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Regionalisation of Innovation Policies and New University–Industry Links in Japan: Policy Review and New Trends

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Abstract *This paper examines developments in the governance of science and innovation in Japan, with a particular focus on the recent 'regionalisation' of innovation policies and policy support for new university–industry linkages. The paper charts the emergence of national funding programmes, greater institutional autonomy and the promotion of regional diversity. The paper presents two case studies to show how different regions have responded to the policy initiatives. The research suggests that there has been some movement towards regional diversity and the emergence of nascent regional innovation systems. However, questions remain as to the development and potential of truly regional governance structures for science and technology and the role of universities.*

Keywords: innovation; Japan; regions; university–industry links

Introduction

This paper discusses the regionalisation of innovation policies and university–industry relationships in Japan. Japan is traditionally known as a centralised country that has favoured the development of university–industry relationships at the national level, and has been seen as the archetypical 'national innovation system'.[1] More recently, however, efforts to promote regional innovation systems and the 'regionalisation' of science policy have been witnessed. This paper will review these trends and outline two cases which demonstrate the efforts underway in different regions.

Over recent years, the Japanese innovation system has been subject to widespread reform. This includes changes to the role of key ministries, changes to the decision making structures for science and technology as well as wide ranging reforms to the governance of institutions involved in scientific and technological research. In Japan, just as in many other OECD countries, policy makers and university administrators have embraced the discourse surrounding 'entrepreneurial universities' and have sought to promote university–industry links as a means to

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stimulate economic growth. One of the main reforms to achieve this has been to change the status of the national universities to 'corporate' entities. This has provided them with greater autonomy and independence for universities to become more entrepreneurial, responsive to regional and student needs, as well as more diverse and efficient.

There has also been a strong push to promote regional development in Japan. Following the passage of the Science and Technology Basic Law in 1995, local government has held responsibility for 'formulating and implementing policies with regard to the promotion of S&T corresponding to national policies and policies' and each of the three successive Science and Technology Basic Plans implemented since 1996 have contained a section which has outlined objectives for the regional level. Within this general framework, efforts have been made both to encourage local governments to become more efficient, to embark upon administrative reform through mergers, as well as develop their own economic base. National funding measures have been used on a competitive basis to support these objectives.

This paper will therefore review the extent to which the 'regionalisation' of national science and innovation policies has been accompanied by the emergence of new university–industry links. Emphasis will be placed upon: (1) the policy instruments used; (2) the level of organisational embeddedness; and (3) the ability of universities to coordinate innovation support policies. The paper is derived from original data obtained through interviews at ministries, universities and the secretariats of local cluster initiatives; government science, technology and innovation policy documents over a period from the mid-1990s; and other secondary data.

The structure of the paper is as follows. Following this introduction, the next section examines the current Japanese policy context surrounding the 'regionalisation' of science and innovation, including 'cluster' initiatives and policies promoting university–industry links. The following section then highlights the changing policy environment in which efforts have been made to improve university–industry links focusing on the codification of property rights. We then illustrate two emerging regional innovation systems whereby universities in each region are developing particular activities that seek to link global knowledge flows into their local area. In the concluding section, the nature and constraints of Japanese multi-level structures for science and innovation policies are discussed. The paper suggests that while policy has proceeded, there are still limitations in regional capacity for developing regional innovation systems due to human resource and infrastructural issues. The regional innovation system in Japan is still in a nascent phase.

Regionalisation of Science and Innovation and Changing Models of Local Economic Development in Japan

The term 'region' can be used in policy frameworks in different ways, with interactions transcending the boundaries of a particular region to link up with global, national and other regional systems.[2] Furthermore, clarification of the importance of the various mechanisms in different contexts that drive the development of regional innovation processes and identification of the specific nature of policy influence is essential. Therefore, an 'integrated view',[3] one that brings together both top-down and bottom-up characteristics of innovation policies, is necessary. The emerging regional governance of science and innovation can be seen as an on-going process for harnessing multi-level partnerships and multi-actor spaces,

and networking for local economic development rather than as a simple transfer of power from the central to the local and regional level.

In Japan, the regionalisation reform drive has come largely from the centre, which can be described as a form of 'top-down decentralisation'.[4] Traditionally, Japan is known to have developed broad national technology strategies with long-term scientific and technology goals. The literature on the Japanese innovation system suggests that national or corporate strategies have, until very recently, been the main focus rather than regional and local initiatives with a consequent dearth of literature on 'regional innovation systems'.[5] The Regional Innovation System (RIS) idea is therefore relatively new and, relative to the situation in European countries, has not received much attention in policy frameworks until very recently. Where discussion has proceeded, however, Abe observed that Tōhoku is seen as an example of a *dirigist* system of innovation where funding has been largely centrally determined, with a high level of co-ordination.[6] However, recent changes were observed where a new regionalisation of innovation has been observed.[7]

Regionalisation of innovation strategies began in the 1980s with the Technopolis program and the introduction of regional collaborative research centres at universities. The Technopolis program sought to create links between universities and local industry with prefectures becoming increasingly involved in supporting basic science and advanced technologies in addition to the traditional role of supporting standard technologies in technology-following small- and medium-sized enterprises (SMEs) via the *Kosetsushi* centres (public research institutes funded by local authorities).[8]

The local economic development model based on the framework of the Technopolis program served the purpose of promoting science in peripheral areas with the leading role played by central government. It acted as a departure point for the increasing regional sensitivity of national policies for science and technology. However, despite promising policy developments and aspirations, policy thinking did not generally serve the Technopolis program well in practice.[9] The evaluation of these initiatives in terms of their impact on local economic competitiveness varied, and some observers pointed out many constraints and limitations in terms of the development of locally embedded university–industry relationships. Local linkages within the Technopolis areas were not strong, partly due to the fact that most branch subsidiaries retained strong vertical links with their headquarters rather than opening up new production spaces for local firms.[10] Moreover, industrial policy instruments such as tax incentives, inexpensive loans, and large-scale infrastructure investments were most useful for large firms placing branches in the regions rather that stimulating new local start-up ventures.[11] Until recently, the development of bottom-up processes of regional governance of science and innovation with the multi-actor and multi-level structure remained constrained.

Local governments in Japan operate at sub-regional level, including 47 prefectures and 3,190 municipalities as of 2003. There is no formal institutional mechanism operating at the regional level as such in research policy and funding terms. The only exception to this structure is the existence of nine regional economic bureaus operated by the Ministry of Economy, Trade and Industry (METI) which oversee economic and industrial policies at the regional level across prefectures (see Figure 1). The nine bureaus are expected to develop plans, become nodes to coordinate local networking and alliances between prefectures to inform firms about central government aid schemes and to support the development of prefectures in the region.

Figure 1. METI regions.
Source: METI Regional Bureaus, 2005, available at: http://www.meti.go.jp/english/aboutmeti/data/aOrganizatione/keizai/regional/01.htm, accessed November 2007.

This lack of governance at the regional level has constrained the development and regionalisation of innovation and effective university–industry links in Japan. The role played by the METI regional economic bureaus in fostering collaboration and networks is acknowledged in the successful development of locally based clusters. Coupled with growing economic activities which encompass bounded local areas, the existence of the METI regional economic bureaus can be seen as an acknowledgement of an increasingly regional dimension to science and innovation policies.

More recently, emphasis has been placed on local government to develop greater autonomy from central government in order to generate greater distinctiveness. From 2004 the different regions were organised into distinct blocks which include members from regional government, central government regional agencies and members from the Japan Science and Technology Agency (JST)'s regional Plaza initiative. Until the mid-1990s, policies focused primarily on maintaining networks of SMEs in the manufacturing sector. However, given the ongoing 'hollowing out' of the manufacturing sector, such an approach was deemed insufficient. The new policy focus was targeted to creating linkages between different groups of actors including SMEs, large enterprises, universities and other research institutions, and promoting innovative capability of local production.[12]

Following the passage of the Science and Technology Basic Law in 1995, a special responsibility for local governments was explicitly set out, chiefly in Article 4 of the Law. More recently, Law 111 introduced in 2006 sought to give greater autonomy to

regional authorities and has sought to clarify the role and responsibilities of regional government and the promotion of greater reform towards distinctiveness at the regional level.[13] At the same time as greater autonomy for regional governments has been promoted, after the First Science and Technology Plan in 1996, various policies have also been put in place to support the emergence of regional research systems.

Since the end of the 1990s, through the implementation of 'local cluster strategies', complex patterns of inter-firm and inter-organisational relationships have been promoted at the local and regional levels, with universities being recognised as key players in generating the industrial competitiveness of the regions. Recent cluster policies in Japan include 17 Industrial Cluster Projects (Second Phase, 2006–10) promoted by METI (the Ministry of Economy, Trade and Industry, re-organised in 2001 from MITI), 18 Knowledge Cluster Initiatives promoted by the Ministry of Education, Sports, Culture, Science and Technology (MEXT), and the more recent, integrated 'Regional Cluster model'. Fostering the university–industry linkage represents a 'point of convergence' for MEXT with its remit in university issues and METI which is responsible for the industry agenda.

The Industrial Cluster Initiative implemented by METI, based on the so-called 'business approach' to innovation policies, aims at revitalising regional economies and promoting industrial accumulation through promoting networks between industry, university and public research institutes (for instance, through regional and D consortiums), and through supporting the creation of new businesses and new industries. The ultimate goal is to promote new business creation combined with existing local industrial strengths. While the financial scale of the Industrial Cluster Project is rather limited, it is expected that in implementing these activities, a variety of governmental subsidiaries and grants will be utilised.

The Knowledge Cluster Initiative supported by MEXT, based on the so-called 'academic approach' to innovation policies, was developed from existing policies for the promotion of science and technology activities in regions. The initiative aims to construct a 'regional system of technological innovation', based on industry–university–government collaboration by forming networks of Centre of Excellence (COEs) in regions. University–industry–government links have been promoted in 31 designated urban areas whereby starting up and developing of new industry unique for each region is encouraged. This policy initiative assumes a bottom-up approach, with action plans proposed by local governments rather than being imposed from above by central government.

University Reforms and University–Industry Links in Japan

Since the government of former Prime Minister Junichiro Koizumi took office in April 2001, educational reform has been greatly accelerated. Social pressure within Japan has been increasing since this time for higher educational reform. Furthermore, in *The World Competitiveness Yearbook* published by the International Institute for Management Development, Japan was ranked lowest among 49 economies surveyed with regard to 'university education meeting the needs of the economy'.[14]

In May 2001, METI proposed a plan for reforming universities as part of national industrial policy. In June 2001, the *Basic Principles for Structural Reform on Universities*, known as the *Toyama Plan*, was released by MEXT, in which the direction of further university reforms was delineated.[15] Three major changes were proposed: (1) the

reorganisation of national universities including the merger of some institutions; (2) the introduction of putative business methods to national universities through a process of 'incorporatisation'; (3) the introduction of competitive mechanisms into the university sector, including national, public and private universities.[16]

University–industry links, meanwhile, had proceeded on a largely informal basis up until the mid-1990s.[17] University invention committees determined whether a technology should belong to the nation or whether the intellectual property should be held by the researcher, and many universities failed to fully exploit their intellectual property. This system was seen as relatively unpopular and inefficient by some[18] with technology transfer proceeding through a donation based system using a give and take relationship between firms and university faculty.[19] However, while bibliometric analysis suggested that the number of links were significant, and that the system was 'fast and low cost',[20] many university technologies granted to firms were underexploited with most interaction taking the form of basic science issues or narrowly defined tasks.[21] Motivated by efforts to reverse this situation as well as through observation of the success of the US economy throughout the 1990s, a number of policy measures were introduced that have gradually formalised the Japanese innovation system and introduced organisations and a more legal structure to transfer activities (see Table 1).

Legal frameworks to promote university–industry technology transfer were enacted from 1998, and 44 Technology Licensing Organisations (TLOs) have been established as of 2007, either as private companies, non-profit corporations or embedded within a university.[22] Some TLOs serve one university while others serve a number such as Tōhoku TechnoArch, which serves 11 regional universities. As corporate bodies, universities are now able to own and manage their intellectual property rights (IPRs). The incorporation of the National Universities in 2004 has seen many universities seek to develop stronger local links and has also allowed universities to reform their institutional structures.[23] Since 2003, 43 universities have received financial support from the government to set up 'Headquarters for Strategic IP Management' so that each institution can deliver its own policy for income generation based on their IPRs. In practice, many institutions have difficulties in setting appropriate mechanisms linking university departments, TLOs and such new IP Headquarters to develop a licensing culture within the university itself.

While the number of patent applications increased following passage of the Technology Transfer Law in 1998, from 2006 the number of applications began to decrease. Against this background, it has been pointed out that for each university the income balance from intellectual property related activities has been modest,

Table 1. Japanese reform processes and legal–institutional frameworks towards university incorporation

1998	The Administrative Basic Law
1998	A report 'The Image of Universities in the 21st Century' by the University Council
1999	National Institute for Academic Degrees and University Evaluation (NIAD–UE)
2000	Block grant system introduced
2001	Independent Administrative Institutions (IAIs)
2001	A reform plan for universities known as the 'Toyama Plan'
2001	Centre of Excellence scheme
2003	The National University Incorporation Law
2004	Incorporation of the national universities

per case the processing time has been short with insufficient searches; and management mistakes have enlarged the problems faced by university TLOs; some excessive staffing issues and barriers have made the importance of amending the intellectual property exploitation strategy desirable.

Also, there have previously been very few economic incentives for Japanese academics to engage in licensing and other entrepreneurship activities. Disincentives for such activities arose from significant administrative, agent-related, maintenance and negotiation costs. MEXT has created a budgeting scheme whereby national universities promoting university–industry co-operation and patenting can be allocated additional funds.[24] To further open the university system to society, a law prohibiting the exchange of personnel between universities and industry was amended in 2000 which facilitated national university faculty members to work as consultants with private companies.

The Japanese government has supported new spin-off company creation from universities through de-regulation and by providing subsidies to R&D activities. In 2001, the *Hiranuma Plan*, aimed at increasing 'venture businesses born in universities' was launched, targeting to 'create 1,000 within three years'. In the data provided by MEXT, as of 2000, there were 127 new enterprises spun-off from universities, which compared to 368 in the US and approximately 200 in the UK. By 2001, this number had risen to 251, to 424 in 2002 and as of 2003, the creation of 614 small businesses could be attributed to Japanese universities (see Figure 2).

Kneller points out that many of the university start-ups are virtual companies with low invested capital, sales and numbers of employees.[25] However, some of these start-ups draw on the research of major university laboratories and networks of researchers that span several universities. Some of the most successful start-ups, in terms of market capitalisation following initial public offerings (IPOs), owe their success largely to the laboratories from which they arose and to the researchers in those university laboratories.[26]

The increasing importance of 'science-based industries' such as life sciences, information technology (IT) and nanotechnology, with strong linkages with scientific research activities as their main feature reflects the increased contribution of academic research to industrial innovation.[27] A recent survey conducted by RIETI gives an overview of R&D collaboration between firms and universities.[28] Although Japan's national innovation system is characterised by a focus on in-house R&D conducted mainly by large firms, the survey results show that external collaboration in R&D efforts is becoming fairly widespread. One of the most common routes of the information flow from academic research to industrial innovation is through the publication of papers. However, university–industry links take a

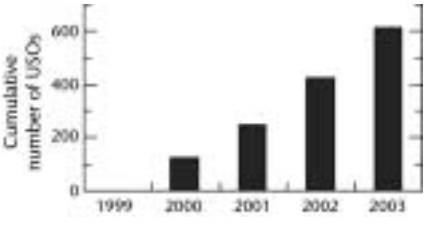

Figure 2. Cumulative number of university spin-off firms.
Note: USO=university spin-off firms.
Source: adapted from Motohashi, *op. cit.*

variety of forms such as joint research, consultation, commissioned research as well as licensing and spin-out. Figure 3 shows the style of university–industry collaboration by size of firms.

Large firms primarily use such collaboration with universities for joint research projects aimed at strengthening their in-house technological capabilities and achieving long-term benefits, while a higher percentage of SMEs capitalise upon technical consulting and take part in joint R&D targeting projects which are closer to the final product stage.[29] Among the key actors in this respect are technology-based, R&D focused SMEs which can tap into external alliances such as university–industry collaboration thus linking knowledge 'exploration' and 'exploitation' systems.

Emerging Regional Innovation Systems in Japan

This following section provides two short regional case studies to illustrate the roles of universities in linking local innovation with global knowledge flows within the emerging regional innovation systems. Both regions have seen a growth in the number of links between universities in the area and regional firms, however, these links have tended to be by the smaller regional universities rather than the main former imperial national universities, which have developed stronger national links.[30] The former imperial universities in each region are developing their own links on a national and international level.

The Kyushū Region

The Kyushū region consists of seven prefectures (Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki and Kagoshima). Fukuoka is a prefecture with a population of five million as of the year 2000. Fukuoka prefecture has served as the cultural and economic centre of Kyushū Island, accounting for 40% of the total population and production output in Kyushū. The annual economic activities in the prefecture amount to US$150 billion, and the level of economic activity in the Kyushū region

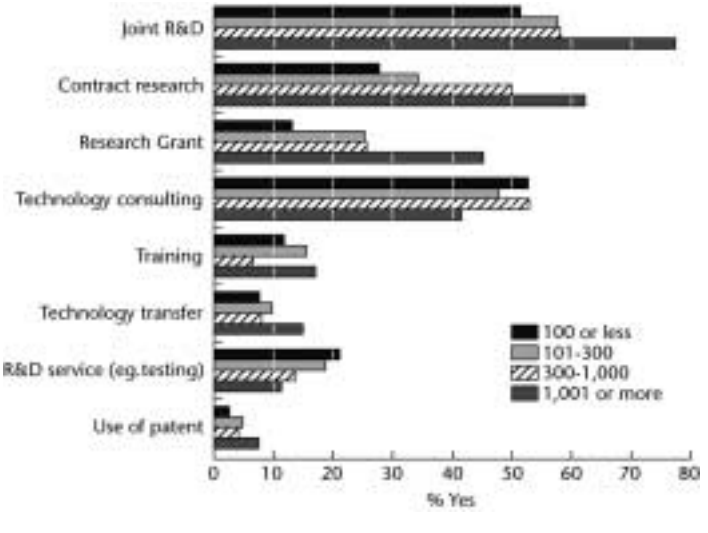

Figure 3. Style of university–industry collaboration by size of firms.
Source: adapted from Motohashi, *op. cit.*

as a whole is estimated to be the equivalent of that of South Korea. The area has a good human resource supply with Fukuoka having the second largest number of students per head after Tokyo. In Fukuoka metropolitan area, there are 12 Science and Technology Universities and seven junior colleges, and 19 technical colleges specialised in information studies.

Kyushū has been known as 'Silicon Island' since the 1960s. Kyushū is now home to 366 semiconductor-related factories, whose production output in 1999 was 1,095 trillion yen or 31.2% of the total output for this sector in Japan. Fukuoka prefecture has recently developed its semiconductor industry with System LSI (Large Scale Integration) as a major product, which is essential for hardware development in promoting Japan's IT revolution. The recent 'Silicon Cluster Initiative', designated by the METI Kyushū regional bureau, builds on the semiconductor industrial agglomeration which has been growing in the region over the last three decades, aiming at enhancing the international competitiveness and R&D functions of the sector. This network involves about 150 firms, 42 universities, higher education institutes and public research institutes, 17 local governments and five financial agencies. There are a number of financial, technological and operational support schemes to System LSI-related venture companies, and other related R&D firms to create frontier businesses. At the municipal level, the cities of Fukuoka and KitaKyushū have formed the Greater Kyushū Knowledge Cluster, which is funded by MEXT and focuses on IT. Another area where the Kyushū region has strengths is in environmental technologies due to its history as an important centre of heavy and polluting industries such as steel. In KitaKyushū Science Park, there is a joint initiative between four universities (including a private research university from Tokyo, the KitaKyushū Municipal University and the Kyushū Institute of Technology), eight research centres and 44 firms. There are also a number of foreign university research centres located in the Park. This Science Park was initiated by the strong leadership of local government, and it is managed by the city's Foundation for the Advancement of Industry, Science and Technology (FAIS).

Aiming at the expansion of the market of new-generation industries in Kyushū, such as IT and the environment industry, a new local agency, Kyushū Economy International (KEI), provides opportunities for industrial exchanges with foreign enterprises, and assists in the establishment of business partnerships with enterprises overseas. In order to form the international network of human resources in industry in Kyushū, KEI promotes and encourages internship and training projects between overseas students and trainees of Asian nations and enterprises and economic organisations in Kyushū.

In the city of Fukuoka there is a special structural zone, 'Fukuoka Asian Business Special Area', where deregulation measures have been granted by the central government to promote the city as an important business hub in Asia. Some of the measures include:

- encouraging foreign skilled workers by giving longer visas for foreign researchers and IT technicians, and special visas for students taking night courses at graduate schools;
- promotion of start-ups by foreign researchers; and
- attracting and supporting foreign firms that invest in the region.

Transnational region-wide initiatives have already taken various forms, sometimes with universities as the main participants. For example, Kyushū University is

the largest research university in the Kyushū region and since its 'incorporatisation' under the university reform initiatives in April 2004, it has launched a new strategy to liaise with Asian nations. There are also new forms of university–industry linkages developing. For instance, Kyushū University has reached an alliance with the Development Bank of Japan to develop strategic international collaborations encompassing Asian nations. The university has established research links in the semi-conductor field within Kyushū region, together with the Shanghai area in China, and the Hshinchu high-tech area in Taiwan. This international network is now called the Fukuoka Silicon Seabelt project, encompassing a wider range of Asian regions, industry associations and local governments and venture capital enterprises.[31] Kyushū University's Intellectual Property Management Centre is working collaboratively with Shanghai Jiao Tong University in China to promote university–business links in Kyushū and Shanghai, matching business needs and university expertise. The university is also working closely with the Industrial Technology Research Institute (ITRI) in Taiwan in developing international knowledge transfer. The university's internationalisation strategy explicitly identifies developing links with Asia, building up centres of excellence in research, establishing international university–industry links in partnership with local authorities and industrial associations as major activities. Overall, it appears that a new model of university–government–industry alliances, inter-cluster networking, and entrepreneurship in Kyushū is emerging with links into Asia.

The Tōhoku Region

The Tōhoku region consists of six prefectures (Aomori, Iwate, Akita, Miyagi, Yamagata and Fukushima). Tōhoku region has recently suffered from a shrinking 'branch economy', especially through the shift of factories overseas and a reduction in public sector employment. However, there has long been a recognition that important technological and intellectual seeds exist in the region, and the momentum for university–industry–government collaboration has increased since the mid-1990s. The TICP (Tōhoku Intelligent Cosmos Plan) is a regional R&D project jointly initiated in 1987 by the leading industrial, academic and administrative bodies of the entire region. It has promoted the creation of bases for advancement of industrial technology and the enhancement of information functions, technological capacity and academic expertise. The goal of the TICP is to lead the Tōhoku region into being a base for R&D activities and a hub for research and industrial development in Japan. An advanced industrial structure was foreseen where traditional, region-based industries and leading-edge industries could coexist and prosper in close relationship. Three supporting bodies have been set up to implement the Tōhoku Intelligent Cosmos Plan.

First, we are concerned with the measures taken by the city of Sendai. Sendai lies in Miyagi prefecture and is seen as a knowledge hub in the region. It is the largest city in Tōhoku with a population of around one million, and home to Tōhoku University, one of the largest research universities, which carries out a number of large budget research projects. In total there are 13 higher education institutions within the city, many having strong university–industry links. The city has promoted international university–industry linkages with a focus on strategic areas such as IT, health and welfare, environment and advanced technology. For example, the city has set up a 'Sendai–Finland Wellbeing Center Project' in collaboration with Finland, an advanced IT and welfare country. This project aims to create

new businesses in the field of value-added welfare equipment and services with the joint efforts of companies both in Finland and in Sendai.

Second, at a wider regional level, the Council for Tōhoku regional industry promotion has been set up by the regional office of METI and includes six prefecture governments, the city of Sendai and various industrial associations. The main activity of the Council is to promote investment in the region with a focus on high technology.

Third, in 2004, the MEMS (Micro Electro Mechanical System) Park Consortium was established in Sendai. The city mayor, the governor of Miyagi prefecture, the Director of the Japan Investment Bank in Tōhoku, the METI Tōhoku Bureau Director, and the President of Tōhoku University, along with representatives from the private sector, have worked together to set up this consortium. The MEMS Park Consortium is trying to link basic research to applied products with financial support for R&D. Recently, the city of Sendai has made a Memorandum of Understanding with the German Fraunhofer Association to advance MEMS technology and R&D activities.

Conclusion

This paper has examined recent Japanese experiences for the decentralisation of science and innovation. It has reviewed some of the policy initiatives and ongoing institutional developments that have triggered a rapid transformation of science and technology and innovation policies.

With industrial change and recent government policy shifts (following the 1995 enactment of the Science and Technology Basic Law) the structure and financing of science and technology activities in Japan has experienced profound change. This can be characterised as a tendency towards: (a) a gradual 'regionalisation' of innovation policies through decentralisation of science and technology governance; (b) a dynamic innovation process with science-based industries (SBIs) with a strong emphasis on new university–industry links; and (c) the emergence of interdependent multi-level innovation systems.

The principal question remains whether or not the recent Japanese 'top-down' regionalisation of science policy has led to new regional governance arrangements, involving the construction of multi-level and multi-actor innovation systems. The two case studies discussed above suggest that the regionalisation of innovation policies in Japan since the 1990s has seemingly led to the emergence of new university–industry relationships and new spatial relationships of innovation. It appears that there is a growing interdependence between innovation systems at different levels of scale rather than either national or regional/local scales being predominant. However, the new trends also represent challenges for policy makers and innovation support organisations.

In light of ensuring the sustainability of innovation systems in Japan, closer attention needs to be drawn to the uneven economic, human resource and institutional infrastructure within the national system as a whole. Thus reservations have been expressed about the capacity of universities in peripheral areas given the high concentration of existing R&D efforts in core academic institutions such as the University of Tokyo and other former 'imperial' universities. However, the results of our analysis indicted that former imperial research universities, such as Kyushū and Tōhoku universities, have played important roles in linking local innovation to global knowledge flows, and strengthening regional innovative capabilities. Wider

structural problems include how to meet skill shortages in peripheral regions given greater employment opportunities in the national industrial heartland. Especially in local contexts, universities have to recognise the role of existing links between universities, public research institutes and local business.

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23. L. Woolgar, 'New institutional policies for university–industry links in Japan', *Research Policy*, 8, 2007, pp. 1261–74.
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27. H. Odagiri, 'Advance of science-based industries and the changing innovation system of Japan', COE RES Discussion Paper Series, No. 64, June 2004.
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29. *Ibid.*
30. National Institute for Science and Technology Policy (NISTEP), *Triple Helix in Local Areas: Local Innovation Systems and National Universities,* March, NISTEP, Tokyo, 2007 (in Japanese).
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