4: The Changing Governance of Japanese Public Science[1]

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Overview

This chapter provides an overview of Japan's public science system (PSS) and the major changes under way concerning its governance. From the end of the Second World War until 2004, Japan's national universities, which account for the great majority of basic science research, were under the direct control of the Ministry of Education, Culture, Sports, Science and Technology (known as Monbusho before 2001 and Monbu-kagaku-sho, or MEXT, thereafter). Government research institutes (GRIs) similarly were under the direct control of their responsible ministries until about the same time. Since 2000–2004, various policies have been initiated to change the governance and administrative system of national universities and GRIs across a wide front. Financial and administrative independence and mobility of researchers have been encouraged and comprehensive evaluation procedures implemented. The push towards greater financial independence is indicated by a continuing decline in general operational and administration subsidies (block grants) to universities, which now must compete for a growing supply of competitive research funds. However, some of these competitive programmes are aimed explicitly at creating a limited number of centres of excellence. Some are under the control of ministries and their academic advisers who strongly influence research themes and award decisions.

This chapter adopts a system-wide analytical perspective. It is based on twelve years of experience in an interdisciplinary graduate-level education and research centre of the University of Tokyo, and frequent contacts with scientists and students. It also draws upon a large number of interviews over the past decade with companies that deal with universities. However, most first-hand observations are from Japan's best endowed and most prestigious university. Therefore, the perspectives of researchers in some of Japan's GRIs and good but lesser known universities may not be adequately represented in this chapter.

Japanese Public Science Institutions

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[1] *citation*: Kneller, R. 2010. 'The changing governance of Japanese public science' In R. Whitley, J. Glaser & L. Engvall (eds), *Reconfiguring Knowledge Production: Changing Authority Relations in the Sciences and Their Consequences for Intellectual Innovation* (Oxford: Oxford U. Press) pp 110-145.

Japan's public science system consists of (1) universities, (2) government research institutes (GRIs), and (3) consortia and collaborative centres.

Universities

In 2008 Japan had 86 national universities that since 2004 have been incorporated under the jurisdiction of the Ministry of Education, Culture, Sports, Science, and Technology. In addition there are 90 universities under the jurisdiction of local governments and 589 private universities offering at least a four-year basic (bachelor's) degree. National universities account for the majority of university science and engineering research, as well as the bulk of graduate education conducted in Japan.[2] The most prestigious of the national universities are those designated as Imperial Universities prior to the Second World War. These are the University of Tokyo and Kyoto, Osaka, Tohoku, Nagoya, Hokkaido, and Kyushu Universities. Among these, the *big four* (Tokyo, Kyoto, Osaka, and Tohoku) receive the largest amount of support under almost any government programme. For example, in the three years 2006–8, they accounted for 44 per cent of all MEXT grants-in-aid for scientific research—hereinafter grants-in-aid or GIA—to national universities and 35 per cent to all types of universities. The University of Tokyo alone accounted for 16 per cent of all MEXT GIA to national universities in 2007 (http://www.jsps.go.jp/j-grantsinaid/index.html). This concentration of funding among Japan's top four or five universities is at least twice that among the UK's top four or five universities (http://www.hesa.ac.uk/index.php/content/view/807/251/).

The best known private universities are Keio and Waseda Universities in Tokyo but their research funding is less than any of the previously named national universities. They rank 12th and 16th respectively among 2008 recipients of MEXT GIA. But this amounted to only 12 and 10 per cent, respectively, of the University of Tokyo's share. A few other private universities also attract excellent science and engineering researchers. Among local government universities, the leading recipients

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[2] Thus, although national universities accounted for only 22% of total student enrolment in 2008, they enrolled 59% of Japan's 263,000 total graduate students, including 65% of masters students and 76% of doctoral students in science and engineering. In 2008 they received 68% of R&D funding under MEXT's grants-in-aid programme, the largest single source of government funding for project specific university R&D: http://www.mext.go.jp/b_menu/toukei/001/08121201/index.htm.

of 2007 GIA were Osaka City and Osaka Prefectural Universities, ranked 25th and 28th respectively (http://www.jsps.go.jp/j-grantsinaid/index.html).

Overall, the national government is by far the largest funder of university R&D. Even private universities receive substantial subsidies from the national government. The contribution of prefectural and other local governments to research in national universities is negligible so far. However, very recently there have been cases of local governments donating land and infrastructure for the expansion of national universities. This may mark the beginning of local governments engaging with national universities as a means to promote regional development.

Government Research Institutes (GRIs)

The GRIs are research institutes linked to various science-related ministries.[3] Their overall funding for natural science and engineering research and development (R&D) is about 60 per cent that in universities. Many GRIs with large budgets are laboratories within mission-specific agencies such as the Defence Ministry, the space agency (JAXA), and the atomic energy agency (JAEA). The most important GRIs with a multidisciplinary scope and basic science orientation are Riken (in English: the Institute for Physical and Chemical Research) and the National Institute for Advanced Industrial Science and Technology (AIST). Riken is an independent administrative institution under MEXT, while AIST is an independent administrative institution under the Ministry of Economy, Trade, and Industry (METI). Among all GRIs, Riken probably hosts more graduate students and postdoctoral researchers than any other. Riken's 2008 budget was M¥ 111,500 (M¥ 100 ≈ 1 MUSD), while AIST's 2009 budget was M¥ 88,700.[4] In comparison, the University of Tokyo's total 2007 budget was nearly twice Riken's and external support for research in the University of Tokyo (excluding salaries of permanent staff and general research allowances of professors) was two-thirds of Riken's total budget including salaries. In other words, universities as a whole (particularly national universities) are the dominant actors in Japanese public R&D. Moreover, the largest national universities conduct more research than the largest multidisciplinary, fundamental-science-oriented GRIs.

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[3] Often GRI researchers are also eligible to apply for project funding from other ministries, including MEXT grants-in-aid.

[4] http://www.riken.jp/engn/r-world/riken/outline/index.html, http://www.riken.go.jp/r-world/riken/info/pdf/keikaku2008.pdf and http://www.aist.go.jp/aist_j/outline/h21_plan/h21_plan_8.html.

Consortia and Collaborative Centres

Other major venues for public science include *consortia* of various companies organized by the government (usually METI) to conduct R&D on a particular theme in a free-standing laboratory. A recent example is the Extreme Ultraviolet Association to develop techniques of ultraviolet lithography. However, the trend is probably towards consortium research simply being dispersed among the various partner laboratories rather than being centred in a new free-standing laboratory.

Another public science programme involving dedicated research facilities (sometimes rented from universities) is the Japan Science and Technology Agency's (JST's) Exploratory Research for Advanced Technology (ERATO) programme. ERATO projects are well funded and are formulated by JST (since 2001 part of MEXT) and its advisers to address important, cutting-edge scientific issues. Only about four new projects are initiated each year. Usually they involve researchers drawn from several university or GRI laboratories. Participation by overseas academics is not uncommon. Nor is participation by industry researchers, but unlike the 1980s, the vast majority of ERATO projects are now directed by academic scientists. Of all Japan's public science programmes, ERATO has probably received the most praise in Japan and abroad, in terms of both quantifiable metrics (Hayashi 2003) and recognized scientific achievements (JTEC 1996).

Changes in the Governance of Japanese Public Science

Analysis of the governance of the Japanese public science system focuses first on the legal status of national universities, which provides the basis for their limited autonomy. This leads naturally to an examination of recruitment of academic staff, resource allocation, evaluation procedures, and technology transfer.

Legal Status of National Universities: Incorporation

<p>In 2004 the national universities were incorporated, a step that provided the basis for them to develop as autonomous institutions. Nevertheless their autonomy remains limited by dependence upon the MEXT for salaries of full-time staff as well as most infrastructure costs. Salaries of full-time faculty and administrative staff are paid from an *operational and administration (O&A) subsidy* (in Japanese: *unei koufu kin*) from MEXT to each national university. These subsidies are determined by a formula, but the important variables, such as number of faculty and numbers of expected graduate students, are based upon precedent, with any changes negotiated between MEXT and

the individual university. MEXT also provides *operating expense subsidies* to most private universities which amount to about 15 per cent of their total budgets. This is less than the 45–60 per cent of national university budgets covered by O&A subsidies, which implies that private universities have to cover a greater proportion of their costs through tuition charges. Nevertheless MEXT operating expense subsidies are important for private universities. All these subsidies come from MEXT's *general university accounts* budget, which MEXT must negotiate with the Ministry of Finance (MOF). MOF has placed steady pressure on MEXT to reduce this budget item, and as a result these subsidies have been reduced by about 1 per cent annually since 2005, although reductions have varied among universities.[5]

The number of full-time equivalent (FTE) faculty and administrative positions that MEXT will fund in each major department of each university is generally still a matter of negotiation between the university and MEXT. Universities can borrow FTEs from various departments to form a new department.[6] However, this freedom is limited both by the existing departmental structures and the need to obtain MEXT's approval for major changes. This need for MEXT approval may be more a result of universities' strategies to obtain funding from MEXT for new FTEs, than of MEXT's wanting to have control over their allocation. A university desiring new FTEs usually submits to MEXT a plan to fund a new centre or subdepartment, and these requests specify the number and level of various associated faculty positions, and also the anticipated number of graduate students. Thus, it may seem inappropriate for a university to say a few years later that it does not need FTEs in particular departments and to start shifting FTE allocations on its own. A member of several high-level policy committees indicated that MEXT may nevertheless be willing to give universities substantial say over allocation of FTEs among disciplines. However, currently the main issue is how to absorb cuts in O&A subsidies rather than distribution of that funding (see below).

<pi>Universities have flexibility in how they manage funding from competitive MEXT programmes such as *Centres of Excellence (COE)* and *Special Coordination Funds*. The former provide mainly programmatic funding, some of which is used to

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[5] See http://www.mof.go.jp/singikai/zaiseseido/siryou/zaiseib190521/02_a.pdf, and also http://www.zendaikyo.or.jp/siryou/2009/04-09-koufukin-itiran.pdf for O&A subsidies for individual universities.

[6] e.g. a university can borrow FTEs from engineering and economics to form a subdept of technology management within the engineering or economics dept.

upgrade research facilities and to hire non-permanent researchers, especially post-docs and junior faculty on time-limited appointments. The latter cover a wide range of activities ranging from support for training and non-permanent researchers to co-funding of cutting-edge research with private companies.

Major universities have compiled 'action plans' setting forth visions of how they want to develop, and outlining major steps to reach these goals. For example the University of Tokyo's Action Plan seeks to

- create an educational system for interdisciplinary fields;
- secure university-wide common spaces (including research facilities);
- form links with local communities around its various campuses.

It also lists goals indicating that it is beginning to establish a framework for autonomous financial management, a prerequisite for it to act autonomously, strategically, or entrepreneurially. Such goals include:[7]

- easing institutional restrictions, in particular deregulation of funds management, asset utilization, long-term borrowing, issuance of bonds, investments, and tax provisions governing donations;
- establishing a budget system that can support autonomous and decentralized basic education and research;
- establishing rules for the effective use of the president's and department heads' discretionary funds.

As required under the terms of the incorporation law, national universities have also drawn up specific *mid-term plans* setting forth the goals they hoped to achieve in the first four years following incorporation (April 2004 to March 2008) and their progress with respect to those goals. These mid-term plans are a major focus of the evaluation exercises (see further below). GRIs have had to submit similar mid-term plans as part of their evaluation process.

The University of Tokyo's Mid-Term Plan submitted to MEXT in June 2008 is 179 pages long. It covers a wide range of educational, research, administrative, and infrastructure programmes in some detail. It indicates that most financial support will have to come from MEXT. However, it also celebrates the raising of M¥ 13,000 from 2005–8 for the university's endowment fund. This represents about 6 per cent of the University's total FY 2008 budget of M¥ 220,000. While this amount is small in

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[7] See http://www.u-tokyo.ac.jp/gen03/pdf/ActionPlan2005-2008.pdf.

comparison to many UK and Canadian universities, and much smaller in comparison to many US universities, it represents a credible start.[8]

Recruitment of Academic Staff: Increasing Openness and Mobility

Coleman (1999) and Kneller (2007*b*) describe the traditional *kouza* system (modelled on the traditional German professor *chair system*) that constituted the organizational basis for Japanese university teaching and research. The full professors were simultaneously the heads of laboratories and had considerable freedom to choose their research directions—within the limitations of available funding and often limited human resources. Each head was lord of his castle, even though it might be small (Bartholomew 1989; Coleman 1999; and personal observations beginning 1997). This independence extended to recruitment and promotions, with the professor choosing who would fill vacancies at the laboratory's assistant level, often from among his graduating students. These assistants would gradually advance to fill vacancies emerging at the associate and finally full professor levels, a process well described by Coleman. A typical *kouza* consisted of one professor, one associate professor, two assistants (often euphemistically called *assistant professors* in English), and sometimes one *koushi* (instructor) whose primary responsibility would be teaching.

However, open recruitment (i.e. wide and open solicitation of applications and selection on merit) may finally be gaining traction, though it is probably not yet the norm in major universities. Data from the Japan Science and Technology Agency (JST) website, where academic positions are most frequently advertised, shows a steady year on year increase. In 2008 about 1,500 vacancies in national universities were advertised at the associate professor level.[9] Since there were in this year about 17,600 associate professors in national universities nationwide,[10] and the average duration of an associate professorship can be assumed to be six years, about 3,000

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[8] See http://www.u-tokyo.ac.jp/gen01/pdf/keikaku1904.pdf, http://www.u-tokyo.ac.jp/gen02/pdf/chuki_keikaku21.pdf, and *University of Tokyo Data Book* (2008).

[9] http://jrecin.jst.go.jp/seek/SeekDescription?id=006 and http://jrecin.jst.go.jp/seek/html/h20/jobinfo2.pdf. In terms of changing one's institutional affiliation the transition from assistant to associate professorship usually involves the most significant change, one that is often mandatory (see below).

[10] MEXT (2008): *Basic School Survey*, table 29.

vacancies would arise each year, so applications to fill these vacancies appear to have been openly solicited in about half the cases. Even when applications are widely solicited by open advertisement, sometimes a lead candidate has already been designated by influential professors and advertisement of the position serves mainly to legitimize a pre-determined selection. Called ‘empty open recruitment’ (in Japanese, *kara koubo*), this probably applied to a significant proportion of advertised positions prior to 2000 (Coleman 1999). However, recent discussions with faculty who have taken part in open recruitments suggest that, more often than not, such solicitations are genuine, at least in the sense that the selection committees are willing to consider seriously strong candidates from the outside.

A review of the national universities’ open advertising on the mentioned site for associate professor positions in the eight months from November 2008 to June 2009 indicates that most vacancies are in lesser known national universities. Only about 10 per cent are in the big four, an additional 15 per cent in other former Imperial Universities and yet another 10 per cent in other major national universities, in particular, Tokyo Institute of Technology and Tsukuba, Hiroshima, Kobe, and Okayama Universities. This suggests the trend towards increased reliance on open recruitment is proceeding more slowly in elite universities.

In the University of Tokyo and probably other elite universities, recruitment for faculty vacancies typically begins with formation of a search committee of five or six professors, usually from the same department or centre. This committee will recommend a name to the entire department which then has the opportunity to discuss the nominee. Usually discussion is minimal, and it is extremely rare for an alternative candidate to be proposed ‘from the floor’. This system means that one or two influential professors on the search committee usually play the main role in filling the vacancy.

But even without open advertisement, capable candidates hear about vacancies in elite universities and make sure they are on the radar screens of professors likely to serve on recruitment committees. How they do so probably depends more upon their actively seeking out contacts or trying to build their own professional reputations than upon introductions by their professors, which probably was more common in the past (author’s inquiries and Coleman 1999). One important way to build a professional reputation is publication in English in respected international journals, although such publications are rarer (and thus their importance for promotion also less) in the humanities and social sciences (author’s inquiries). In any case, it has become easier for good science and engineering graduates of second-tier universities to compete for vacancies in the elite universities, as described below.

There is a Ph.D. glut in Japan and many graduates from elite universities are looking for teaching positions, even in second-tier universities (Ledford 2007; Shodo 2007). Open recruitment enables these universities to compete for such talent. Also, open recruitment seems to be well entrenched in the GRIs. Between 2004 and 2007 all 1,059 full-time research positions at Riken were filled by open advertisements widely soliciting applications, as were 94 per cent of 511 full-time research positions at AIST.[11]

Engineering and natural science professors have explained that, until even as late as 2000, the traditional model described by Coleman (1999) applied. However expectations have altered, and now researchers aspiring to academic careers should change institutions, either just after receiving their doctoral degree or when moving from an assistant to associate professorship. These professors also say that they are less obligated now than in the past to find jobs for their students. ‘It is now up to them to find jobs’ is a common refrain. These changes in attitudes were encouraged, perhaps even initiated by, the Government’s Second and Third Science and Technology (S&T) Basic Plans issued in 2001 and 2006, respectively, which made the independence and mobility of young researchers national goals.

A review of biographical information on over seventy researchers in over thirty laboratories in the big four national universities, plus Nagoya, Hiroshima, and Okayama Universities indicates these changes are indeed occurring, although it also shows that, even among older cohorts, some researchers did move between institutions early in their careers. The review considered laboratories that were mostly (about 80 per cent) working in various fields of mechanical engineering (including biomedical engineering, nano-materials, and robotics) with the remainder mostly in chemistry.[12]

Most full professors were born before 1970. Their career paths can be classified as matching one of three patterns.

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[11] http://www8.cao.go.jp/cstp/siryo/haihu77/siryo4-1-3-5.pdf.

[12] A less systematic analysis suggests that the findings described below apply also to biology and physics. However in medicine it is more common for promotions to occur within the same institution. Career patterns for the social sciences and humanities were not analysed. Note 13 and the accompanying text suggests that the same trends are likely to be found for economics, but not to law.

Pattern A
About a quarter spent their entire academic career from undergraduate studies to their current professorship in the same institution, with the possible exception of a few years in a non-permanent position in an overseas university.
Pattern B
About 30 per cent have earlier in their careers worked at another institution, usually a private company or government research institute, but are now professors in the same university where they did all their undergraduate and graduate studies. The sojourn usually occurred after a few years as a research assistant (since 2007: assistant professor). Pattern B is probably more common among engineering than natural science faculties, mainly because outside of engineering it is rare for academics to spend time in industry early in their careers.
Pattern C
About 45 per cent had more significant career shifts, involving in almost all cases education as well as some faculty experience in a different university. Consistent with what has already been said with respect to pattern B, the most frequent time for a career change came after serving several years as a research assistant. Although numbers are small, pattern C is less common in the case of University of Tokyo and Kyoto University faculty. It seems that, in the past, these most elite universities often trained persons who became faculty in other prestigious universities, but the opposite happened less frequently.

The effects of policies that encourage greater mobility would only be seen in the career paths of associate professors, typically born in the latter 1960s or early 1970s, or assistant professors (before 2006: research assistants), who mostly were born after 1970.

In the case of associate professors, about 60 per cent have followed pattern C. Most of these completed undergraduate to doctoral work plus several years as あ research assistant (assistant professor) in another university before assuming the associate professorship in a new university. Patterns A and B are about equally common, approximately 20 per cent each. These percentages appear to apply even to the University of Tokyo.

In the case of assistant professors pattern C is the most common, but at about 45 per cent, less so than in the case of associate professors. An almost equal number of assistant professors have followed pattern A, i.e. they have no experience in any other academic institution, except in a few cases in an overseas university.

The above indicates that the policy of encouraging young academic researchers to change institutions is resulting mainly in transfers between the assistant and associate professor stages in their careers. Also, it seems that opportunities are expanding for assistant professors from highly regarded universities such as Tohoku and Waseda to obtain permanent associate professorships in the most prestigious universities, i.e. Tokyo and Kyoto. Whether assistant professors who leave Tokyo and Kyoto for other universities will return to their Alma Maters at a higher rate than occurred in the past remains to be seen.[13] However, this would require the government to establish more FTE positions at the associate and full professor level at a time when it is trying to reduce such positions.

The above findings are supported by annual surveys ranking various departments according to percentage of so-called 'pure blood' faculty (i.e. percentage of full-time permanent instructors (*koushi*), associate professors, and full professors who graduated from the same university. These show declines in inbreeding between 2002 and 2007 in major universities. For example, in engineering, University of Tokyo topped the pure blood rankings in 2002 at 87 per cent, but by 2007 this had declined to 72 per cent. Kyoto (second in 2002) declined from 81 to 72 per cent. Declines also occurred in major private universities such as Keio. Among the disciplines analysed, law faculties tend to have the highest rates of internal recruitment and economics faculties the lowest.[14] In all disciplines, rates of internal recruitment and promotion vary greatly between universities. Tokyo and Kyoto Universities are always near the top, tending to confirm the above findings that, until quite recently, these two universities often trained faculty for other universities but rarely recruited from other universities (Ikeuchi 2004; Imatani 2008).

In the past, laboratories were basically inherited by the associate professor when the full professor retired. Under such circumstances opportunities for young researchers to strike out to explore their own interests were limited (Normile 2004). However, at least in the large universities, opportunities for young faculty to pursue

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[13] About half of current full professors in Tokyo and Kyoto followed pattern B, in that they left, usually to work several years in companies, and then returned.

[14] In law, the University of Tokyo topped the rankings in both years (97 to 91% from 2004 to 2007) while Kyoto University was second (80 to 76%). In economics Kyoto University topped the rankings in both years, but the decline was more pronounced (73 to 57%), while in the University of Tokyo the proportion of 'pure blood' faculty declined from 58 to 42%.

their own projects and sometimes to head their own laboratories have increased. The following are among the major underlying factors:

1. New laboratories that are headed by young associate professors are being established. This is often the result of negotiations between universities and MEXT to establish new FTEs, as discussed above. At the same time, more grants are being made available specifically for young researchers. Some of the larger of these, such as JST's PRESTO grants, have enabled young researchers to equip independent labs. In other words, these funds are often combined with salary support from MEXT to provide a complete package that allows associate professors in their late thirties or early forties to pursue independent research.
2. The influence of the traditional *kouza* system has diminished, so that now the filling of vacancies becomes the concern of the department, or more commonly a sub-department of three to six labs. This does not diminish the importance of patronage by established professors in recruitment and promotions, but it does mean that promotions are no longer seen primarily as continuing a particular professor's line of research, but rather as promoting the (sub)department and its particular scientific field.[15]
3. Since the reforms in 2000 that enabled researchers to be hired on time-limited appointments using competitive research funds, a large number of time-limited

[15] e.g. in the author's own centre in the University of Tokyo, when professors in artificial organs, informatics, economics, and history of science retired or moved, their particular field of research was not continued by a new hire or new promotion. Rather influential search committees were formed to identify respected researchers who were seen as likely to increase the centre's visibility, make significant contributions, etc. Within the centre there is consensus that a balance should be maintained between the centre's main fields of research: engineering, technology for disabled persons, and life, environmental, material, and information science. But as professors retire or move, fields of research do shift. Similarly, the author has heard detailed descriptions of recruitment procedures in the mathematics and synthetic biochemistry depts in Tokyo and Kyoto Universities. When vacancies arise, the dept members meet to consider potential candidates and also the types of expertise most desired in terms of current scientific frontiers and the possibility of synergy with other dept members. Little weight is given to continuing the specific line of research of the departing faculty member. Less systematic evidence suggests these considerations have become the norm in first-tier universities, at least in the natural sciences and engineering. While this system may promote quality research and synergies at the sub-department level (sometimes a group of only five faculty researchers), it does not help build wider cross-disciplinary synergies.

faculty positions have been created. In 2006, these amounted to 15 per cent of all national university faculty positions, and 26 per cent of assistant professors (Cabinet Office data). Often these non-permanent faculty are called *project* assistant (or associate, etc.) professors, indicating they are employed with funds for a large research project. As these projects tend to be awarded to elite universities (see below), these project faculty tend to be similarly concentrated. Most are young. Fewer than 20 per cent are near the end of their careers. Although they usually do not have their own laboratory, because it is understood that they will have to compete for positions three or five years hence, they often are given freedom to pursue their own research interests so long as they fit within the scope of the project.

As in the case of increasing mobility, probably the main impetus for these changes came from the Second and Third Science and Technology Basic Plans. In other words, they were centrally initiated.

In summary, although faculty patronage is still necessary for hiring and promotions in elite universities, open recruitment and mobility are increasing, along with opportunities for young researchers to pursue their own interests. However, rather than talent becoming more evenly distributed the trend seems to be the opposite. Centripetal forces are stronger.

Resource Allocation: Elite Universities vs. Others

Beginning in 2005, one year after incorporation of the national universities, the Ministry of Finance and MEXT started to cut O&A subsidies by about 1 per cent annually for all national universities. O&A subsidies account for 43 per cent of the total overall budget of national universities, 59 per cent if patient fees for university-affiliated hospitals are excluded. The subsidies to private universities are also being reduced.[16]

Aside from lowering the overall government budget deficit, part of the rationale for these reductions dates from the so called Toyama plan set forth in 2001 by the then Education Minister Ms Atsuko Toyama. This plan envisaged a shift to competitive funding for university research as part of an overall effort to make

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[16] For FY 2008 national university and private university budgets, respectively: http://www.mext.go.jp/b_menu/shingi/gijyutu/gijyutu4/010/siryo/08020812/003.pdf and http://www.shidairen.or.jp/blog/files/doc/h191227seifuyosan.pdf. For other years similar URLs can be found using same headings as in 2008 documents. See also n. 4 above.

universities more competitive and efficient. It also envisaged about thirty universities rising to world-class educational and research levels. The remainder would be classified as 'education oriented' universities and their research funding limited accordingly. The plan did not go into details about how universities would be allocated among these two tiers or how a university might boot-strap itself from the lower to higher tier (Cyranoski 2002).

The Toyama Plan gave rise to the 21st Century Centers of Excellence (COE) Programme which made funds available competitively, usually for a fairly broad department (or subdepartment) level research and educational programme or for a theme that crosses department lines. Probably from its inception, COE funding was considered to be a partial substitute for O&A subsidies—but a substitute that only a relatively small number of universities would receive, allowing some to expand advanced level education and research while others would have to scale back such programmes (Cyranoski 2002; Shinohara 2002).

A commonly mentioned (but perhaps never officially set forth) corollary of the Toyama plan was that O&A subsidies would be reduced across the board for all universities by 1 per cent annually for the first five years beginning in 2005. Subsequently, the education oriented (i.e. second-tier) universities would face steeper reductions of 2 per cent annually, while the approximately thirty top-tier research-oriented universities would continue to face only 1 per cent annual cuts. However, current policy documents are less precise. They mention growing projected shortfalls in funding for permanent staff and infrastructure as well as the need to take into consideration each university's unique situation and the results of the *mid-term evaluations*, discussed below.[17] Although speculation is rife that beginning in 2010, O&A subsidies will be cut even by 3 per cent annually, university officials suggest that it might be more likely that 1 per cent cuts will continue for the foreseeable future, especially considering that the present evaluation reports do not provide a clear basis to determine which universities should be subjected to more severe cuts (see below).

In the case of the University of Tokyo, O&A subsidy cuts from FY 2005 through FY 2009 averaged about M¥ 950 (slightly over 1 per cent) annually. However, this has been more than offset by increases in competitive or industry funding. In particular since 2005, University of Tokyo awards of government commissioned

[17] See http://www.zendaikyo.or.jp/katudou/kenkai/daigaku/08-7-30seimei.pdf and http://www.gyoukaku.go.jp/genryoukourituka/dai67/shiryou2.pdf.

research and corporate joint research have increased substantially, the former by about M¥ 2,800 annually and the latter by M¥ 400 annually.

The same phenomenon applies to the other former Imperial Universities and indeed to national universities as a whole. Overall O&A subsidies decreased by M¥ 37,200 from between FY 2004 and FY 2007. However, funding from all the other principal sources increased by more than double this amount. 65 per cent of this increase was accounted for by government-commissioned research (mainly from JST and NEDO), 15 per cent by industry-sponsored joint research, and most of the remainder by donations, primarily to the University of Tokyo.[18]

The appendix contains figures show trends for all the major funding and brief descriptions of the programmes. Figure A1 shows that MEXT O&A subsidies remain the most important source of funding by far for national universities, although both absolutely and as a proportion of total funding the share is decreasing. Figure A2 shows that most other major funding sources support project-specific research. The exceptions are COE funding which aims to enhance research infrastructure—but by covering personnel costs it indirectly supports specific projects—and donations which, in addition to often supporting specific research, sometimes support ancillary activities such as travel, holding of conferences, and even building construction. MEXT GIA have traditionally been the largest source other than O&A subsidies. But GIAs have plateaued, while COE, joint research, donation, and especially commissioned research continue to increase—to the point where the latter almost equals GIAs. Commissioned research is usually funded by government agencies such as JST and NEDO, an issue discussed below. Figures A3 and A4 show that these trends are magnified in the case of the University of Tokyo, where O&A subsidies are proportionately less than for national universities as a whole and commissioned research is the second largest source of funding.[19]

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[18] Indeed among the 19 national universities that receive the most overall funding (those listed in Figs. 4.1 and 4.3), only one seems to have suffered a clear decline in total funding since 2005. This is Hiroshima University, which generally is regarded as among the top ten national universities. Kanazawa University's total funding also declined slightly comparing 2004–5 and 2006–7 total funding. So the tipping point at which most universities experience overall losses is probably below the twentieth university ranked in terms of overall funding.

[19] In some other major national universities, specifically Osaka, Kyushu, Hokkaido, and Tokyo Institute of Technology, commissioned research funding in 2007 also surpassed MEXT GIAs (Cabinet Office data).

The non-O&A subsidy programmes, in particular government-commissioned research and the new Global COE, are highly skewed in favour of elite universities. The big four accounted for 47 per cent of commissioned research paid to national universities in 2007 and 2008, which is even higher than their 44 per cent share of GIA. Their share of the new Global COE programme over the same two years (51 per cent) is likewise higher. As for Special Coordination Funds and joint research with industry, the big four accounted for 41 and 39 per cent respectively in 2007. In contrast, they accounted for only 21 per cent of O&A subsidies in 2007–8.

In summary, the most equitable programme is being scaled back and although the loss is more than made up for by competitive programmes, these tend to be awarded to elite universities. Moreover, the fastest growing and probably soon-to-be largest category of competitive programmes, government-commissioned research, is not only one of the most skewed towards elite universities, but also one of the most dominated by the ministries and small elite groups of academic advisers in terms of selection of themes and award decisions (see below).

Thus, as cuts in O&A subsidies continue or even accelerate in second-tier universities, severe costs reductions will probably be necessary. Criticisms are heard.[20] However, to an outside observer these seem more muted than similar protests in Europe. In addition to standard cultural explanations, a possible explanation is widespread acknowledgement that consolidation among universities, especially the nearly 600 private universities, is necessary. Another is lack of a unified response from universities, with the elite universities feeling less threatened than second-tier national universities, and both these groups feeling they ought not to be subject to the same consolidation pressures as most private universities. A third explanation might be the different role the research assessment exercise is playing in these reductions (see below).

But even the elite universities are facing severe challenges, because so far all rely on O&A subsidies to pay salaries of permanent faculty and administrative and support staff. None has adopted a soft money system that would tap the increasing funding for project-specific research to pay such salaries. However, according to senior advisory committee members and university officials, MEXT would probably permit

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[20] See e.g. the analysis from Miyazaki National University, http://meg.cube.kyushu-u.ac.jp/~miyoshi/jsa_symposium/4-4.pdf, and the position paper by the All Japan Association of University Faculties: http://www.zendaikyo.or.jp/katudou/kenkai/daigaku/08-7-30seimei.pdf.

this. Indeed, the ultimate goal of the MEXT and the Ministry of Finance may be to force at least a partial adoption of such a system, for example, the pooling of some of the project-specific funds to pay the salaries of assistant professors who have permanent employee status. Holding back this step is not so much the government—although some officials in MEXT do oppose soft funding for any permanent faculty positions—but senior professors who would probably lose control over assistant professorship positions allocated to their labs by their universities. Another reason concerns pension regulations, it being harder to accrue pension benefits if one's salary is not guaranteed. However, many familiar with university policy debates believe that some movement in this direction will inevitably occur over the next few years.

Evaluation: A System Loosely Coupled to Funding

The 2004 university incorporation law mandated recurring evaluation of each university's performance. Similar provisions are included in the laws transforming many GRIs into 'special administrative entities' with a similar degree of autonomy as the national university corporations. Beginning in 2005, as part of the evaluation process, each faculty member must report annually the numbers of publications (noting separately those in international journals), collaborative research projects, awards, patents, etc. for that year. These data can be used for promotion decisions. They are also aggregated by department as part of the evaluation process.

Another key input into the evaluation process are the mid-term plans mentioned above. All national universities submitted these plans in late 2007. These were reviewed by the National Institute for Advanced Degrees and University Evaluation (NIAD-UE) and National University Evaluation Committee (NUEC), with the latter playing a supervisory role and the former doing much of the actual evaluation. A former member of the NIAD-UE described this as a complex, time-consuming process. Sometimes the evaluations included site visits but more often they involved teams from the universities making presentations to NIAD-UE and NUEC staff.[21]

The evaluation report on the University of Tokyo is nearly 300 pages long, with separate analyses for education and research in each major department. Reading through it, and the reports on a few other institutions, gives a sense of the report writers

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[21] These reports are now publicly available at http://www.mext.go.jp/a_menu/koutou/houjin/1260234.htm. Major GRIs also submitted similar mid-term plans around the same time, and their evaluation reports are also publicly available.

bending over backwards to offer understanding and constructive guidance. There is no ranking or overall score, either by departments or universities. According to a high-level advisory committee member, this reflects the philosophy of the recently retired head of the NIAD-UE, Takeshi Kimura, that the main goal of the evaluation process should be constructive guidance, not ranking of universities. Such an approach resembles that taken by some European states, such as the Netherlands (Meulen 2007).

Nevertheless, as noted in the previous subsection, some recent MEXT documents indicate that the mid-term evaluations probably will influence the allocation O&A subsidies.[22] However, even Japanese university officials and senior members of advisory committees feel it is not easy to use the mid-term evaluations to decide which universities ought to suffer more severe reductions in O&A subsidies. One official indicated that it was unlikely that the evaluations would play much role at all in any near-term decisions to reduce O&A subsidies. The nature of these evaluations may even be causing the government to rethink any plans for two-tiered reductions in O&A subsidies, and to opt instead for continuing uniform reductions.

Japan may be taking a unique approach of eschewing use of research evaluations to determine funding, but instead forcing all universities to rely more on competitive funding. However, for this strategy to be effective, universities will have to solve the salary dilemma and competitive funds will have to be allocated fairly, so that the researchers and projects that receive funding really are likely to be the ones that deserve it most. Whether this is the case is explored in the section on peer review below. Also the section on government influence notes that evaluation of individual large projects has become strict.

Technology Transfer: Joint Research with Large Companies

A series of reforms between 1998 and 2004 were intended to facilitate cooperation between universities and industry and to give universities incentives to commercialize their discoveries. However, growth in licensing of independently created university inventions has been feeble. The same is true for formation of startups with strong business prospects, except for some startups in software or life sciences. The dominant mechanism of university–industry cooperation and transfer of university discoveries has become collaborative (joint) research. In major national universities, about half of all university discoveries on which patent applications are filed are attributed to joint research with private companies. About three-quarters of all inventions that are

[22] http://www.gyoukaku.go.jp/genryoukourituka/dai67/shiryou2.pdf .

transferred to industry (either by joint patent applications or licenses) are attributed to joint research.

Except in the life sciences, joint research partners are overwhelmingly large established companies. However, joint research accounts for less than 7 per cent of these universities' research funding, *not including* salaries for permanent staff. This means that publicly funded commercially relevant discoveries are being leveraged by the companies that provide joint research funding. This has recreated the situation that existed before the 1998–2004 reforms, when the vast majority of university discoveries were passed by university inventors directly to companies that gave donations to their laboratories. This method of transfer is usually quick and transaction costs are fairly low. However, large companies exclusively control the intellectual property and their obligations to develop the discoveries are weak (Kneller 2008, 2007*a*, 2006)

Among industrialized countries, Japan has by far the highest proportion of issued patents covering university discoveries that are co-owned by private companies (approximately 60 per cent). Almost all of the co-owning companies are large domestic companies that, by virtue of co-ownership, have the exclusive right to develop and use the inventions.

Factors Underlying Skewed Resource Allocation

Peer review

In most natural science laboratories O&A subsidies (block grants) are insufficient to obtain the instruments and hire technicians and post-docs to conduct ground-breaking research. The same is true for social scientists who carry out large-scale surveys or who need expensive databases, and researchers in any discipline who need more than just occasional international travel funds. Nevertheless, it should be noted that graduate students have traditionally been self-funded. They must pay tuition (although in national universities this is relatively modest) and bear all their own living expenses. Thus for Japanese faculty, graduate students have generally been a free resource (observations and inquiries by author).

Standard MEXT GIA are the largest source of project-specific funding, providing the bread and butter of research support throughout Japanese universities. Even in prestigious universities, these are the main source of support for researchers in the humanities and social sciences, although in some elite universities, COE funding is supporting a significant amount of teaching and research in these fields (author's observations).

The peer-review committees that evaluate funding applications to these programmes are rarely dominated by faculty in prestigious universities. In the case of MEXT grants-in-aid, reviewers are recruited from members of academic societies and other university faculty who have published or previously received GIAs in the field. Each reviewer serves for two years, so turnover is frequent and many academics from across Japan serve as reviewers during their careers. Each application is usually assigned to six reviewers. An analysis of the academic positions of each of the reviewers on eight committees (two each from chemistry, biomedicine, engineering, and social science) in both 2002 and 2007 shows that, in 2002, on average 16 per cent were from the big four. In 2007 this had climbed to 25 per cent. In each of these periods, at least a quarter of reviewers were from universities that are not well known.[23] Yet in this most democratic of Japanese funding programmes, awards are still highly skewed, although they are so numerous that much funding does filter down to less prestigious universities.

Rather than dominance by epistemic elites, a more pertinent criticism is that the review process for GIA applications is rushed, with few procedures to ensure quality. Except in cases of extremely negative or positive evaluations, there is no need for reviewers to explain any of their scores. Sometimes reviewers are not familiar with proposed research fields. Often they must squeeze reviews of a large number of applications into already tight schedules. There is no exchange of opinions among reviewers that might afford some proposals a second, more careful, look.[24]

Similarly it would be difficult to argue that the COE peer review committees are dominated by elite academics, although perhaps there is a trend in this direction. In the 2002 review process, two of the five proposal review committees, interdisciplinary

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[23] http://www.jsps.go.jp/j-grantsinaid/14_kouho/meibo.html.

[24] Compare the summary of NSF and NIH peer review in Kneller (2007*b*). These and other shortcomings were noted by Coleman (1999). The author has observed that junior faculty tend to write the majority of GIA applications although they usually add the name of the laboratory head as one of the applicants, often as the principal investigator. In such cases, the laboratory head's publications are included in the application document, and as Coleman (1999) has noted, laboratory heads are usually named as co-authors on all publications from their laboratories. Thus the combination of capable young researchers and laboratory heads with impressive publication lists may give laboratories in elite universities an advantage in competing for GIA funds. Compared to second-tier universities, they attract more capable young researchers and their senior faculty tend to have more impressive publication lists.

studies and medicine/life science, lacked members from the big four, while for the humanities and social science review committee, eight of twenty-three members (35 per cent) came from this group. In 2007, big four representation on the interdisciplinary studies committee had climbed to 18 per cent and on the medicine/life science committee to 32 per cent, although it had fallen to 9 per cent on the humanities/social science committee.

Nevertheless, what seems most striking about the membership of these committees is their professional diversity, with members drawn from companies, GRIs, journalism as well as academia.[25] Herein may lie one of the shortcomings of the COE evaluation process. While the reviewers can scrutinize the programmatic aspects of proposals, they probably do not have sufficient expertise, time, or energy to probe deeply into what sorts of new research and training programmes will be conducted, or their implications for science and the national economy. Also the pattern of awards suggests that proposals from prestigious institutions that already have considerable programmatic experience and infrastructure tend to receive higher scores than proposals from innovative researchers in smaller institutions where improved programmatic capabilities would help innovative research to take off and have an impact.

Similar to the perspectives among natural science academic researchers in the UK discussed in Chapter 8, those in Japan seem to agree that forefront research in their field requires expensive infrastructure and large numbers of researchers. For many forefront natural science projects, most types of GIA are insufficient (exceptions being two categories that provide awards over 500,000 USD per year). Aside from these limited forms of GIA and COE programmatic funding, mechanisms for funding large projects generally are limited to MEXT Special Coordination Funds (SCF), commissioned research by government agencies such as JST and NEDO, and industry-sponsored commissioned or collaborative research.

As in the case of GIA and COE, it would be difficult to argue that the allocation of SCF is dominated by academic elites. The programme has only seven peer-review committees. Each has typically ten members, although the largest, training in advanced interdisciplinary fields, has approximately twenty reviewers representing a wide spectrum of universities and GRIs. Among the interdisciplinary fields panel 8 per cent were members of the big four in 2003, 16 per cent in 2007. Among the panel

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[25] http://www.jsps.go.jp/j-globalcoe/03_iinkai_meibo.html.

dealing with biomedicine and bioethics, 36 per cent were from the big four in 2003, 30 per cent in 2007.[26]

Government

On the other hand, themes for the major government-commissioned research programmes such as those of JST and NEDO (often called *national projects*) are determined in a top–down manner, and the chief scientists that lead proposal review teams tend to be well-known, elite scientists (Kneller 2007*b*). Moreover, government-commissioned research is the fastest growing category of competitive research funding with the aggregate total approaching that of GIA (see Figure A2). Thus, while most funding programmes are not dominated by academic elites either in terms of setting research goals or selecting among competing applicants, in one of the most important categories of programmes, they probably are. This raises the prospect of the government playing an increasingly influential role in determining university research themes and in shaping the scientific careers of young scientists.

In addition, compared at least to the USA, a larger proportion of government university research funding (including the mechanisms mentioned above, except for some of the main types of GIA awards) is awarded to groups of laboratories (Kneller 2007*a*: 61). Typically the senior professors leading these multi-laboratory projects distribute funding among junior researchers in a trickle-down fashion. It seems likely that this creates another barrier to encouraging young and mid-career researchers to formulate and pursue their own creative projects. Most of these large projects undergo mid-project and end of project reviews by panels of ministry officials and outside scientists (*ad hoc* peer-review panels) that are strict in the sense that projects are rated and suspension in mid-term is not uncommon. Assessment is partly on the basis of whether the projects met their stated goals, and identifiable near-term achievements often are important to obtain a high score.[27] This type of immediate results-oriented

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[26] http://www.mext.go.jp/b_menu/houdou/19/05/07051420/002/005.htm, http://www.mext.go.jp/a_menu/kagaku/chousei/1284635.htm, and similar pages.

[27] e.g. mid-term reviews over the past two years of about twenty-five large-scale university–industry interdisciplinary projects under the Special Coordination Funds Programme, resulted in cancellation or suspension of over a third of the projects. Those that received particularly high marks had early stage concrete achievements such as working prototypes of diagnostic instruments (discussions with ministry officials and US NSF personnel who have compared NSF and Japanese government project evaluation procedures).

evaluation may divert researchers from challenging, risky projects whose breakthroughs are not likely to be recognized for several years.

The main R&D ministries are staffed predominantly by graduates from elite universities: 57 and 85 per cent of career employees joining MEXT and METI, respectively, in 2005 were graduates of the University of Tokyo or Kyoto University. If graduates from Tohoku and Osaka Universities are included, the proportion for MEXT would increase to 64 per cent (that for METI would remain unchanged).[28] For a variety of reasons, the ministries may believe that concentration of resources is beneficial, or a traditional practice that need not be altered (especially if the practice favours their Alma Maters).

But some of bureaucracy's support for resource concentration may be based on misperceptions. For example, conversations with Cabinet Office staff members suggest that NIH's comprehensive Cancer Centers Program was probably construed by the Cabinet Office as a programme to establish a small number of elite cancer research and clinical care centres and thus a model for Japanese centres of excellence programmes. In fact these centres are fairly widely distributed and there is probably no underlying assumption within NIH that concentrating funding in a limited number of national centres of excellence will bring economies of scale in research discoveries or patient care.

Finally, unlike in North America, Germany, or Switzerland, there is scant scope in Japan for competition between regions to build outstanding universities. They do not offer an alternative source of funding for university R&D. The appropriateness of Tokyo and Kyoto Universities remaining at the apex of higher education has never been seriously questioned. Universities were not supposed to compete for funding until the Toyama plan. Now as the proportion of competitive funding increases, there is scope for competition. But pay scales remain regulated and central ministries determine the allocation of the bulk of funding, i.e. of O&A subsidies plus commissioned research. University of Tokyo presidents and department heads may rotate every two or three years, but their positions guarantee them close ties with the ministries and this probably ensures a sympathetic hearing to proposals that ensure the University continues to receive the lion's share of funding. Those who hold key positions in the other big four universities probably have similar ties with the ministries. (See for example Shodo 2007, confirmed by personal observations.)

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[28] Data from various ministries between 2002 and 2005 compiled annually at http://www.geocities.jp/plus10101/the-todai.html.

Academic Advisory Committees

The influence of elite academics can also be felt through advisory committees on S&T policy. The highest level committee for coordinating S&T policy is the Council for Science and Technology Policy (CSTP) whose members consists of seven cabinet members with S&T responsibilities and eight 'experts' from academia and industry. Among the eight experts, two are directors of major corporations and six are academics. Half of the experts either received most of their education in the big four universities or spent most of their research and teaching careers there. However three of the academics, including the chair among the experts, had little or no affiliation with former Imperial Universities and at least two of these three followed untraditional and difficult career paths.[29]

The thirty-member Council for Science and Technology (CST) is MEXT's main advisory council for S&T affairs.[30] Just over half its members either were educated primarily in big four universities or spent most of their professional careers in these universities. This proportion was somewhat smaller in most of the CST's eleven subcommittees.

The Centre for Research Development Strategy (CRDS) is an advisory body within JST whose mission is to identify priority research topics for government support.[31] Thus it influences the direction of government-commissioned research. Its eleven members include four well-known academics, three government officials, a former vice president of AIST, and two representatives from industry. All but two or three of the eleven either graduated from or spent much of their professional careers in the big four universities.

Finally the Science Council of Japan (SCJ) advises the Prime Minister and the country at large on a broad range of science related issues. Somewhat akin to the US National Academy of Science, its 210 council members consist mainly of heads of various universities, GRIs, and major departments, as well as professors (many from the humanities and social sciences) from a cross-section of universities.

As shown by Tanaka and Hirasawa (1996) the advisory councils can have an important influence on S&T policies. However, they also found that council

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[29] http://www8.cao.go.jp/cstp/yushikisyahoka.html.

[30] http://www.mext.go.jp/english/org/struct/049.ht.

[31] http://crds.jst.go.jp/en/activity/Our_approach.html.

recommendations have been mediated by the ministries, and that the ministries often shape the agenda for the advisory councils. Moreover, because members are appointed by the ministries, they 'tend to respect the ministries' intentions'. Thus in Japan's case, the influence of bureaucrats (often mid-level section heads) may be considerable, in some cases greater than that of the elite academics on the advisory committees.

In summary, graduates or faculty of the most elite universities are highly represented in senior advisory committees. However, the influence they have relative to bureaucrats may not be great. Thus it is unlikely that academic elites are the main force in perpetuating the concentration of research resources in a few universities. Rather a symbiotic relationship between ministry personnel (middle as well as high-level bureaucrats) and respected scientists and administrator in the elite universities ensures these universities have privileged access to resources. The ministries rely on these universities for the nation's most important basic scientific output, while the universities rely on the ministries for funding. Countervailing, centrifugal forces that might nurture competing institutions are weak. Indeed, the following factors probably reinforce the trend towards concentration: the perception among young researchers that facilities are best in the elite universities, increasing opportunities for capable researchers from the outside to compete for junior faculty positions in the elite universities, and a seemingly widely held perception in academia and the bureaucracies that concentration of resources is necessary to produce world-class science.

Conclusions

Salient Features of the Governance of the Japanese PSS

A review of the other chapters in this volume suggests some areas in which Japan's system of public science governance is unique. Foremost among these is the high degree of concentration of resources in a small number of universities. Another is close cooperation between universities and companies, particularly the large proportion of patented university discoveries that are exclusively controlled by large collaborative research partners. This relationship and its implications for science and Japan's economy have been discussed elsewhere (Kneller 2007*a*). Finally, Japan's soft approach to research evaluation, coupled with a steady march towards an American-style system of soft-money funding even for permanent staff salaries, seems unique. More speculatively, there is the possibility of a tilt towards applied research in the major government-funded commissioned research programmes. However, the extent to which these programmes really are application oriented (or designed to promote national industrial competitiveness) and whether Japan's funding priorities in this regard are any different from those of most other countries are beyond the scope of this chapter.

Implications

Although a complete analysis of the implications of resource concentration is not possible here, insights can be gained from citation data (Negishi 2009; Thomson Reuters 2009). These data attribute citations among Japanese universities in proportion to co-authorship. In other words, a publication co-authored by two University of Tokyo, one Nagoya, and two Cambridge researchers would be attributed 40 per cent to Tokyo, 20 per cent to Nagoya, and 40 per cent to Cambridge and any citations would be allocated proportionately (Negishi 2009).

The following analysis matches numbers of apportioned 2006 and 2007 citations to 2003–7 publications to various measures of inputs into novel scientific research. Efforts were made to measure inputs at times when they would be likely to have had the greatest impact on publications cited in 2006 and 2007. However, limitations on some of the input data constrained the possibilities for matching the time periods of inputs with the 2006–7 citations. The nineteen universities selected for this analysis are the top-ranked Japanese universities for the inputs under consideration. GRIs were excluded because their funding and personnel structures are different from those of universities. However, in terms of crude numbers of citations between 1998 and 2008, Riken, AIST, and the MEXT's National Institute of Natural Science, would rank 7th, 10th, and 14th respectively.[32]

Numbers of full-time faculty (assistants to full professors, including persons on time-limited contracts) plus numbers of graduating doctoral students was used as a metric for personnel inputs into creative science, since this would include university

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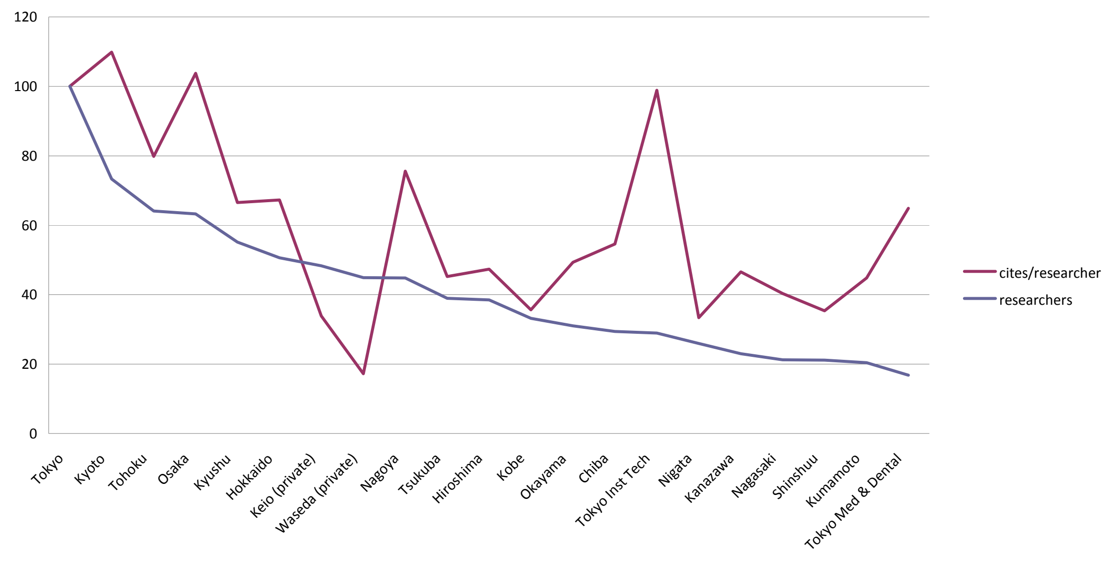
[32] http://science.thomsonreuters.com/press/2009/top_japan_research_institutions/. The ratio of science/engineering/agriculture/health to arts/humanities/law/social faculty and students is roughly 3:1 in most of these universities. Therefore, different mixes of disciplines (with some disciplines more likely to produce more highly cited papers than others) is probably not a factor in explaining the trends in Figs. 4.1–4.3, except in the case of Tokyo Institute of Technology (TIT) and Tokyo Medical and Dental University, where almost all students and faculty are in science/engineering and health sciences, respectively. Also all universities have medical schools except TIT and Waseda, so a significant proportion (roughly one-third) of research in all universities except these two is biomedical related.

researchers who would be involved in formulating research, analysing results, and writing the resulting papers. Figure 4.1 lists the nineteen universities in order of decreasing number of full-time faculty and shows a declining trend in citations per scientist as university size decreases. Especially after removing Tokyo Institute of Technology (TIT) and Tokyo Medical and Dental University (TMDU) which have distinctive personnel structures, the trend is so clear that, even if all doctoral students were included in this metric, the trend would still be apparent.[33] In other words, on their face, these data do not suggest that concentration of resources is harming scientific output. Moreover, the top private universities seem to have a weaker output compared to similar-size national universities.

Fig. 1: 2006-07 cites to 2003-07 pubs (apportioned by univ) / full time 2005-06 reseacher (faculty + doctoral graduates/year) (Univ Tokyo = 100)



These findings are probably explained in part by the fact that faculty in the smaller universities concentrate more on teaching and less on research, and by higher percentages of young researchers on the faculties of large, compared to small, universities. In 2007, 28 per cent of faculty in the big four were younger than 37 years compared to only 19 per cent of faculty in Kanazawa, Nagasaki, Shinshuu, and

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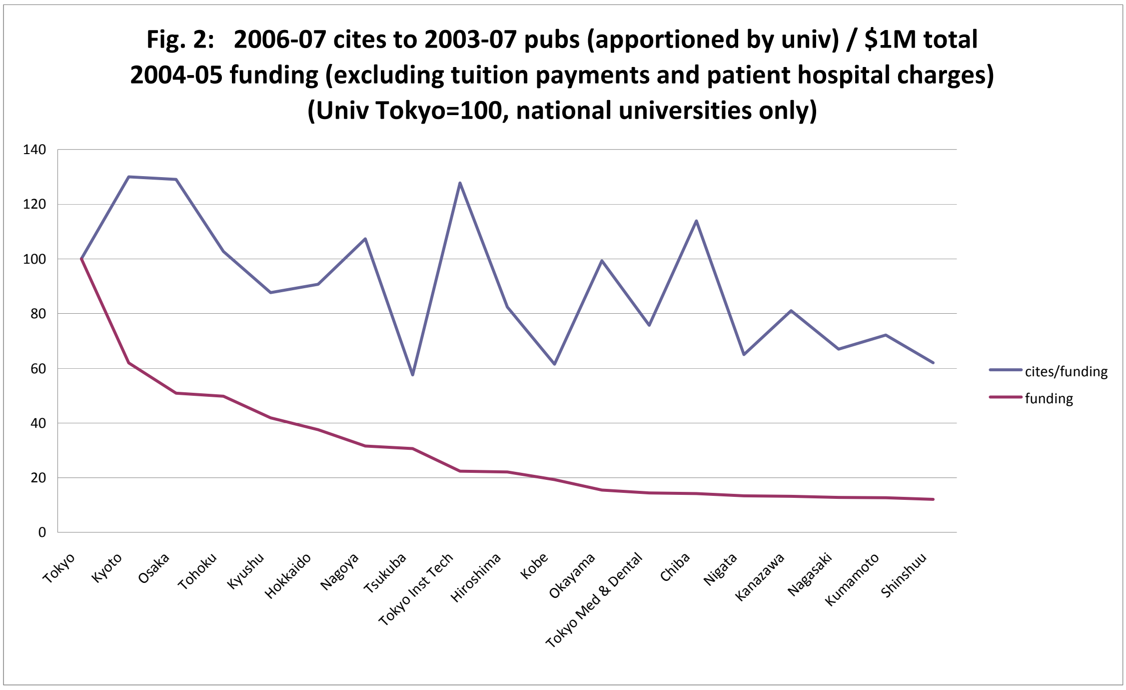
[33] A doctoral programme in science or engineering usually takes three years, with the first year devoted largely to course work and the last two years to research.

Kumamoto Universities (Cabinet Office data). Direct observations confirm that, even in the best private universities, faculty tend to have higher teaching loads than in national universities of roughly equal or larger size.

When using total funding as a metric for total inputs into creative science and ordering the universities accordingly, citations to publications per unit of funding shows a modest declining trend as funding decreases (Figure 4.2).[34] However, the declining trend in citations per unit of funding is not as sharp as the decline in citations per scientist (Figure 4.1). Also, compared to the University of Tokyo, productivity in terms of highly cited research is higher in Kyoto, Osaka, and even Chiba Universities (not to mention TIT which might have an advantage because almost all its research is in science and engineering). Productivity in Nagoya and Okayama Universities appears approximately equal to that of University of Tokyo.



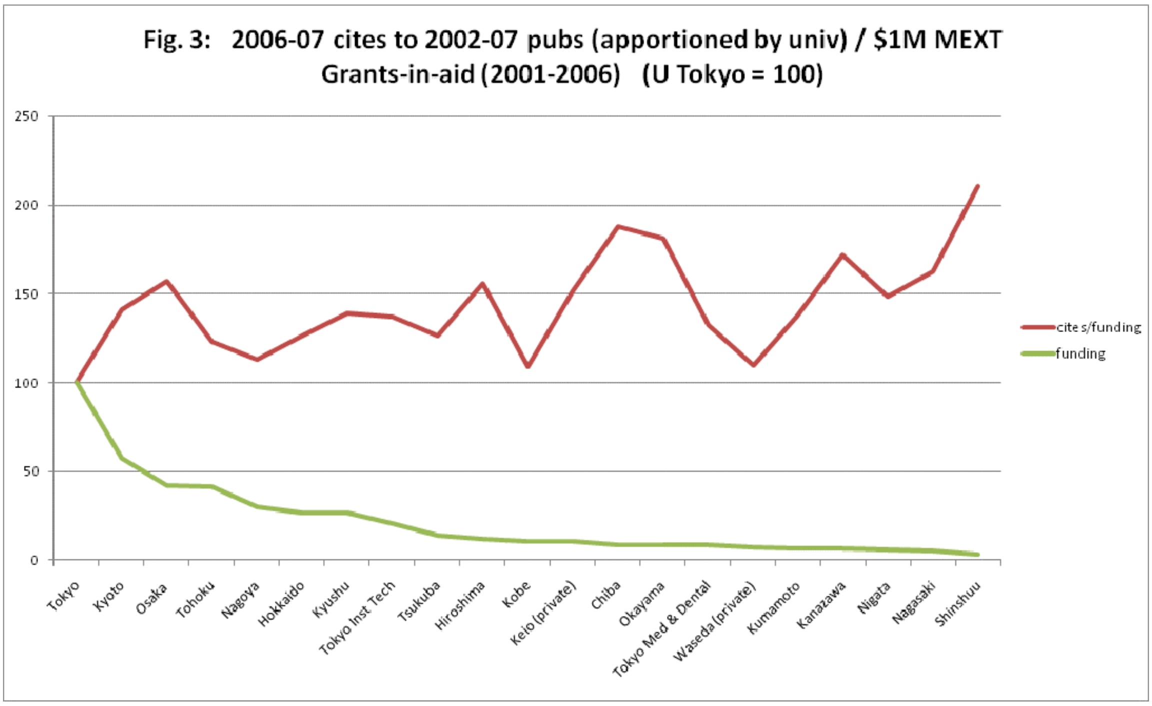
[34] Strictly speaking Fig. 4.2 does not include all funding, because it excludes student tuition payments, and patient hospital charges. However, tuition accounts for less than 10% of the University of Tokyo's total income, net hospital patient charges and tuition rates are basically the same in all national universities.

Recall from Figure A1 in the Appendix that total funding consists about 75 per cent of O&A subsidies that cover mainly personnel costs and about 25 per cent of competitive funding which covers project-specific (mainly non-personnel) costs. Indeed the curve showing citations per unit of O&A subsidies (not shown) is similar to the curve for citations per scientist (Figure 4.1). Thus the difference between the trends in Figures 4.1 and 4.2 probably is mainly accounted for by the impact of project-specific funding that does not include salaries for permanent staff. This effect seems to moderate the phenomenon shown in Figure 4.1 which shows sharply declining productivity per researcher as university size decreases.

Figure 4.3 is consistent with the moderating effect of competitive, project-specific funding proposed above. It shows that citations per unit of GIA have a clear inverse association with total GIA received by each university. Curves showing citations per unit of commissioned research or COE funding show the same trend, but it is even more pronounced.

Of course, casual inferences can only be drawn with extreme care. Taken together, Figures 4.1–4.3 simply show that, along the continuum from large to small universities, competitive funding declines more quickly than citations which decline more quickly than total funding, which declines more quickly numbers of scientists. At most, Figure 4.3 tentatively suggests that capable researchers in the smaller universities are relatively starved of non-salary research funding and that redirecting some of these funds to smaller universities will result in a net gain of citations for Japanese university research.

In any case, if the peer reviewers evaluate GIA applications properly, they ought to be aware of highly cited articles in their field from the universities submitting applications and, if these articles come from the same laboratories as the applicants, this ought to have a positive bearing on their evaluations. However, the large disparity between GIA awards and citations shown in Figure 4.3 (about 70 per cent more citations per unit of funding attributable to small universities compared to the University of Tokyo) suggests that peer-review panellists sometimes are not aware of such publications.



In addition, these trends probably suggest the relative strength of the big universities lies more in attracting skilled scientists than in economies of scale associated with their possessing lots of equipment, data access, travel opportunities, etc. The latter are usually purchased with competitive funds. If equipment, data access and travel, but not brains, are what gives elite universities greater scientific productivity, we would probably not see the moderating effect of competitive funding (Figure 4.2 compared with Figure 4.1) nor the trend in favour of non-elite universities shown in Figure 4.3.

Of course this may vary according to discipline. It may be that trends in Figures 4.1–4.3 would be found for separate analyses of citations to biology, chemistry, and some engineering publications, but not for citations to high energy physics research, where access to very expensive equipment may be essential for ground-breaking research. In fields such as experimental physics, the advantage of elite universities with respect to citation productivity may be just as strong with respect to competitive funding as it is with respect to scientific personnel. However, data for such field-specific analyses are not available.

In addition, it is not clear if the advantage of elite universities with respect to having, on average, more capable scientists is additive or multiplicative, i.e. whether bringing many bright researchers together increases creative output beyond what they could achieve as individuals. Collaboration between laboratories is not common in

Japanese universities (Cyranoski 2002; Kneller 2007*a*; and recent interviews with companies collaborating with universities). If the effects are mainly additive, then providing bright energetic researchers with incentives to work in universities other than the big four probably would not hurt Japan's total output of high-quality science. Figures 4.2 and 4.3 even suggest (albeit tentatively) that, if this is accompanied by access to competitive funding, overall scientific productivity might increase.

Conversely, as O&A subsidies diminish, if competitive funding is concentrated in a few elite universities, bright scientists will be reluctant to work anywhere else and the process of concentration will continue. Also the increasing mobility and meritocracy of the recruitment process may accelerate the concentration of the best scientists in a small number of universities. The largest and most favoured universities probably will then have little need to be entrepreneurial or more independent from government influence.

Appendix

Figure A1 shows trends from 2004–7 (the years for which data for all categories are available) for all sources of funding for all national universities. Figure A2 shows trends for the main categories of project-specific research funding in national universities over a longer time period. Figures A3 and A4 show the same trends for the University of Tokyo alone. Figures A3 and A4 illustrate the more pronounced and growing impact of large, government-funded commissioned research projects in the most prestigious national universities.

Fig. A1: National university funding, all principal sources including O&A subsidies (but excluding tuition and hospital patient charges)

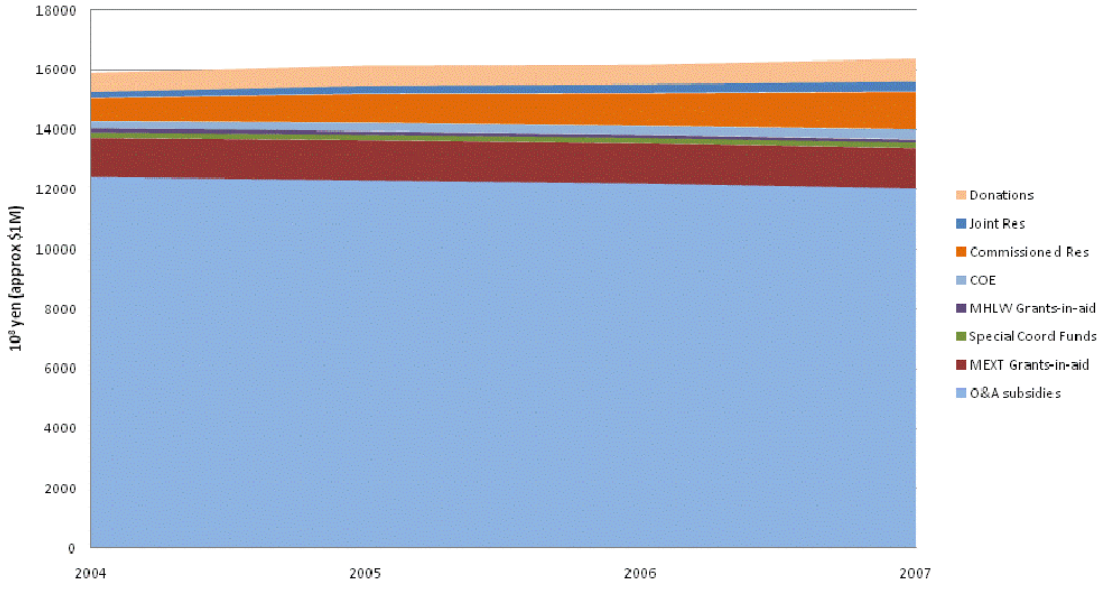
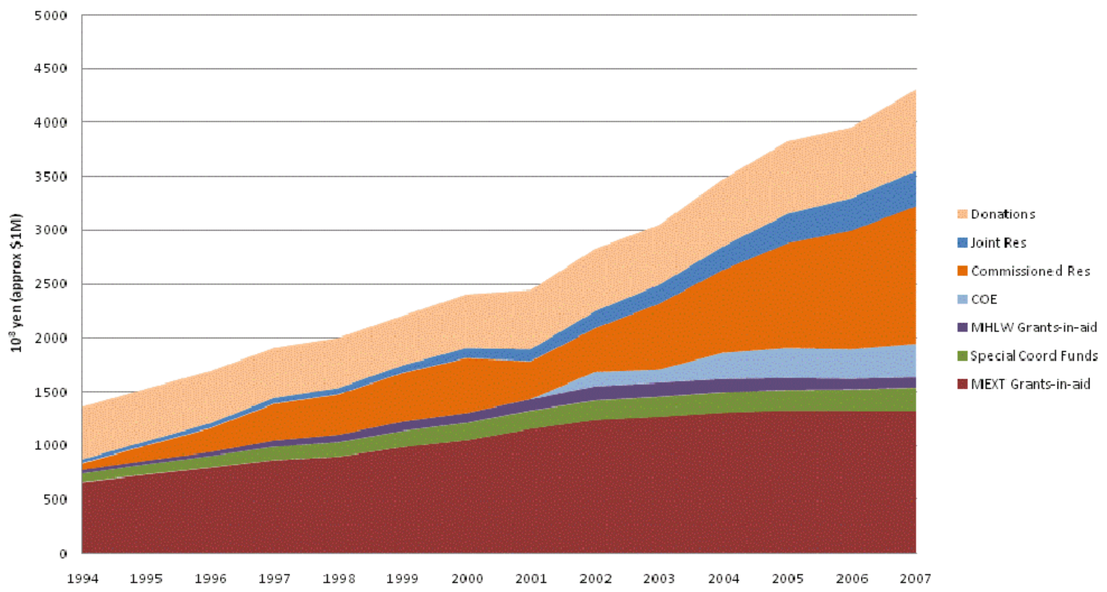


Fig. A2: National university funding, all principal sources excluding O&A subsidies, tuition and hospital patient charges



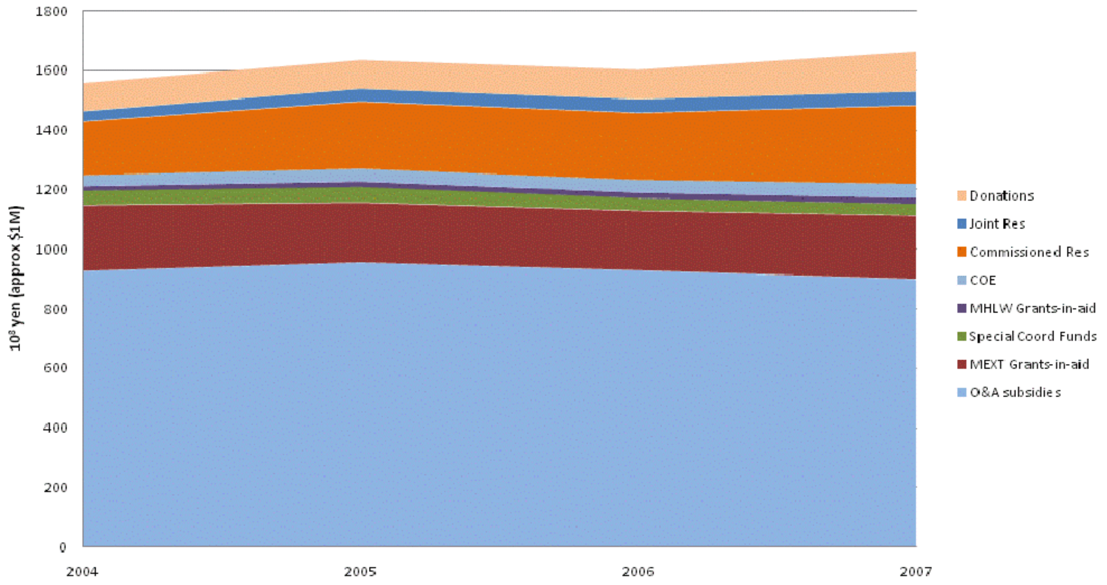


Fig. A3: University of Tokyo funding, all principal sources including O&A subsidies (but excluding tuition and hospital patient charges)

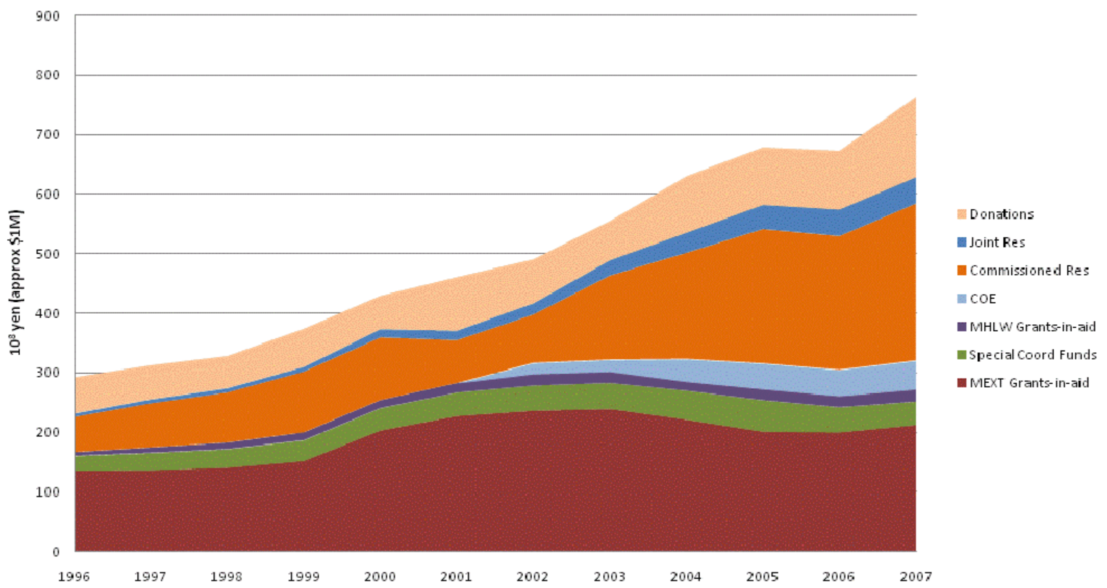


Fig. A4: University of Tokyo funding, all principal sources excluding O&A subsidies, tuition and hospital patient charges

The main data sources for these charts are Cabinet Office, MEXT, and the *University of Tokyo Data Book* for various years.

As noted in the text, the increase in university R&D funding is due mainly to an increase in commissioned research. These usually are large projects funded by government agencies, such as METI’s New Energy Development Organization (NEDO) or the Japan Science and Technology Agency (JST) under MEXT. A small percentage of commissioned research (barely 4 per cent in national universities in 2005) is commissioned by private companies (Kneller 2003; JST 2007, 2009) As noted in Kneller 2007*b*, these are top–down programmes where research topics and awardees are determined by agency officials in consultation with a small number of well-known academics. JST and NEDO are the largest sources of university-commissioned research (JST: 503 x 10^8 yen, NEDO: approximately 170 x 10^8 yen in 2008) (NSF Tokyo Office, Rept. Memo. #09-01) although substantial research is also commissioned by the Ministry of Health, Labour, and Welfare and the Ministry of Internal Affairs and Communications (Kneller 2007*b*; Tanaka 2006).

GIA contain subcategories that run the gamut from small grants for young researchers of about 10,000 USD to Specially Promoted Research Projects of that receive about 1 million USD annually. However, the largest portion of funding consists of grants to individual investigators of about 20,000 to 50,000 USD per year. For researchers in second- and third-tier universities, this is the main source of research support.

Joint research funding is primarily from private companies.[35] It has been increasing steadily since reforms in 2000 greatly reduced administrative hurdles associated with joint research. Somewhat surprisingly, donations from private companies have continued to grow slowly, even though in terms of the IP rights companies obtain and their ability to specify the research that is to be done, joint research contracts offer significant advantages over donations. By far the largest donations in 2007 were to the University of Tokyo to meet its goal of establishing an endowment of 130 x 10^8 yen before its 130th anniversary in 2008.

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[35] From 2005 through 2007, national or local government agencies, or government corporations such as JST and NEDO, accounted for 20% of the total 1092 × 10^8 yen joint research funding to Japanese universities (JST 2009). The small proportion of public-sector funding for joint research and the small proportion of private-sector funding for commissioned tend to balance each other out. For a ‘big picture’ understanding of proportionate sources of funding, it is appropriate to consider that joint research funding is from the private sector, while commissioned research is from government affiliated entities.

References

Bartholomew, James (1989) *Formation of Science in Japan: Building a Research Tradition* (New Haven: Yale University Press).

Cabinet Office (various years) *Understanding the Scientific and Technical Activities of GRIs and National University Corporations* (Dokuritsu gyousei houjin, kokuritsu daigaku houjin nado no kagku gijutsu katsudou no haaku, shoken torimatome): at http://www8.cao.go.jp/cstp/budget/trimatome.html.

Coleman, Samuel (1999) *Japanese Science: From the Inside* (London: Routledge).
Cyranoski, David (2002) 'Independence Days', *Nature*, 419 (Oct.): 875–6.

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: 1421–42.

Ikeuchi, Satoru (2004) 'Universities Ought to Let in Outside Wind, Faculty Also Need to be Exposed to Outside Currents (Daigaku wa gaibu kara kaze wo ireru beki, kyouin mo soto no kaze in ataru hitsuyou ga aru)', in *University Rankings (Daigaku Rankingu) 2004* (Tokyo: Asahi Newspaper Publishers), 114–17.

Imatani, Akiru (2008) 'Too Many Barriers to Movement (Idousuru ni wa houheki ga oosugiru)', in *University Rankings (Daigaku Rankingu) 2009* (Tokyo: Asahi Newspaper Publishers), 148–55.

JST (2007) *Industry–University Databook 2007* [in Japanese] (Tokyo: JST).
JST (2009) *Industry–University Databook 2008–2009* [in Japanese] (Tokyo: JST).
JTEC (Japan Technology Evaluation Center) (1996) *Japan's ERATO and PRESTO Basic Research Programs*: http://www.wtec.org/loyola/erato/toc.htm (accessed May 2007).

Kneller, R. 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(2): 329–449.

—— (2006) 'Japan's New Technology Transfer System and the Preemption of University Discoveries by Sponsored Research and Co-inventorship', *Journal of the Association of University Technology Managers*, 18(1): 15–35. Repr. in *Industry and Higher Education*, 21(3).

—— (2007*a*) *Bridging Islands: Venture Companies and the Future of Japanese and American Industry* (Oxford: Oxford University Press).

—— (2007*b*) 'Prospective and Retrospective Evaluation Systems in Context: Insights from Japan', in Richard Whitley and Jochen Gläser (eds.), *Changing Governance of the Sciences: the Advent of Research Evaluation Systems* (Sociology of the Sciences Yearbook; Dordrecht: Springer), 51–74.

—— (2008) 'Invention Management in a Major Japanese University and its Implications for Innovation', in *AUTM Technology Transfer Practice Manual*, 3rd edn. (Deerfield, Ill.: AUTM), iii/2.

Ledford, Heidi (2007) 'Scientists to Spare', *Nature*, 449: 1084–5.

Meulen, Barend van der (2007) 'Interfering Governance and Emerging Centres of Control: University Research and Evaluation in the Netherlands', in Richard Whitley and Jochen Gläser (eds.), *Changing Governance of the Sciences: The Advent of Research Evaluation Systems* (Sociology of the Sciences Yearbook; Dordrecht: Springer), 191–202.

MEXT (2008) *Basic School Survey* (Gakkou kihon chousa hokoku sho) (Tokyo: Kokuritsu insatsu kyoku): available at http://www.mext.go.jp/b_menu/toukei/001/08121201/002.pdf.

MEXT (various years) 'Industry–University–Government Cooperation Achievements (San-gaku-kan renkei no jisseki)': data at http://www.mext.go.jp/a_menu/shinkou/sangaku/sangakub.htm.

National Science Board (NSB) (2008) *Science and Engineering Indicators 2008* (Arlington, Va.: US National Science Foundation).

Normile, Dennis (2004) 'Older Scientists Win Majority of Funding', *Science,* 303 (19 Mar.): 1746.

Negishi, Masamitsu (2009) 'Trend Analysis on the Disparities among Japanese Universities Observed with the Number of Publications and Citation Counts (Ronbun su, inyou su kara mita wagakuni no daigaku aida kakusa no doukou bunseki)', *Journal of the Japan Society of Information and Knowledge* (Jouhou chishiki gakukai shi), 19: 158–69.

Preparation for the Civil Service Examination (Koumuin shaken juuken ja-naru) (2004–5): data summary at http://www15.atwiki.jp/gakureking-mirror/pages/16.html.

Shinohara, Kazuko (2002) *Toyama Plan: Center of Excellence Program for the 21st Century* (Tokyo Regional Office Report Memorandum #02-05 (21 June); Tokyo: National Science Foundation): http://www.nsftokyo.org/rm02-05.html.

Shodo, Mizuki (2007) *Ko Gakureki Wakingu Puua* (Highly Educated Working Poor) (Tokyo: Kobunsha Shinsho).

Tanaka, Hisanori (2006) 'The Competitive Research Funding System: Expanding the Review System and Measures to Prevent Wrongdoing (Kyousou teki kenkyuu shikin seidou: fusei boushi taisaku to shinsa seido no kakujuu wo chuushin ni)', Issue Brief No. 55 prepared for the National Diet Library (6 Dec. 2006) at http://www.ndl.go.jp/jp/data/publication/issue/0555.pdf.

Tanaka, Yoichi, and Hiraswawa, Ryo (1996) 'Features of Policy-Making Processes in Japan's Council of Science and Technology', *Research Policy,* 25: 999–1011.

Thomson Reuters (2009) Statistical Analysis by M. Negishi on 'National Citation Report (NCR) for Japan'.

University of Tokyo Data Book (various years) (Tokyo: University of Tokyo Press; issued annually in English and Japanese).