Chapter IV

SUMMARY OF MAJOR FEATURES OF SEVERAL FOREIGN APPROACHES TO TECHNOLOGY POLICY

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Foreign experience can offer several useful lessons as to why and how specific policies succeed or fail under a given set of circumstances. In effect, it provides a testing ground for policies in action that can be instructive to the analyst. On the basis of extensive studies previously undertaken by the authors on the policies of several foreign countries, both developed and underdeveloped, the following review highlights the major thrust of policies in four technologically advanced nations. The reasons for this selection are that each case illustrates either some similar factors that are present in the U.S. environment or some contrasting approaches that might be instructive. While there is no implicit suggestion that the United States could or should employ similar techniques, the purpose of the analysis is to outline the objectives that have tended to dominate foreign technology planning.

The Gilpin report to the Subcommittee on Economic Growth of the Joint Economic Committee' argued that the most distinctive example of differences in approach are those of Japan and the United Kingdom. The former is commonly cited as an illustration of a highly successful pursuit of technological growth while the latter demonstrates policies that have had disappointing results. The G i l pi n report observes that these cases are interesting not simply because of their contrast, but because of their relevance to the U.S. position today. On one hand, there is a tendency to pursue policies in the United States, which have not been successful abroad, notably in the United Kingdom. On the other hand, the Japanese example, which for so long has been dismissed as irrelevant to U.S. circumstances, appears to have an increasing number of useful lessons to American policy makers.

The following paragraphs offer an overview of the principal thrust of the major national programs, including the original or innovative features of those programs.

JAPAN

It is clear that the unique circumstances of the Japanese industrial environment have accounted heavily for Japan's successful exploitation of technology. The tightly organized industrial structure, the government-industry -banking partnership, the weight of government direction of economic activity and the notable self-discipline of Japanese entrepreneurs and workers are always cited.

The distinguishing feature of Japanese technology policy as such has been its total and complete identification with economic growth policies. The use and development of technology have been the backbone of industrial growth. Low-technology and inefficient industries unable to compete with firms in the developed Western

'Robert Gilpin, Technology, *Economic Growth, and International Competitiveness*, a report prepared for the Subcommittee on Economic Growth of the Joint Economic Committee. U.S Congress (Washingotn, D.C U.S. Government Printing Office, 1975)

countries have been allowed to die out rather than be protected. Protective policies have been employed only to the extent that they aid the development of infant or emerging high-technology industries. The Japanese government has made a distinction between its treatment of large business enterprises and small business. The role of both is recognized as important in the industrial structure. Whereas the larger firms may appear to spearhead Japan's export drive, the government nevertheless has a strong policy for the technological and business infrastructure support of the small firm.

Japanese policy has stressed the commercialization of technology in the economic growth process. Until very recently, little R&D funding emanated from the government. In fact, the government's role in technology and innovation has been highly indirect. R&D and its commercial development has been left to industry while the government has concentrated heavily on creating the environment for its industry to operate in.

Government "technology policy" thus has consisted principally of the following elements:

- Heavy emphasis on technical education and training highly skilled manpower resources available to industry,
- Emphasis on consumer technologies responding to market demand, as opposed to investments in basic R&D, "big science, " and national prestige projects.
- Strong export orientation of the economy with the resulting need for Japanese firms to compete with the most technologically advanced international firms.
- Careful manipulation of the industrial structure to prepare sectors and firms to meet international competition; limited protection of infant industries until prepared to compete; and elimination of technologically weak companies.
- Avoidance of technology monopolies by Japanese firms by mandatory licensing to competitors of firms attaining dominant market positions.
- Government support for industry through analyses of export markets and available foreign technologies.
- Tax credits and deductions for industrial R&D and accelerated depreciation for pilot plants and R&D facilities.

GREAT BRITAIN

The British example contrasts sharply with the Japanese in most respects. First, the circumstances underlying innovation have perhaps played a role as important in the weakness of British technological policy as it has in the success of its Japanese counterpart. The positive industrial-financial-government partnership which has been the key element of Japanese strength has been far less present in Great Britain. Similarly, British technology policy has had less relation to the economic growth strategy of the government.

British government policy has focused heavily on supporting R&D efforts in basic fields. On one hand, this orientation has made it possible for the British to make major contributions to science and technology, in particular, areas of big science such as defense, nuclear energy, and space. On the other hand, this emphasis has been heavily on the supply-side with lesser attention given to market demand (at home and abroad) for the products of current research or to the problems faced by British industries in commercializing promising new technologies.

The British government, rather than the private market, has tended to make most of the key decisions on technologies to be developed by the country. Reliance on and support of private sector initiatives have not been key features in the British experience. Industry-wide research associations have been fostered by the government to respond to the needs of the private sector, but they have not had a major impact on private firm behavior.

Outside the public sector itself, the government has concentrated on the university system to expand the country's technical and scientific base of knowledge. Although the universities

have developed strong programs in basic science, there has been a minimum of spillover effect into industry.

Finally, the British have not followed a strong manpower policy, as several other developed countries have done, to prepare technical personnel specifically for the needs of industry and technological change. The environment has been marked by poor relations with the labor force, low worker mobility, and strong worker resistance to change.

Several programs, however, merit close attention as important experiments by the government to bring technologies to the commercial stage. The National Research Development Corporation (NRDC) has been closely watched as an interesting experiment in government-industry partnership with relatively favorable results, while the Launching Aid program raised high expectations but fewer results. The Preproduction Order Support Program has produced interesting results in bringing advanced equipment already developed into commercial use.

The NRDC has been the subject of close observation due to its unique character and the interest that other countries have shown in the experiment. NRDC is a public corporation (divorced form direct government management) supporting innovation via several activities, either (a) by paying part or all of the development costs, (b) by licensing public sector technologies, or (c) by entering into joint ventures with national private companies. The NRDC is a modest undertaking but a relative success. Its main success has come through its exploitation of public sector technologies especially those coming from the universities and research councils.

- Launching Aid has had as its objectives the reduction of commercial risk facing manufacturers by interest-free loans to the developer, repayable as a levy on sales or licenses. Unlike NRDC, this program has not been marked by significant success. Its investments have flowed primarily into government-designated projects rather than private market initiatives.

- The Preproduction Order Support Program aims at encouraging industry to utilize advanced equipment on a loan basis from the government with the option of purchasing the equipment after a trial period. The Department of Industry buys equipment from the manufacturer and lends it to selected industrial users. This program has shown some success, particularly in the machine tool industries, where the program, in effect, aided in introducing numerically controlled machine tools.

FRANCE

French policy, much like that of Great Britain, has been characterized by heavy government support of civilian technology. This is particularly true of both governments' commitment to heavy investments in big technologies such as computers, aircraft, and nuclear energy.

Consistent with France's highly centralized administrative structure, French science and technology policy is characterized by strong direction and control and a measure of long-range planning. Most technology policy has been dictated by France's political commitment to industrial and technological independence. The objective of maintaining at least one domestic supplier in every important industry—a policy requiring extensive government subsidies, frequently to weak industries—has had mixed results in stimulating innovative entrepreneurial behavior.

French policy makers have linked technoloqi - cal and economic growth policies more closly than the British. Great emphasis has been given to strengthening the industrial structure in France by encouraging mergers of companies into stronger national entities to respond to foreign competition. Strengthening the technological base of these firms has been a key objective. Similarly, the French have emphasized the importance of firm participation in the training of manpower resources.

The main outline of the French programs is as follows:

- "Concerted Action Programs' '—with committees created to coordinate research in specific areas.

- "Thematic Action Programs' '—designed to coordinate interdisciplinary applied research among laboratories normally undertaking basic research projects.
- "Pre-Development Aid'' —helping research organizations launch work on new technologies.
- "Development Aid'' —providing loans to meet development costs of private firms.
- "National Agency for the Valorization of Research" (ANVAR)–assisting researchers, inventors, and small firms in developing innovations.
- Tax Incentives
  - all operating R&D expenses fully deductible costs,
  - accelerated depreciation of R&D facilities, and
  - tax deduction of capitalized R&D resources in a new organization
- Worker Training—payroll tax for worker re - training programs.

WEST GERMANY

Unlike France, Germany relies far more on market forces and industry -government-university cooperation than on regulation and control by the government. Government assistance is normally granted only where the market is expected to be sufficiently strong to guarantee the success of the program. As a result, German aid tends to focus on influencing the "climate" for innovation through indirect measures rather than designating or promoting specific development of technologies. However, a notable exception has been the German government's direct role in developing major technologies (electronics, computers, etc.), much as in Britain and France.

A positive factor in the German environment for innovation is the relatively high level of cooperation that exists among industry, universities, and government. Largely due to this factor, government action is not directed to stimulating joint programs as much as in France, for example. The principal German policy orientation is in efforts to reduce the costs of R&D for private firms and encouragement of large technically based corporations in advanced technological areas.

Several programs are of particular interest in the German case:

- Extensive network of research institutes largely supported by federal and state governments, ranging from basic research (e.g. Max Planck Institutes) to applied industry-oriented research (e.g. AIF—Industrial Research Organizations).
- Priority programs including the "big science" programs and the "key technologies" program; the later is focused specifically on R&D for industrial innovation and includes direct government cost-sharing with industry,
- The "first innovations" program consisting of interest-free, forgivable loans whereby the government meets 50 percent of the cost of commercial development of a new technology. If the effort fails, the loan is cancelled.
- Venture capital through an independent consortium of banks (WFG) supported by government guarantees under which the consortium purchases equity shares in new companies undertaking innovative projects.

SUMMARY OBSERVATIONS

On the basis of the previous four cases and several other studies,[2] the principal elements that tend to emerge in observing the foreign experience are the following:

1 Direct government support of R&D in firms–by varying degrees, most developed countries provide facilities (direct, indirect,

[2] *The Current International Economic Climate* and Policies *for* Technical *Innovation*, by Science Policy Research Unit, University of Sussex, United Kingdom, in collaboration with Staff Group Strategic Surveys TNO, The Netherlands.

or both) to encourage R&D functions within private firms.

2. Use of government demand through procurement policies has the effect of reducing risk and uncertainty for the innovative firm and as such constitutes one of the most effective tools of most industrialized countries in stimulating technological change.

3. Provision of capital by the government to firms desiring to introduce innovative products or processes to the market. Most countries have programs to meet the capital needs of private firms, either by venture capital corporations that buy equity shares in the firms or by direct government "start-up" funding available to firms introducing new technologies.

4. Concern with industrial structure—most developed countries have seen the necessity to force or encourage industrial restructuring to meet the requirements of rapid growth and international competition with technologically advanced firms. This has been accomplished through mergers, formation of public companies, elimination of technologically weak firms, and limited protection for emerging technologically weak and technologically oriented firms.

5 Emphasis on export capacity and international competition. All four countries discussed have viewed technological progress as an essential element in capturing new export markets and foreign competition as an important impetus of technological change.

6. Emphasis on labor-training and manpower development policies as a key feature in technological development. Most developed countries view the quality of manpower skills as their direct responsibility in strengthening the conditions for technological change.