
5c. Theoretical Foundation and Policy Process of Science and Technology in the U.S.: A Report on OYCF Teaching Trip

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During December 2003 and January 2004, I taught a short course on “Theoretical Foundation and Policy Process of Science and Technology in the U.S. – Its Learnability in China’s Specific Settings” in the School of Public Policy at Tsinghua University, Beijing. The teaching trip was supported by the OYCF-J. J. Cao Teaching Fellowship.

Overview of the Teaching Trip

I arrived in Beijing on Dec. 18, 2003, and left Beijing for Shanghai after the last class on Jan. 10, 2004. The lectures began on Dec. 22 and consisted of seven sessions. The audience consisted of graduate students in the School of Public Policy at Tsinghua University and students from other schools of Tsinghua University (such as School of Economics and Management and School of Architecture), Peking University, and other research institutes in Beijing area.

This course introduced the basic assumptions and theories underlying the U.S. science and technology policy making, as well as the practical science and technology process in the U.S. This course gave students an overview of the U.S. science and technology system. The unique traits of the course were related to MIT: I stressed quantitative policy analysis tools that are the strengths of MIT compared to similar studies in other universities; and I introduced the MIT Technology and Policy Program to give a snapshot of the U.S. technology and policy research and education.

Beneath most fights over science and technology policy in the U.S. sits the classic debate over balancing risks of market failure and government failure, credibly assessing knowledge, and managing tradeoffs between efficiency and ethics. This course was structured around major economic and political theories of regulation, modified by taking into account problems associated with integrating scientific and technical information into public and private decision-making. While stressing the pros of the U.S. system that China can learn, we also pointed out the differences in the cultural, historical, social and political settings of the two countries. We have to understand the uniqueness of China. The discussion of comparisons between China and the U.S. was an important part of the classes.

The course was divided into 4 blocks: introductory session (1 class), political economy of science and technology policy (2 classes), policy analysis toolkits (1 class), and special topics (3 classes). Cases were drawn to illustrate each topic. Comparisons of practices between the U.S. and China were presented.

Introductory Session

On Dec. 22, I gave the first lecture. This lecture provides a summary of major justifications for and critiques of public policies. The justifications include classic microeconomic defenses of the role of government in mitigating economic market failures and philosophical arguments on equity and individual rights. These justifications for public policy are subject to critiques of government failures, including representational bias, influence costs and regulatory costs, organizational and bureaucratic politics and regulatory rigidity.

The process view of science and technology policy is built around an understanding of the policy

cycle, i.e., policy analysis, policy formulation, policy implementation, and policy feedback. This cycle is a variant of the typical decision-making cycle. Although the rational-scientific approach, which highly values analytical techniques, is salient, the stakeholder analysis is key to the policy process. The politics of determining the final policy, usually the authorization, budgeting, and implementation, take central stage.

Political Economy of Science and Technology Policy

The topics listed in this block are categorized according to types of market failures and government failures. On Dec. 25, I gave a lecture on market failures, covering unstable property rights, imperfect competition, externalities, adverse selection, tipping, and coordination problems. For each type of market failure, we worked through major theories, examined technical or non-technical cases, considered problems associated with nominal solutions to these market failures, and then discussed the contemporary comparison between China and the U.S. To cure the market failures, government has to enter the game, but government interference will inevitably bring in the failures related to government. On Dec. 26, I gave a lecture on government failures, covering collective action dilemma, regulatory capture, bargaining and influence costs, organizational processes, bureaucratic interests and politics. How to balance market failures and government failures is the key to public policy, including technology policy.

Policy Analysis Toolkits

On Jan. 6, I gave a lecture introducing rational-scientific policy analysis toolkits. The toolkits include qualitative and quantitative methods. As a student from MIT, I stressed the quantitative methods that are MIT's strengths. The quantitative methods can be divided into three categories: social quantitative analysis, economic analysis, and systems analysis. The lecture stressed several relatively new methodologies in economic analysis and systems analysis, such as real options analysis, system dynamics, and CLIOS analysis (Complex, Large-scale, Integrated, Open Systems analysis). A fair amount of time was spent on real options analysis. This method transplants the financial options theory to value other kind of decision. R&D (Research and Development) projects have many key aspects resembling options. Real options analysis is very helpful in formulating a sensible R&D policy.

Special Topics

The course was also interspersed with a few special topics. On Dec. 29, I gave a lecture on Research Policy and Innovation, which covered topics such as sources of innovation, intellectual property, corruption in science and conflicts of interest, public/private investments in innovation, venture capital, and technology transfer. Innovation and technology policy is one of the most important topics related to the creation of science and technology knowledge in China. There are different methods to promote the science and technology capability of a nation, such as public funding of research, fiscal incentives to promote private research spending, and consolidations and adjustments in IPR (Intellectual Property Rights) to sharpen incentives for private research spending. Our discussions covered a range of questions. For example, what are the pros and cons of each method? How should governmental decision-making on the allocation of research spending be structured? How to promote the transfer of science and technology knowledge into application? How to facilitate knowledge transfer from research institutes to industries? What is the role of international technology transfer in the development of domestic science and technology capability in developing countries? How can developing countries get the most from the established science and technology achievements in developed countries?

On Jan. 9, I gave an introduction on MIT's Technology and Policy Program, covering its course design, faculty composition, master's and PhD education plans, admissions, career development of students, and latest research interests. This introduction appealed to the audience because of the similarity between MIT and Tsinghua University, both being technology schools with solid science research and engineering development capability. The introduction of various aspects of the technology and policy education and research at MIT served as a showcase for both Tsinghua students and faculty. For students, it was a window to other systems of learning and innovation, and helped enlarge the scope of their views and generate new ideas. For faculty, it provided ideas to improve their current educational programs. Universities are among the most important units that build up a nation's technology and innovation capability. It is vital for Chinese universities to study U.S. universities' education and research systems.

Besides lecturing, finding out what graduate students at Tsinghua University were doing was also beneficial. On Dec. 23, I talked with around ten graduate students under the advisement of Professor Su, Jun, Dean of the School of Public Policy at Tsinghua University. They showed their work on technology policy, covering R&D policy, biotechnology policy, standardization, national technology infrastructure platform, etc. I gave them my views on their respective research. This was an occasion for mutual communication rather than one-way lecturing. By information exchange, we shared and developed an understanding of China-specific problems, and most importantly, what we could learn from the U.S. practices and what we could not copy from the U.S. practices. We have to develop a China-specific way of developing national science and technology capability.

Thoughts from the Teaching Experience

I myself learned a lot from the teaching experience, too, especially about the reality of technology policy and science and technology capability in China. China's investment in R&D in 2001 was \$12.56 Billion, around 1/25 of that of the U.S. and 1/2 of that of South Korea. Despite the biggest brain drains in world history, human resources may be among the major advantages for China in many areas such as manufacturing. China has 890,000 R&D personnel, next to Japan, being the second largest in the world. However, the percentage of R&D expenses in national budget has decreased. In 1998, R&D accounted for 4.36% of national budget; in 2001, it decreased to 3.72%. Nevertheless, although the investment cannot be compared to the investment in the U.S., Japan, Europe, or other developed nations, its reward has been tremendous. For example, among the three most important science and technology publication indices, China accounts for 3% of the publications, ranking 6th in the world.¹ In contrast, in the beginning of 1990s, China ranked 15th in the world.

Despite the development of science and technology capability in China, there remain two most crucial problems. The first is the lack of radical innovation. Similar to Japanese, Chinese are good at continuous improvement in small steps, but not particularly competent in radical innovations that may improve the performance in geometric measures. The second problem is academic corruption. Like other areas in China, corruption in science and technology is epidemic. Because of the huge investment of various resources, the science and technology arena has become a fertile soil for rent-seeking. The corruption takes different forms thanks to high education levels of the people involved. And its dreadful impacts are no less than corruption in other corners of Chinese society. The root of the problem is deep. First of all, it relates to the cultural heritage of China. Chinese society is always central-controlled by human(s), while a western society consists of independent identities under a legal system. The origin of innovation

¹ The U.S. takes the lead with a share of 30%, and the U.K. and Japan rank second with 8%, respectively.

is relentless probes into nature and independent thinking. People can find that an incredible amount of seemingly implausible projects are explored, supported and encouraged in U.S. universities. Maybe 99,999 out of 100,000 of these projects turn out to be futile, and only one succeeds to change the world, but the 99,999 failures are spirits of innovation that support and contribute to the one success. There has been few such innovation spirits in China. One possible source of this problem is academic corruption in China. One feasible way to alleviate the dire consequences is to design a legal system to check deviations from academic ethics.

The pragmatic solution to foster a robust domestic science and technology capability is beyond the science and technology policy arena. It relates to a fundamental issue for most social and economic problems in China: the need to establish a system beyond individuals while encouraging individual independence. The task is formidable given the cultural burden and current situations in Chinese society. By participating in OYCF activities and teaching, I hope to meet people with similar thoughts and dream to contribute to our motherland - China. Whether succeeding or not, we put every drop of our sweat in our dreams.

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