Science & Innovation for Global Sustainable Development

- Capitalization of Science to Socio-Economic Value

Nobuo Tanaka
Director for Science, Technology and Industry
Organisation for Economic Co-operation and Development (OECD), Paris, France
Japan

Yoshiaki Tojo
Head
Economic Analysis and Statistics Division, Directorate for Science, Technology and Industry
Organisation for Economic Co-operation and Development (OECD), Paris, France
Japan

1. Challenges facing the innovation system in Japan

Innovation performance does not match the high level of input

Japan recorded the third highest R&D intensity in the OECD area at 3.1% of GDP in 2004, compared with 2.7% in the United States and 1.9% in the EU15 (Figure in page 3, line 1~4). Japan's high ranking is primarily due to the business sector, whose R&D intensity was also the third highest in the OECD, accounting for three-quarters of total R&D expenditures. On the funding side, business-sector financing of R&D – at 2.4% of GDP – was considerably above the OECD average of 1.4%, while government financing of R&D matched the OECD average (0.7% of GDP).

Japan had the third highest number of researchers relative to total population in the OECD area (line 5), with 10.4 per thousand in 2003, compared with 9.3 in the United States and 5.8 in the European Union. As with R&D spending, about three-quarters of researchers are in the business sector. The expansion of higher education enrolments has also boosted human capital in Japan (line 6): tertiary-level graduates as a percentage of total employment was the second highest in Japan at 41% in 2003, compared with an OECD average of 29%. Moreover, the proportion of tertiary degrees in science and engineering (line 7) is above the OECD average of 26%.

The overall output from investment in innovation has not been commensurate with the large amount of inputs. While Japan's contribution to global patenting is large relative to its population (line 9) and R&D efforts, a large proportion, as much as two-thirds according to a recent study, is idle – so-called "sleeping patents". Although its production of scientific articles is growing rapidly, Japan's share of 9% of the world total in 2001 was well below its contribution to global R&D and patents. Japan ranks slightly below the OECD average in the number of scientific articles per population (line 8), even after adjusting for the number of citations. Regarding basic research, the Japan Science Council estimates that efficiency in public R&D in the four priority areas (life science, information technology, environment, and nanotechnology and materials) is around half of that in the United States and major European countries.

According to a survey of firms in Europe and Japan, the proportion of Japanese companies reporting success in innovation during 1999-2001 is only 22%, well below the EU average of 41% (as of 1998-2000), although there is a need for caution in evaluating such survey results. There is evidence that the impact of R&D on the economy has weakened during the past decade. A study by the Cabinet Office found that the

efficiency of private-sector R&D declined during the 1990s. Although economic stagnation and structural problems during the post-bubble period, notably in the financial system, plays substantial role in declining MFP growth during the 1990s, the fact that Japan recorded a decline in MFP growth despite higher R&D spending suggests that its investment in innovation was less efficient.

Factors explaining the low return on innovation input

Important factor to foster good management for successful innovation is framework conditions, which include efficient financial system, sound product market competition, and openness to the internationalised production and R&D. Here Japan shows its weakness costing her failure in transition of the innovation system to the global standard.

Japan is weak in a risk-taking culture and entrepreneurship

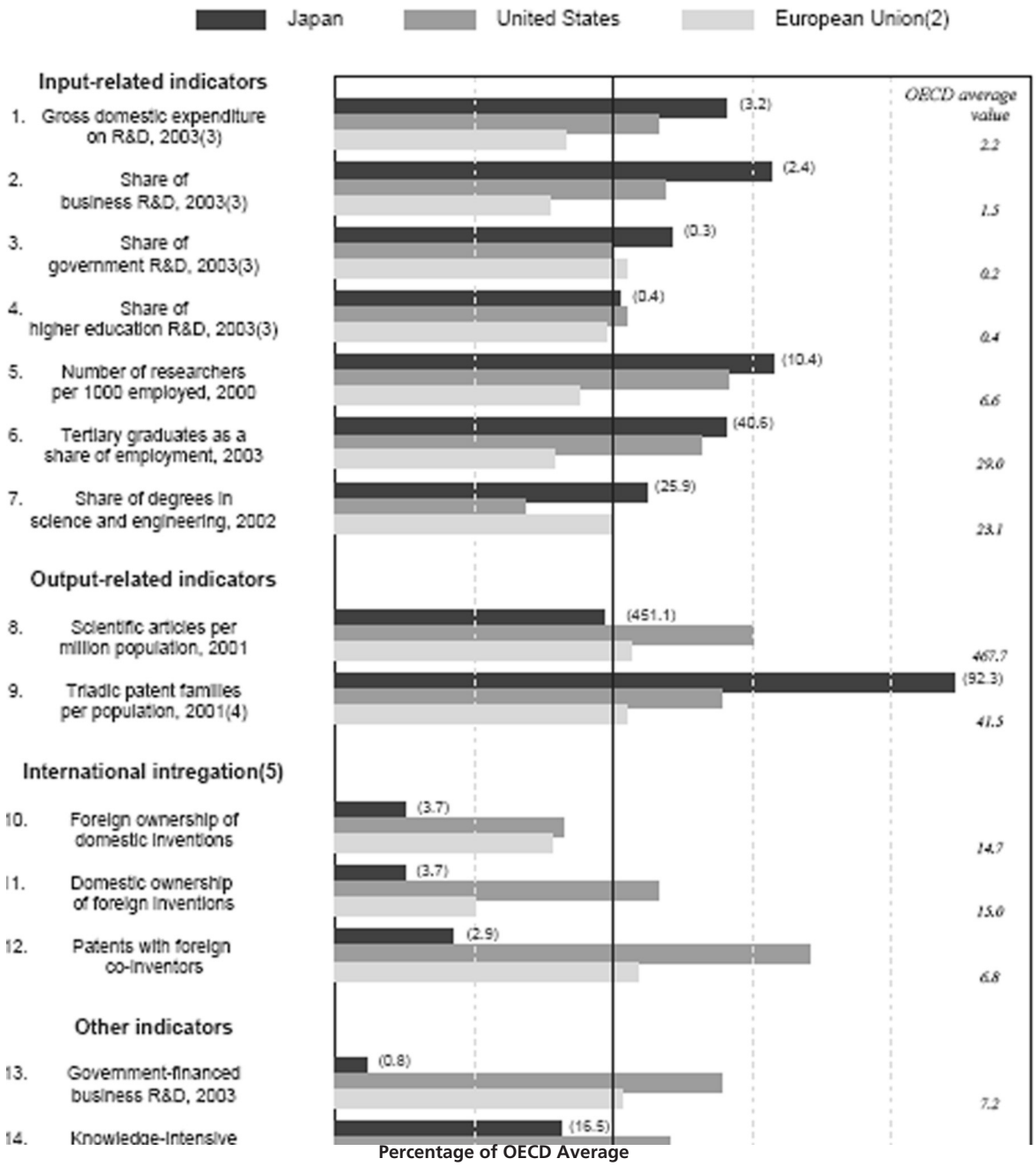
Venture capital investment and entrepreneurship is exceptionally weak in Japan. Venture capital investment as a share of GDP is the second lowest among OECD countries (line 16). Business start-ups are also less frequent in Japan, accounting for 4% of firms compared with around 10% in Europe and 14.3% in the United States in the late 1990s. A recent study shows that the net contribution to overall productivity growth of the entry and exit of establishment during recessionary periods in Japan is smallest compared with preceding studies for U.S., Canada, the U.K., and South Korea. Slow progress in reforming regulations, especially in the service sector, has also hindered innovation and productivity growth.

Japan is the least active in international co-operation in R&D and patenting

During the period 1999-2001, Japan was the lowest in the OECD area in each of the measures of international integration (lines 10 to 12). Foreigners owned less than 4% of domestic inventions in Japan (line 11), well below the 12% level in the United States and the European Union. The share of patents with foreign co inventors in Japan was less than 3%. Foreign affiliates accounted for 4% of manufacturing R&D in Japan, substantially below the level of around 18% in the United States and the European Union. Japan is also isolated from international mobility of highly skilled human resources, ranks lowest among OECD countries in share of immigrants to total highly skilled population. Japan benefited from only 0.7% of migration streams directed towards OECD countries in 2001, while the United States and the European Union enjoyed 37% and 29% respectively.

Ties between the business sector and research organisations in the public sector are weak

Links between firms and research institutes in government and higher education are weak in Japan. For example, the share of government-financed business R&D in Japan was 0.8% in 2003 (line 13), the lowest in the OECD, compared with 7% in the European Union and 10% in the United States. The movement of researchers among institutes, an effective way to transfer knowledge and technology, is extremely low in Japan, reflecting rigid employment practices. The average number of job changes by researchers in Japan is 0.8 times during their career, significantly less than in some other countries, such as the Netherlands (3.5), Australia (2.6), Germany (2.0) and the United States (1.6). Of the academic researchers who changed jobs, 85% moved to another academic post and only 6% went to the business sector in 2003.



1. The year varies among countries. See the source for information on exact years for individual countries.
2. EU15 (line 1-9, 13-16). EU25 (line 10-12)
3. As per cent of GDP.
4. Patents filed in the United States, Europe and Japan.
5. During the period 1999-2001.

Source: OECD, Main Science and Technology Indicators 2006/1 (line 1-5, 9, 13)
Science, Technology and Industry Scoreboard 2005 (line 6-8, 10-12, 14-16)

Figure International comparison of Japan's innovation performance
OECD = 100, latest available year (1)

2. Upgrading innovation system in Japan

Since weakness of the innovation system in Japan lies not in aggregated level of R&D investment but its capacity to extract innovation output and economic value from it, government programmes to improve the national innovation system should be more focused on boosting value creation process in the business sector along with upgrading technology itself. This requires greater linkages among policies for science and technology on the one hand and a wide range of framework conditions, such as the product, financial and labour markets, and competition policy, and education on the other. Given that the core of the problem lies in the weak entrepreneurship and the relatively closed and self-contained innovation system, framework policies that improve the allocation of resources and open up research systems should be placed at the centre of reform.

Strengthening market institutions for risk capital and innovation activities

Institutional weakness in communication, evaluation and control of risks inherent to the innovation activities lies as the major factor behind this underperformance of risk capital provision in Japan. One way to diffuse best practices is to provide financial markets with sufficient and material non-financial information about intellectual assets, thereby improving the exercise of ownership rights and tightening the financial discipline of management and boards, with positive economic consequences. The evidence suggests that additional public disclosure would enhance capital market efficiency and stock market valuations are influenced by the extent and type of information on intellectual assets that is publicly disclosed.

Intellectual property rights (IPRs) aim to provide incentives to undertake R&D and inventive activities, but their impacts also differ substantially across sectors and largely depend on their use. Once firms develop and patent an invention, they can commercialise it themselves; alternatively, they can use the patent to attract external financing, license or sell it to third parties in exchange for royalties or freedom of action. It is important to accelerate market creation for transaction and capitalisation of intellectual property rights. IPR policies should also be well designed to give adequate rewards to innovation, while ensuring competitive pressures to encourage firms to create, implement and diffuse innovations.

Stronger competition also play key role in encouraging innovation activities and promoting the diffusion of technology and good management. Regulatory framework should be reviewed and reformed continuously in line with changes in technology and other factors, particularly in the areas of medical and social welfare services, while further strengthening competition policy.

Opening up self-contained innovation system and enhancing mobility of researchers and workers

Foreign R&D has a substantial impact on domestic economy thorough international spill-over. There is an estimate that buoying effect of foreign R&D on domestic output (output elasticity: 0.46) was more than twice as much as that of domestic business and public R&D (0.13 and 0.17 respectively) for 16 OECD countries in 1980-98. The impact of foreign-produced knowledge, however, depends upon openness of cross-border channels for recipient country as well as its capability to digest such knowledge. As R&D activities are increasingly internationalised, it becomes more important to ensure the openness of their country to for-

eign technology, through flows of goods, of people or of ideas, and ensure that firms have the absorptive capabilities needed of making the best of foreign technology. Japanese self-contained innovation system, having worked well in a catching-up era, should be modernised and internationalised to raise its efficiency. Japan should continue its commitment for opening-up its economy as well as facilitating worldwide economic integration through WTO rounds as well as FTAs / EPAs.

A lack of mobility of researchers is a key weakness of the innovation system in Japan, in part because it limits the scope of interaction between research institutes in the government, business and higher education sectors. It is thus commended to enhance the mobility of labour, including researchers, in part through increasing the portability of public and corporate pensions and reforming retirement allowances at public research institutes. Expand the use of open competition in hiring, performance-based pay and fixed-term contracts may also reduce "in-breeding" in public research institutes and universities. In addition to the mobility of researchers, relax employment protection on regular workers to facilitate organisational changes would allow firms to benefit more fully from introducing new technology.

Well-targeting innovation-specific policies and improving public-business linkage

In order to activate the technology diffusion market, scientific output must be well targeted and transferred widely and smoothly from the scientific sector to business sector. Universities and public research institutes should play a larger role in enhancing venture investment through a better match of their R&D base and business base. Further increase of competitive grants in the allocation of public R&D funds, accompanied by transparent and efficient evaluation system, shall be commended. Local governments, universities and public research institutes should be allowed more flexibility to strengthen links with the business sector to create efficient innovation cluster.