SUMMARY OF THE DISCUSSIONS "THE FIFTH U.S.-JAPAN SCIENCE POLICY SEMINAR"

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Introduction

A critical element in Science Policy decision making is an understanding of how scientific knowledge passes from human resources – scientists and engineers – through research institutions – public, private, or academic – to provide physical and economic outcomes. To help improve this understanding in their two countries, the National Science Foundation and the Japan Society for the Promotion of Science convened the Fifth U.S.-Japan Science Policy Seminar at the East-West Center in Hawaii on May 21–24, 1989.

Session I: Supply of Scientists and Engineers

Mr. Fechter opened the presentations with a paper on the human resource base for science and technology (S&T) in the United States. Mr. Fechter noted the need to motivate young people to study S&T particularly in quantitative fields at the doctoral level, and to retain them in those fields; a question raised the issue of whether young students are more motivated to a career by excitement or monetary reward. Dr. Stephan's paper focused on the research consequences of an aging U.S. Scientific community. Dr. Stephan has found that by correlating the number of articles published by Ph.D.s with age, an age-dependent decline in productivity is observed. One question suggested that federal funding to support early retirement for academics – paralleling similar support in industry – may be warranted.

Dr. van der Meulen's paper concentrated on factors affecting the supply and demand of scientists and engineers in the 1990 s, and contrasted those factors as they apply to academia and to industry and government. A question saw federal funding to industry to hire S&T personnel as directly competing with academia for talent. Dr. Ganz-Brown's discussion of women in science and engineering contrasted the rise of women's share of overall employment in those fields with the greater rise of their share of employment in law and medicine. Her presentation prompted discussion of

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how a woman's need to interrupt her career if she has a child affects her career choice.

Dr. Okamura's paper, estimating the future supply of scientists and engineer in Japan, predicted an increasing share of researchers in the industrial sector. Dr. Kodama's presentation noted in particular the growing employment of scientists and engineers in the Japanese finance and insurance sectors, and the failure of universities to respond to changing demand by reorganizing to emphasize teaching information technology. He also raised the issue of whether the growth of granting Ph.D.s for dissertations only is a healthy response to an environment of rapid technological advance.

Following Dr. Sakai's presentation on Japanese programs to support S&T education, participants raised several questions during general discussion. One comment proposed that youth are more likely today to choose careers based on monetary incentives, while another pointed out the poor preparation of U.S. high school students in math and science. Several other questions were aimed at whether the apparent preference of Japanese companies to hire Masters over Ph.D.s reflected a different attitude toward creative innovation.

Session II: Science and Technology in Regional Development

Dr. Matsuyama opened the session with a discussion of Japan's technopolis program and the Kumamoto technopolis in particular. Responding to a question on scientists' preferences of places to relocate in Japan, he stated that all the technopolises are equally new and untested in this regard. Dr. Tezuka's presentation on Nippon Steel Corporation's regional development projects – particularly, R&D centers – promoted a number of comments on Japanese firms' use of R&D to diversify into areas, outside of, but related to their main lines of business. Dr. Nagai commented that regional development centers require talented research leaders and an advancement system within regional organizations which does not force researchers to become managers.

In his presentation, Mr. Koppel raised the question of how to measure the success of regional development programs. Discussion followed on government entities' desire for rapid increases in employment. Mr. Norris' paper detailed the need for a focus on regions in development promotion. His description of plans to link regions in different countries prompted comments on how government could facilitate the process.

Mr. Cohen's and Dr. Ries' presentations both raised questions about what characteristics make a region appropriate for economic development programs. One answer noted the need for committed political leadership. The role of top research universities in development was also discussed, as Dr. Ries pointed out that the federal government will often fund specific

departments or individuals for development programs in less-prestigious universities as well. Dr. Inose added that in Japan, top national research universities have played a smaller role in regional development than local and regional universities have.

Session III: Outcomes of Science and Technology

The final session of presentations began with Mr. Ban's examination of an econometric model for measuring the value of patents. Mr. Ban concluded that the rate of return from R&D is relatively high in Japan, and that the total value of patent rights has grown despite a relatively high concentration of patents with limited values. Considerable discussion followed on the question of how patent activity is related to the ability to commercialize S&T. Several participants described the need in the Japanese patent system to file additional patents on applications of a basic idea in order to protect and strengthen the basic patent. They suggested that U.S. research entities may not be sufficiently diligent in filing those additional patents. One participant commented that smaller institutions and companies do not have enough financial resources to file so many patents, while another asked whether the failure of U.S. researchers to follow through on applications was related to their relatively lesser success in commercializing discoveries.

Dr. Kinoshita's paper led to discussion of how international cooperation in R&D can be promoted, particularly in the field of biotechnology – a field in which the Japanese possess a strong tradition in fermentation technology. Dr. Inada's paper raised the contention that advancement of S&T investment in the United States will require basic changes in macroeconomic variables such as the savings rate. Participants then discussed the problem of measuring quantitatively the output of R&D investment, and one participant expressed the hope that Japanese basic research results will be made as available to U.S. scientists as U.S. research has been in the past for Japanese researchers. The comment then followed that U.S. companies will need in addition to improve their ability to commercialize such research, whatever its country of origin.

Dr. Gellman discussed the need for and effectiveness of methods to measure the output of R&D, noting that the broader the scale of such analysis, the more tenuous it becomes. The question of the importance of the process of diffusing R&D results prompted the answer that the very high share of effort involved in diffusing results may indeed deter some corporate planners from investing in seeking basic innovation.

Dr. Le Maistre discussed the Rensselaer Polytechnic Institute's programs to promote regional economic development, the practical problems the University has faced in those programs, and the observable outcomes of those programs. The succeeding discussion focused on the apparent reluctance of U.S. researchers to go to Japan for research programs,

despite the observation that those who have gone have found an environment that is very open to them. The motivations of companies to participate in university-sponsored development programs was also discussed. Dr. Nicholson's presentation closed the session with a description of 3 M's organization and evaluation of R&D activities. In answer to a question, Dr. Nicholson predicted the growing importance of having technical R&D personnel working in laboratories overseas.

Session IV: Roundtable Discussion

This session was chaired by Dr. John Boright, Director, Division of International Programs, National Science Foundation and Dr. Fumio Kodama, Director, Japanese National Institute of Science and Technology Policy.

Dr. Boright initiated the discussion by calling for comments on the topics raised during the seminar and for recommendations for future science policy actions in the United States and Japan. Discussion then turned to the issue raised in Session I of the differences between doctoral degrees in the two countries and the significance of "dissertation doctorates" in Japan. Dr. Le Maistre asked whether Japanese doctorates are seen more as evidence of a specific achievement – the doctoral research project – or, as in the American case, have an additional role in certifying the overall scientific ability of the candidate. Dr. Corson described Cornell University's philosophy of teaching a doctoral student the general skills and techniques to perform in-depth research across a range of fields. According to Dr. Nagai, both course-work and dissertation doctorates in the Japanese system require deep understanding of a specific, narrow topic. Dr. Inose pointed out that the oral and written qualifying examinations for Japanese doctorates measure the candidate's breadth of scientific competence. He added that in recent years, Japanese course-work doctors benefit from the chance to take classes on very recent technological developments, but that in some respects there may be too much emphasis on course-work and not enough on research in the coursework doctoral programs.

Mr. Cohen raised the question of how the doctorate benefits not only the scientist, but society as a whole. He suggested that study of the social value of doctorates be considered as a topic for future seminars. Dr. Stephan suggested the distinction that U.S. doctorates prepare students to contribute to science, while Japanese dissertation doctorates – which are often earned relatively later in the scientist's career than in the United States – serve more to recognize a contribution already made. Mr. Fechter asked if a dissertation doctorate might be considered a form of continuing education – a refresher program for the scientist. If so, this Japanese approach might be an effective solution to the problem of scientists' declining productivity over time. Dr. Okamura concluded this portion of the discussion by pointing

out that while some professors may prefer their students to obtain course-work doctorates – in part because such students provide a pool of research assistants – the students may benefit more from performing their research in industry, where the research equipment is more advanced, and obtaining a dissertation doctorate later.

Before turning to the Session II topic of regional development, Dr. Boright expressed appreciation to the Japanese for helping to support the National Science Foundation's programs to place U.S. scientists in Japan. Mr. Fechter pointed out the importance of ensuring a positive experience for the first U.S. participants in these programs, because these scientists will communicate with their colleagues and create a lasting impression in the United States.

Introducing the discussion of science policy and regional economic development, Dr. Boright asked for comments on the political power structure of regional development in Japan, possible links between regions in the United States and Japan, and the opportunities for bilateral cooperation in the realm of continuing education. Dr. Kodama began by pointing out that because of the centralization of Japanese industry in the Tokyo area, Japanese regions outside the capital may benefit from links outside Japan to overcome that Tokyo-oriented bias. Dr. Matsuyama added that although the concentration of resources in a single location – in Japan's case, Tokyo – is efficient, Tokyo's physical and social infrastructure has become oversaturated. He added that the strongest driving force for the success of the technopolis strategy may be the support of the prefectural governors, and noted the similarities between the prefectures' development programs and those of the regions in the United States that were discussed in this symposium.

In response to a question about the funding of Japan's regional development programs, Dr. Tezuka and Dr. Inose described the funding mechanisms of several types of programs. In most of those programs that receive central government support, some matching funds from local (prefectural) government and participating industries are required. In these programs a local entity makes the initial project proposal and application for funds, but a central selection committee chooses which projects to approve for support. Sometimes the funds are provided as low-interest loans that must only be repaid if the project is successful; when the support is an outright gift, the share of central government participation is usually smaller.

Dr. Ries suggested that sister-city cultural relationships could expand to include regional science and technology programs. In order to avoid conflicts arising from competition between U.S. and Japanese private firms, these programs could focus on public-goods issues such as water quality or toxic waste control. Dr. Gellman warned that regional cooperation in basic research and development is likely to frustrate the participants because of the long lead time before achieving concrete results; cooperation in the

production of goods or services, however, would produce immediate benefits that would justify and bolster support for the cooperative relationship. Mr. Norris suggested that the development of computer-distributed networks and supporting course materials for continuing education could be an excellent area for international cooperative links between regions.

Turning to the topic of Session III – measuring the outcomes of science and technology investment, Dr. Ganz noted the limitations of using relative numbers of patents to measure a country's or an industry's level of scientific advancement. She noted the need for better understanding of the sociology of patent applications; the variability of patenting behavior among industries and among nations; and the limitations in setting a price on the value of a particular patent. Dr. Inada underscored the need for adequate macroeconomic policies to ensure a pool of capital for basic research investment. Dr. Nicholson noted the complexity of the decision on whether to patent: It may not be sensible to patent a product with a very short life cycle, such as one in a series of technologically related products. Furthermore, process patents are much more difficult to enforce than product patents, so innovative processes should often be kept unpattented and undisclosed.

Addressing the topic of Japanese industry's use of U.S. university research, Dr. Okamura noted that Japanese companies often do not seek research from Japanese universities because they feel that their own capabilities – in particular, the background of their research personnel – are very similar to those of the universities. Dr. Gellman pointed out the need to determine the equitable terms of trade between Japanese investment capital and U.S. intellectual property. Dr. Kodama added that equitable terms of trade would be in Japan's interest, because more intellectual capital could then flow to Japan. Several participants then discussed whether the United States will continue to produce high quality intellectual capital, given the problems with the U.S. supply of scientists noted in the first session. Dr. Boright suggested that the National Science Foundation conduct a study of basic research investment decision making in Japanese companies and then submit it to review by the Japanese participants at the next seminar meeting.

Session V: Concluding Remarks by Co-Chairmen

Dr. Okamura opened the session with discussion of possible directions for future U.S.-Japan science policy seminars. Dr. Okamura suggested limiting future meetings to one main topic with keynote speakers, and also the possibility of holding followup meetings for further discussion within the two participant countries. Dr. van der Meulen proposed as a future seminar topic cooperative research between U.S. and Japanese universities. Dr. Le Maistre suggested discussing ways to improve the bilateral exchange of

scientists and students. Dr. Corson raised the possibility of considering entirely different types of science issues, such as global biological and environmental issues – issues which readily lend themselves to international cooperative efforts.

Other suggested procedural changes included meeting more often with a narrower agenda each time; holding one public session during the seminar in order to increase exposure and influence; making the papers available sooner; enabling preparation of more relevant and penetrating questions; including other countries as guest speakers or as full participants; and locating meetings within the participant countries and conducting tours of research facilities.

Following this discussion, Dr. Corson and Dr. Okamura formally closed the seminar.