Association and Political Change in the Japanese Bio-Industry

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Abstract

In this paper I analyze the structure and functions of associations in the Japanese bio-industry, and their role in the change of industrial policy. Elaborating on Jessop's governance approach, I hypothesize that associations in the high-technology industries organize in the form of a governance system, rather than a corporatist system. Drawing on empirical analysis, I conclude that a governance system based on "forums" has been established, and it is promoting change in the Japanese industrial system.

Keywords

Governance, forums, associations, biotechnology, bio-industry, bio-policy, innovation, political change

Contents

1 Introduction

In the 1970s and 1980s Japan showed a comparatively high capacity to manage the decline of mature industrial sectors (like textiles and shipbuilding), and at the same time promote the development of new industries (like cars, machinery, and electronic devices) with high

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international competitiveness. Because of this, foreign researchers have studied the Japanese social systems that were supposed to be the basis of that capacity. Thus, among others, the subcontracting system, the company group system, and the relationship between industry and government were analyzed in order to find measures that could be applied abroad. All those systems have characteristics that reduce the role of the market, promote long-term cooperative relations, reduce uncertainty and collectivize risk and decisions.

However, during the 1990s a tremendous change occurred. While many Japanese companies were moving their plants abroad and cutting jobs at home, Japan was falling behind its industrial competitors in the development of new industries, like the IT industry and bio-industry, and now it was Japan that was looking abroad for recipes to transform its economy.

On a more theoretical level, we can say that those “rigid” social relations systems (Dore, 1986) were functional to satisfy the requirements of the industrial technology and international economic system of that period. In other words, they were suited to the accumulation system in a specific period in the transition process from Fordism to post-Fordism. However, at present, those systems would not be functional for the accumulation system in a further step in the development of post-Fordism, characterized by globalization and the increasing technological and scientific base of industry. Then, the problem that must be considered here is whether or not the Japanese system of relations between industry and the state is able to modify other social systems in order to make them functional for the new economy, and to reform itself if necessary in order to remain efficient.

According to the theory of neocorporatism, the associational structure of corporatism generates incentives for companies to cooperate with each other and with the state in order to create efficient industrial policies and adapt industry to economic and technological changes. However, from the point of view of Jessop's theory of governance, neocorporatist structures would be too hierarchical to be able to promote the wide participation, exchange of information, and organizational flexibility necessary to promote industrial innovation and international competitiveness. Thus, the creation of new organizational forms, which promote participation in horizontal power relations, is required.

The objective of this paper is to test the hypothesis that in industrial sectors based on new technologies neocorporatism would introduce inefficient rigidities, and thus it is more probable that associations in those sectors develop a more horizontal system, which promotes the cooperation and flexibility needed for industrial innovation. To this end, I analyze the associational structure of the Japanese bio-industry and its relationship with industrial policy change. I conclude that this associational structure has evolved from the mid-1990s to constitute a system of governance formed by “forums”, which are promoting change in industrial policy and other sub-systems in the Japanese industrial system in order to promote the development of bio-industry. This governance system, at the same time, is modifying itself in order to be efficient in this new economic context.

2 Associational system in the Japanese bio-industry

2.1. The theoretical view

According to the theory of neocorporatism, there are two possible systems of interest intermediation between companies and government: corporatism and pluralism. What distinguishes one model from the other is the associational structure of business interest associations–i.e. intra-organizational structures and inter-organizational structures–and their relationship with the state.

In neocorporatism, the inter-organizational structure is that of a pyramidal hierarchy. Associations representing different interests of companies in a sector are members of a superior-ranking association, and depend on this association's capacity to access state policy-making, and/or on this association's services. Similarly, at intra-organizational level the sections representing different interests in an association are structured in a pyramidal hierarchy. Lower-ranking sections depend on higher sections' resources and access to the decision-making process. Because of this associational structure and the restriction of access to policy-making to the associations of higher rank, in corporatism the membership–both associations and individual companies–becomes dependent on the top bureaucracy of the associational system. In other words, the associational structure establishes incentives for members' compliance with the associations' decisions. Thus, there is a top-down structure of power that allows associations to manage the conflict between different interests of the membership, and impose on them measures that are supposed to promote the general interests of the industrial sector, acting as *private interest governments* (Schmitter and Streeck, 1981; Streeck and Schmitter, 1985; Coleman, 1988). Since this system promotes negotiated cooperation in policy-making between industry and the state, it is supposed to be able to generate efficient industrial policies, and thus promote industrial adaptation to economic and technological changes (Katzenstein, 1985).

Contrasting with corporatism, in pluralism the associational structure is flat, associations are not integrated into other associations, and thus they represent narrow interests. The non-existence of higher-ranking associations, or their dependence on the membership (rather than the dependence of this on the association's top bureaucracy), has the consequence that conflicts between different interests are not managed and consensus between companies in a sector is difficult to reach. Because of this, associations compete with each other to influence the government's policy-making. They do not become incorporated into the policy-making process by cooperating with the government, rather just exercise pressure on it.

From the point of view of the theory of neocorporatism, a corporatist system would be suitable to create and implement industrial policies necessary for the development of new high-technology industries. By the same token, a pluralist system would not be able to promote the exchange of information, cooperation, generation of a general strategy, and so on, necessary for the promotion of the new industry.

The governance approach, however, offers a different model of relations between groups in a

society and the state, one which does not conform to corporatism or to pluralism. According to Jessop's (1997) governance approach, the governance system consists of the coordination between social groups and promotion of wide interests through a network system of horizontal, rather than vertical, power relations. The governance approach, rather than emphasizing the power relations between associations and their membership, and between associations and the state, emphasizes communication, negotiations, and participation in the decision-making, among several actors in a society and the state, in order to discover new common interests and promote cooperation. The wide participation of actors from different parts of the society in this system is considered to promote the coordination among different interests and different policies, making possible the agreement and implementation of a general economic strategy. In this system the state's action, rather than imposing policies on the society, is more oriented to support the participation of social groups in the policy-making process, to enable them to decide and implement policies by themselves (Andersen and Kjaer, 1993; Jessop et al, 1993; Jessop, 1997).

In this system, associations neither compete with each other as pressure groups, nor impose top-down decisions on dependent members. Associations act as forums and as forum organizers and participants (Valls, 2001). On the one hand, associations establish a place where members from different parts of the society and the state can meet, communicate, negotiate and cooperate in specific projects. On the other hand, associations meet in wider forums with other associations in order to communicate, negotiate and cooperate. Differently from corporatism, the participation in associations and compliance with their decisions is more voluntary. Thus, the incentives for the promotion of cooperation among the membership, and with the state, are different from those in corporatism. Here the incentive is not the dependence on the association, but the consideration of the maximization of members' own interests. This implies that the participants in such "forums", with their mutual interaction, realize the mutual interdependencies, complementarities, and benefits of the development of cooperative projects. The realization of these mutual interdependencies, and the association's activity promoting the interaction, also prevent the system's fragmentation into pluralism.

Here below, I describe the structure, interrelations, and functions of associations in the Japanese bio-industry. I argue that the associational system does not conform to the neocorporatist type or to the pluralist type, but that they are "forums" constituting a governance system.

2.2. Inter-organizational structures

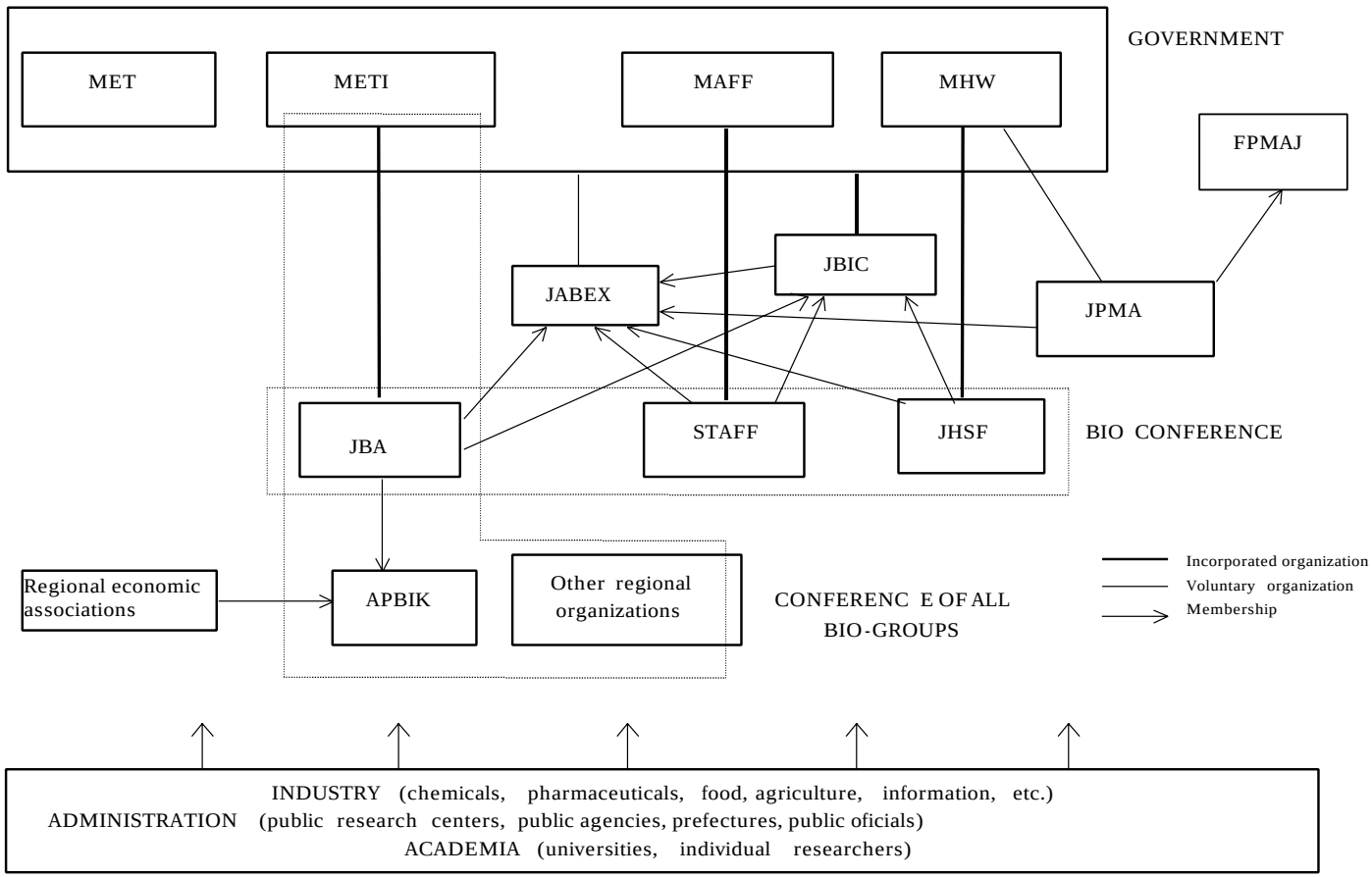
When the Ministry of International Trade and Industry (MITI / METI)[1)] officially targeted biotechnology as a new industry to foster, it asked the Japanese Association of Industrial Fermentation (JAIF) to organize a section dedicated to biotechnology. This was founded in 1983 as the Bio-Industry Development Center (BIDEC). In 1987 BIDEC and JAIF merged into the Japan Bio-industry Association (JBA), an incorporated foundation, with the aim of promoting

Table 1. Bio-industry associations in Japan

	Year of foundation	Membership	Resources	Related agency and type of relation	Aims
National level					
Japan Bio-industry Association (JBA). 財団法人バイオインダストリー協会	1983, 1987	・Industry: 241 companies from many sectors ・Administration: 75 public organizations ・Academia: 1,252 university researchers	・Budget: 2,374 million yen ・Staff: 37 ・Direction: 48	・MITI (METI) ・Incorporated foundation	Promotion of all bio-industry (old and new), international representation, standardization
Society for Techno-innovation of Agriculture Forestry and Fisheries (STAFF). 社団法人農林水産先端技術産業振興センター	1990	・Industry: 137 members from different sectors (including 4 regional cooperatives and the national agriculture cooperative) ・Administration: 47 Prefectures ・Academia: 13 university researchers	・Budget: 4,510 million yen ・Staff: 129 (including its research center) ・Direction: 21	・MAFF ・Incorporated association	Promotion of biotechnology, and other advanced technologies, related to agriculture, forestry, fisheries, and food industries, and research
Japan Health Sciences Foundation (JHSF). 財団法人ヒューマンサイエンス振興財団	1984, 1986	・Industry: 145 companies, in the pharmaceuticals, chemicals, medical devices, and textile goods sectors	・Budget: 4,500 million yen ・Staff: 15 ・Direction: 48	・MHW ・Incorporated foundation	Promotion of basic and applied research in the health sector, and research
Japan Pharmaceutical Manufacturers Association (JPMA). 日本製薬工業協会	1968	・Industry 83 research-oriented pharmaceutical companies	・Budget: 726 million yen ・Staff: 32 ・Direction: 40	・MHW ・Voluntary association	Promotion of the pharmaceutical industry oriented to research
Japan Biological Informatics Consortium (JBIC). 社団法人バイオ産業情報化コンソーシアム	1998, 2000	・Industry 79 companies related to biotechnology (many sectors), electronics and information industries	・Budget: 4,470 million yen ・Staff: 7 ・Direction: 24	・4 ministries ・Incorporated association	Promotion of bioinformatics, analysis of SNPs and proteins, data base management
Japan Association of Bio-industries Executives (JABEX). 日本バイオ産業人会議	1999	・Industry: 64 individual members related to modern biotechnology ・5 representatives of bio-industry associations ・5 directors of public research centers ・54 presidents of companies in many sectors	・Budget: n.a. ・Staff: 4 (JBA) ・Direction: 17	・Government ・Voluntary association	Represent modern bio-industry in front of the government
Regional level (*)					
Association for the Promotion of Bio-Industry in the Kinki Region (APBIK). 近畿バイオインダストリー振興会議	1985	・Industry: 68 companies from many sectors ・Administration and other organizations: 20 members from local administration and economic associations ・Academia: 20 university researchers	・Budget: 23.8 million yen ・Staff: 1 ・Direction: 5	・METI-Kinki, local and regional administration ・Voluntary association with official recognition	Promotion of the cooperation among industry, academia, and regional administration for cooperative R&D projects, technology transfer, general support to bio-industry

(*) Other regional associations are the Hokkaido Bio-Industry Association (HOBIA), Association for the Promotion of Bio-Industry in Toyama Region (APBIT), Chubu Bio Forum (CBF), Senri Life Science Foundation, Tohoku Bio-Industry Promotion Association (TOBIN), Chugoku Bio-Industry Techno Forum, Shikoku Environment Bio Salon, Kyushu Industrial Technology Center - Bio-Industry Forum, and so on
Sources: Home page of every association (2001); JBA (2000); MHW (2000); Tsuba (2001)

Figure 1. Associative structure of the Japanese bio-industry



MET: Ministry of Education and Technology, METI: Ministry of Economy, Trade and Industry, MAFF: Ministry of Agriculture, Forestry and Fisheries, MHW: Ministry of Health and Welfare
JBA: Japan Bio-industry Association; STAFF: Society for Techno-innovation of Agriculture, Forestry and Fisheries; JHSF: Japan Health Sciences Foundation; JPMA: Japan Pharmaceutical Manufacturers Association; JABEX: Japan Association of Bio-industries Executives; JBIC: Japan Biological Informatics Consortium; APBIK: Association for the Promotion of Bio-Industry in the Kinki Region; FPMAJ: Federation of Pharmaceutical Makers Associations of Japan

the industrialization of all sectors in old and new biotechnology (JBA, 2001).[2)]

Other ministries and agencies also had interest in biotechnology. These were the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Ministry of Health and Welfare (MHW), the Ministry of Education (ME), and the Japan Science and Technology Agency (JSTA).[3)] MAFF organized the incorporated association Society for Techno-innovation of Agriculture, Forestry, and Fisheries (STAFF) in 1990; and MHW organized the Japan Health Sciences Foundation (JHSF) in 1984 (incorporated in 1986). STAFF and JHSF are especially oriented to undertake research financed by their respective Ministry. Also, in the pharmaceutical sector, the Japan Pharmaceutical Manufacturers Association (JPMA) had already been established in 1968, with the aim of promoting research in the pharmaceutical sector, and became interested in biotechnology as a way to develop new medicines.

In addition, matching the attempts by regional and local administrations to promote bio-industry, from the mid 1980s associations at regional level were established.[4)] The aim of these associations is to promote the exchange of information between industry, academia, and administration, increase their collective knowledge about biotechnology, and promote the public acceptance of biotechnology.

From the first *bio-boom* the different Ministries were competing to extend their policies to sectors outside their jurisdiction, which has been qualified as *bureau pluralism* (Aoki, 1988). In *bureau pluralism* different agencies establish a close and long-term relation with industrial sectors under their jurisdiction, reaching a high degree of shared interests. In addition, agencies compete with each other for more power and economic resources, attempting to maximize those interests. This intra-governmental pluralism is also reflected in the associative structure composed by the three associations incorporated into a ministry until the late 1990s (JBA, STAFF, and JHSF).

However, in bio-industry, different sectors share the same interests in basic research, in safety regulations, and so on; and companies easily diversify into the different sectors. As the interests of the different sectors are quite in common in the bio-industry, they cannot be compartmentalized by competing state agencies. This is demonstrated by the fact that many companies are member of several bio-industry associations, or all of them,[5)] and that industry was complaining to the government about the lack of coordination of its different bio-policies (Tanaka, 1991).

In the present period of “bio-anxiety” and “bio re-foundation” (see below), matching with the government's move toward inter-ministerial joint policy-making, associations have reorganized and established two new associations with the participation of the four associations and companies from all sectors. The voluntary Japan Association of Bio-industries Executives (JABEX), established in 1999, is oriented toward participation in the new policy-making for bio-industry promotion. The Japan Biological Informatics Consortium (JBIC) was established in 1998, and incorporated as a foundation to the four ministries (METI, MET, MHW, and MAFF) in the year 2000. JBIC's main aim is the development of bioinformatics, which is part of the

government's new joint policy for bio-industry. This present associational structure is characterized in the following way:

1) Since the members have other channels of access to the state, the top association JABEX does not exercise top-down control on its members. JABEX is even dependent on JBA secretary services and information. JABEX is not the top of a neocorporatist system, but a forum where different associations, companies, and research centers exchange opinions and generate common political petitions to the government. However, this has not led to a politically weak association. As we will see, JABEX has played a relevant role in the elaboration of the government's National Strategy for Bio-industry.

2) The inter-associational structure is not a pyramidal hierarchy; rather, associations relate to each other by their common membership in JABEX and JBIC, and by their participation in forums in order to exchange information, increase shared knowledge, and promote cooperation in their activities (Figure 1, Table 2). There are two of such forums, which gather once a year. One is the Conference of All Bio-groups. The participants in this Conference, established in 1991, are representatives from 11 regional associations, regional branches of METI, METI's Section for the Biochemical Industry, and JBA. The main topics they are trying to promote are the establishment of venture companies, the establishment of technology-transfer organizations (TLOs), the relationships between industry, academia, and administration, and the increase of regional administrations' budget for biotechnology (JBA, 2001). The other forum, the Bio Conference, was established in 1992, and joints the three sector associations (JBA, STAFF, and JHSF). This Conference joins these associations with biotechnology-related ministries, providing a place for the exchange of information and opinion on public policies and bio-industry problems (JBA, 2001).

Table 2. Interrelations between bio-industry associations

From: / To:	JABEX	JBIC	JBA	STAFF	JHSF	JPMA	APBIK
JABEX		・1 representative in the direction	・1 representative in the direction ・Secretary, office ・Data	・1 representative in the direction	・1 representative in the direction	・1 representative in the direction	—
JBIC	・Representation ・Relation with other associations		・Secretary, office ・1 representative in the direction ・JABEX	・1 representative in the direction ・JABEX	・1 representative in the direction ・JABEX	・JABEX	—
JBA	・Representation ・Relation with other associations	・Millennium Project ・JABEX		・Bio Conference ・JABEX	・Bio Conference ・JABEX	・JABEX	・Conf. of All Bio-Groups
STAFF	・Representation ・Relation with other associations	・Millennium Project ・JABEX	・Bio Conference ・JABEX		・Bio Conference ・JABEX	・JABEX	—
JHSF	・Representation ・Relation with other	・Millennium Project ・JABEX	・Bio Conference ・JABEX	・Bio Conference ・JABEX		・JABEX	—
JPMA	・Representation ・Relation with other associations	・JABEX	・JABEX	・JABEX	・JABEX		—
APBIK	—	—	・1 representative ・Conf. of All Bio-Groups	—	—	—	

Sources: Home page of the respective associations (2001); JBA (2000)

3) Associations, rather than competing with each other for different public policies, distribute and coordinate among them different tasks (Table 1, Table 2). Thus, JBIC is undertaking the development of the Millennium Project, and the other associations participate in its management through their participation in JBIC. JABEX represents the whole modern bio-industry before the government, and is a place for generating common policy demands. JBA is the main bio-industry think-tank, and the other associations and the government use the data elaborated by JBA. Further, JBA has provided JABEX with a secretary, as well as one to JBIC before it became an incorporated association; and JBA is in the center of the different forums in which different associations meet (Figure 1). STAFF and JHSF are especially oriented toward research, mainly with funds from their ministry. In addition, the regional associations promote bio-industry at regional level, by organizing study groups and exchange of information, and, in the case of APBIK, coordinating cooperative R&D projects of local companies and university researchers.

2.3. Intra-organizational structures

As with inter-organizational structures, intra-organizational structures of these bio-industry associations differ from the two models considered by the theory of neocorporatism. Their characteristics are as follows:

1) The membership is not composed by just one category of actors–for example, one industry–but by three categories of actors: industry, academia, and administration. Even within every category there are several subcategories, such as different industrial sectors, researchers in public and private centers, and national and local administrations. This heterogeneous participation is not only at the membership level (Table 1), but also in the direction of the associations (Table 3). This, again, shows that these associations are not lobbies trying to influence public policymaking in order to promote their represented narrow interest. Neither are they hierarchies where the bases adopt top-down decisions. They are forums of communication, discussion and negotiation among members from different parts of the society and the state.

Table 3. Composition of the direction of bio-industry associations

	JABEX	JBIC	JBA	STAFF	JHSF	JPMA	APBIK
University researchers	—	Presidency: 0 Directors: 3 Councilors: -	Presidency: 4 Directors: 9 Councilors: 30	Presidency: 2 Directors: 0 Councilors: -	n.a.	—	Presidency: 1 Directors: - Councilors: 2
Public officials	—	Presidency: 0 Directors: 2 Councilors: -	Presidency: 0 Directors: 5 Councilors: 4	—	n.a.	—	Presidency: 0 Directors: - Councilors: 1
Companies	Presidency: 0 Directors: 12 Councilors: -	Presidency: 6 Directors: 10 Councilors: -	Presidency: 1 Directors: 30 Councilors: 18	Presidency: 5 Directors: 12 Councilors: -	n.a.	Presidency: 5 Directors: 35 Councilors: -	Presidency: 3 Directors: - Councilors: 4
Other associations	Presidency: 5 Directors: 1 Councilors: -	Presidency: 0 Directors: 3 Councilor: -	—	—	—	—	—

Sources: Home page of the respective associations (2001); JBA (2000); MHW (2000); Tsuba (2001)

2) These associations internally are not organized in sections that represent different interests (according to products or regions), and that are coordinated by superior sections through top-down authority. The sections are oriented to tasks. For example, JBA's sections are the Committee for Technology and Information, Committee for International Exchanges, Committee for Socio-Industrial Harmonization, Committee for Safety and the Environment, and the Forum for Exchange between Academia and Industry (JBA, 2000). According to the statutes of the different committees, most of them are open to the participation of members from industry, academia, and administration, in their activities and direction. Most of the activities of the committees are oriented toward the exchange of information and generation of shared knowledge through study meetings and joint research.

3) The organization of the associations shows a certain degree of flexibility. Inside the association, smaller groups, formed by the concerned members in a specific topic, are organized in order to discuss about it and explore new action programs. Thus, JBA in 1999 created the Biotechnology Industrialization Forum with the aim to promote new venture companies in biotechnology. Its activities are the organization of symposiums for entrepreneurs, scientists, venture capitalists, technology transfer organizations' personnel (TLO), and so on; and the organization of a committee of senior members of JBA, who act as consultants. Also, since 1999, 30 chemical companies are joined in the Green Biotechnology Strategy Forum, to discuss a strategy to implement biotechnology in the production process in order to reduce the generation of pollution and waste.[6)]

Another example is the fluid organization of APBIK. Its administrative structure is limited to the Secretary General and the Coordination Committee, formed by members of the association with high expertise in biotechnology and business. This committee organizes meetings and study groups for technology transfer and elaboration and implementation of R&D projects. These study groups are open to all the interested members. In the process of discussion in the study groups, R&D projects are elaborated, and the membership is self-selected during the process. In addition, the committee supports the study groups with its expertise and personal networks.[7)]

Further, STAFF and JBIC organize study groups specific to different members' interests and specific topics, in a flexible manner.[8)] And JPMA has also created an internal network of companies to realize shared research on SNPs.[9)]

4) Associations receive most of the funds for research from the government, and administer them. However, this may not produce an excessive dependence of the members on the associations. This is because: the association members possess the expertise; the intra-organizational structure (above-mentioned) disperses the power among the different sections of the organization; and big companies also have access to the government by themselves. Thus, it is reasonable to think that these associations are not able to impose decisions without the consensus of the membership.

From this analysis it is possible to conclude that the bio-industry associations in Japan

conform neither to the model of neocorporatism nor to the model of pluralism. These associations are rather forums where members from different parts of the industrial world (different industries), the academic world (different fields), and various parts of the state (different ministries, central and regional administrations, bureaucrats and researchers) can exchange information, negotiate cooperative programs, increase their collective knowledge, participate in policy-making, and administer state resources. However, to consider that these "forums" are relevant actors in industrial change, it is necessary to demonstrate that they have been influencing it. This is the topic of the next section.

3. *Bio-boom* in Japan

3.1. Development and characteristics of the Japanese bio-industry

Old biotechnology in Japan was highly developed in traditional industries using fermentation, especially in food and alcoholic beverages, but also in chemicals and antibiotics. By the beginning of the 1980s the US bio-industry had begun to grow fast, and MITI was trying to catch up. In 1981 MITI targeted modern biotechnology in its Program on Basic Technologies for Future Industries (Jisedai sangyo kiban gijutsu kenkyu kaihatsu seido). MITI's move encouraged more than 150 companies (especially from the pharmaceutical, chemical and food industries)[10] to invest in modern biotechnology research, with the expectation of a future big growth of the market of biotechnology-related products (see Table 4), in what has been called the first *bio-boom* (Miyata, 1994: 12).

A second *bio-boom* occurred in 1985 as a reaction to the consequences of the second oil-shock. On the one hand, depressed heavy industries (steel, metals, cement, petrochemicals and shipbuilding) diversified into biotechnology. On the other hand, local governments in regions affected by industrial decline promoted biotechnology in order to try to reduce unemployment.[11] However, at the beginning of the 1990s Japanese bio-industry suffered the effects of the burst of the economic bubble and *endaka* (Miyata, 1992: 12). This implied a deceleration in the market growth, and in the private and public investment growth rate in biotechnology in the mid-1990s.

In total, from 1989 to 1998 the Japanese new-biotechnology related market has grown by 490% in 9 years, from ￥200,000 million to ￥1,180,000 million. And between 1997 and 1998 it has grown 16% (METI, 2001).

Japanese bio-industry has been characterized by its particular industrial structure and its system of innovation. Japanese bio-companies have been big companies that progressively diversified into biotechnology. Only in the late 1990s have biotechnology-specialized venture companies begun to appear. Big companies' investment has been the engine of bio-industry development in Japan (Miyata, 1994: 13). Concerning the innovation system, the lack of venture companies means that big companies realize not only applied research, but also generic applied research,[12] while basic research is undertaken by universities and public laboratories (Tsugawa, 1997: 51). In addition, basic research in life sciences in Japan is weak compared to

other countries, a gap that is especially remarkable in genetic research.

By sector, in 1998 the pharmaceutical industry was the sector occupying the first position in the bio-industry market, with 36.8% of the sales. However, it had reduced its dominance and its total amount of sales from 1996 when it represented 58.7%. This sector is supposed to rise explosively due to the completion of the human genome de-codification, and the new developments in gene functions and protein structure and functions analysis, which are expected to give rise to medicines adapted to each individual (order-made medicines), and genetic treatment. However, except in antibiotics, the Japanese pharmaceutical industry is weak at the international level.

The chemical industry is the second-tier bio-industry sector, with a 20.9% of the market of biotechnology related products, and has progressively increased its production. Many bio-chemical products are intermediate products for the pharmaceutical and food industries, and many chemical companies have been diversifying into the pharmaceutical industry. Internationally, Japan has an even-level competitive profile in enzyme-applied products and recombinant products, and a strong profile in microbial products (Tsugawa, 1997: 50). In addition to biotechnological products, attempts are being realized to convert conventional industrial process to biotechnological processes, in order to reduce pollution, waste, and energy consumption.

Agriculture, fishery and forestry biotechnological production greatly increased from 1996 to 1999, from 3.6% to 20% of the market of biotechnology-related products. Recombinant food is highly regulated and 100% imported. However, agricultural products developed by tissue culture or cell fusion are abundant, and also products for feeding and for the health of fish (Ishikawa, 2000: 8). Rice genome de-codification is a main research project of the Japanese government.

Although the processed-food industry is the mainstay in the market of traditional biotechnology-related products, in the market of new biotechnology it represents a small part, just 4.0% in 1999. However, the application of new biotechnology for improving enzymes and microorganisms for fermentation has an important effect in the final production of this sector.

The rest of the industry is mainly composed of the biotech-supporting industry and the environmental industry. It has greatly increased its production from 1996, when it represented 6.6% of the biotechnology related market, coming to cover 21.3% of it in 1999. In the biotech-supporting industry, bioinformatics is a vital sector for the research on gene functions and protein structure and functions from now on, and thus for the development of the biotechnology-applied pharmaceutical industry. In this area Japan is weak and political measures (see the Millennium Project below) have been taken to accelerate its development.

3.2 Bio-policy until the mid-1990s

The policy to promote the development of bio-industry in Japan can be divided in two periods. Here I analyze the period from 1981 to the mid-1990s. For this, I consider two aspects of the bio-policy. First, I discuss the lack of a general government strategy, and the strategy established by

MITI in order to develop the new sector. Second, I consider MITI's main research program, since it offers a good example of the relationship between government and industry for the promotion of bio-industry.

3.2.1. General strategy

Until the late 1990s a general strategy for bio-industry promotion of the whole government was not reached in Japan.[13] Until then there was competition instead of coordination among the different ministries' policies[14] (Howels and Neary, 1992). However, since MITI is the ministry most related to the industrial application of biotechnology, through the analysis of its published *Vision* (MITI, 1988) it is possible to understand its conception of an efficient bio-industry and its promotion strategy. The main characteristics of this *Vision* can be arranged as follows:

1) There is an optimistic evaluation of the growth of investment in biotechnology, the number of patents taken by Japanese organizations, and the capacity of the Japanese industry to catch up with the U.S. by applying new biotechnology to its fermentation industry. However, it recognizes that Japan is weak in basic research and genetic technology.

2) It is considered that public research programs like the *Jisedai* program, which establish joint research between all the big companies in a sector and public research centers, will help to overcome the Japanese delay in basic research and genetic research, and to catch up with the US.

3) Some problems with the Japanese biotechnology research system are pointed out. These are the shortage of researchers, the need to create more databases, and the need to reinforce patents' protection. However, no specific measures to solve these deficiencies are proposed.

4) It is considered that the research system will be improved with the promotion of the relationship between industry, university and administration, for the exchange of information and cooperative research projects in areas targeted by MITI. However, specific programs and the issue of the distribution of property rights are not discussed.[15]

5) There are no measures oriented to change the industrial and the investment systems. The big company is considered as the engine of innovation, realizing R&D in-house and in collaboration with other companies and research centers in public research programs.

In short, MITI's *Vision* considers that big companies are the actors suitable to develop this new industry, that measures to change the industrial and investment systems are not necessary, and that the ministry's leadership through joint research programs can compel industries and researchers to cooperate and, with this, overcome the weaknesses of the Japanese bio-industry and catch up with the US. Also, this plan does not propose specific measures, and ignores the need to coordinate with other ministries' policies.

MITI's *Vision* was elaborated by the Bioindustry Promotion Committee, which was composed of representatives from the main companies in bio-industry, university researchers, and JBA. Thus, the overarching vision on the Japanese bio-industry expressed in the *Vision*, and the strategy to promote it, was shared by MITI, the industry, and academia (or at least part of it).

3.2.2. The Program on Basic Technologies for Future Industries

The Program on Basic Technologies for Future Industries (Jisedai Program) was initiated by MITI in 1981, for a period of 10 years. Its aim was the promotion of new advanced-technology industries that were supposed to be basic to the development of the whole industry in the next century.[16] The program for biotechnology is composed of three projects (bioreactor, recombinant DNA, and cell culture), and represents a big part of MITI's biotechnology budget (40.9% in 1983).[17] Concerning the form in which the relationship between different actors is structured in this program, the following characteristics can be observed:

1) The program was elaborated by MITI, and companies were pushed to participate. Some companies rejected participation and others, although participating, would have preferred to develop cooperative research with companies different from those participating in the Program (Saxonhouse, 1986: 128; Howells and Neary, 1991: 100-101).

2) The organization to structure the relationship among the companies participating in the program, the Biotechnology Research Association (Baiotekunoroji kaihatsu gijutsu kenkyu kumiai), was an organization imposed on them. And, in this association, it was not possible to reach consensus on specific activities (Fransman, 1999: 219).

3) The participants in the program were big companies, which were competing with each other in the market. This lead to competition among the research teams, shortage of information exchange, and lack of consensus in a common research project. This is reflected by the scarceness of shared patents resulting from the projects (Fransman, 1999: 220).[18]

4) Only in the bioreactor's project did the companies' researchers work together in a public research center. In the other projects the companies conducted the research in-house independently. Also universities and other research centers did not have a relevant role in the program. The relations were only among companies, and they were not good relations.

5) Property rights for the results of the research were shared by MITI and the companies according to a contract. Other kinds of property distribution, and other issues, like the promotion of venture companies, were not considered.

6) The results of research were in applied fields (Frasnsman, 1999). This caused lack of advancement in basic research available for the whole industry, and also made more difficult the cooperation among competitor firms participating in the program.

It is possible to conclude that the aims, the participants, and the structuration of the relations between the participants were state-imposed. And came out of the overview about bio-industry held by MITI and industry. This overview is based on the believe that big companies are the engine of innovation, that structural changes are not necessary, and that the state has the capacity to direct collaborative research among companies with public-research programs.

According to MITI's (1994: 61) evaluation, the program helped to catch up with the US and as a mechanism to train specialized personnel. However, foreign analysts consider its results were scarce (Saxonhouse, 1986; Howells and Neary, 1991; Fransman, 1999); and, as we will see, Japan has in fact failed in its attempts at catching up.

4. “Bio re-foundation”

4.1. Japan’s “bio-anxiety”

In the 1980s and the first half of the 1990s the Japanese bio-industry and government, and also many external analysts, considered that Japan was catching up with the American bio-industry and becoming a front-runner (Table 6), and the market for biotechnology related products was predicted to grow hugely (Table 4).

Table 4. Predicted market of biotechnology-related products in Japan for the year 2000

Organization	Million yen
Institute of Manufacturing Technology. MITI (1980) (a)	4,196,000-6,781,000 (in 1975 prices)
JBA (1985) (b)	6,312,000 (in 1980 prices)
MITI (1993) (c)	3,000,000

(a) MITI, 1984; (b) MITI, 1988; (c) Miyata (1994)

However, from the mid-1990s there has been an increasing feeling of crisis in the Japanese bio-industry. This is what I have called the period of “bio-anxiety” and attempts at “re-foundation” of bio-industry, which is taking place in Japan at present. Different from the bio-booms, rather than the entrance of a high number of companies, the structural change in bio-industry characterizes this period. Thus, venture companies have begun to appear, the orientation of public policies has changed, and also the associational structure and associations' activities have been reformed. What has led to this new period is the increasing delay of the Japanese bio-industry with respect to Western countries, and the non-realization of the predictions on the development of the Japanese bio-industry. For example, while in 1993 the Japanese government was still predicting a market of biotechnology-related products of ¥3 trillion for the year 2000, in 1999 the market barely exceeded ¥1 trillion. The situation of the Japanese bio-industry, in comparison with Western countries, is as follows (Table 5):

1) The size of the Japanese market of biotechnology-related products is just 60% of the size of the American market. In addition, 80% of the Japanese market is occupied by imported products or products made in Japan using American technology (Miyata, 2000).

2) The number of companies in the modern biotechnology sector in Japan is less than 1/6 of the number in the US. And the difference is even more striking when considering their composition. In the US most of the companies are biotechnology-dedicated ventures, while in Japan most of the companies are big multi-sector companies. Japanese bio-ventures began to appear only in the second half of the 1990s, and from 1998 to the year 2000 they have risen from 60 to 140. In addition, in the US many venture companies have been born out of universities, while in Japan university researchers have founded only 3 companies. Also, the employment provided by bio-industry is in Japan around 1/5 of that in the US.

3) Japan represents 20% of the patent applications related to biotechnology in the world, while the US represents 50%. The gap is wider in the case of bio-medical patent applications.

Table 5. Japan's bio-industry delay (1998)

	Japan	US	EU
Market (¥ million) (a)	1,179,470	1,963,000	464,515 (b)
Companies (c)			
・Big companies	260	800	540
・Venture companies	60	1,300	700
・Total	320	2,100	1,240
Employment (c)	30,000	150,000	28,000
Investment in life-science research (a) (¥ million)			
・Public (%)	560,000 (40.5%)	2,080,000 (66.7%)	
・Private (%)	823,400 (59.5%)	1,039,500 (33.3%)	
・Total	1,383,400	3,119,500	
Approved biomedicines (c)	36	78	
Patent applications in the world (1998) (d)	20%	50%	21%
Bio-medical patent applications in the world (1990-2000) (e)	15%	60%	25%
De-codified DNA (c)	10%	60%	30%
Organic resources in conservation (c)			
・Genetic resources	8,000	71,000	64,000
・Microorganisms in conservation	11,000	105,000	
・Vegetables in conservation	210,000	550,000	
University TLOs (a)	8	175	
Venture companies from universities (a)	3	2,214	
Patent attorneys (1997) (c)	4,030	19,404	
Graduates in Biology (1996) (c)	1,875	62,081	
Postgraduates in Biology (1996) (c)	996	12,009	
Researchers in life science (c)	129,452	305,300	
Published papers in molecular biology, genetics, and microbiology (1992-1994) (f)	8,927	45,176	
Participation in the total export of biotechnology products (g)	4%	37%	20%

Sources: (a) Miyata (2000); (b) Chigira (2001); (c) Bio-industry Technology Strategy Committee (1999); (d) JPO (2001a); (e) JPO (2001b); (f) Toyo Trust Bank (2001); (g) 21st Century Bio-industry Foundation Conference (1998)

Japan represents just 15%, the U.S. 60%, and the EU 25%. Also the number of biomedicines approved in Japan is the half of that in the US. In addition, the number of patent attorneys in Japan is much lower than in the US.

4) Public investment for basic research in the US has been huge, running ahead in basic research in the genetic field. The Japanese government, although it has been increasing it, has a small budget for biotechnology. The result is that American researchers have de-codified 60% percent of the human genome, and researchers in the EU have de-codified 30%, but researchers in Japan have de-codified only 10%. As a consequence, about 10,000 patents related to genetic engineering have been registered in the US, but in Japan only around 4,600, of which 55% were originated from abroad (69% of the foreign applications were from the US) (Science and Technology in Japan, 2000: 9).

5) In Japan there is a shortage of researchers and university graduates in life-science fields; and infrastructures needed for research, like organic resource banks, are insufficient. Also, there is a shortage of infrastructures for technology transfer from universities to the industry. Thus,

in 1998 there were 8 TLOs in Japan, while in the U.S. they were 175.

4.2. New bio-policy

From the mid-1990s a new policy to promote the development of bio-industry in Japan has been introduced. The general strategy for this is expressed in the National Strategies on Bio-industry Development (Baiosangyo gijutsu kokka senryaku). These Strategies were elaborated by the Bio-industry Technology Strategy Committee (Baio sangyo gijutsu senryaku iinkai), and adopted by the government as its national strategy in 1999. Analyzing these Strategies I show how the overview of bio-industry and promotion policies has changed, and the role associations have taken in this political change. In addition, with the analysis of the Millennium Project I discuss the relationship between industry and government in a specific research program.

4.2.1. General strategy

The present strategy of the Japanese government for the promotion of bio-industry is established in its National Strategy for Industrial Technology–Bio Area (Baio bunya kokka sangyo gijutsu senryaku), approved in 1999. The Bio-industry Technology Strategy Committee elaborated this plan. The committee was organized at JABEX's initiative in 1999, in order to participate in the elaboration of the National Plan (Science and Technology in Japan, 1999). The main companies working with modern biotechnology, some university researchers, researchers from public research centers, and the ministries concerned with biotechnology composed this council.

The contents of the Strategy are strongly influenced by two documents. One is the report of the 21st Century Bio-industry Foundation Conference (21seiki no baiosangyo rikkoku kondankai). This conference was held in 1998 with the participation of bio-industry companies, the four ministries and one agency related to bio-industry (MITI, ME, MHW, MAFF, JSTA), and university researchers. The other document is the Helix Plan, a policy plan for the promotion of bio-industry proposed by JABEX in 1999.

Since representatives from the main companies in bio-industry, the four ministries and one agency, and some university researchers, composed the 21st Century Conference and the Bio-industry Technology Strategy Committee, we can consider that there is a wide consensus among industry, government, and academia on the strategies suitable for developing the bio-industry. The main characteristics of the Strategy are as follows:

1) One of the main aims of the Strategy is the promotion of venture companies as the engine for the industrialization of biotechnology. For this, it also proposes the modification of the investment system in order to promote venture capital. This is through the reform of the tax system, and the establishment of venture funds, instead of the traditional main-bank system. Also, at local level, the promotion of biotechnology is based on venture companies. Thus, the idea of the big company diversifying into new sectors as engine of innovation has been abandoned.

2) Public investment for research is, at the same time, increased and provided more

selectively to projects evaluated in a competitive way. Also, the state takes a less directive role in public research projects, allowing more participation of industry and academia, in order to promote the matching of technological seeds and industrial needs.

3) As a consequence of the beginning of the post-genome[19] research era, which implies the need to coordinate more actors for research, and to elaborate and interconnect organic resource banks and data bases, emphasis is put on these areas. It also proposes the promotion of life-science areas at universities. These are problems already identified in the 1988's *Vision*, but they are still unsolved.

4) The Strategy is shared by the bio-industry companies, the ministries, and academia, and fixes the common aim of reducing the gap with the US, and reaching a market of ￥25 trillion, and 1,000 start-ups, by the year 2010. In addition, this Strategy has been elaborated with the participation of all implied ministries, industries, and academia, and establishes the need for continuing the joint elaboration and implementation of a general strategy, and of collaborative research projects.

In consonance with the evaluation and orientations reflected in the 21st Century Report and the National Strategy, new polices aiming at structural change have been elaborated. In 1998 the law for the establishment of technology-transfer organizations (TLO) was passed; in 1999 a law that allows companies to appropriate the intellectual rights of the results of research undertaken with public finance,[20] the law that deregulates public researchers' side-jobs, and a law to support new venture business[21] were also passed. In addition, the patents law has been revised; an "angel" tax system for venture capitalists, two share markets for high technology, and venture funds have been established.[22] All these changes contrast with the policies of the previous period.

In these areas the bio-industry associations are playing an important role. APBIK is promoting the creation of a venture fund for bio-industries in the Kinki region, which will be provided with two billion yen by the business community in the region and METI (Kansai Electric Power Co. Inc., 2000, 6). Also, the different associations organize programs to support venture business with the use of the association's members' expertise. Associations also try to promote the creation of TLO by promoting contact between universities, capitalists, and industries, in study meetings. Associations also coordinate the creation and application of cooperative research plans, searching for the economic, technical and human resources they require. Finally, associations undertake a great amount of research contracted by the state, thus supplementing the members' technical resources with the state's economic resources.

4.2.2. The Millennium Project

The Millennium Project was approved by the government in December 1999, with the aim to promote industry oriented to computerization, the aging society, and environmental issues. It is a 4-year plan, and its execution began in the year 2000. From its financial allocation of ￥250,000 million for the year 2000, ￥64,000 million were for biotechnology. The aim is to promote bio-

Table 6. The change of cosmovision in the Japanese bio-industry

"Traditional" overview 1) The analyst's evaluation (Chief editor of Nikkei Biotech)[23] : "The gap between American and Japanese development of biomedicines is closing rapidly. (...) At the present stage, Japanese, American and European enterprises are vying for leadership in the development and commercialization of biomedicines (...). In fact, there is a high probability for Japanese multi-lateral enterprises to assume an advantageous future position in the development of medical drugs due to their integrated capabilities based on biotechnology and supported by the introduction of technology and know-how from other industrial fields" (Miyata, 1993: 12-13). 2) MITI's evaluation: "Considering the Japanese level in applied microbiological techniques, the government's support for biotechnological R&D, and the introduction of technology through Japanese companies in cooperation with American companies, it is possible to catch up with the United States within 5 years" (MITI, 1982: 135-136) 3) Industry's evaluation (BIDEC): "When this new technology was established in the United States in the 1970s, private enterprise in Japan was generally lagging years behind. During this period the Japanese began to study it. (...) Nowadays, as far as the practical application of modern biotechnology is concerned, it can no longer be said that Japan is lagging behind the United States and Europe" (Mori, 1986: 58-59).[24] 4) The foreign evaluation (Office of Technology Assessment (US), 1984):[25] "Because of its strength in fermentation, Japan is going to be the strongest competitor of the U.S. in biotechnology" (METI, 2001a).
"New" overview 1) The analyst's evaluation (Chief editor of Nikkei Biotech): "Japan has already lost the first round in front of the United States. However, if Japan changes its behavior it may not repeat the mistakes of the 1980s" (Miyata, 2000: 50). 2) METI's evaluation: "Japanese innovation structures and modalities are fraught with problems, as illustrated by complaints that Japanese research and development is inefficient and unreceptive to new ideas, and by concerns that Japan lags behind the United States and Europe in information processing, biotechnology, and other fields. If we are to achieve the necessary breakthroughs, it is essential that Japan devise forceful yet flexible innovation-support systems and that we enhance our people, innovative technological insights, intellectual foundations, and other knowledge resources by encouraging the development of personal creativity and clearly prioritizing our investment in research and development" (METI, 2001c). 3) Industry's evaluation (JABEX, 1999): "Japan is largely delayed respect the West in the construction of a suitable environment for bio-industry. That is to say, in basic infrastructures for organic resources information, original research oriented to industrial application, venture companies creation, technology transfer from universities to industry, social acceptance, and so on. Continuing like this, Japan will not be able to develop the bio-industry (...) expected for the 21st Century" (JABEX, 2001). 4) The foreign evaluation (Medical and Economic Research Organization (US), 1996): "Japan has been catching up in high-technology industries, however it is in semiconductors, automobiles, electronics, electric, and other engineering sectors. In the life science field Japan is not even a player" (METI, 2001a).

industry oriented to the health care of the aging society. It has three thematic areas: health care; development of functional crops and foodstuffs, and implementing crop production using less agrochemicals; and development of bioinformatics, which is necessary for the research and industrialization of research results from the other areas (Science and Technology in Japan, 2000; MITI, 2000). The main characteristics of the relations between actors that this project establishes are:

1) This project is a national project, elaborated together by the 4 ministries and one agency related to biotechnology, following the orientations established in the National Strategy. In addition, this project widely adopts the aims, terms, specific projects, distribution of tasks, and the public investment demanded in JABEX's policy demand to the government (the Helix Plan, 1999).

2) The Millennium Project distributes the tasks to be developed by each actor. Universities and national research centers are in charge of the basic research, but also JBIC and STAFF have a role in their areas in basic research. And private companies' researchers participate in the specific research projects.

3) Collaborative research and the participation of researchers from private companies is managed by JBIC. Companies in the sector of bioinformatics had previously established this association, differently from the Biotechnology Research Association in the Jisedai program. And its composition shows complementarities between companies in the information and electronic industries, and companies in the chemical, pharmaceutical, and food industries.

4) The intellectual rights on the results of basic research are shared by the state and the companies, but the companies can appropriate the patents on the results of applied research. Also, analyzed basic data on genes and proteins will be publicized, in order to be useful to the whole industry.

5) Not only big companies participate, but also the participation of venture companies is promoted, and additional support is provided to them in order to be able to apply the research results.

The conclusion of the previous analysis is that the overarching vision of government, industry, and researchers of the ideal Japanese bio-industry, and the policies to develop it, has changed. Until the beginning of the 1990s there was a general belief in the capacity of large firms in the biotechnology sectors to innovate in-house and participate in collaborative research programs organized by the government. However, due to the feeling of crisis caused by the delay of Japanese bio-industry compared with the US and EU, at present there is the belief that a system that promotes the birth of venture companies that realize applied generic research is fundamental for the international competitiveness of bio-industry. This requires changes in the finance system, in the university system, and in the system of relations between university and industry. Also, the role taken by government has changed. It is now more oriented to the support of basic research with a large amount of money, and gives economic and relational support to companies to relate with universities and research centers, and to promote venture companies. This means that the government becomes less directive and more supportive. Associations have taken a more relevant role in the decision-making and implementation of this political change. Further, the change of policy reinforces the role of associations.

Table7. Evolution of bio-policy in Japan

"Traditional" policy (1981 to mid-90s)	"New" policy (From mid-90s)
Fragmented strategies, competition	General strategy, relative coordination (21.6% of the public bio-budget is coordinated policy)
Policies based on cooperative research between big companies in government projects	Policies based on the promotion of venture business, networks between industry, universities, and administration
Government leading	State-private sector consensus on general strategy Relational role of government
Public research projects to stimulate relations among competitors	Public research projects to stimulate complementary relations
Associations are instrumental	Associations take a leading role in policy-making
Big companies as the engine for development	Venture companies as the engine for development
Finance by public agencies and main banks	Finance by public agencies and venture capital

5. Conclusions

The first conclusion of this paper is that the associational structure in the Japanese bio-industry is neither corporatism nor pluralism, but a system of governance characterized by wide participation in the decision-making process and rather horizontal power relations. In this system many actors from different social systems in Japanese society–universities, public research centers, public agencies, and companies from many sectors–take part in the decision-making process. The organizational form that the associations adopt in this system is what I have called "forums". These "forums" constitute the infrastructure that supports the interaction among several actors, search for complementarities, and development of cooperative projects.

As long as other industrial sectors become more technology-based, we can expect that the organizational form of "forums" and the governance system should spread. This is a topic that requires more empirical research.

The second conclusion is that the Japanese industrial system is changing. I have showed how the policy for the promotion of bio-industry in Japan has changed from the mid-1990s. In the period from 1981 to the mid-1990s, there was a wide consensus on the role of the big company diversifying into biotechnology as the engine of innovation. Also, the government was taking a directive role organizing cooperative research among big companies. However, from the mid-1990s Japanese bio-industry companies, government, and researchers have awoken to the increasing gap between them and the United States. The new overarching vision for bio-industry emphasizes the role of venture companies, the relations between universities and industry, and the technology-transfer system. And the policies elaborated to achieve this attempt a structural change in the industrial, investment, and innovation systems. This change of overall vision is not only in bio-industry, but has become generalized to the whole industry. However, high-technology sectors' performance is more dependent on the adequate mix of cooperation and flexibility than other industrial sectors. Because of this, and the comparative delay in the development of these sectors, they are leading the structural change, and thus

promoting the change in the whole Japanese industry.

The third conclusion is that the governance system described above is playing an important role in promoting such industrial change. The “forums” help to create a general strategy for the development of bio-industry, implement research policies, and develop their own policies in coordination with the general strategy, thus promoting the relationship between business and universities, cooperative research projects, technology transfer, and the promotion of venture companies. In addition, the associational system also has reformed itself in order to overcome its previous limitations for the promotion of bio-industry. Thus, it has moved from a system fragmented by the relation of associations with public ministries, to a system that connects the totality of bio-industry sectors, and divides tasks among the different associations.

In this paper I have emphasized the technological dimension. The technological characteristics of bio-industry require fluid relationships between many actors in order to support the innovation process and the establishment of the new industry. However, the capacity to establish such relationships and the specific form in which to organize them should be affected by the existing national institutions. A look at the bio-associations' membership in several countries (BIO, 2001) shows that associations composed of industry, academia, and public officials are not rare, although there are some differences among countries. Yet, the grade of state involvement in industrial policy, the grade of development of relations between industry and universities, the specific problems faced by a national bio-industry, and so on, are issues that should affect the activities and political capacity of such associations. These topics require further empirical research.

In the Japanese case, the associational structure reflects the previous history of inter-ministerial competition. Also, the remarkable research activity with public funds that associations develop in Japan is a characteristic resulting from the government's high involvement in industrial policy. Finally, the underdevelopment of the relations between industry and academia, and the lack of infrastructure supportive of venture companies, is a cause of the leading role that associations have taken in order to solve these problems. Further, it could be that without the action of these associations, Japan would be unable to reform its industrial system in order to establish efficient high-technology industries.

Notes

1) From January 2001, this ministry has changed its name to the Ministry of Economy, Trade and Industry (METI). In this paper the abbreviations MITI and METI are used according to the name of the ministry in the period concerned.

2) Old biotechnology refers to the industry that applies fermentation or brewing technologies in the process of production. New biotechnology refers to the techniques of recombinant DNA (rDNA), cell fusion, cell cultivation, bioprocesses, and so on.

3) From January 2001, JSTA has been incorporated into the Ministry of Education (ME), changing its name to the Ministry of Education and Technology (MET). In this paper the abbreviations ME and MET are used according to the name of the ministry in the period concerned.

4) These associations are Hokkaido Bio-Industry Association (HOBIA), Association for the Promotion of Bio-Industry in the Kinki Region (APBIK), Association for the Promotion of Bio-Industry in Toyama Region (APBIT), Chubu Bio Forum (CBF), Senri Life Science Foundation, Tohoku Bio-Industry Promotion Association (TOBIN), Chugoku Bio-Industry Techno Forum, Shikoku Environment Bio Salon, Kyushu Industrial Technology Center Bio-Industry Forum, and so on. In addition there are many other more informal regional "study groups" where industry, academia, and local administration join and interact. In 1988, MITI had identified 73 such groups, most of them established between 1986 and 1987 (MITI, 1988: 117-123).

5) Some examples of companies belonging to the main bio-industry associations are: Ajinomoto, Meiji Seika, Kirin Beer, and Kyowa Hakko, members of six associations; Takeda, Mitsubishi Chemicals, and Tanabe, members of five associations; Aventis, Asahi Beer, Takarashuzo, Daiichi Pharmaceutical, and Sumitomo Pharmaceuticals, members of four associations; and Sumitomo Chemicals, and Mitsubishi Tokyo Pharma, members of 3 associations.

6) This analysis is based on the data in the Annual Report of JBA (2000).

7) This analysis is based on an interview with the Secretary General of APBIK.

8) This analysis is based on data on the home page of the respective associations (STAFF, 2001; JBIC, 2001; JPMA, 2001).

9) "Single nucleotide polymorphisms" (SNPs) refer to the differences among individuals in their genes. Thus, scientists expect to find the cause of different predispositions to specific illnesses in the SNPs.

10) Chemical companies were pushed also because of falling rates of profit (Fransman, 1999).

11) Bio-industry at a regional level has been encouraged through the establishment of regional research centers. These are attempts to promote regional development through biotechnology applied to regional agriculture products. However, the number of regional research centers that open every year has been reducing due to local governments' fiscal crisis (Nikkei Biotech, 2000).

12) Generic applied research refers to research that is oriented to the creation of products rather than the discovery of scientific laws. However, different from applied research, it is not oriented to the creation of a specific product, and its results can give birth to many different products.

13) Even at present, although a general strategic plan and some specific policies have been agreed by the 4 ministries related to biotechnology (METI, MET, MHW, MAFF), there are still many difficulties when the issue is to develop a joint activity, or the joint use of facilities (interview with an official at the Office of Biochemical Industry of METI).

14) For example, from 1980 different ministries had developed individual programs for the analysis of the human genome. However, they have been uncoordinated and competing with each other. This has led to international criticism of the Japanese contribution to the de-codification of the human genome. In 1990 the Human Genome Committee was established with the aim to reinforce cooperation among ministries and assure efficient research on the human genome (Science and Technology in Japan, 1992: 12-14). However, the poor advance in genomic research in Japan in the late 1990s, and the fragmentation and shortage of databases and organic resource banks, shows that such coordination was not achieved.

15) At that time, the results of research developed by private companies with public money had to be shared by the state and the companies.

16) In addition to biotechnology, new materials and electric devices also were targeted.

17) This percentage is calculated from data in Saxonhouse (1986: 108).

18) However, the same author considers that the program had some positive effects, since it promoted the transfer of the research results to other companies, and the companies taking part in the project developed more research in biotechnology, and exchanged more information, than they would have otherwise done.

19) The genome era refers to the period when research was oriented to the de-codification of the human genome, in the 1990s. This research has already been completed. At present, the analysis of gene functions, and protein structure and functions has begun. This is called the post-genome research. This is supposed to give birth to new medicines and treatments. This type of research requires the analysis of huge amounts of data and the realization of experiments.

20) Sangyo katsuryoku saisei tokubetu sochiho.

21) Chusho kigyo gijutsu kakushin seido.

22) However, problems still remain. For example, in the case of national universities, patents are granted either to the individual researcher or to the state, since national universities cannot hold patent rights. This discourages research since patenting is too expensive for individuals. Also, university researchers' careers depend on the number of published papers, and the number of patents held by the researcher is not taken into account. This discourages researchers' cooperation with industry and application for patents (Science and Technology in Japan, 1999: 7).

23) This opinion on this subject is quite representative of the Japanese evaluation of its bio-industry, because the analyst is the Chief Editor of the main journal on biotechnology and industry in Japan, and he has taken part in different advisory bodies on biotechnology, like the Bio-industry Technology Strategy Committee.

24) Y. Mori was Manager of the Bioindustry Development Center (BIDEC) of the Japanese Association of Industrial Fermentation, which later were integrated into the Japanese Association of Biotechnology (JBA).

25) Office of Technology Assessment (1984) *Strategy for the Development of Biotechnology–International Comparison. Washington: OTA.*

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日本のバイオ産業におけるアソシエーションと政治転換

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要約：本稿では、日本における企業と政府の関係のあり方、いわゆる産業団体システムが、日本の先端技術産業を促進するような産業システムをどのように転換させてきたのかを検討する。この検討に際して、本稿が提示するのは、先端技術産業においては、産業団体システムは、ネオ・コーポラティズムではなく、より水平的な構造、いわゆるガバナンスによって組織されるという仮説である。なぜなら、イノベーションは、協力とフレキシビリティーのバランスをなによりも必要とするからである。日本のバイオ産業における産業団体の構造と機能を分析することによって、この仮説について検証するのが本稿の目的である。

そのために、まずガバナンス論とネオ・コーポラティズム論を比較しつつ、日本におけるバイオ産業に焦点をあて、そこにおける技術革新の特徴と、それを促す諸システム、特に産業団体システムについて分析した。日本のバイオ産業に関する産業団体システムはネオ・コーポラティズムでもなく、プルーラリズムでもない新たな調整システムである。このシステムは産・官・学が参加している団体によって編成されている。この団体について本稿は「フォーラム」という新しい概念を用いて定義した。この「フォーラム」によって編成された諸システムが、バイオ産業をめぐる産・官・学、各界の関係、またはそれぞれの内部における諸関係を自己調整しているのである。

次に、日本におけるバイオ産業・政策の転換を分析する。バイオ政策のあり方は、従来型政策が展開された1981年～90年代半ばまでと、産業構造や研究開発システムを目指す新たな政策が遂行されるようになった90年代半ば以降の２つの時期に区分することができる。その政策転換には、バイオ産業団体システムの調整のあり方が影響を与えているといえる。また逆に、政策がそのシステムを変化させてきたともいえる。ここでは、その両者の関係の実態について論じた。

今日、日本ではバイオ産業の発展をねらいとする産業構造の転換や、技術開発システムの再編が進行中である。この過程における政策決定・遂行は産・官・学、各界間の「交渉」によって行なわれている。本稿では、それをネオ・コーポラティズム的なシステムというよりもガバナンス・システムとして捉えている。ただし、それはこれまでのガバナンス論が見出してこなかった「フォーラム」という新たなガバナンス・システムであることをここでは明らかにした。

キーワード：ガバナンス，「フォーラム」，アソシエーション，バイオテクノロジー，バイオ産業，バイオ政策，イノベーション，政治転換

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