Review

Japanese Science Policies and Their Impacts on Scientific Research

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Japanese Science Policies and Their Impacts on Scientific Research

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Abstract: Innovation in science and technology arises from balanced supports for basic research, applied research, and societal implementation. However, changes in Japanese science policy that shifts toward top-down, evaluation-based, and competitive funding practices appear to have undermined Japan's long-term research sustainability and innovation potential. The "selection and concentration" strategy (prioritization of specific research areas) and "competition principle," combined with persistent reduction in Management Expenses Grants, have significantly altered Japan's research environment for the worse. Together with these policy changes, the introduction of fixed-term contracts in academia has increased instability at both the institutional and individual levels and has diminished the time and resources available for long-term basic research. Academic careers in science have become less attractive, as evidenced by declining doctoral student enrollment. These changes threaten the potential for scientific discoveries that lead to innovation. Although initiatives such as the introduction of University Research Administrators (URAs) have been implemented to support researchers, such efforts remain insufficient to counterbalance the systemic challenges faced by Japan's research ecosystem. To reestablish a stable research environment, rethinking the strategy may be necessary, including restoration of stable institutional funding, sustainable career pathways, and balanced funding allocation to basic science that foster seeds for future innovation.

Keywords: science policy; Japan; research management; research administration; University Research Administrator (URA); graduate school; postdoctoral researchers; tenure-track positions; Ministry of Education; culture; sports; science and technology (MEXT); University

1. Introduction

Scientific research plays a crucial role in driving technological advancements and fostering economic growth. In Japan, where natural resources are limited, science and technology have been fundamental pillars of national strength. Over the past few decades, the Japanese government has implemented various policies to enhance research and innovation, with the aim of maintaining the country's global competitiveness (Ministry of Internal Affairs and Communications 2016). However, contrary to their original intentions, these policies have significantly impacted the structure, sustainability, and overall productivity of scientific research in Japan.

This review examines how science policy changes have affected Japan's research ecosystem over recent decades. To address these challenges, it also explores potential remedies, including the role of University Research Administrators (URAs), a recently introduced profession in academia (Takahashi and Ito 2023). The review highlights the need for more balanced research funding allocations, sustainable career development, and reinvestment in fundamental science to revitalize Japan's scientific foundation.

2. Analytical Framework

The impact of Japanese science and technology policy reforms is assessed through an analytical framework structured around three key dimensions: financial resources ("money"), temporal resources ("time"), and human capital ("people"). These well-established categories are widely

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acknowledged in the science policy literature as central to sustaining long-term, curiosity-driven research (Igami 2017). "Money" refers to changes in national-level research funding structures, including the shift toward competitive grants and targeted allocations, and their effects on basic science (Aagaard, Kladakis, and Nielsen 2019). "Time" refers to the reduction in time researchers can devote to scientific work due to increasing administrative and institutional demands(Monde 2024). "People" addresses the rise of fixed-term employment and increasing employment precarity, which have contributed to psychological strain among researchers, as well as the declining number of graduate students (Hornyak 2022).

By organizing the analysis along these three dimensions, this paper provides a systematic framework through which to evaluate the cumulative effects of policy reforms on Japan's research ecosystem. This approach allows the discussion to move beyond individual policy components and toward an integrated understanding of how financial resources, time, and people—three core pillars of scientific work—have been reshaped by policy-driven institutional reforms.

3. Japan: Science and Technology-Driven Country

Japan, which is scarce in natural resources, should base its national strength on scientific research and technological development (Omi 1996). This belief is embodied by the Science and Technology Basic Law, enacted in 1995, which requires formulation of a new basic plan every five years. The plan guides science and technology policy for the relevant period. The first plan started in 1995, was renamed at 6th plan in 2021 as the “Science, Technology, and Innovation Basic Plan”, in accordance with the amendment of the above law as the “Science, Technology and Innovation Basic Law” enforced in 2020. This change was made to put more stress on fostering innovation and redirecting universities toward implementation of the research and development for the society, rather than conducting just curiosity–driven researches. These plans describes specific science policy measures to be executed and thus are supposed to drive the advancement of science and technology and realize innovation.

The Science, Technology and Innovation Basic Plan is formulated with consideration of trends in the Japanese economy. It includes a target ratio of research funding to Gross Domestic Product (GDP), as well as specific strategies and policies to stimulate scientific research development (Mitsubishi Research Institute Inc. 2016). However, Japan’s research and development (R&D) expenditure, as a percentage of GDP, has remained relatively flat over the past 15 years, particularly in comparison with other science-oriented G7 countries and neighboring economies (Figure 1). In the 5th Science and Technology Basic Plan that covered 2016-2020 period, a target was set to achieve research and development (R&D) investment of at least 4% of GDP through both public and private sector contributions. This goal has not yet been achieved. In 2023, a record-high research and development (R&D) investment of 3.7% of GDP was recorded (Statistics Bureau of Japan 2024). Thus, Japan's research and development investments remain insufficient to support its self-proclaimed status as a science-driven nation.

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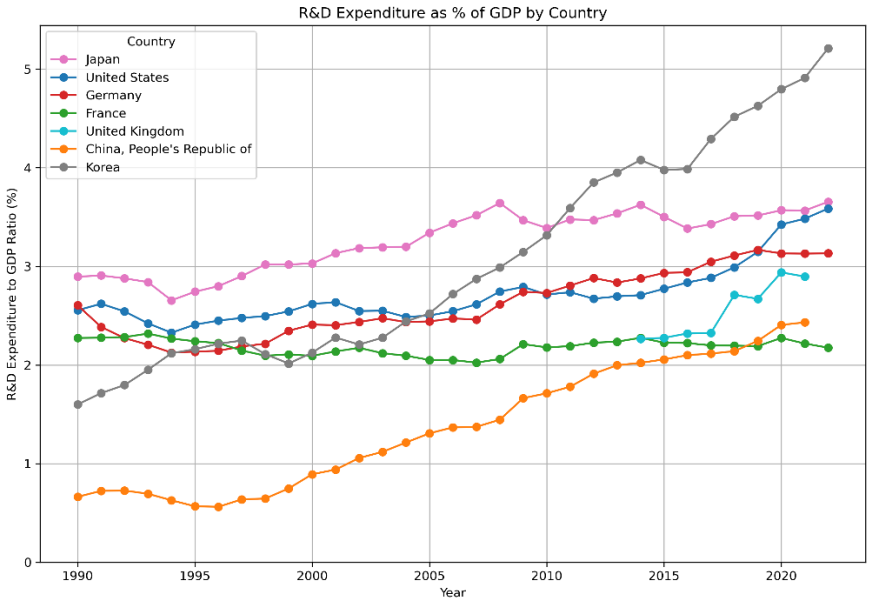

Figure 1. Research and development (R&D) expenditures as a percentage of gross domestic product (GDP), 1990–2022. Expenditures on R&D in science and technology include personnel, materials, operating, and capital costs across industry and academia. Data are from Science and Technology Indicators 2024, compiled by the National Institute of Science and Technology Policy (NISTEP), Ministry of Education, Culture, Sports, Science and Technology (MEXT).

4. Stagnation of Economy and Decrease of Scientific Strength in Japan

Because economic growth is closely interrelated with advances in science and technology—each reinforcing the other (Watanabe and Hemmert 1998)—stagnation in one has a severe impact on the other. Now Japan is suffering from staggering in both. Japanese economic growth has been staggering over the last 30 years as shown in the comparison among G7 countries and Japan's neighbors (Figure 2). Besides, Japan is the only country in G7 that showed virtually no increase of average wages over the last 30 years (Asia Pacific Dept International Monetary Fund (IMF) 2023). These trends suggest that Japan's relative economic position has weakened in recent decades. Given the interrelationships between science and economy, it may not be surprising that Japanese research activities have also been staggering, which was demonstrated as decreases in the ranking of number of scientific publications, and top 10% most cited papers (13th in the ranking measured during 2019-2021)(Ikarashi 2023; National Institute of Science and Technology Policy (NISTEP) 2024). The decline of scientific activity has been readily recognized, warned, and discussed (Mainichi Shimbun Investigative Team 2019; Toyoda 2019; Iwamoto 2019).

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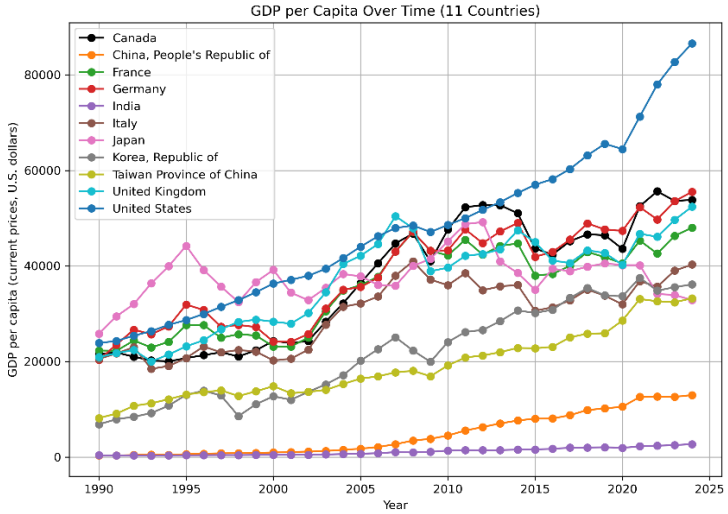

Figure 2. GDP per Capita during the period of 1990 -2024 in G7 countries and neighbors. (data from https://www.imf.org/external/datamapper/).

Does this indicate that the overall budget for science and technology has been reduced in recent years? Not necessarily. Although there have been periods of stagnation and even slight declines, the government's budget for science and technology has generally increased over the past few decades (Figure 3). The issue is not the total amount of funding, but rather the manner in which these funds are allocated. In recent years, changes in Japanese science policies—such as the introduction of the "competition principle" and "selection and concentration"—have notably affected basic research in particular. Nonetheless, the targeted allocation of funds is only one factor that has impacted scientific research in Japan. Other factors include issues related to "people" and "time": a decrease in the number of doctoral students and tenure-track researchers, as well as insufficient time dedicated to research. These issues have been empirically documented. Toyoda (Toyoda 2019), through extensive quantitative analysis of publication trends and indicators such as the number of university faculty members and their time allocated to research, demonstrates the severity of Japan's declining research capacity. In the following sections, we will examine these factors in detail.

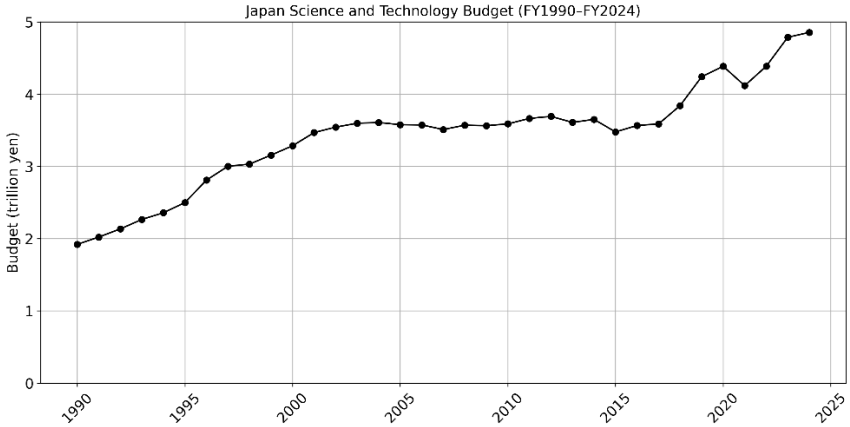

Figure 3. Trends in Japan's Science and Technology Budget. Japanese Government's Initial Budget for Science and Technology during FY2000–FY2024 in trillion yen (Data from MEXT NISTEP Science and Technology Indicators 2024).

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5. Corporatization of National Universities: Intended Reforms and Unintended Consequences

In Japan, basic scientific research, which serves as a critical source of technological innovation, is primarily conducted by universities, whereas industrial research tends to be more application-oriented. National universities, in particular, play a central role, as more than half of the national budget for basic research—distributed through KAKENHI grants by MEXT—is allocated to them. For example, KAKENHI in 2024 were awarded to national universities with 59.8% (34.9 billion yen), private universities with 20.9% (12.2 billion yen), public universities with 6.0% (3.5 billion yen), and other institutes for the rest (MEXT 2024). Therefore, any changes in policies regarding national universities have significant influences on the research activities in Japan.

In 2004, the Japanese government transformed national universities into corporate entities under a new legal framework . This corporatization was implemented with the aim of enhancing managerial autonomy, enabling universities to operate more flexibly, and fostering competition among institutions to improve performance and global visibility (Amano 2006). According to MEXT, the shift was intended to allow each university to define its own strategic direction, streamline operations, and develop distinctive educational and research profiles (MEXT 2023).

After corporatization, national universities in Japan steadily increased their industry-academia collaborations, boosting the number and value of joint and commissioned research projects (Figure 4). Many universities established dedicated liaison offices, set up incentive systems for faculty engagement, and strengthened intellectual property management (Yamamoto (Ed.) 2007). As a result, self-generated income from commissioned research, intellectual property licensing, and donations significantly increased, leading to greater financial autonomy and improved transparency in university management (Yoshida 2007). In an interview (Yomiuri Shimbun 2018), Makoto Gokami, President of the University of Tokyo states that corporatization was inevitable, with no real alternatives available at the time. He notes that the deterioration of national universities had already become a serious problem by the 1980s, and suggests that had the situation been allowed to continue, the outcome would have been even more disastrous. He defined the university as a "hub for driving social transformation" and has undertaken reforms in university management, including the issuance of Japan's first university bonds in 2020, through which 20 billion yen was raised.(Gokami 2019; Murata 2021; Hanawa 2021). Overall, corporatization opened up new avenues for national universities to strengthen their financial autonomy, promote innovation, and enhance their role as drivers of societal transformation.

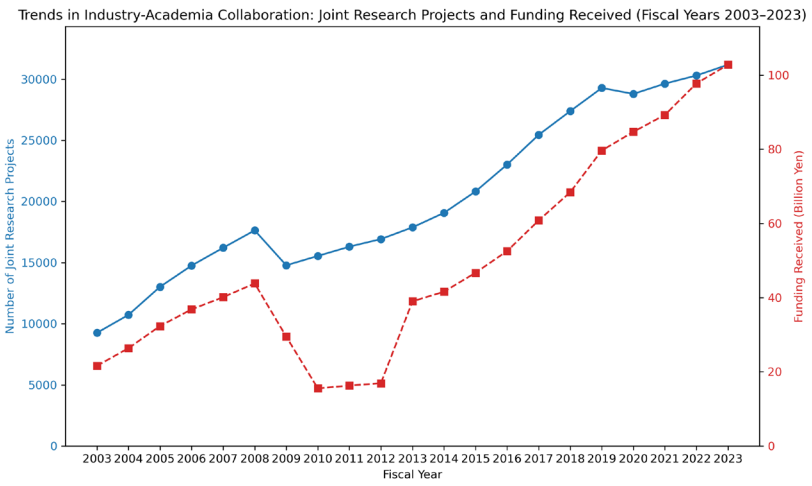

Figure 4. Trends in Industry-Academia Collaboration: Joint Research Projects and Funding Received (Fiscal Years 2003–2023). The number of joint research projects with industry (solid line) and the amount of funding received by academic institutions from companies (dashed line). Data from "Status of Industry-Academia

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Collaboration and Related Activities at Universities and Other Institutions" (https://www.mext.go.jp/a_menu/shinkou/sangaku/sangakub.htm).

However, despite these benefits, the implementation of corporatization has also produced negative consequences for Japan's academic research system (Yamagiwa and Fujii 2018; Asahi Shimbun Investigative Team 2024; Mainichi Shimbun Investigative Team 2019). Most notably, the policy was accompanied by a steady reduction in the "Management Expenses Grants for National University Corporations"—a key source of stable institutional funding. The grants were reduced by approximately 1% annually, resulting in a 10% decrease over a decade (Figure 5), based on the assumption that universities would compensate for the shortfall through increased competitiveness and external income generation. This reduction was implemented under strong pressure from the Ministry of Finance (Mainichi Shimbun Investigative Team 2019; Yamagiwa and Fujii 2018). The routine research and development funding per faculty member has decreased in tandem with reductions in operating expense grants (Igami and Kanda 2024). In practice, this reduction in core funding has severely limited the resources available for research infrastructure and daily operations, impacting research output (Toyoda 2019).

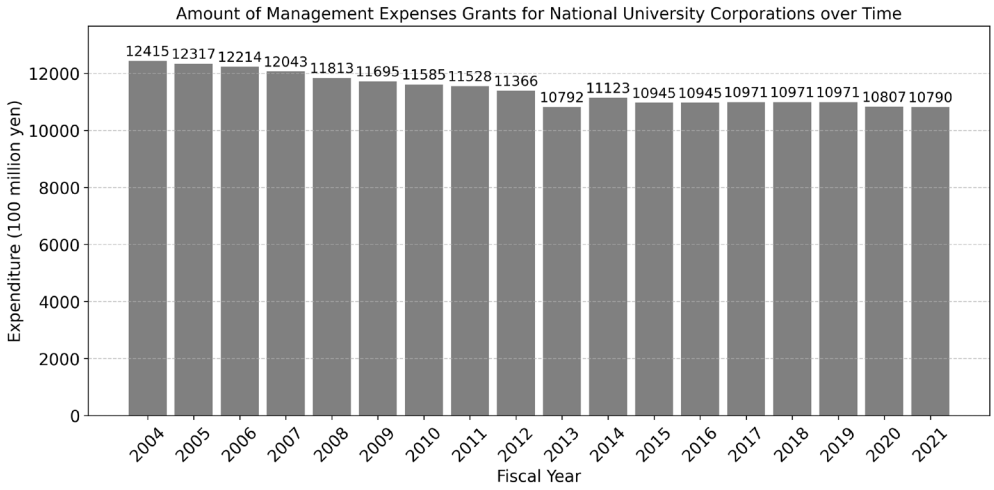

Figure 5. Changes in the Amount of Management Expenses Grants for National University Corporations Over Time. Data from the Reference Materials for the MEXT Study Group on the Future of Operational Subsidies for National University Corporations during the Fourth Medium-Term Objective Period (18 June 2021 meeting). (https://www.mext.go.jp/b_menu/shingi/chousa/koutou/108/toushin/mext_00003.html).

Obviously, the corporatization of national universities and the reduction of Management Expense Grants for National University Corporations are two distinct issues and should not be conflated. Indeed, during the process of enacting the National University Corporation Act, the following supplementary resolution was adopted: "In calculating the amount of management expense grants and other funding, efforts must be made to secure an amount that ensures education and research activities at each national university can be carried out even more reliably than before, taking into full account the level of public funding provided prior to incorporation." (The National Diet of Japan 2003). Contrary to this resolution, however, the reduction of Management Expense Grants has been implemented alongside corporatization (Mizuta 2024). Akito Arima, former president of the University of Tokyo, who played a leading role in promoting the corporatization of national universities during his tenure as Minister of Education, later expressed regret, characterizing the reform as a failure due to the government's failure to uphold its initial promises (Nakayama 2020).

Policies that gradually extended the retirement age from 60 to 65 implemented during the same period (2001-2013) further tightened the budgets in national universities. Since a major portion of the Management Expenses Grants was used to fund faculty salaries, many institutions were forced to

 doi:10.20944/preprints202504.0718.v3

freeze new permanent hires, leading to a shortage of younger faculty and a decline in faculty diversity (Nakatomi 2011; Gokami 2019).

While the overall operational budget decreased, the proportion of funding distributed through competitive grants increased. For example, the FY2004 and FY2018 were compared, while total science budget decreased by 5% from 1.93 trillion yen to 1.84 trillion yen, the competitive grant increased from 0.36 trillion yen to 0.43 trillion yen, or 18.7% to 23.2% of the total amount (MEXT 2018a). In 2019, the government went further and introduced MEXT-evaluation based differential allocation for approximately 10% of the Management Expenses Grants for National University Corporations, despite the grants' original purpose of serving as a source of fundamental research funding (Asahi Shimbun Investigative Team 2024; Takeuchi 2019; Miyaki 2024; Mizuta 2024). Thus, the trend toward increasingly competitive allocation of funding shows no sign of abating and has had a significant impact on the basic operation of scientific research.

In sum, while corporatization was introduced as a means to modernize governance and improve agility, the simultaneous reduction of core institutional funding has significantly weakened Japan's research ecosystem, raising deep concerns about its long-term resilience and international competitiveness. (Shimada 2022; Asahi Shimbun Investigative Team 2024).

6. "Selection and Concentration": A Shift Toward Top-Down, Targeted Budget Allocation Prioritizing Specific Research Areas

Alongside the introduction of competitive principles, the notion of "selection and concentration" has been upheld as a tenet. This targeted budget allocation approach, whereby the Japanese government directs funds toward selected research areas, first emerged in the Second Basic Plan for Science and Technology (FY2001–FY2005)(Cyranoski 2001). The second plan concentrated investment on four specific fields chosen by the government, and the tendency toward prioritization in budget distribution has grown ever more pronounced in subsequent years. Because the overall science and technology budget was not increased, areas not prioritized—and even essential expenditures such as operating subsidies for national universities—experienced budget cuts.

A key proponent of this prioritization approach is the Council for Science, Technology and Innovation (CSTI), formerly known as the Council for Science and Technology Policy (CSTP) (Cyranoski 2001). Although the CSTI did not originally have authority over budget allocation, a 2013 partial amendment to the Cabinet Office Establishment Act granted the Cabinet Office the power to manage its own research budget. As a result, the CSTI has transformed from a budget-assessing advisory body into a funding authority that allocates its own funds and administers large-scale research grant programs (Suda 2021).

Another notable aspect of this targeted budget allocation is its application-oriented nature, which tends to overlook basic science. Research proposals that present a clear pathway to practical implementation are more likely to receive funding (Hirao and Hoshino 2024). This emphasis on immediate applicability risks overlooking the unpredictable nature of breakthroughs, which often emerge from curiosity-driven basic research and are appreciated only in retrospect.

In the preceding sections, the focus has been on "money." We now turn to the issue of "people" the individuals at the heart of scientific progress.

7. The Introduction of Fixed-Term Employment at National and Public Universities and Its Drawbacks

The presence of aging faculty with reduced research engagement is frequently identified as a constraint on university research productivity (Sabharwal 2013; Blackburn and Lawrence 1986; Cole 1979). In order to foster continual academic exchange and acceptance of diverse expertise—vital for energizing education and research, in 1997, at national universities, fixed-term employment was introduced, as outlined by the Fixed-Term Faculty Act. By this law, positions other than full professorships and tenure-track associate or assistant professorships in national and public

 doi:10.20944/preprints202504.0718.v3

universities became subject to fixed-term contracts. This had a huge impact on the academic community in Japan (Maeda 1997). The contracts typically last five years with only one possible renewal, with a maximum contract duration of ten years before mandatory departure (Kondo 2016). Although postdoctoral researchers were already in unstable positions due to short-term contracts ranging from one to several years, assistant professors—who are mostly non-tenured in Japan—as well as higher-ranked lecturers and associate professors without tenure, also found themselves in precarious situations. In some cases, individuals even reverted from assistant professorship back to postdoctoral positions, highlighting the severe instability of the system (Young Academy of Japan 2014). A more recent survey (EPMEWSE 2023), targeted members of academic societies affiliated with EPMEWSE, shows no improvement in the highly competitive academic job market. The survey included both employed and unemployed researchers (n = 4,918). Among the unemployed researchers at the time of the survey (n = 175), respondents reported their former job titles as follows: associate professor (7.5%), lecturer (2.3%), a position ranked between associate and assistant professor in Japan, assistant professor (4.0%), and researcher (28.7%).

Fixed-term positions come with obvious drawbacks in Japanese science development. First, in this situation, many young researchers are compelled to choose research topics that yield short-term results, leaving them little room to take on ambitious projects that could lead to significant innovation. Second, researchers must constantly search for their next position, preventing them from fully dedicating themselves to their work. Third, fixed-term faculty members are often required to focus on their own research projects, making it difficult to provide consistent supervision and guidance to students (Okumura and Ikuta 2021).

The limited prospects for securing a permanent academic position have been associated with elevated psychological stress among researchers. This issue has been highlighted in various reports, including a 2022 *Nature* article in which early-career scientists in Japan describe feeling "disposable" under fixed-term employment arrangements (Hornyak 2022). Similarly, Katayama (2022) documents numerous cases of forced contract terminations, suggesting systemic instability in research employment (Katayama 2022). In some instances, stress arising from job insecurity has been mentioned in connection with scientific misconduct (MEXT 2014a), though comprehensive psychological studies on this relationship remain limited. These observations indicate the need for further empirical investigation into how employment conditions affect research ethics and morale in Japan's academic system.

The former president of the University of Tokyo, Dr. Makoto Gokami succinctly captures the current state of academia in his book, A Vision for the Future of Universities: Building a Knowledge-Intensive Society (tentative translation) (2019), stating: "Researchers hired on fixed-term contracts are not necessarily granted permanent positions, even if they achieve significant research accomplishments." As a result, many young researchers are forced to conduct their work under constant uncertainty about their future (Hornyak 2022; Okumura and Ikuta 2021). This situation significantly influences the career decisions of undergraduate students in the lab, as they witness how even accomplished senior researchers struggle to secure permanent positions. Thus, research positions no longer seem to constitute a genuine profession, rendering them unappealing as a career path for younger generations.

8. Non-Renewal of Contracts and Its Negative Effect on the Sustainability of Japanese Science

With an intention to ensure job stability for temporary workers, the amended Labor Contract Act—effective from April 1, 2013—introduced the "indefinite-term conversion rule," which allows fixed-term employees to gain indefinite status after a certain period. The threshold is five years for those in administrative or educational positions, and ten years for those in fixed-term employees engaged in highly specialized work, such as researchers, laboratory technicians, and fixed-term faculty (CSTI 2013). The intent of this law was to secure long-term employment; however, the rule has produced an unintended consequence. Many researchers and staff are employed on time-limited

 doi:10.20944/preprints202504.0718.v3

grants, and universities often lack the budget to offer permanent positions. Institutions frequently terminate contracts at or just before the five- or ten-year thresholds, at which the right to indefinite employment would otherwise be granted (Katayama 2022). This practice of non-renewal, often referred to as *yatoi-dome* in Japanese, has been criticized for undermining the purpose of the indefinite-term conversion rule (The Science Council of Japan's Executive Committee 2022). This non-renewal forces highly skilled personnel to leave their positions despite ongoing research needs (Kanai 2024). In many cases, the same positions are refilled with new individuals—sometimes even with the same person after a six-month "cooling-off" period—highlighting that the issue stems not from a genuine budgetary shortfall, but from a systemic workaround to evade the conversion mandate (Sasaki 2018; scienceinjapan.org 2024).

A 2024 survey of 2,465 respondents affiliated with universities and research institutions—including faculty, postdoctoral researchers, technical staff, and students (scienceinjapan.org 2024)—revealed persistent and systemic employment instability among fixed-term researchers. Approximately 60% of respondents reported that the 2013 amended Labor Contract Act had negatively affected their employment, suggesting that the legislation has undermined, rather than improved, job security. Nearly half of the respondents submitted open-ended comments that described the realities of contract non-renewal and expressed stress and anxiety related to unstable employment. The survey also documented the widespread use of "cooling-off" periods to circumvent eligibility for indefinite-term conversion. These findings indicate that the so-called "non-renewal problem" remains far from resolved. Notably, the survey also indicated that some universities and research institutes do not engage in such evasive practices, highlighting significant variation in employment policies across institutions.

The non-renewal practice adversely affects Japan's research system: it strips individuals of job security, impairs project continuity for lab leaders, and benefits no one. Although these practices are widely criticized as being contrary to the spirit of the law—and there are instances where their legal impropriety has led to litigation(Takahashi 2023a; Kanai 2024)—many affected employees refrain from pursuing legal action, likely due to concerns about potential negative impacts on their careers. While the indefinite-term conversion rule was designed to promote job stability, it has ironically jeopardized the careers of personnel including people engaged in scientific research, compromising the overall research activity in Japan (The Science Council of Japan's Executive Committee 2022; EPMEWSE 2023; scienceinjapan.org 2024).

9. Expansion of Graduate Education and the "10,000 Postdocs Project" and Their Consequences

In academia, it is widely believed that the deconstruction of the research ecosystem began with the "strategic focus on graduate schools" policy implemented in the 1990s (Motomura 2009). This reform involved expanding graduate education, reassigning faculty affiliations from undergraduate schools to graduate schools, and reorganizing graduate school majors—all supported by preferential government budget allocations. The shift in focus resulted in increased graduate student enrollment without a significant rise in faculty numbers, nearly doubling the student-to-faculty ratio (MEXT 2018b). Because most Ph.D. students pursued academic careers—and were not necessarily welcomed by industry (Enoki and Hamanaka 2014)—the academic job market became oversaturated with applicants (Motomura 2009).

One of the factors that worsened the academic job market for scientists in Japan was the "10,000 Postdocs Project", introduced under the first Science and Technology Basic Plan (1995–2000)(Science and Technology Policy Symposium Executive Committee 2010). The Japanese government implemented an employment funding subsidy program aimed at doubling the number of postdoctoral fellows, more than ten thousand postdocs, to strengthen Japanese research activity. The plan assumed that a significant amount of postdoctoral fellows would make transition into industry jobs, but this expectation was not met. In reality, Japanese industries are generally reluctant to hire PhD holders who are too highly specialized and older, as they do not align well with the company's

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career path system (Enoki and Hamanaka 2014). Meanwhile, job opportunities in academia remain extremely limited, as previously described. Another contributing factor is that many graduate students tend to pursue academic careers rather than industry positions (MEXT 2022; Matsuzawa 2019; NISTEP 2023). This further intensifies the competition for academic jobs, making the job market even more challenging (Kobayashi 2016). The number of postdocs were indeed nearly doubled by the plan, from 6,224 postdocs in 1996 to 11,127 in 2002 (MEXT 2002), but job opportunities did not increase for them. As a result, many postdoctoral researchers struggle to secure permanent positions and find themselves repeatedly moving from one temporary postdoc position to another as their contracts expire. This cycle has resulted in an aging postdoctoral population, with 20.7% of postdocs aged 35–39 and 16.4% over 40, out of a total of 14,237 postdoctoral fellows in the fiscal year 2012 (MEXT 2014b). According to fiscal year 2021 data, of the 13,657 postdocs, 11.5% were between 40 and 44 years old, 6.8% were between 45 and 49 years old, and 11.6% were over 50, showing significant increase of aged postdocs (30% of postdocs were over the age of 40)(NISTEP 2024a).

Given that Japanese science policy prioritizes the careers of young researchers, the oversupply of postdoctoral researchers produced under the 10,000-Postdocs Plan has led to increasingly limited opportunities for securing permanent academic positions as they age. Consequently, this cohort has come to be seen as a neglected generation—one that grew older without ever receiving the benefits of policies designed to support early-career researchers (EPMEWSE 2023). No party has assumed responsibility for the shortcomings of the 10,000 Postdocs Project. Instead, on March 26, 2024, MEXT announced a similar initiative—this time aimed at tripling the number of PhD holders—titled "Get a PhD—Doctoral Human Resources Action Plan." The plan sets a goal of increasing the number of PhDs per one million population to one of the highest levels worldwide by 2040 (a threefold increase relative to the 2020 level). Although MEXT calls on industry to expand its recruitment of PhD holders, it remains uncertain whether industry is adequately prepared to integrate such highly qualified individuals into its workforce.

10. Decreased Number of Graduate Students, the Core Driving Force of Research

One of the significant manifestations of the decline in Japan's research activity is the marked decrease in the number of graduate students in science and technology fields, as illustrated in Figure 6. Since the early 2000s, the number of students enrolling in graduate programs—particularly doctoral courses—has steadily declined. One might assume that this trend could be attributed to demographic shifts, such as Japan's declining birthrate (Yonezawa 2020). In fact, the 18-year-old population peaked at 2.05 million in 1992 and has steadily declined since then, reaching 1.09 million in 2023—a reduction of nearly half over 30 years—according to a MEXT document (MEXT 2025b). In contrast, the number of university entrants and the university enrollment rate have shown a steady increase over the past 30 years (MEXT 2025b). While the number of enrollments in master's programs at graduate schools has not shown as drastic a decrease as that observed in doctoral programs, a notable trend is the significant decline in the advancement rate from master's to doctoral programs (Figure 6e, 6f). These statistics suggest that the declining birthrate is unlikely to be the primary cause of the trend. Rather, as discussed below, the issue seems to lie in the diminishing motivation among undergraduate and master's students to pursue doctoral study.

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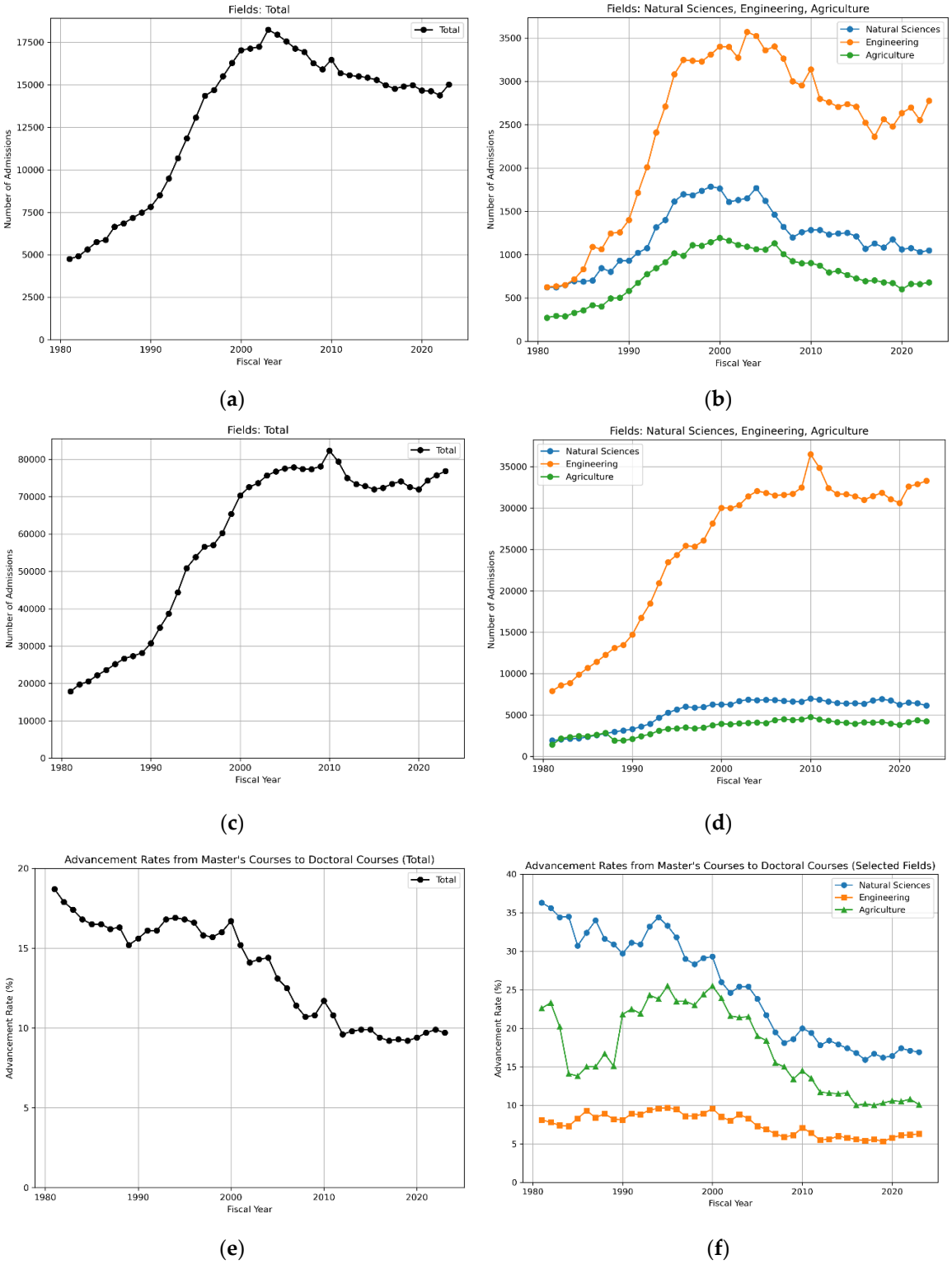

Figure 6. Graduate School Enrollment Trends. (**a**) Number of admissions from master's courses to doctoral courses across all departments; (**b**) Number of admissions from master's courses to doctoral courses in selected departments (natural sciences, engineering, and agriculture); (**c**) Number of admissions from undergraduate programs to master's courses across all departments; (**d**) Number of admissions from undergraduate programs to master's courses in selected departments; (**e**) Advancement rates from master's courses to doctoral courses across all departments; (**f**) Advancement rates from master's courses to doctoral courses in selected departments. Doctoral enrollment has declined markedly since 2003, whereas enrollment at the master's level has been largely maintained over time. Data from Science and Technology Indicators 2024, NISTEP, MEXT.

 doi:10.20944/preprints202504.0718.v3

Surveys conducted by the National Institute of Science and Technology Policy (NISTEP) indicate that students forgo doctoral education primarily due to economic hardship and structural issues in the academic labor market. Key concerns include financial insecurity (Enoki 2001) during graduate study (38.4%), uncertainty about career prospects after obtaining a PhD (31.1%), poor return (e.g., lifetime earnings) relative to the cost of pursuing a doctoral degree (30.4%), and low perceived attractiveness of academic careers (27.0%)(survey respondents: n=17,525) (Watanabe, Kawamura, and Tsuchiya 2023). These concerns are reinforced by structural trends within academia itself, including the proliferation of fixed-term contracts, limited prospects for secure academic employment, and the overall lack of sustainable career pathways for early-career researchers.

This convergence of evidence—statistical trends in enrollment, survey responses, and structural labor conditions—points to a fundamental issue: the erosion of research careers as a viable and attractive option for young people (Iwamoto 2019). Graduate students have traditionally been the primary engine of university-based research, and their decreasing numbers are affecting the overall research capacity of Japanese universities. In a recent MEXT survey, university faculty identified the shortage of graduate students (master's and doctoral) as the most critical constraint in the category of research personnel, followed by the lack of postdoctoral researchers and other research staff (MEXT 2025a). This perception underscores the growing concern that doctoral programs are becoming hollowed out, raising alarms about a future decline in the number of researchers (Iwamoto 2019). This issue is also reflected in national policy discussions. The Fifth Science Technology Plan notes that *"Challenges remain in creating environments that enable young researchers to demonstrate their abilities, and there is growing reluctance among highly capable students to pursue doctoral studies"(Japan Cabinet Office 2016).* A more explicit concern is expressed in a call for proposals for a new funding program, in which MEXT describes the current situation as follows: *"In Japan, financial insecurity during doctoral programs and uncertainty regarding future career paths have led to a decline in doctoral enrollment and made it the only major country where the number of PhD recipients is decreasing. Many capable students have become disillusioned with a career in research, raising serious concerns about the hollowing-out of the nation's future capacity for science, technology, and innovation."*(MEXT 2020) There is an urgent need to incentivize doctoral study and postdoctoral research by providing adequate support and career prospects (Nagane 2024).

Thus far, we have examined issues concerning financial resources and human capital in research. Next, we turn our attention to the significant impact that university reforms and the increased ratio of competitive funding have had on the dimension of time.

11. Declining Research Time Amid Increasing Administrative Demands

Regarding research time, the introduction of competition among universities and the reallocation of budgets based on institutional evaluations have substantially reduced the time available for research activities. To respond to the demands of university reform, faculty members are compelled to allocate significant time to administrative tasks—such as fulfilling evaluation requirements, preparing proposal documentation, and drafting proposals for competitive funding—in addition to their educational responsibilities, rather than devoting their efforts to publication of research output (NISTEP 2024b). Notably, the proportion of research time among faculty across all universities declined markedly from 46.5% in 2002 to 37.2% in 2008, and, according to the available data, remained largely unchanged until 2018 (Igami and Kanda 2020). According to a 2022 MEXT survey, the top constraint on faculty research performance was lack of time (76.4%), followed by insufficient funding (56.1%), inadequate research environment (33.7%), and shortage of research personnel (30.1%)(MEXT 2025a).The reduction in dedicated research time underscores the urgent need to provide specialized support to help alleviate the administrative load and enable researchers to focus more effectively on their scholarly pursuits.

 doi:10.20944/preprints202504.0718.v3

12. Expectation for the Research Administrators (URAs) for the Support of Researchers in Academia

A shortage of dedicated time for research in universities is often cited as one of the major causes of decreased research capabilities in Japan (Toyoda 2019). University researchers are increasingly occupied with administrative tasks related to university reforms, institutional evaluations, and the preparation of extramural grant proposals. To reduce these administrative burdens, the role of supporting specialists—namely, University Research Administrators (URAs), a new profession introduced in 2011—has been expanded. URAs are similar to research management and administration professionals (RMAs) who work with researchers at universities in Europe and North America (Yang-Yoshihara, Poli, and Kerridge 2023). Although Japan's URA system was modeled after U.S. research administrators (Takahashi 2023b), Japanese URAs are expected to work more closely with researchers to play an active role in fostering research rather than merely managing research budgets, as dedicated officials already handle the administrative aspects of research expenditures (Yamano 2016).

By the Japanese government's initiatives to implement URAs in academia, the number of URAs has increased significantly over the past decade, reaching 1,512 at 172 institutions in FY2022 (Takahashi and Ito 2023). Research Administration and Management in Japna (RMAN-J) , a professional organization for URA members, was established in March 2015 to support their activities and to formalize the new profession (Takahashi and Ito 2023). URAs are expected to become a catalyst for innovation in Japan (Ito 2024).

URAs in Japan are highly skilled professionals—often holding a Ph.D. in science—who work closely with researchers to reduce administrative burdens and enhance research capacity (Institute for Future Engineering 2018; Yano, Murakami, and Hayashi 2013). Their responsibilities span a wide range of activities, including support for university evaluations, grant proposal preparation, pre- and post-award administration, research management, facilitation of industry–academia collaboration, and the planning of interdisciplinary research initiatives (Takahashi 2016; Takahashi et al. 2018). However, for URAs to serve as a driving force in fundamentally addressing the decline in Japan's research capacity, it is desirable that they not be confined solely to an expert roles but also assume positions that enable them to contribute to university management (Mitsubishi Research Institute Inc. 2017) and ultimately to science and technology policy formation at the governmental level. Enhancing their status and expanding their influence would significantly strengthen efforts to restore Japan's research capabilities.

13. Maximizing the Possibility for Innovation to Happen: Rebalancing Japan's Research Funding

In recent decades, Japan has increasingly embraced a strategy of targeted funding—concentrating national research investments in a limited number of strategic fields such as AI, quantum technology, and biotechnology (Japan Cabinet Office 2021). This approach seeks to align scientific output with national priorities and generate economic and societal impact. Indeed, some targeted programs have yielded visible successes: for example, government support played a significant role in advancing iPS cell research, which culminated in Nobel Prize-winning work (Japan Cabinet Office 2013) and has since led to high-profile translational applications (Soma et al. 2024; Sawamoto et al. 2025). These outcomes demonstrate that targeted investment can be effective, especially when national goals are clear and long-term institutional support is provided.

However, targeted funding has its own limitations and trade-offs. Emphasizing alignment with predefined goals and short-term outcomes may constrain researchers' flexibility and creativity. Basic science—by its very nature—requires time, tolerance for failure, and freedom from rigid performance metrics (Osumi 2023). A retrospective analysis of several Nobel Prize-winning discoveries illustrates this point. Osamu Shimomura, fascinated by the chemical properties of bioluminescent proteins, identified green fluorescent protein (GFP) as a byproduct while characterizing aequorin from jellyfish

 doi:10.20944/preprints202504.0718.v3

(Shimomura 2005). GFP later revolutionized cell biology. Similarly, Tasuku Honjo discovered the PD-1 molecule while investigating programmed cell death, a finding that ultimately led to immune checkpoint inhibitors and transformed cancer therapy (Okazaki and Honjo 2007) Yoshizumi Ishino accidentally identified unusual repeated DNA sequences in the E. coli genome, later known as CRISPR, which laid the groundwork for genome editing technologies (Ishino, Krupovic, and Forterre 2018). Shinya Yamanaka demonstrated that terminally differentiated mammalian cells could be reprogrammed into induced pluripotent stem (iPS) cells. His work was based on John Gurdon's earlier discovery of reversible cell differentiation (Yamanaka 2020; Gurdon 1962).

These groundbreaking innovations were not the result of top-down directives but rather emerged from investigator-driven curiosity and long-term support for fundamental research. They often originated from modest laboratories without the expectation of immediate societal impact. Just as a favorable outcome in a lottery cannot be selected in advance, future transformative discoveries cannot be produced solely through targeted investment. Therefore, striking the right balance between targeted and broad-based funding is essential. While strategic investment can catalyze progress in key national areas, a healthy research environment also depends on distributed, stable support for bottom-up, curiosity-driven science. Broadly distributing small- to mid-scale grants—as demonstrated in life sciences and medicine (Ohniwa, Takeyasu, and Hibino 2023)—is more effective at promoting the emergence of new research topics than concentrating large grants among a few elite institutions. Japan's future research policy should not pose these funding models as mutually exclusive, but rather aim to optimize their coexistence.

Rebalancing the current funding structure—by restoring baseline institutional support, invigorating small- and mid-scale competitive grants, and safeguarding academic career pathways—should help revitalize scientific creativity, sustain diverse research cultures, and secure long-term innovation capacity. Such measures are essential to maintaining the research diversity and flexibility necessary for enabling unpredictable but high-impact scientific breakthroughs.

14. Japan's Unique Challenges

Although this review has focused on the unintended consequences of science policy reforms in Japan, many of the mechanisms discussed—such as fixed-term academic employment, competitive research grants, and targeted funding—are not unique to Japan. Across countries, similar policies have been implemented to enhance researcher mobility, the agility of scientific research, and alignment with national innovation goals. Fixed-term contracts are indeed common in the early stages of academic careers, such as postdoctoral positions. However, successful performance during this phase typically leads to clear advancement pathways, including tenure-track appointments or permanent academic positions (Castellacci and and Viñas-Bardolet 2021). In contrast, Japan's academic system structurally lacks mechanisms to ensure career continuity based on research performance (Maeda 1997), often leading to the expiration of contracts even for researchers with a strong record of academic publications, as discussed in the previous sections.

While institutional and legal reforms are important, they may not be immediately feasible. More fundamentally, however, the persistent reduction in baseline institutional funding—particularly the Management Expenses Grants—has severely limited universities' ability to secure stable research positions. One key issue is the lack of rigorous policy evaluation: science and technology reforms are often implemented without systematic assessment of their outcomes, allowing unintended consequences to persist unaddressed while new, similarly structured initiatives are introduced. Reversing this trend and restoring stable public funding would be essential for rebuilding institutional capacity and ensuring long-term career pathways for researchers. In the meantime, practical measures—such as strengthening research management through the deployment of University Research Administrators (URAs)—can help mitigate adverse effects within the current system, but cannot substitute for fundamental reform of the research ecosystem.

 doi:10.20944/preprints202504.0718.v3

15. Limitations and Future Directions

15.1. Limitations of the Present Study

This review is subject to several methodological constraints that warrant acknowledgment. First, since research activities are influenced by multiple interrelated factors, establishing a causal relationship between a specific science policy and its outcomes is inherently challenging (Tomizawa 2025). Second, the analysis relies primarily on policy documents, institutional reports, and aggregate statistical data, thereby lacking systematic tracking of individual researchers' career trajectories in relation to their academic achievements. The absence of longitudinal data linking research performance to career outcomes constitutes a significant limitation in understanding the human impact of policy reforms. Moreover, the scope remains confined to the Japanese context, precluding comprehensive international comparative analysis.

While this review examines available macro-level data and institutional perspectives, it cannot fully capture the experiences of researchers who have transitioned out of academia, nor can it adequately assess the correlation between research productivity and career sustainability at the individual level.

15.2. Directions for Future Research

While comprehensive analyses of Japan's declining research capacity exist, notably Toyoda's extensive quantitative examination of publication trends and research performance indicators (2019), systematic evaluations linking specific policy reforms to individual career outcomes remain limited. A critical gap is the absence of longitudinal studies that correlate researchers' academic achievements with their career trajectories, particularly given the methodological challenges of tracking researchers across institutional boundaries.

Future research should develop methodologies that capture both quantitative performance metrics and qualitative career experiences, examining how structural employment policies affect research continuity at the individual level. Such studies are essential for understanding the relationship between research productivity and career sustainability within the current academic system.

16. Conclusions

Innovation requires a continuum from basic research to applied development and societal implementation. Japan's shift toward 'selection and concentration' policies and competitive funding has undermined this ecosystem, particularly compromising curiosity-driven basic research that historically yielded transformative discoveries.

The persistent reduction in Management Expenses Grants has created cascading effects: fixed-term employment contracts destabilize research careers, doctoral enrollment has declined as academic paths lose appeal, and researchers' time for actual research has diminished under administrative burdens. These structural changes threaten Japan's long-term innovation capacity.

While initiatives like University Research Administrators could provide partial relief, fundamental reforms remain essential. Restoring baseline institutional funding, rebalancing competitive grants, and establishing sustainable career pathways are critical for revitalizing Japan's scientific ecosystem and securing its future as a science-driven nation.

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Abbreviations

The following abbreviations are used in this manuscript:

GDP	Gross Domestic Produce
MEXT	Ministry of Education, Culture, Sports, Science and Technology
CSTI	Council for Science, Technology and Innovation, Cabinet Office,
URA	University Research Administrator
NISTEP	The National Institute of Science and Technology Policy
EPMEWSE	The Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering

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