2.0.2 STI policy targets and instruments

IWABUCHI Hideki[1] AKAIKE Shinichi[2]

First Published August 28, 2018 Final Updated July 2, 2020

Abstract

This paper provides an outline of the basic policy instruments of science, technology and innovation policy. This manuscript is a preliminary version.

Keywords

Science, technology and innovation policy, policy instruments, taxation, regulation, policy finance

1 What policy instruments are available?

Having reviewed the definition of science, technology and innovation policy and the various characteristics of science, technology, and innovation policies, I would now like to consider the instruments of science, technology and innovation policy in greater depth.

Gault (2011), for example, is a pioneer in classifying the instruments of science, technology and innovation policy, and attempts to categorize them into five policy instruments: markets, people, innovation activities, public institutions, and international engagement. However, before returning to the basics and discussing the categorization of instruments of science, technology and innovation policy, it is worth noting how instruments of public policy are generally categorized. According to Akiyoshi Takao, Ito Shuichiro, and Kitayama Toshiya (2015), instruments of public policy can be categorized into direct provision, direct regulation, inducement, and others.

1 Counselor, Mission of Japan to the European Union.
2 Senior Fellow, National Institute of Science and Technology Policy (NIST); Attaché to the Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT); Counselor, Japanese Cabinet Office.

1.1 Direct provision

- Provision of public goods (e.g., national and social security, roads, streetlights, and lighthouses).
- Provision of quasi-public goods (i.e., merit goods) justified by non-rivalrous and non-excludable consumption (e.g., education, housing, medical care, and culture).
- Things that the government provides from a paternalistic perspective based on the social judgment that, if left to private choice, the supply will be insufficient.

1.2 Direct regulation

- Existence of externalities (e.g., environmental regulations).
- Existence of economies of scale (e.g., antitrust and price controls).
- Addressing information asymmetry (qualification systems; e.g., medical and legal systems).
- Social regulations (e.g., labor regulations).

1.3 Inducement

- Guidance to guide a specific action in a favorable direction (e.g., subsidies, low-interest loans, loan guarantees, interest subsidies, tax incentives, sanctions, and penalties).
- Incentives and building a mechanism to provide ongoing incentives (e.g., tax systems such as environmental taxes and the creation of new markets such as emissions trading).

1.4 Other

- Educational methods, that is, the presenting of the facts (e.g., food labeling systems and travel safety information).

The main policy instruments of science policy, technology policy, and innovation policy, respectively, can be organized in line with this classification of public policy instruments (Table 1). This is relatively simple for science policy, and the policy instrument of direct provision of the "good" of scientific knowledge is central. Scientific knowledge that is widely published in the form of articles is available to everyone and is non-exclusive in its consumption, meaning that there is a risk of undersupply unless it is supplied as a public good. In contrast, different policy instruments are chosen for technology policy. The government—or, in the case of Japan, the Ministry of Economy, Trade, and Industry—selects specific technological fields and provides subsidies and tax incentives for technological development in those target fields (inducement of guidance), and presents a vision that identifies growth industries (i.e., enlightenment). Moreover, a large number of policy instruments are used in innovation policy. For example, there are cases where the policy instrument is regulation, such as pro-innovation regulatory policies, and where the policy instrument is inducement (incentives), such as pro-innovation public procurement. Therefore, it should be noted that policy instruments tend to change and diversify as we move from science policy to technology policy to innovation policy.

Table 1: Policy instruments for science policy, technology policy, and innovation policy

	Science policy	Technology policy	Innovation policy
Direct supply	Production of scientific knowledge		
Direct regulation			Regulation to accelerate innovation (environmental regulation, competition policy, consumer protection, etc.)
Incentive		Subsidy/tax benefit toward designated technology development Training toward designated industry [Guidance type]	Public procurement to accelerate innovation General subsidy for education/training [Inducement type]
Others (enlightenment, etc.)		Creation of a vision to identify growth industries	Cultivation of the environment for entrepreneurship, improving the information access for citizens

Reviewing recent international policy trends in the instruments of science, echnology and innovation policy, we can see that the importance of “innovation policy” involving science and technology is drawing worldwide attention. For example, the 2010 OECD Innovation Strategy states that “policies that reform the structure of the framework supporting innovation, such as the removal of regulatory barriers to innovation and entrepreneurship, including administrative rules and regulations, and tax systems that contribute to growth, can play a major role in enhancing innovation and growth.” Moreover, according to the 2015 revision of the OECD Innovation Strategy, “policymakers will be required to go beyond research and innovation policy as they are narrowly defined and combine a range of ‘policy groups for innovation’ that will vary according to the policy context.”

Furthermore, the following are emerging policy trends in the US Innovation Strategy (2015), many of which relate to so-called innovation policy: smart regulations to support emerging technologies, government services in the twenty-first century (i.e., policies to hire and retain talent in government), leveraging financial innovation to address priority national issues, and the increasing role of the “demand-driven” model in US innovation strategy.

With this growing interest in innovation policy in recent years, it is worth looking at the strengths and weaknesses of Japan’s science, technology and innovation policy based on the World Economic Forum’s

(WEF) international competitiveness ranking. Table 2 shows Japan's ranking for each of the various indicators used to calculate the WEF's international competitiveness ranking. Among these, typical indicators relating to science policy include "supply of scientists and engineers" and "quality of scientific research institutions." In terms of these indicators, Japan ranks third and seventh in the world, respectively, which is extremely high. On the other hand, Japan's evaluation is generally low for indicators relating to "innovation policy," including "government procurement of advanced technology products" (ranked 21), "government regulation" (ranked 64), "availability of venture capital" (ranked 24), "taxation as an investment incentive" (ranked 71), and "hiring and firing practices" (ranked 133). (Note, the WEF's international competitiveness ranking does not take into account any indicators relating to technology policy.) As such, while Japan's science, technology, and innovation policy is regarded as strong in terms of science policy, it is regarded as weak in terms of innovation policy.

Table 2: Japan's international competitiveness rankings

Pillar: Innovation	Global ranking
Availability of science and engineers	3rd
Quality of scientific research institute	7th
Government procurement of advance tech products	21st
Pillar: Institutions	Global ranking
Burden of government regulation	64th
Pillar: financial market development	Global ranking
Venture capital availability	24th
Pillar: Goods market efficiency	Global ranking
Effect of taxation on incentives to invest	71st
Pillar: Labor market efficiency	Global ranking
Hiring and firing practices	133rd

※Ranking among 144 countries
※Evaluation items include institutional environment (21 items), infrastructure (9 items), macroeconomic (5 items), primary education and sanitation (10 items), higher education (8 items), commodity market efficiency (16 items), labor market efficiency (10 items), financial market (8 items), technological adjustment (7 items), market scale (4 items), business sophistication (9 items), innovation (7 items)

Source: World Economic Forum, Global Competitiveness Report 2014–15.

The Japanese government is not oblivious to the strengths and weaknesses of its science, technology and innovation policies. As noted, the concept of "science, technology and innovation policy" was first raised in the Fourth Science and Technology Basic Plan (FY 2011–2015) as a means of addressing science and technology and related innovation policies in an integrated manner. Moreover, in a policy speech given in February 2013, Prime Minister Abe set out a policy goal of creating "the world's most innovation-friendly country." This goal is also set out in the Abe administration's growth strategy, "Japan is Back."

In addition to measures relating to support for R&D and technology development expenses, which have been the focus of traditional science and technology policy, it is becoming increasingly important to promote policies that mobilize a wide range of measures facilitating innovation, such as taxation, policy finance, public procurement, and regulatory reform.

2 How does this relate to other policy areas?

This section discusses the relationship between science, technology, and innovation policy and other policy areas. In doing so, it focuses on economic policy, social security policy, and security policy, and offers an overview of their relationship with science, technology and innovation policy based on recent Japanese government policy in each policy area.

First, with regard to economic policy, the White Paper on Economic and Fiscal Policy (2016 edition) formulated by the Cabinet Office addresses science, technology and innovation in the context of the investment behavior of Japanese companies. More specifically, the report focuses on R&D investment, capital investment, and M&A as corporate initiatives to strengthen growth. Meanwhile, in the Basic Policy on Economic and Fiscal Management and Reform 2017 (approved by the Cabinet on June 9, 2017, as the so-called Policy Framework 2017), the word “science” appears seventeen times, “technology” thirty-six times, and “innovation” twenty-two times. Considering that these three terms appeared only eight, sixteen, and two times, respectively, in the initial 2001 Policy Framework formulated by the Cabinet Office, the link between economic policy and science, technology, and innovation policy has strengthened during this century. Although the Policy Framework 2017 cites the reform of work styles, growth strategies, the revitalization of consumption, and regional development as priority issues, references to science, technology and innovation policy are primarily located in the growth strategy section. More specifically, in the context of investment promotion, the report calls for the promotion of investment in innovation as well as FDI in Japan, and lists the concentration of policy resources in strategic areas and regulatory reform to promote innovation through social demonstration as growth strategies.

In respect to social security policy, based on the Health, Labor and Welfare White Paper (2016 edition) formulated by the Ministry of Health, Labor, and Welfare, the Japanese government’s social security efforts can be broadly classified into eleven types. Of these eleven types, one is positioned as involving science, technology and innovation, namely, the promotion of healthcare-related innovation. More specifically, this type comprises measures for the research and development of pharmaceuticals and medical devices, approval reviews, development of systems for clinical research and clinical trials, and harmonization with international pharmaceutical regulations. In sections other than medical care, science, technology and innovation is discussed in the context of improving the efficiency of methods for providing welfare services, such as the use of advanced technologies in nursing care.

Regarding security policy, based on the Defense White Paper (2016 edition) issued by the Ministry of Defense, the government’s security efforts can be broadly classified into four categories: (1) organizations responsible for defense, (2) international cooperation on security, (3) defense equipment and technology, and (4) relations with local communities and citizens. Of these, science, technology and innovation is mainly involved in category (3), and consists of measures such as the research and development of equipment, technical cooperation with foreign countries, and equipment procurement.

In other policy areas, science, technology and innovation policy is employed in the form of the institutional design of innovation-promoting regulations, procurement, and so on, as well as research and development in various fields. In this respect, the involvement of science, technology and innovation policy with other policy areas appears to be increasing.

These points notwithstanding, there are doubts about discussing policies based on vertical classifications. For example, the argument of Takeo Akiyoshi, Shuichiro Ito, and Toshiya Kitayama (2015) can be summarized as follows:

- When we hear the term “policy classification,” the first thing that comes to mind is probably the classification of individual policy areas such as industrial policy, agricultural policy, environmental policy, transportation policy, and foreign policy.
- This vertical categorization is easily understood. However, there is no basis to this policy classification besides the fact that they are policy fields.
- The vertically classified policy means nothing more than that those policy areas exist (i.e., there are ministries and departments responsible for them).
- Even the Oxford Handbook of Public Policy and other Western handbooks on public policy do not include a chapter or even a passage on policy classification.
- It is difficult to find a clear axis for the classification of public policy, which contains many different aspects.

Therefore, keeping in mind that vertical policy categories have no meaning beyond the ministry responsible for them, we have tried to discuss how science, technology and innovation policy relates to other policy areas (i.e., ministries responsible) within the Japanese context (Figure 1).

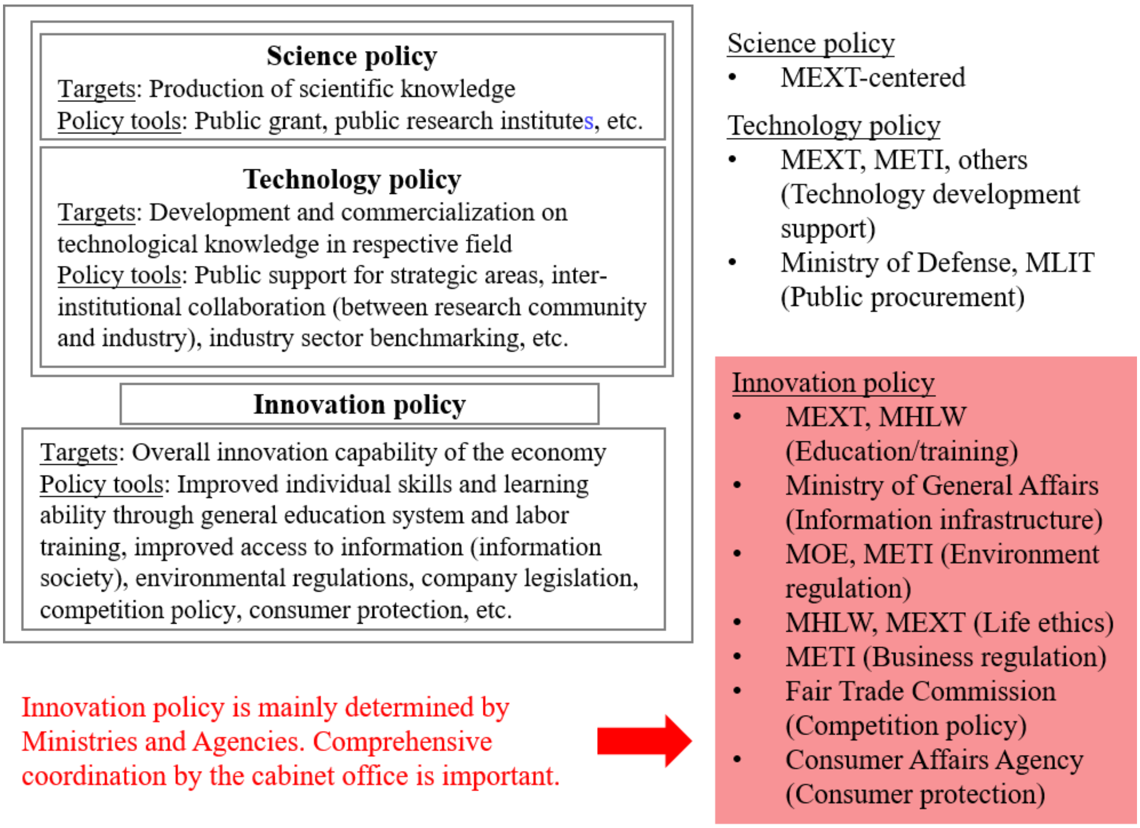

Figure 1: The relationship between science, technology and innovation policies and central government agencies.

First, science policy has relatively little to do with other policy fields due to the nature of its policy objective, namely, the production of scientific knowledge. Second, due to the nature of the policy target of the development and commercialization of technological knowledge, technology policy has a great deal to do with various policy areas related to the use of technology. For example, the Ministry of Defense security policy and Ministry of Land, Infrastructure, Transport and Tourism public works policy, which are under pressure to procure advanced technologies, are closely related to technology policy. Third, there are a wide range of policy areas involved in innovation policy because of its extremely broad policy target—that is, the overall innovation capacity of the economy. Indeed, it relates to almost all the fields of central government policy. For example, Ministry of Health, Labor, and Welfare (MHLW) labor policy is related to the improvement of individual skills, while Ministry of Internal Affairs and Communications information and communication policy pertains to access to information.

Therefore, science, technology, and innovation policy relates to a wide range of other policy areas, and is characterized by the fact that more policy areas (i.e., ministries) become related to it as we move from science policy to technology policy to innovation policy. In other words, while science policy can be implemented largely independent of other policy areas (i.e., ministries and agencies responsible), innovation policy involves almost all the ministries and agencies of central government, increasing the importance of the overall coordination function across policy areas (i.e., ministries and agencies responsible). That is to say, within Japan's administrative structure, the Cabinet Office is responsible for the overall coordination of policies.

The Japanese government is not oblivious to these characteristics of science, technology and innovation policy, and has been reforming its administrative structure. A past example is the Science and Technology Agency, which was established by the Prime Minister's Office in 1956. One of the roles of this administrative agency was the general coordination of affairs relating to the science and technology of relevant administrative agencies, and it remained in place until the 2001 reorganization of central government, that is, the Hashimoto Administration's reforms. With the reorganization of the central government, the overall coordination of the affairs of relevant administrative agencies—the core function of the agency—was transferred to the Cabinet Office, which established the Council for Science and Technology Policy. Moreover, the Act for Establishment of the Cabinet Office was amended in 2014, adding administrative duties relating to the development of an environment for creating innovation to the Council for Science and Technology Policy, which was expanded and reorganized into the Council for Science, Technology and Innovation. In light of the growing importance of innovation policy in addition to science and technology policy, the Cabinet Office has strengthened its overall coordination functions.

Essentially, while steady progress has been made in the development of the administrative structure, the challenge for the implementation of future science, technology and innovation policies is to put these administrative reforms into practice.

References

Gault, F. (2011). Developing a science of innovation policy internationally. In Fealing, K. H., Lane, J. I., Marburger III, J. H., and Shipp, S. S., editors, The science of science policy handbook: Innovation and technology in the world economy, 156–182. Stanford University Press.
https://www.sup.org/books/title/?id=18746

Lundvall, B.-Å. and Borrãs, S. (2005). Science, technology, and innovation policy. In Fagerberg, J., Mowery, D. C., and Nelson, R. R., editors, The Oxford handbook of innovation, 599–631. Oxford University Press.
http://www.forskningsdatabasen.dk/en/catalog/2389367317

Okamura Asako, Shineha Ryuma, Nozawa Satoshi, Hara Yasushi, Fukuya Takeshi, Kobayashi Shinichi. (2013). Kagaku gijutsu inobēshon seisaku kenkyū no yōsō (Tokushū: Kagaku gijutsu inobēshon seisaku no kagaku) [Science, technology, and innovation policy aspects (Special issue: The science of science, technology, and innovation policy). Research and Technology Planning, 28(1):9–50.
https://www.jstage.jst.go.jp/article/jsrpim/28/1/28_KJ00008954045/_article/-char/ja/

Kiyoshi Takao, Ito Shuichiro, Kitayama Toshiya (2015). Kōkyō seisaku-gaku no kiso [Foundations of public policy studies]. Yuhikaku Books, Tokyo.
http://www.yuhikaku.co.jp/books/detail/9784641184282