on the 2002 physical chemistry review committee.[7]

The chair of the committee distributes the application by mail to six members on the basis of a quick overview of the research theme. Nevertheless, each reviewer often must review over 150 applications covering a wide range of subjects within five weeks spanning the busy New Year's period. Reviewers rate each application on a 0 to 5 scale for research theme (originality, importance, etc.) and also for research plan (clarity, feasibility, ability of researchers, etc.). The six sets of scores are then sent to a higher level committee that ranks applicants according to their scores, makes adjustments if necessary and also makes preliminary funding decisions. There is one such higher level committee for all fields of chemistry, and it consists of 12 professors from science, medical and engineering faculties in various universities.[8]

Finally a super committee of 20 persons overseeing all JSPS administered programs certifies the funding decisions of the 18 higher level committees and

5 This includes topics such as molecular structure, crystal structure, electron states, radiation chemistry, chemical reactions, fluid chemistry, molecular spectroscopy, high molecular energy state processes, electrical chemistry, radiation chemistry, electron energy processes and surface and boundary chemistry.

6 JSPS is a corporation under MEXT that has handled many of MEXT's extra mural funding programmes as well as scholarships for collaborative activities. JSPS administers the Grant-in-aid programs that tend to have lower per project funding, while MEXT directly administers the programs with large budget projects. In addition to Basic Research grants, MEXT Grants-in-aid include other subprograms with different prospective review mechanisms (see Table 2).

7 Panel members are nominated by various professional societies to the Japan Science and Technology Council which then suggests names to JSPS. Panel members serve two year staggered terms. The 2002 physical chemistry review panel consisted of one associate professor and 11 professors, ten men and two women, drawn from Tohoku University (the chair), the University of Tokyo, the National Institutes of Natural Science (a major MEXT research center), and Okayama, Kyushu, Hiroshima, Ochanomizu, Nagano, Hokkaido, Hokuriku and Keio Universities.

8 The names and affiliations of these committee members are available online from MEXT. In the field of chemistry, three of the twelve members reviewing applications for funding beginning in 2004 happened to be from the University of Tokyo.

addresses any global or contentious problems. In fact, however, funding decisions are determined by the scores assigned by the six reviewers from the initial specialty area review committees. *At no point in this process is there discussion among reviewers on the merits of particular proposals.* Reviewers are not required to explain their scores, and reasons for success or failure are not conveyed to applicants. However, applicants whose applications are rejected can request the average of the six reviewers' scores and their approximate percentile ranking.

Approximately 96 billion yen or 850 million USD was distributed in this manner in 2002, over one-third of MEXT's direct competitive support for university R&D. Moreover, in terms of numbers, this accounts for the vast majority of university R&D projects. The average yearly size of Basic Research awards ranged from 1.4 million yen (~13,000 USD) for category C awards to 20 million yen (~180,000 USD) for category S awards.

After MEXT Basic Research Grants-in-Aid, JST's Strategically Promoted Creative Research Program (also known as the *JST Basic Research Program*) is the largest source of university R&D funding. The three main types of projects under this program are CREST (Core Research for Evaluational Science and Technology)[9] PRESTO (Precursory Research for Embryonic Science and Technology)[10] and ERATO (Exploratory Research for Advanced Technology)[11].

CREST applications must be for collaborative research involving several laboratories, and they should be targeted on one of the approximately 12 new research themes that JST announces each year.[12] JST selects a respected scientist to supervise review of applications under each theme. Most of the scientists-supervisors are professors in elite universities. These supervisors in turn select 6 to 8 advisors for their review team. Most of these advisors are also professors in elite universities, although many panels include one person from a large company. The supervisor assigns each application to two advisors who read and score them. Then the committee meets to decide on a short list of candidates who will be interviewed. After the interviews the committee agrees on final awardees. Unsuccessful applicants are informed why their applications failed. In 2003, 117 new awards were made, most for five years. The average annual amount of support was slightly under 1 million USD.

PRESTO projects usually involve a single laboratory. However the process of designating new priority research fields each year and selecting among applicants is similar to CREST. In 2002, 147 new projects were funded. Funding averages about 150,000 USD annually, with most projects lasting three years. PRESTO has a special subprogram to support the training of postdocs and PhD students pursuing dissertation research. Funding under this subprogram supports the junior researcher as well as the mentor and thus is generally higher than projects that support only an individual researcher.

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9 In Japanese: senryaku teki souzou kenkyuu suishin jigyou.

10 In Japanese: sakigake kenkyuu.

11 In Japanese: souzou kagaku gijutsu suishin jiggyou.

12 Examples of new themes in 2003 are 'nano-scale processes and manufacturing for high performance communication' and 'molecular bio-elements and biosystems for medical therapies'.

Each *ERATO* project is centered around an innovative scientist with charisma and organizational skills whom JST recruits both to initiate and oversee the project. Only four ERATO projects are initiated each year, but each receives about 3 million USD annually for five years – a generous level of funding. JST staff consult with scientists of all ages for suggestions about persons who are doing pioneering research in areas where Japan needs to boost its S&T capabilities and who are also good team leaders and mentors. After a multistage vetting and interview process, JST selects four project supervisors who are given funding to set up a new laboratory and nearly free reign to recruit a research team. Usually the research teams have consisted of about 30 persons divided among two or three research centres (space is often rented from universities or GRIs).

In the past, few *kouza* members participated in these projects (except for the project supervisor, who was often an academic and was expected to devote about 20 percent of his/her time to the project). The rest were usually researchers from companies seconded to the project for two or three years, and postdocs or PhD candidates finishing their thesis research. Now the proportion of *kouza* participants has increased and the proportion of industry participants has decreased. In the first ten years of the ERATO program (1981 to 1990) about one quarter of the projects were headed by industry scientist, but since then only about five percent have had industry supervisors, indicating a shift to more basic research themes. Supervisors are predominantly from elite universities, even more so over the most recent ten year period.

Of all of Japan's government science programs, ERATO has received the most praise from Japanese and foreigners. It has been one of the most successful programs in terms of generating patent applications and academic papers co-authored by scientists in different institutions.[13] Foreigners and Japanese based in foreign universities have participated, even as project supervisors.[14] Examples of successful ERATO research show that a top down, non-peer review process of project selection by a small scientific staff can work in some cases.[15] Nevertheless, now that the program has shifted to more basic research, a follow-up evaluation may be in order to determine whether significant achievements are arising as frequently as in the past.

[13] Source information for this paragraph is provided by a report from the Japan Technology Evaluation Center (JTEC 1996) and by Hayashi (2003).

[14] For example, Dr. Shuji Nakamura, the inventor of the blue diode laser, is supervisor of an ERATO project that began in 2001, one year after he left Nichia Chemicals and became a Professor in the University of California, Santa Barbara.

[15] One of the first projects in 1981 studied ultra-fine particles and developed methods for depositing thin films of such particles now in commercial use. One of the participants in this project, Dr. Sumio Iijima later discovered carbon nanotubes while working at NEC. Most of the supercomputing electronics research worldwide is now based on the manipulation of single flux quanta that builds upon research carried out in an ERATO project begun in 1986. Ultra-fine resolution dual laser interferometers for use in X-ray lithography to manufacture computer chips were developed in another ERATO project. Dr. Ryoji Noyori, who won a Nobel Prize for chemistry in 2001, headed an ERATO project on molecular catalysis beginning in 1991.

Although JST's budget for its Strategically Promoted Creative Research Program is substantial, the number of scientifically trained staff who manage the process of selecting research themes and scientist-supervisors is probably only around twenty, much less than the in house scientific staff of the US NSF or NIH. A small number of senior scientist-advisors to JST make key decisions on research priorities and who will constitute the review committees. These advisors have eminent reputations, but sometimes based upon work many years in the past. Many are still active in universities, GRIs or corporate research, but they are also very busy. This pyramidal top-down decision making system that characterizes the JST programs probably can make good decisions for a country that is still catching up to forefronts of science established in other countries. However, persons who are following the lead of eminent scientists probably have an advantage in applying for funding.[16] For a scientific community that is already at the forefront of human knowledge, such a system may not be the most effective to support research that will extend those frontiers further.

MEXT Special Coordination Funds for Promoting Science and Technology have been in use for several years. Beginning 2001, however, on the recommendation of the Prime Minister's Science and Technology Council, about 150 million USD began to be made available annually for new programs to increase Japan's capabilities in key areas of science, technology and medicine. Emphasis was placed on boosting Japan's international S&T competitiveness, improving university-industry coordination, and ensuring that promising publicly funded discoveries are developed. A unique aspect of the Special Coordination Fund is that they can be used to pay salaries for non-permanent *kouza*-equivalent positions, in other words, for non-permanent (usually five year duration) professorships, associate professorships, etc. In 2003 about 90 awards were made under the various Special Coordination Fund subprograms. Most of these subprograms involve funding for specific projects. The smallest were awards to young researchers, about 20 in number. The largest were three Strategic Human Research Resources awards, each of approximately 10 million USD each annually, made to an entire department or centre to employ non-permanent research staff.

Regardless of subprogram, award decisions were made by 15 Working Groups. One working group, for example, reviewed all applications related to life sciences. It was chaired by the Director of the National Neurological Centre. Its other 13 members included the head of basic research at Ajinomoto, the head of the Intellectual Property (IP) Department of Kissei (a medium size pharmaceutical company), the head of research at GeneCare (a biotechnology company) the Director of the National Centre for Cancer Research (Japan's largest cancer research centre), a research group leader at Riken (MEXT/JST's flagship GRI), and eight professors, five of whom were from either the University of Tokyo or Kyoto University. In other words, members include many busy, prominent persons who can probably provide helpful insights on broad policy issues, but may have difficulty

[16] Based upon conversations with researchers who have applied to these programs.

evaluating the details (or lack thereof) in the various proposals.[17] After initial reviews, finalists are called for interviews. Persons who have taken part in these interviews report that questions tend to be general. Following the interviews, the committees make their final recommendations, which are reviewed by an advisory committee consisting of the chairs of the 15 working groups plus six other persons.

The distribution of new awards in 2003 mirrored the distribution of MEXT Grants-in-aid and government commissioned research shown in the Appendix[18] - predominantly to a few elite universities, except that a substantial number of awards went to GRIs.[19] Although there has been no comprehensive evaluation of program results, concerns that some projects were poorly conceived and wasteful have been frequently voiced off the record by senior academics and government officials.

The *Centres of Excellence (COE) Program* was one of the main outcomes of the 2001 Toyama Plan[20] to reform Japanese universities in order to help revive the Japanese economy. It was originally conceived as a means to raise education and research standards in approximately 30 universities so that they could meet world standards of excellence (for the discussion of a similar attempt in Germany see Weingart and Maasen, this volume). It was also intended to introduce the concept of competitive resource allocation based upon external evaluations. Universities could submit applications in 2002 and 2003 for funds to employ post doctoral level researchers and research assistants, pay stipends for graduate students, purchase equipment, build or rent research space, invite leading researchers from overseas and to support international collaborative research. 113 projects were initiated in 2002, 133 in 2003 and 28 in 2004.[21] None were initiated in 2005 and 2006. New projects are expected to be funded beginning in 2007 under a new Global COE Program, with funding concentrated on a smaller number of universities in order to implement the original intent of this program - to develop up to thirty world class academic centres. The retrospective evaluation system mentioned in the text will be used to select recipient universities or departments.

The award process was similar to that for Special Coordination Fund applications. Each of the ten areas mentioned in the previous note had a review committee of 22 to 27 members. The COE review committees tended to be made up of persons from even more diverse backgrounds than the Special Coordination Fund working groups. For example, the 2003 medical science review committee had 23 members including heads of cancer research centres, professors of nursing, the head

[17] The committees can request that outside experts review particular applications. It is not clear how often they did so.

[18] Sources for the information in this paragraph are in documents accessible under various URLs beginning http://www.mext.go.jp/a_menu/kagaku/chousei.

[19] Also, only one of the Young Researcher awards went to an applicant from one of the seven former Imperial Universities, i.e., those listed in table 3 of the Appendix.

[20] The Plan was named after Ms. Atsuko Toyama, Minister of MEXT, who issued the plan in June 2001 after consulting with Prime Minister Koizumi.

[21] Applications for 2002 had to relate to life science; chemistry or materials science; IT or electronics; human literature; or new interdisciplinary fields. Applications for 2003 had to relate to medical science; mathematics, physics or earth science; mechanical or civil engineering; social science; or new interdisciplinary fields. The 2004 applications simply had to be innovative. (NSF 2004)

of a rehabilitation technical college and even the head of a technical high school. These review committees had the option of asking outsiders to comment on particular proposals. Final decisions were made by a committee of six MEXT administrators and 17 other persons, mainly university professors or GRI laboratory heads. Each project receives on average 1.5 million USD per year. The following table shows the disbursement of COE funds in 2006 for projects initiated 2002-2004. It is heavily weighted in favour of the same elite universities that are leading recipients of Grants-in-aid and government commissioned research (Appendix).

Table 1. Centres of Excellence disbursements in 2006 for projects initiated in 2002-2004[22]

Rank	University	10^8 yen[2]	Percent
1	U Tokyo	44.24	12.7
2	Kyoto U	33.35	9.6
3	Osaka U	24.14	6.9
4	Tohoku U	20.06	5.8
5	Keio U	17.69	5.1
6	Hokkaido U	17.39	5.0
7	Tokyo Inst. of Technology	17.21	4.9
8	Nagoya U	17.07	4.9
9	Kyushu U	12.15	3.5
10	Waseda U	10.19	2.9
11	Kobe U	8.51	2.4
12	Tokyo Medical & Dental U	5.02	1.4
13-91	All other recipients	121.81	34.9
Total		348.83	100

The Japanese government has recently placed priority on increasing research funding opportunities for young researchers. However, having to rely on the professor for laboratory space, key equipment, supplemental funding and support staff, means that even recipients of such awards still must coordinate their research with the *kouza* head (Normile, 2004). Some major funding programs involve the distribution of large funds to a senior principal investigator who then distributes the funds to other collaborating *kouza* heads in other departments or universities.[23]

More generally, over one-third of competitive funds available for universities come from programs that tend to fund large projects involving multiple laboratories. These include the following programs listed in table 2, which account for 36% of

[22] Source: http:// www.mext.go.jp/b_menu/houdou/18/04/06041308/003.htm. Most projects last five years. Throughout this chapter, funding figures are given in units of 10^8 yen, which is approximately equal to 0.9 million US$, or roughly 1 million US$. The exact equivalence depends upon fluctuating exchange rates and purchasing power parities.

[23] MEXT's Priority Area Research projects (recently folded into the new Development of Innovative Seeds and the Promotion of Key Technologies Programs) and JST's CREST and ERATO projects tend to be of this type.

MEXT's total competitive research budget: Grants-in-aid for Specially Promoted Research; CREST; ERATO; Research for the Future (JSPS);[24] COE; [25] and Special Coordination Funds (SCFs) for Strategic Human Research Resources, Pioneering Research in new Fields and Training for Emerging Fields.[26] In addition, most funding from the New Energy Development Organization (NEDO)[27] of the Ministry of Economy, Trade and Industry (METI), and most Ministry of Public Management funding for universities also involve either multiple laboratories or (more frequently) a combination of university laboratories and companies (table 3). Table 4 provides the funding totals for competitive research funding in Japan in FY 2002.

[24] The latest projects were started in 1999. The program is being phased out. Some functions will be carried on by new programs.

[25] The Cabinet Office's 2002 list of competitive S&T funding programs that is the main data source for table 2 (note 28) does not classify the COE Program as 'competitive research support.' I have nevertheless included it in my analysis because of its importance as a major new source of S&T research support, and because project proposals are solicited and evaluated competitively. The COE data in table 2 are for projects initiated in FY 2002, the first year of the program (source: NSF Tokyo Regional Office Report Memorandum 02-08 available at www.nsftokyo.org/rm02-08.html). See table 1 for 2006 funding levels.

[26] Information on the various SCF Programs to Promote Reform of the Science and Technology System is at http://www.mext.go.jp/a_menu/kagaku/chousei/gaiyo4.html. Not included in table 2 is another category of SCF--continuation funds for multi-year 'general research' programs begun before 2001. No new projects were initiated in either 2001 or 2002 under these continuing SCF programs, and I do know how these projects were initially selected. These continuation funds amounted to 187 x 10^8 yen in 2002, and are included in the Cabinet Office's 2002 list of competitive S&T funding programs that is the main data source for table 2 (note 28). Thus the total SCF budget in the Cabinet Office list is 187 x 10^8 yen greater than the 178 x 10^8 yen budget shown in table 2 specifically for SCF programs to promote S&T reforms. The total budget for competitive S&T programs shown in the Cabinet Office list is also correspondingly higher than the totals in table 4 (after adjusting for COE funding, which is not included in the Cabinet Office list).

[27] NEDO is a corporation under METI that carries out most of METI's competitive extramural research funding. Its scope covers many fields in addition to energy.

Table 2. Major MEXT competitive research funding programs[28]

(Subprograms in normal type)

Program name	2002 budget (10^8 yen)	No. new projects in 2001	Annual funding per project (10^8 yen)	Duration of pro-jects (yrs)
University, industry and gov't. cooperation for innovative enterprise creation[A,I]	**71**	**28**	**0.1-0.5**	**3-5**
Grants-in-Aid for Research	1,703	21,000		
JSPS: Basic research	812	9466	< 1.0	1-5
JSPS: Exploratory research	40	1074	<0.05	1-3
Support for researchers younger than 37	134	4170	<0.3	2-3
Specially promoted research	127	13	< 5.0	3-5
Priority area research	386	3394	0.2-6.0	3-6
Disseminating res. results	34	780	Varies	1-5
New Special Coordination Funds to Promote S&T System Reform[26]	178	~150		
Industry-university-government results-oriented joint research.[A]	28	35	0.27	3
Strategic human research resources development	40	2	< 10.0	5
Research support for researchers younger than 35	15	66	0.05-0.15	≤ 5
Pioneering research in new fields[I]	66	24	0.5-2.0	5
Training for emerging fields	19	7	< 2.0	5
JST Basic Research Program	427	~370		
CREST[I]	289	173	0.83	≤ 5
PRESTO[I]	64	184	0.17	1-5
ERATO[I]	62	4	3.2	5
International Coop. Research	16	2	?	5
Centres of Excellence[25]	182	113	0.10-5.0	5
JSPS Research for the Future	90	0[7]	?	5

[A] Program generally has applied research focus or aims to develop competence in particular technical areas.

[I] Program open to applicants or co-applicants from private industry.

[28] Main (umbrella) programs are in *italics*. Subprograms are in normal type. Figures include funding to private companies, GRIs, and universities. The main source is the Prime Minister's Cabinet Office's official list of competitive S&T research funding programs at http://www8.cao.go.jp/cstp/project/compe/haihu02/siryo1.pdf. Data for the subprograms of JST's Basic Research Program are available at www.jst.go.jp. See notes 25 and 26 for additional sources and explanations related to the SCF and COE programs. Since subprograms with annual budgets below 1 B yen (~10 M US$) are not listed in this table, the sums of the budgets for the listed subprograms are less than the total funding levels for the main programs.

Table 3: Major Competitive Government Research Funding Programs of Funding Agencies other than MEXT[29]

Program name	2002 budget (10^8 yen)	No. new projects in 2001	Per project funding range (10^8 yen)	Duration of projects (yrs)
Ministry of Public Management (includes former Ministry of Posts and Telecommunications)				
Strategic Communications R&D[A,I]	14	?[30]	0.1-0.5	3-5
Japan Key Technology Centre: Promotion of corporate research in basic technologies[A,I]	107	11	no set limit	usually ≤ 5
Ministry of Health, Labour and Welfare (MHLW)				
Grants in Aid for Health Research[I]	393	1251	0.01–10.0	1-3
Basic Research in Health and Medicine	98	10	0.5-1.0	≤ 5
Ministry of Economy, Trade and Industry (METI)				
NEDO: Industrial Technology Research[A]	53	93	0.3-0.4	2-3
Ministry of Agriculture, Forestry and Fisheries (MAFF				
Research to Apply Advanced Agricultural Technologies[A,I]	18	?	0.1-1.0	≤ 3
Basic Research to Create New Technologies[I]	42	13	≤ 1.0	< 5
New Enterprise Creation R&D[A,I]	17	6	≤ 0.6	< 5
Environment Agency				
General Environmental Research[I]	29	13 (+ 7 smaller for young researchers)	0.02-1.0	≤ 3
Grants in aid for Research into Fields such as Environmental Disruptors of Biological Pathways[I]	10	30	0.01-1.0	≤ 3

[A] Program generally has applied research focus or aims to develop competence in particular technical areas.

[I] Program open to applicants or co-applicants from private industry.

[29] Includes funding to private companies, GRIs, and universities. Source: document issued by the Prime Minister's Cabinet Office: http://www8.cao.go.jp/cstp/project/compe/haihu02/siryo1.pdf. Programs with annual budgets below 1 B yen (~10 M USD) are not listed in this table. Thus the sum of the listed programs is less than the total for the non-MEXT programs in table 4.

[30] Probably no new projects were approved in 2002. Most of participants in projects initiated in previous years are large electronics companies.

Table 4. Funding totals

Programs	Funding Total (10^8 yen)
Non-MEXT programs (including those not listed in table 3)	817
Total for MEXT programs (including those not listed in table 2)	2,657
Total for all competitive funding programs	3,474

In addition, private companies have great influence over Japanese university research. Upwards of a third of inventions in major universities are attributed to company-sponsored research, the percentages being even higher for inventions on which patent applications are actually filed. Private company funding accounts for about 20% of activity-specific university research (i.e., funding net of salaries for full time faculty and administrators, construction, and operational and administrative subsidies). But only about 10% of this is contract research that gives the companies rights to jointly own IP. The other 90% is funding in the form of donations that do not give the donors rights to IP. However, many inventions that probably were made with government or donation support are attributed to corporate-sponsored contract research allowing the corporate sponsors to control resulting IP. Industry researchers engaged in joint research doubled from 1398 in 1992 to 2821 in 2002 (MEXT 2003). This has facilitated the pre-emption by companies of university discoveries by large companies (Kneller 2006).[31] It may also reflect an increasingly applied emphasis in university research.

The *kouza* (laboratory) head is usually responsible for coordination with companies and with laboratories in other universities. Thus young researchers who want to participate in these multi-laboratory projects must do so as part of the larger *kouza*. Such research may have the advantage of bringing many minds to bear on a problem, but it tends to foreclose opportunities for young researchers to pursue new lines of inquiry. It probably also favours the larger universities that already have the equipment, networks and prestige useful for large projects.

Many of the government funding programs have an applied emphasis and some of these encourage collaborations with industry in consortium-like arrangements.[32] Even programs labelled as Basic Research Programs such as JST's CREST, PRESTO and ERATO stress the need for research results to have practical applications and social contributions. In the case of programs funded by METI's NEDO and the Ministry of Public Management, the aim is more explicitly to

[31] In major US universities, probably less than 10% of inventions are attributed to company-sponsored research, and the proportion of these that have company co-inventors is low.

[32] In most of the JST's CREST review panels, one of the (six to eight) members is a representative from industry. Kneller (2007) describes the predominance of consortium research in many government programmes funding cutting edge university research, with the notable exception of MEXT Grants-in-aid.

achieve advances with direct applications for industry. The question arises whether it is appropriate to allocate a large proportion of (young) talent and public funding to topics that are someone else's brainchild, and that may constitute translational or applied research that private companies could fund on their own. Under such circumstances, the need for rigorous, expert based peer review is particularly great.[33]

THE ADVENT OF RETROSPECTIVE RESEARCH EVALUATION

A retrospective RES system has been in place since 2000. Moreover, improving the research evaluation system was one of the main goals of the Second Science and Technology Basic Plan adopted in 2001 (Blanpied 2003). Organizationally, research evaluation has grown out of the accreditation process under the purview of the National Institute for Academic Degrees and University Evaluation (NIAD-UE).[34] Under the NIAD-UE system, universities have considerable leeway how to evaluate themselves, including their research.[35] NIAD-UE has itself reviewed specific departments or faculties within a growing number of universities to check the quality of self-evaluations, and offer feedback. Sometimes the focus is on research within a particular department and sometimes on themes such as international cooperation and exchange that span all the activities of a university.[36]

Many universities are using quantitative indices of research progress such as numbers of publications, research grants, prizes, patent applications, and invited presentations by faculty (MEXT 2005). As a particular example, the University of Tokyo collects information annually from individual faculty on numbers of publications in international journals, contributions to society,[37] contributions to new fields of science and education, numbers of international presentations, number and titles of international collaborations, input into scientific data bases,[38] and major awards.

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[33] In addition to the careers of young researchers and public resources being at stake, results of applied research projects sometimes are not subject to retrospective evaluation in academic publications. Also such funding may have anti-competitive effects (Kneller, 2007). While NEDO staff often do consult with industry and academic advisors before announcing research themes and they occasional solicit outside evaluations of particular proposals, to a large extent selection decisions are made internally by METI/NEDO staff without broadly solicited, critical debate.

[34] NIAD-UE is an independent administrative agency under MEXT established in 1991 to award university degrees. In 2000 its mandate was broadened (and its name changed from NIAD to NIAD-UE) to include university evaluation.

[35] Self-evaluation should address at least eleven themes (goals). Research is actually a twelfth and optional theme. However, universities that want research accreditation should be evaluated by a working group of NIAD-UE experts every seven years (MEXT 2005).

[36] Thus in 2000, NIAD-UE reviewed research in the faculties of general science in six universities and faculties of medicine in six others universities. In 2001, it reviewed research in law in six universities, education in six other universities and engineering in six other universities. In 2002, it reviewed research in the humanities in nine universities, economics in eight universities, agriculture in seven universities and general science in six universities.

[37] Especially practical benefits of one's research such as products on the market, or actual applications in industry, health, etc.

[38] E.g., gene and protein data bases.

Through to 2009, the results of the evaluations will be for MEXT's and the individual universities' internal use—in the latter case, mainly for self appraisal, improvement of data collection, and promotions. But beginning in fiscal year 2010, they are supposed to be the basis of determining which universities should receive accelerated reductions in operational and administrative subsidies.

The combination of the COE programme, retrospective research evaluation and budget cuts may be seen as a well conceived long term strategy to shift support for Japanese university research entirely to competitive funding. The plan incorporates a generous transition period that will be particularly long in a few universities - not necessarily the elite universities appearing in the Appendix but universities where scientific output in proportion to students or courses is high. In other words, universities where many faculty are engaged primarily in research will be spared the swiftest cuts, precisely to enable productive scientists who spend most of their time on research to continue to do so. This may be in keeping with the advantage often attributed to block grant funding as it enables researchers to undertake riskier, longer term projects than if they had to apply for funding for a new project every several years.

But as suggested above, an alternative interpretation is that this combination reflects a misguided conviction that the path to good science involves conferring elite status on a small number of institutions and providing them preferential access to resources beyond even the highly skewed allocations that exist today--rather than facilitating mobility of researchers and competition among them and their institutions.

In contrast, the US has approximately 200 research universities, of which 96 are classified as research intensive.[39] The distribution of government funding among universities is more even. The vast majority of federal funding is distributed through competitive grants or contracts—the largest portions through the peer review mechanisms of the National Institutes of Health (NIH) and the National Science Foundation (NSF) (NSB 2006). The NIH and NSF peer review committees usually have more expert reviewers and more focussed critical debate on individual proposals than any of the Japanese peer review mechanisms. Thus, they are probably better at detecting novel research proposals from researchers who are not well known (i.e., young applicants) or not from elite universities (Hayashi 1996; Coleman 1999; Suga 2004; Normile 2004; Kneller 2007).[40] Regardless whether it would make sense for Japan to try to implement NSF or NIH-style systems of peer review,[41] the US experience suggests that relying on competitive funding, rather than block grants, is compatible with a high level of university autonomy and a great variety of intellectual approaches in research, as noted by Whitley in this volume—provided funding is plentiful and fairly allocated.

However, a system that relies upon competitive, time-limited funding for most research expenses (i.e., a soft money system), must rely on such funding for a

[39] According to the classifications of the Carnegie Foundation for the Advancement of Teaching (http://www.carnegiefoundation.org/).
[40] For a critical perspective on NIH peer review, see Kaplan (2005).
[41] MEXT is debating implementing a NSF style system.

significant proportion of the salaries for full time university staff. The prospective peer review system and the administrative competence of Japanese universities must be improved to make a soft money system of salary and research funding work—and to avoid the pitfalls of such a system noted by Whitley, Engwall and Nybom, and others in this volume. So far, however, no system to supplement salaries from competitive research funds has been approved. This is under active discussion, as the subsidy reductions begin to cut into salaries. One sticking point is how the funding agencies will monitor faculty assertions that they are devoting a specified proportion of their time to particular projects. Another issue is that the amounts of competitive awards will have to be increased in order to cover salaries. In other words, much of the money saved from cutting back on block grants ought to be transferred to competitive programs to cover salary costs.

Doubt remains as to whether these issues can be resolved. Even leading Japanese universities have yet to establish strong, competent contract offices than can handle research funds from government and industry. For such a system to work effectively, these offices would have to be able to:

- Ensure the universities' intellectual property interests are protected;[42]
- Collect appropriate overhead (indirect costs) and distribute these to appropriate parts of their universities;[43] and
- Monitor compliance with award terms, including whether faculty are allocating their time appropriately between projects.[44]

But if they did develop such administrative competence, not just with respect to contracts, but also with respect to financial management in general, they could begin to break out of their dependence on government subsidies. They could begin to act entrepreneurially, which (despite risks related to conflicts of interest) might generate more research opportunities, especially for young scientists seeking to pursue new ideas. They could begin to hire permanent or tenure-track faculty using competitively awarded funds, a step no national university has yet taken.[45] Because

[42] Currently, the most valuable inventions pass directly to companies with minimal royalty and development obligations (Kneller 2006).

[43] Currently overhead rates are low (10% to 30%, compared with 50% or more in US universities). However, they are set arbitrarily without any attempt to estimate actual indirect costs for university research. In contrast, although US rates are high, they are supported by calculations of various indirect costs that are reviewed by the funding agencies and the General Accounting Office. Moreover, overhead payments in Japan have essentially been hijacked by the individual laboratories and departments performing the research so that they can be ploughed back into additional expenditures by these laboratories. While this boosts resources in these laboratories, it deprives the universities of funds that they might otherwise use for broader benefits, such as providing young researchers with startup funds and smoothing out gaps in competitive funding for individual researchers, so that a system of soft money competitive funding can work smoothly.

[44] Leaving this up to the funding agencies would risk undue bureaucratic delays and intrusion of government into academic affairs.

[45] Competitive funds have been used to pay stipends for graduate students and, less frequently, time-limited faculty positions (primarily research oriented positions, sometimes bestowed upon retirement age researchers from companies sponsoring joint research). The closest approximation to soft-money funding of permanent faculty positions have been a few large company funded 'endowed chairs' that provide enough funds to cover the salary of a single professor until retirement.

these would be university-funded positions, the persons who fill them need not be attached to particular *kouza*.

So far, the impact of retrospective research evaluation is greatest in non-university intramural research, i.e., research conducted within GRIs. For example, in 2003 METI was allocating 10% to 15% of the budget of its flagship GRI, the National Institute for Advanced Industrial Science and Technology (AIST), according to the results of annual evaluations of research results. Researchers whose work was rated as excellent were receiving bonuses. Plans were under discussion to link the budgets of AIST's various component institutes to the results of the annual research results evaluations - to integrate retrospective evaluation into the setting of mid and long term goals (Blanpied 2003). Most of AIST's research funds are allocated from METI, and each component institute has discretion regarding the allocation of funds among various projects. In other words, budget allocation is largely internal, not by external peer review. In such cases, retrospective evaluation is the only means to evaluate research output and to determine whether this output matches agency goals. Thus, retrospective evaluation may be particularly appropriate for GRIs whose budgets are allocated internally among various projects, provided their research mandates are clear.[46]

FINAL REMARKS

As suggested by Whitley in this volume, many features of national public science systems influence the effect of retrospective evaluations and block grant funding. Given the nature of the postwar Japanese research system as summarised in this chapter, the most likely result of the strong system of retrospective evaluation scheduled to take effect in 2010 is justification of budget cuts that will reinforce the elite status of a few universities - although less pessimistic outcomes are possible. In any case, the current soft evaluation system is providing feedback for individual researchers and their universities.

But the larger issue is what combination of funding and review systems is most likely to provide judicious support for a large number of researchers to pursue original creative science. As an initial proposition, it probably makes little sense to impose a strong evaluation system on top of the kind of prospective peer review that has been established in Japan. Here, the likely result is for retrospective evaluation to reinforce and perpetuate the effects of the prospective evaluation system, that is, for the retrospective results to be pre-ordained by the basic funding system. Prospective peer review usually takes into careful consideration past accomplishments, either by individuals (in the case of individual applicants) or by institutions (in the case of applications for broader scope institutional programs). Thus, to do it retrospectively in a separate process would be duplicative.

On the other hand, in the absence of effective prospective peer review, retrospective evaluation that will guide future funding is probably essential. This is

[46] This is consistent with Cozzens' description in this volume of research evaluation conducted by US GRIs.

the case in those government laboratories whose funding is distributed by legislative or ministry appropriations. Cozzens' chapter in this volume shows how a semi-weak[47] evaluation system can be helpful to science agencies in determining the success of current programs and for planning new programs. NIH intramural site reviews are clearly a strong type of retrospective system, but largely successful due to the high level of expertise and objectivity of the reviewers.

A tentative conclusion from these examples is that the stronger the review system (either prospective or retrospective), the greater the need for objective, specialist, yet also diversified, expertise among the reviewers. Another lesson that emerges from the Japanese experience is that block grants can reinforce elitism, rather than equalizing opportunities among universities and promoting diverse competing centres. On the surface, MEXT's system of allocating operational and administrative subsidies is objective and formulaic, based upon numbers of faculty, graduate programs, special research facilities, etc. But ultimately these independent variables are decided by MEXT, and the result is the skewed distribution of subsidies shown in the Appendix. Universities that receive relatively low allocations should ask whether, rather than seeking a continuation of subsidies, they should campaign for replacing subsidies with competitive funding based upon objective, expert-based, and transparent peer review. Indeed, this may be the ultimate direction of current MEXT policies.

Good prospective peer review could go a long way to provide young researchers with funds to pursue their own scientific directions, help universities build administrative competence, and establish an alternative to the current semi-feudal system where key administrative decisions impacting education and research are made at the level of individual *kouzas*. Even assuming that the current uneven distribution of resources reflects a corresponding uneven distribution of talent, competitive funding and competent peer review will probably lead to a more even distribution. Capable researchers will be more willing to work in lesser known universities, if they know they can receive funding there. Finally, objective, expertise-based peer review would enable even agencies whose main missions are *not* to support of basic science to make better funding decisions. It should encourage them to articulate their goals more clearly and not leave decisions up to bureaucratic fiat or to the opinions of a few senior scientists. But if a shift to competitive funding is to be successful, other reforms must occur concurrently.

REFERENCES

Blanpied, William (2003), *The second science and technology basic plan: a blueprint for Japan's science and technology policy*, US National Science Foundation Tokyo Regional Office Special Scientific Report no. 03-02 (19 May 2003).

Coleman, Samuel (1999), *Japanese Science, From the Inside*, London: Routledge.

Hayashi, Masao (pen name: Hakuraku Rokubiru) (1996), *Amerika no kenkyuuhi to NIH [NIH and Amercian Research Funding]*, Tokyo: Kouritsu.

[47] Here I am using 'weak' and 'strong' in Whitley's sense to distinguish between evaluation systems that provide feedback primarily for self-evaluation (weak), and those whose results are used to determine funding allocations (strong, see Whitley, this volume).

Hayashi, Takayuki (2003), 'Effect of R&D programmes on the formation of university-industry-government networks: comparative analysis of Japanese R&D programmes', *Research Policy*, 32, 1421-1442.

JTEC [Japan Technology Evaluation Center] 1996, *Japan's ERATO and PRESTO Basic Research Programs*, http://www.wtec.org/loyola/erato/toc.htm (accessed 24 May 2007).

Kaplan, David (2005), 'How to improve peer review at NIH', *The Scientist*, 19, no. 17, 10.

Kneller, Robert W. (2003), 'University-industry cooperation and technology transfer in Japan compared with the US: another reason for Japan's economic malaise?', *University of Pennsylvania Journal of International Economic Law*, 24, 329-449.

Kneller, Robert (2006), 'Japan's new technology transfer system and the pre-emption of university research by sponsored research and co-inventorship', *Journal of the Association of University Technology Managers*, XVIII (no. 1, summer), 15-35.

Kneller, Robert W. (2007), Bridging Islands: Venture Companies and the Future of Japanese and American Industry, Oxford: Oxford University Press.

Matsuo, Yoshiyuki (1997), 'Chiteki sangyou e no toushi de aru kakenhi wa jinrui no atarashii bunka o umidasu [Grants-in-aid as an investment for [producing] intellectual property gives rise to a new human culture]', in Tetsuo Kobayashi (chief ed.), *1997 Daigaku Rankingu [1997 University Rankings]*, Tokyo: Asahi shimbunsha shuppan kikaku shitsu [Asahi Newspaper Corporation Publication Project Division]

MEXT [Ministry of Education, Sports, Culture, Science and Technology] (2003), Kokuritsu daigaku nado no (Kigyou nado tono kyoudou kenkyuu) no heisei 14 nendo no jisshi joukyou ni tsuite [Actual Situation in 2002 Related to Joint Research with Industry in National Universities], issued 31 July 2003.

MEXT [Ministry of Education, Sports, Culture, Science and Technology] (2004), *Heisei 16 nendo Gakkou kihon chousa jouhou sho [2004 Basic School Survey]*, Tokyo: Kokuritsu insatsu kyoku [National printing office].

MEXT [Ministry of Education, Sports, Culture, Science and Technology] (2005), Kenkyuu kaihatsu hyouka ni kansuru genjou oyobi mondaiten (Monkashou ga gisshi suru hyouka) [Current status of research evaluation by MEXT], 15 Feb. 2005.

MEXT [Ministry of Education, Sports, Culture, Science and Technology] (2005b), Heisei 16 nendou daigaku nado ni okeru sangaku renkei nado jisshi joukyou houkokusho [Report on Industry-Academic Cooperation in Higher Education Institutions in 2004], June.

Normile, Dennis (2004), 'Older scientists win majority of funding', *Science*, 303, 19 March, 1746. (This summarizes the original May 2003 Japanese report available at www.mhlw.go.jp/shingi/2003/05/s0509-6i4.html.)

NSB [National Science Board] (2006), *Science and Engineering Indicators 2006*, Arlington, VA: National Science Foundation.

NSF [National Science Foundation] (2004), *Tokyo Office Report Memorandum* No. 04-06, http://www.nsftokyo.org/rm04-06.html (accessed 24 May 2007).

Suga, Hiroaki (2004), Sessatakuma suru Amerika no kagakusha tachi [Diligent American Scientists], Tokyo: Kyouritsu.

Uekusa, Shigeki and Kano Takaoka (2005), Kokuritsu daigaku houjin no zaimu shihyou to sono kanousei [Financial indicators of national universities and their availability], Research on Academic Degrees and University Evaluation 1, National Institute for Academic Degrees and University Evaluation.

Whitley, Richard (2003), 'Competition and Pluralism in the Public Sciences: The impact of institutional frameworks on the organisation of academic science', *Research Policy*, 32, 1015-1029.

APPENDIX: DISTRIBUTION OF PRINCIPAL FORMS OF GOVERNMENT SUPPORT FOR UNIVERSITY RESEARCH

Table 1. Monbusho/MEXT Grants-in-aid (all types, new and continuing projects)

Rank	1995			2005		
	University	Amount (10^8 yen)	% of total	University	Amount (10^8 yen)	% of total
1	U of Tokyo	125.5	13.6	U of Tokyo	201.2	11.7
2	Kyoto U	72.7	7.9	Kyoto U	131.1	7.6
3	Osaka U	61.3	6.6	Tohoku U	94.8	5.5
4	Tohoku U	41.6	4.5	Osaka U	89.8	5.2
5	Nagoya U	34.9	3.8	Nagoya U	64.6	3.8
6	Kyushu U	30.0	3.3	Kyushu U	56.8	3.3
7	Tokyo Inst Tech	30.0	3.2	Hokkaido U	56.1	3.3
8	Hokkaido U	28.5	3.1	Tokyo Inst Tech	45.4	2.7
9	U of Tsukuba	22.2	2.4	U of Tsukuba	30.2	1.8
10	Hiroshima U	13.2	1.4	Riken	26.3	1.5
11	Okayama U	9.5	1.0	Keio U	24.9	1.5
12	Keio U	9.1	0.9	Kobe U	24.7	1.4
13-~500	Other universities	445.5	48.3	Other universities	868.5	50.7
Total		924.0	100		1714.4	100

Sources: For individual universities 1995 see Matsuo (1997). For total 1995 and all 2005 data, see www.jsps.go.jp.

Appendix Table 2: Commissioned Research in 2004 (Source: MEXT 2005b)[48]

Rank	Institution	Amount (10^8 yen)	% of total
1	U Tokyo	177.6	17.5
2	Kyoto U	81.4	8.0
3	Osaka U	77.4	7.7
4	Waseda U	44.1	4.4
5	Tohoku U	42.2	4.2
6	Kyushu U	38.9	3.8
7	Keio U	38.2	3.8
8	Hokkaido U	34.9	3.4
9	Tokyo Inst Tech	29.9	3.0
10	Nagoya U	21.1	2.1
11	National Institutes of Natural Science (a MEXT GRI)	19.1	1.9
12	Tsukuba U	13.0	1.3
13-~500	Other universities and academic research centres	394.5	38.9
Total		1012.3	100.0

[48] Commissioned research includes most project-specific funding from government agencies. Referring to table 2 in the main text, it includes all funding except MEXT Grants-in-aid, Special Coordination Funds, and COE funding. It also includes contract research from private companies that does not involve company researchers working collaboratively in university laboratories. However, such funding probably accounts for less than 5% of Commissioned Research funds, at least in major universities. Most industry funding is either under Joint Research contracts or donations (Kneller 2003).

Table 3. Budget for National Universities' Operational and Administrative Subsidies, April 2004 to March 2010 (projected)[49]

Rank	Institution	Amount (10^8 yen)	Approx. % of total
1	U of Tokyo	5,364	7.3
2	Kyoto U	3,676	5.0
3	Tohoku U	3,122	4.2
4	Osaka U	3,008	4.1
5	Kyushu U	2,819	3.8
6	Hokkaido U	2,541	3.4
7	Nagoya U	2,066	2.8
8-87	Other national universities	51,304	69.4
Approx. total		73,900	100.0

Note: the individually listed top seven recipients happen to be the seven universities that had *Imperial University* status in the prewar era.

[49] These amounts represent total operational and administrative subsidies, not only funds to support research. Sources: For the seven universities, see Uekusa and Takaoka (2005). The six year overall total is an estimate based on overall totals for FYs 2004 and 2005 (drawn from www.mext.go.jp), calculated by applying the same rate of decrease over the entire period, as between FY2004 to 2005, i.e., 98 x 10^8 yen.