Chapter 4

COMPETITION

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THE SPACE POWERS

Dominant Role of Governments

Space activities today are primarily governmental: governments finance the research and development of space technology. They launch and operate satellites. Even though private sector interest in space has increased, governments still constitute the major markets for space-related goods and services. (Civilian satellite telecommunications services in the United States are an exception to this rule, but in most countries outside the United States the telecommunications service industry is owned and managed by the govern merit.)

Given this governmental domination of space activities, competition in space-related goods and services is often not conducted in a free-market environment. For instance, private firms supplying space-related goods and services have often acted as contractors to government agencies, rather than suppliers in a market of many buyers. The role of the private sector in some space-related industries has grown more substantially. In the case of ground equipment for satellite communications, for example, domestic and international firms compete internationally for the business of many buyers. Should materials processing in space prove profitable, private commercial activity may be expected. In the areas of remote sensing and space transportation, though, government involvement is likely to remain large, even though the role of the private sector is expected to expand. Space commerce occurs–and will continue to occur—in a context shaped primarily by the political, military, and economic interests and actions of national governments.

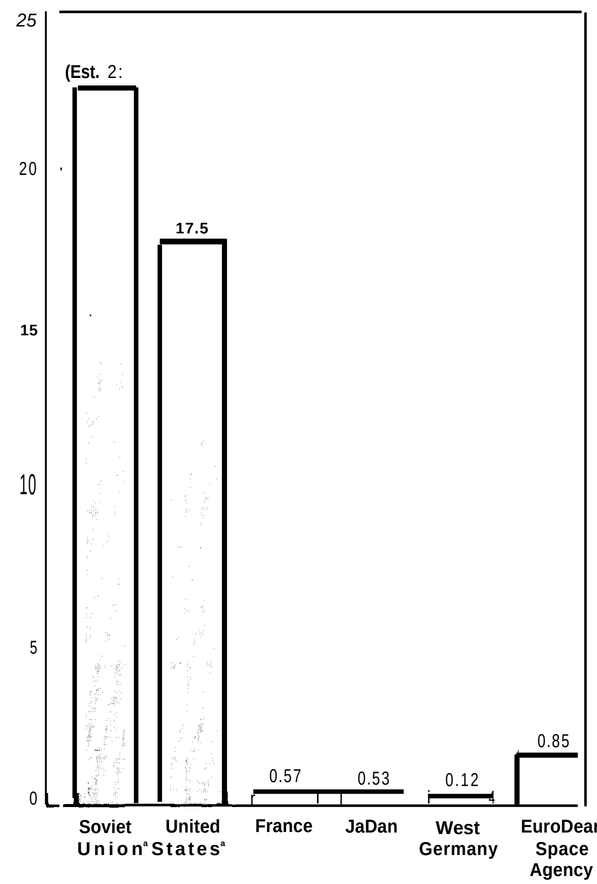
Comparison of National Space Efforts

Globally, the constellation of space powers closely resembles the constellation of political-military powers. The superpowers of space are the United States and the Soviet Union, followed somewhat distantly by Western Europe (with a partially unified space program under the European Space Agency (ESA)[1] and Japan.

When national space budgets are compared (fig. 4-1), the space programs of the United States

[1] Just as the Western European Community is not fully integrated, neither are the space programs of the European Space Agency members. About half of the West German space budget goes into ESA projects. Less than half the French space budget goes to ESA. Most of the smaller British, Italian, Dutch, and Spanish space budgets go to ESA.

Figure 4.1.—National Space Budgets Compared—1984 (billion U.S. dollars)



[a] Includes military space budget, but excludes classified military and intelligence programs.
[b] Estimated cost the United States would incur to duplicate Soviet effort.

SOURCE: Office of Technology Assessment.

and the Soviet Union are by far the largest both absolutely and relatively. Recent estimates mark the overall Soviet space effort as substantially greater than its U.S. counterpart.z [3] Some 600,000 people are thought to be employed in the Soviet space programs, civilian and military (as much as four times the total in the United States). Soviet expenditures on space in 1985 are estimated to be some $23 billion, representing from 1.5 to 2.0 percent of Soviet gross national product (GNP); total U.S. space expenditures are estimated to represent only about 0.5 percent of U.S. GNP.

In contrast, the French, the West German, and the Japanese space budgets are each only about 3 percent that of the United States (civilian plus military). When percentages of GNP devoted to space budgets are taken as indices of national effort devoted to space, the level of U.S. space effort is approximately 6 times that of France, 11 times that of West Germany, and 11 times that of Japan. Although the governments of France, West Germany, and several other European countries (plus Canada) aggregate parts of their space budgets in the European Space Agency, the U.S. space budget is still eight times that of ESA. In short, in terms of spending the United States is by far the leading space power of the non-Communist world, whether the measure of effort is absolute or relative.

[2] Alain Dupas, "Un Programme Spatial En Plein Remouveau, " *La Recherche,* November 1984, vol. 15, pp. 1420-1427.

[3] Nicholas Johnson, "The Soviet Space–Current Plans and Programs–Future Direction, " *Space: The Next Ten Years,* TMSA Proceedings, 1984, p. 94.

Table 4-1 .—Space Expenditure

Country	As a percent of "GNP
United States	0.47
France	0.08
Federal Republic of Germany	0.04
Japan	0.04
Italy	0.03
United Kingdom	0.03

SOURCE: SEST/Euroconsult 1964-M.

INTERSECTING LINES OF COMPETITION

Political Competition

International competition in space began as a highly political duel between the United States and the Soviet Union. The Soviet Union scored a propaganda coup against the United States when it launched the first artificial Earth satellite, Sputnik 1, in 1957. When the U.S. Navy team, having started essentially from scratch, failed to get a Vanguard satellite into orbit, the Army's rocket team under Wernher von Braun, relying on a great deal of accumulated experience dating from the German V2 program in World War 11, managed to launch Explorer 1. An informal race then began to get the first man into orbit. The United States started work on Project Mercury late in 1958, but in 1961 the Soviet Union won that sprint with Yuri Gagarin in Vostok 1. Six weeks later President Kennedy announced his goal of placing Americans on the Moon by the end of the decade. The United States won that long-distance race in 1969.[4] Both sides proclaimed their interest in exploring space for the benefit of mankind, but political motives clearly ranked high in the decisions to race for space.

The Soviet Union, generally inferior to the United States in economic and technological performance, was able to prove superiority in at least some areas. The United States, particularly in the early years, felt a strong need to "catch up" with the Soviet Union. Both sides found in space successes a source of national pride and self-respect. At the same time, they demonstrated to the rest of the world that their respective (and competing) political and social systems were powerful and

[4] For discussions of the evidence as to whether the Soviets were seriously committed to the moon race, see Marcia Smith, "Program Details of Man-Related Flights" in U.S. Congress, Senate, *Soviet Space Programs, 1971-75, Vol. I,* Staff Report Prepared for the Use of the Committee on Aeronautical and Space Sciences, U.S. Senate, 1976, pp. 218-221; see also Charles S. Sheldon, II, "Projections of Soviet Space Plans, " ibid., pp. 502-515.

effective. Moreover, each hoped that recognition as an advanced technical power would enhance its attractiveness as a political and trading partner.

After the United States reached the Moon, the contest became less direct (at least in civilian space activities) between the two great space powers, but the element of political competition remained. By then, several new entrants had entered the field. The European Space Research Organization (a precursor of ESA) seems to have originated in a December 1960 discussion among a group of European scientists about the impact of space technology on science and:

> the then-hot issue of the "brain drain" [owing] to the explosive development of science and technology in the United States.[5]

Although in its first years—between 1966 and 1970—the European Space Research Organization concentrated on scientific research:

> The stated objectives of space collaboration in Europe . . . were constantly presented in a way that obscured the most *fundarnenta/* reason for cooperation, which was to help European industry develop its know-how and potential.[6]

Here is how the Director of Programs of the French national space agency has described French space policy:

> For twenty years France has had the constant will to develop a European capacity in the domain of space and to prove that our country and Europe are in a position, as much in the domain of launchers as in that of satellites and associated ground equipment, to play a role on the world level. This will, which is affirmed equally in the national program and in the European cases, has permitted us to acquire, step by step, the autonomy indispensable for satisfying national and European needs and for developing a dynamic and exporting space industry.[7]

There is not much doubt that the "autonomy" mentioned here means autonomy from the United States, During that same 20 years France has consistently striven for military, political, and economic independence from the United States. It has also encouraged its European partners to do likewise–preferably asserting European independence under French leadership.

The transformation of the French Diamant launch vehicle program into the ESA Ariane program was consistent with this broader French European policy. The French argued in the 1960s and early 1970s that Europe needed its own launch capabilities, independent of the United States, so that a European satellite industry could develop. They expressed fear that although the United States had said it would always make launch services available to the Europeans, it might not actually do so if the Europeans chose to build satellites in competition with American products.

Offering to lead the development of a European launcher within ESA, the French used a cooperative space project for competitive purposes. The French launch vehicle program was brought to bear in the French effort to compete with the United States for leadership in Europe. In addition, European pooling of resources on the Ariane has permitted ESA to raise a challenge to U.S. domination of the market for launch services. Other ESA projects–weather observation satellites and communications satellites–appear designed to reduce European dependence on American suppliers.

Most of the space powers, major and minor, have sought to use their space assets as political instruments for cementing ties with friends and allies and for winning friends and influence in the less developed countries. (See ch. 3 for more details.) The Soviet Union has encouraged the French in their assertions of independence from the United States by offering themselves as an alternative partner in space cooperation.[8] The Soviets have used their Intercosmos and Intersputnik co-

[5] A. Dattner, "Reflections on Europe in Space—The First Two Decades and Beyond," ESA BR-10 (Paris: European Space Agency, March 1982), p. 5.

[6] Ibid., p. 7.

[7] Jean-Marie Luton, "La politique spatiale franchise," *Les Cahiers Francais, No. 206-207,* May-September 1982, p. 89.

[8] As a Congressional Research Service Analyst has put it, "Expanding space relations with France opened up potential opportunities for the Soviets to influence the French politically, particularly in seeking the much cherished Soviet foreign policy goal of dividing the West." Joseph Whelan, "Soviet Attitude Toward International Cooperation in Space," ch. 3 of Soviet *Space Programs: 1976 -80,"* op. cit., p. 290.

The French, for their part, have found it useful to counterbalance U.S. power by forming a closer relationship with the Soviets than the United States would like to see.

operative space programs to strengthen ties with East European and other Communist countries. They have also given extensive assistance to the Indian space program.[9]

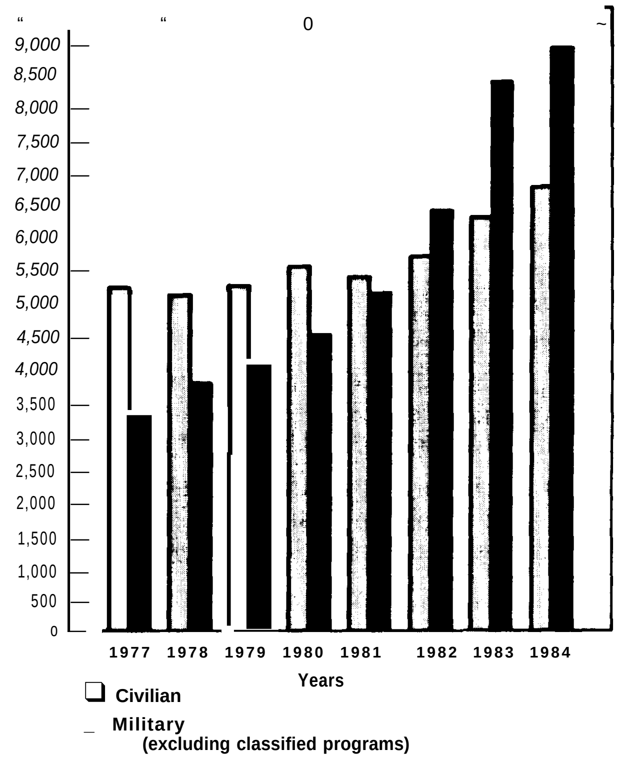
As emphasized in chapter 3, the United States has a long record of international cooperative projects in space technology with both industrialized and non industrialized nations, with both allies and nonallies. Besides seeking the benefits of the international pooling of resources, the United States has also tried to use these cooperative projects to demonstrate: 1) the relative openness of American society, and, particularly, American science, in comparison with the closed nature of Soviet society; and 2) the advantages of association with the United States and its advanced technology.

In the arena of international organization politics, the competitive aspect of space cooperation comes to the fore.I" The United States and the Soviet Union have each tried to show in international forums that it was the more peaceable user of space technology and the nation whose activities were most in the interests of "mankind" or the international community. The Soviet Union has in recent years made much of its willingness to resume negotiations on space weapons, an offer made especially effective by the unwillingness of the United States to discuss the question of arms control measures for space. ' [1]

Military Competition

The space competition between the United States and the Soviet Union has long been military as well as political (fig. 4-2). Many Americans took the launch of Sputnik 1 to signify that the Soviets were about to deploy large numbers of Intercontinental Ballistic Missiles–a feat the Soviet Union did not achieve until several years after

Figure 4-2.—U.S. Civilian and Miiitary Space Budgets, 1977.84 (millions of 1982 dollars)



SOURCE: Office of Technology Assessment.

the United States had done so. Somewhat more quietly, the United States and the Soviet Union set about applying space technology to the enhancement of terrestrial military power. A discussion of the military space programs of the two nations is beyond the scope of this report. However, both sides now make extensive military use of space for purposes of geodesy, navigation, weather forecasting, reconnaissance, missile-launch warning, and communications.

Economic Competition

The one line of space competition in which the U.S.-Soviet antagonistic relationship has not been central has been the economic. Indeed, for most of the Space Age there has been very little international economic competition at all. The Soviet Union has been the main supplier of space-related goods and services to the Communist world. But, except in France and India, it did not try to compete with the United States as the chief sup-

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9"In the case of India, space cooperation was to play . . . [the role] . . . of an instrument for expanding Soviet political influence in this leading country of the Third World, and thus furthering its larger purpose of linking the Third World to the Soviet Union's expected global destiny." Whelan, op. cit., p. 290.

10See the technical memorandum which is part of this OTA study, *UNISPACE '82: A Context for International Cooperation and Competition,* OTA-TM-ISC-26 (Washington, DC: U.S. Congress, Office of Technology Assessment, March 1983).

11See ibid., "Appendix B: The Militarization Issue at UN ISPACE '82, " pp. 61-67.

plier to the rest of the world. Most non-Communist national space programs have been highly dependent on U.S. satellites, U.S. launch services, and U.S.-licensed space technology.

The U.S. space program remains the benchmark by which other non-Communist nations judge the progress of their own. At the same time, Japan and the Western European space powers (especially France) have been seeking greater independence from the United States as the major supplier of space technology and of space-related goods and services. These new space powers are beginning to offer some competition where before the United States held a virtual monopoly. Instead of relying substantially on U.S. suppliers, they are beginning to produce space-related goods and services domestically. Some are beginning to offer export competition as well.

Competition is greatest in the areas of launch services, satellite remote sensing services, and communications satellite equipment and services. Competition in the processing of materials in orbit is currently embryonic but may become significant in the future.

Intersections of the Lines of Competition

In part because space activities are so heavily governmental, the political, military, and economic lines of competition are not so divergent as the above analysis might indicate. In fact, they are sometimes difficult to separate.

1. **Political-economic:** For example, when a government undertakes to build a domestic launch vehicle industry (as have France and Japan), does it do so to conserve or earn additional foreign exchange, or does it do so to remove U.S. influence over the national space program? Economic dependence may seem inseparable from political dependence, and economic independence may be sought even when it is economically inefficient. Government efforts to subsidize exports of space goods or services in order to gain political influence over potential buyers may have "mercantilist" economic motives that reinforce the political competition.
2. **Political-military:** The U.S. military space program may have important effects on the political competition. For example, if the Soviets succeed in fostering the impression that the U.S. program is the main cause of the current "militarization" of space, the United States may lose good will otherwise earned by its cooperative programs and its visible successes in space technology.[12] If the Space Shuttle or a future space station are seen as dominated by the military, that perception may reduce the willingness of the European Space Agency to cooperate in using the U.S. vehicle or platform.[13] U.S. cooperative programs may also be hampered by attempts to limit the export of technology for "national security" reasons.
3. **Military-economic:** The same problem may affect the competitiveness of U.S. firms in the international space marketplace. Efforts to keep American technology out of Soviet hands may also keep it out of the hands of potential Western customers.[14] If the process of controlling exports appears capricious, it could give the United States a reputation of being an unreliable supplier. Technology kept out of hands of the U.S. civilian space program (say, high-resolution remote sensors) may weaken its ability to compete with foreign providers of remotely sensed images.

The impact of the U.S. military space program on U.S. competitiveness in space industries is complex and ambiguous. For example, billions of military dollars spent over many years have certainly helped to build the scientific and technological base, the manpower, and the plants which have made U.S. firms the competitors they are in international space markets.[15] Potential competitors with the U.S. point to this subsidization as ample reason for

[12] *UNISPACE '82*, op. cit.
[13] ESA's bylaws prevent cooperation in military-related activities.
[14] *Technology and East-West Trade: An Update*, OTA-IS C-209 (Washington, DC: U.S. Congress, Office of Technology Assessment, May 1983).
[15] For a report on how government work has benefited one supplier of space equipment, see James Cook, "A Paragon Called TRW," *Forbes*, July 18, 1983, pp. 102-114.

their own government subsidies. On the other hand, it is also true that the increasing government expenditure on military space programs absorbs engineers, technicians, and specialized plants that might otherwise have participated more directly in the civilian competition.

NATIONAL PROGRAMS AND STRATEGIES

Economic Motives for National Space Programs

The economic motives for national space programs are more complex than the straightforward desire to compete for international markets in space goods and services. The space-faring countries commit national resources to space activities in part out of hopes or beliefs that:

- space research will contribute to the general advancement of national scientific development;
- efforts in space technology will contribute to building and maintaining a strong national technology base;
- applications of space technology such as remote sensing or satellite communications will contribute to national economic growth;
- useful products will spin off from space technology;
- leadership in space technology will benefit other industries in international competition by promoting perceptions of the nation as being at the forefront of modern technology in general;
- the space program will foster the development of space-related industries with competitively exportable products; and
- the export of space-related goods or services will help open up new markets for other high-technology exports.

The mix of economic motives varies from country to country. Degrees and kinds of governmental support for space activities therefore vary in turn with national conceptions of how those activities might contribute to economic growth and competitiveness.

The Programs

European Space Agency

The European Space Agency (ESA) is something more than an alliance of national space programs, but something less than a third space superpower. It is a mechanism for pooling the financial and industrial resources (table 4- I) of several European countries in cooperative space projects (see also ch. 3).

The French threatened in 1970 to quit the European Space Research Organization (ESRO) unless it reduced its purely scientific programs in favor of developing applications satellites. In 1971, the European Launch Development Organization (ELDO) abandoned its planned Europa series of launchers. Late in 1972, the French indicated a willingness to provide the majority of funding for a European launcher. In July 1973, the ESRO states accepted the French proposal. In the same year, the European Space Council (with members from both ESRO and ELDO states) arrived at a "package deal" in which they agreed to form the European Space Agency, combining the previous functions of ESRO and ELDO (the actual merger took place in 1975).

During the late 1960s, West Germany supported the French position on the importance of a European launch vehicle independent of the United States. In 1969, the United States offered the Europeans the opportunity to participate in the Space Shuttle program. The Germans were interested. More eager than the French to strengthen cooperative ties with the United States, they were more willing to rely on U.S. guarantees that the Shuttle would be fully available for European satellite launches.

Table 4-2.–National Shares of European Space Agency Projects, 1983

Member state	General budget–ESA Kourou	Science	Meteosat exploitation	ERS-1 Phase B	ECS 1 & 2	ECS 3,4,5	L-Sat phase C/D	Spacelab	ELA-2	Ariane 4
Belgium . .	4.61	4.49	4.50	3.72	3.27	3.19	3.70	5.07	11.00	2.80
Denmark ., ~ ~ ~ ~ ~ ~	2.30	2.51	2.92	1.99	0.33	0.74	1.30	1.81	2.75	0.15
France.	27.47	21.40	25.00	18.31	25.93	26.52	–	12.07	59.55	52.90
Germany	24.88	25.57	25.66	24.00	30.68	30,42	–	64.78	21.00	20.79
Ireland. ... ., ...	0.49	0.54	–	–	–	–	–	–	–	0,04
Italy,	7.36	12.46	12.46	10.61	14.78	13.85	32.80	1.00	2.00	7,75
Netherlands"	5.50	6.00	–	5.00	0.94	1.77	11.80	2.53	–	2.00
Spain	4,76	5.04	–	2.00	0.17	0.53	2.60	3.38	2.50	2.50
Sweden ., ., : : .,	3.92	4,25	–	3.90	1,62	3.97	–	–	–	1,39
Switzerland	3.84	3.99	4.10	1,70	2.13	0.55	–	1,00	1.00	1,60
United Kingdom ...	12.50	13.75	14.05	13.34	20.15	18.46	34.30	7.60	–	3.55
Other participants:										
Austria ,. ..,	0.38	–	–	–	–	–	0.75	0.76	–	–
Norway, ,., ,..	0.54	–	–	1,50	–	–	–	–	–	–
Canada . . . .,,	1.45	–	–	9.10	–	–	9.00	–	–	–
Other income .. ..,,,	–	–	11.31	4.83	–	–	3.75	–	–	4.53

Key

ESA Kourou Launch facility in French Guana for the Ariane launcher
Science includes Exosat–X-ray observatory satellite
International Solar Polar Mission
Hipparcos—Space astronomy satellite
Giotto—probe of Comet Halley
Participation m NASA Space Telescope
Meteosat Exploitation Use of data from the ESA geostationary weather observation satellites
ERS-1 A remote sensing satellite, with sensors for physical oceanography, glaciology, and climatatology To be launched in 1987
ECS 1,2,3,4, & 5 Series of European Communication Satellites to operate 1984-1994
L-Sat Development of large, multi-purpose satellite for direct broadcasting, business communications, experimentation with 30/20 GHz technology
Spacelab: Modular laboratory designed for U S Space Shuttle cargo bay
Ariane Development of vehicle to provide independent European launch services and to compete in the international launch services market
ELA-2 Construction of a second Ariane launch site at Kourou, French Guyana

SOURCE European Space Agency

When the ELDO and ESRO members combined those organizations in the new ESA, they agreed on a division of labor among the three major participants. France would pay for **62.5** percent of the development of the ESA launch vehicle (Ariane). The United Kingdom would pay for most (56 percent) of the Marots maritime communications satellite (later "Marecs A" and "Marecs B"). Germany would take the lead in the Spacelab, a Space Shuttle project, paying for **52.5** percent of its developmental G Thus ESA'S largest single project, the Ariane launcher development under French leadership, was designed to deal competitively with the U.S. space program. The second largest project, the Spacelab under German leadership, was designed to increase cooperation with the United States.

The explicit rationale for ESA was to allow the member states to combine their resources for activities in a field—space technology—too costly for any single European nation to engage in alone. The Convention chartering ESA specifically charges the Agency with elaborating an "industrial policy" designed not only to "coordinate national space programmed in a cost-effective manner," but also to:

> . . . **improve the worldwide competitiveness of European industry by maintaining and developing space technology and by encouraging the rationalization and development of an industrial structure appropriate to market requirements, making use in the first place of the existing industrial potential of all Member States.**[17]

Citing ESA accomplishments in space science, in satellite telecommunications, and **in launch vehicles (the Ariane), an ESA** official boasted in 1982:

> **[these are] . . . cases where Europe can be described as a winning participant in the global world competition for space products, competing successfully with the superpowers, whose space potential is well known to everybody and whose monopoly one thought could not be menaced .18**

[16] Michiel Schwarz, **"European Policies on Space Science and Technology, 1960-1978."** *Research Policy 8, 1979,* **pp. 204-243.**

[17] "Convention **for the Establishment of a European Space Agency, " Article V1.**

16 Dattner, **op.** cit., p. 37.

The members of ESA expect an economic return from their participation in its activities, and the Agency has tried to show that those expectations are being met. It commissioned a series of studies with the Theoretical and Applied Economics Bureau (BETA) of the Louis Pasteur University of Strasbourg aimed at showing the economic benefits of being in ESA. BETA asked a sample of 77 firms to identify the economic value of the benefits they derived from having received ESA contracts. The benefits were described as: "technological" –development of new products, diversification into new fields; "commercial"-increased market penetration; "organization and methods" –knowledge and management techniques learned which improved internal operations; "work factor' '—vaiue of building skilled design and production teams.

The study concluded that the $1 billion which ESA and its predecessors had granted in contracts from the early 1960s through 1975 had yielded another $2.7 billion in benefits to some 550 contractors. In particular, additional exports of $622 million were attributed to the "technological" and "commercial" categories of benefit:

> This indicates the successes achieved by ESA'S contractors in penetrating difficult export markets such as the United States, where they have taken part in space programmed funded by NASA and INTELSAT.[19]

As one judges the validity of ESA claims about the economic value of its programs, one should of course realize that both ESA and its contractors have a vested interest in showing that national returns from the ESA subsidies are greater than the face value of the contracts. Moreover, despite the apparent successes of some European aerospace firms, ESA programs have not necessarily maximized European competitiveness in international markets. The European Space Agency to some extent reflects the continuing resistance of Western European nation-states to genuine integration into a larger political and economic unit.

For example, the European Space Agency Convention provides that the industries of the member states should share "equitably" in the work of ESA—that the contracts granted should be in rough proportion to the contribution of each state's government to ESA. This has become known as the principle of "fair return" or juste *retour.* The principle of fair return means that ESA is not able to choose those firms that may offer the best combination of quality and cost, but instead must distribute its contracts geographically. Then, too, the necessary intermeshing of various national elements into a single project must impose additional costs on the manufacturers.

Other circumstances also deprive the European space-related industries from the benefits of competitive bidding. One problem is that expensive space projects become objects of political pressure. Most ESA contracts are currently negotiated directly rather than competitively. Another problem is that although three international consortia formerly competed for ESA contracts, those consortia are breaking down because of industrial mergers, the juste *retour* principle, and the lack of sufficient business to keep all of the consortia working at once. z"

Differences in national priorities have led to significant departures from another important principle, that of a single European "industrial structure." The communications satellite industry is especially fragmented. Although the Marecs maritime communications satellite is an ESA project, with the second, Marecs B, satellite, British participation went to 69 percent, while the next biggest share was only 13 percent, held by Germany. * The European Communications Satellites (ECS), for telephone and some television transmission, have more even participation: Germany 31 percent, France 26 percent, United Kingdom 20 percent, Italy 14 percent.

[19] "Economic Benefits of ESA Contracts: Summary of a Study Conducted by the Theoretical& Applied Economics Bureau of the Louis Pasteur University of Strasbourg for the European Space Agency," ESA BR-02 (Paris: European Space Agency, October 1979).

[20] See W. Thoma, "The Sophia Antipolis Workshop on the Relationship Between ESA and Industry, " *ESA Bulletin,* May 1983, pp. 13-15.

*Marecs B failed to orbit because of a launch failure. Marecs B2 was successfully launched and deployed in November 1984.

But in direct broadcast satellites, the intra-European competition seems to be growing. Within ESA, the British (34 percent) and the Italians (33 percent) are leading the development of the L-Sat entirely without French and German participation. Germany and France are sharing in the development of direct broadcast satellites (the TV-Sat/TDF 1) entirely outside the ESA framework. Meanwhile, the United Kingdom, despite the lack of an agreed European standard for satellite direct broadcasting, is proceeding with its own national direct broadcasting satellite.

France

In the 1960s, France identified certain industrial projects as "national champions' '—projects intended to bring France prestige and autonomy as well as economic benefit. One such project was the Concorde supersonic transport, a technical success but an economic failure. Another was the Plan Calcul, intended to give France a highly competitive computer industry (marginally successful at best). The French Government continues to try to guide the development of French industry through formal plans (the eighth such plan is now in effect), There is less emphasis on specific projects like the Concorde, but some space projects seem to have taken on the role of "national champions" pursued as much for prestige and independence as for economic reSults.[21]

French President Mitterand and his first Minister of Research and Industry called for increased research aimed at restructuring French industry to reduce imports and increase exports of high-technology products.[22] The Centre *National d'~tudes Spatia/es* (CNES) manages most of the French space program (table 4-2). CNES is an independent agency under the "tutelage" of the Ministry of Research and Industry. It disposes of an annual budget of around 3 billion francs (about $325 million) (fig. 4-3). Much of that money is spent with the four largest aerospace firms of France: Aerospatiale, Matra, SEP, and Thomson-CSF–firms that are themselves owned by the French Government (table 4-3).[23]

CNES, like NASA, operates government research laboratories and oversees contractor work on satellites and launch vehicles. Unlike NASA, CNES itself is a key shareholder in important commercial ventures. Not only has CNES managed the development of ESA'S Ariane launcher, but it is the largest single shareholder (34 percent) in Arianespace, the company created to manage the marketing, production, and operation of the rocket. Similarly, CNES holds **34** percent of SPOT Image, S. A., the company which will sell the services of the French SPOT remote sensing satellite.

CNES formulated the French space policy adopted by the French Government in October 1981. According to the Director of Programs of CNES, the objectives of French space policy include:

> **To consolidate our position in the principal domains of application (telecommunications, television, Earth observation), to construct a solid space industry and enlarge our penetration of the international market** for launchers, satellites, and associated services and ground equipment.[24]

In addition, the French space program is to carry out basic engineering and scientific research to prepare for changes in space systems of the

[21] For a summary description **of recent French industrial** policy, **see "Appendix D: Foreign Industrial Policies" in** *U.S. Industrial Competitiveness: A Comparison of* **Steel,** *Electronics, and Automobiles,* OTA-ISC-135 **(Washington, DC: U.S. Congress, Office of Technology Assessment,** July **1981), pp. 190-200.**

[22] " Mercantilism **for the** *21st* **Century, "** *Business Week,* Jan. **10, 1983, p. 54. For a fuller report on French industrial policy, see the special report on "France,': the same issue, pp. 45-74.**

See also Jean-Pierre Chevenement, Minister of Research and Industry, **"La** Politique Industrielle,'' **in** Industrie & Energie Francaise: **Lettre** *d'information* **No.** 101 **(Paris: Ministry of Research and** Industry, **Sept. 7, 1982). In this speech, the Minister outlined his views on industrial policy to the heads of the French national research organizations and of the nationalized industrial enterprises.**

For a description of French industrial research objectives, see *Recherche et Technologie, No. 2* **(monthly information letter of the Ministry of Research and Technology), September 1982. See also** Joel Stratte-McClure, **"French Technology: Preparing for the 21st Century, " Special Advertising Supplement to** *Scientific American,* **November 1982, pp.** F1-F30.

[23] **One firm, the** Société Européene **de Propulsion (S. E. P.)** nicely **illustrates the French competitive attitude. The French Government created the firm in 1969 to develop solid rocket motors for the French nuclear missile force. In 1971, the Ballistics and Aeronautics Laboratory (L. R. B.A.) was folded into** S.E.P. **to " . . . create a unit competitive with the American companies in the domain of large liquid-fueled motors for satellite launchers. "** Pierre Soufflet, **president and director general of S. E. P.,** ''La **S. E.P.," in "Les** quatres **grands de** l'industrie spatiale française'' **in** *Les Cahiers Français, No. 206-207,* **May-September 1982, p. 11.**

[24] Luton, " **op. cit.,** p. **94.**

Table 4-3.—French Space Programs

Project	Mission	Year	Comment
National programs			
Telecom I	Business telecommunications; TV; telephone; overseas connections	1983	Telecom satellites 1A and 1 B; Ariane launcher
SPOT	Inventory of terrestrial resources by satellite remote sensing	1985	SPOT 1 satellite; Ariane launcher
Biiaterai programs			
ARGOS	Operational service of location and collection of meteorological and oceanographic data	1978-1989	French system aboard 10 U.S. NOAA satellites
ARCAD 3	Study of the magnetosphere	1981	Soviet Arcad satellite; French computer and experiments
SARGOS	Search and rescue of ships and planes in distress	From 1982	French system aboard 6 U.S. NOAA satellites
First manned flight	Studies of materials, astronomy, medicine, biology aboard a Soviet space station	1982	French experiments conducted with French-Soviet equipment
Venera-Halley	Study of Venus in 1985 and Halley's Comet in 1986	1984	French experiments on two Soviet probes
TDF 1	Direct Broadcast Television satellite with two France networks	1985	Cooperative program with West Germany; 1 French TDF 1 satellite, 1 German TV-sat
Projects with European Space Agency (degree of French participation varfes)			
Ariane 1,2,3,4	European heavy launcher developed under supervision of CNES	1979-1986	Ariane 1 qualified 1981; Ariane 2-3 two flights in 1984; Ariane 4 available 1986; Financing mostly French
Meteosat	Imaging, broadcast and collection of meteorological data	1982	1 European Meteosat satellite: Ariane launcher
MARECS	Maritime communications	1982	Marecs A lost in Ariane launch failure; Financing mostly British
EXOSAT	X-ray astronomy	1982	Satellite planned for Ariane launch but switched to U.S. Delta launcher
ECX	European Communications Satellite; intra-European telephone and telegraph	1982-1990	5 satellites; Ariane launcher
Spacelab	Orbiting laboratory integrated with U.S. space shuttle	1983-1986	Financing predominantly German
Giotto	Study of Halley's Comet	1985	Planetary probe to be launched in July 1985; Overflight of Mars in 1986; Ariane launcher
Hipparcos	Study position and movement of stars	1986	Satellite to be launched by Ariane
international programs			
!ntelsat V	International telecommunications	Since 1980	12 satellites plus 3 options on Intelsat network; Launchers: Ariane and Atlas Centaur

SOURCE: Adapted from Cahlers Francais, "Les enjeux de l'esnare," No. 206-207, May-Sepatember 19S3, p. 91

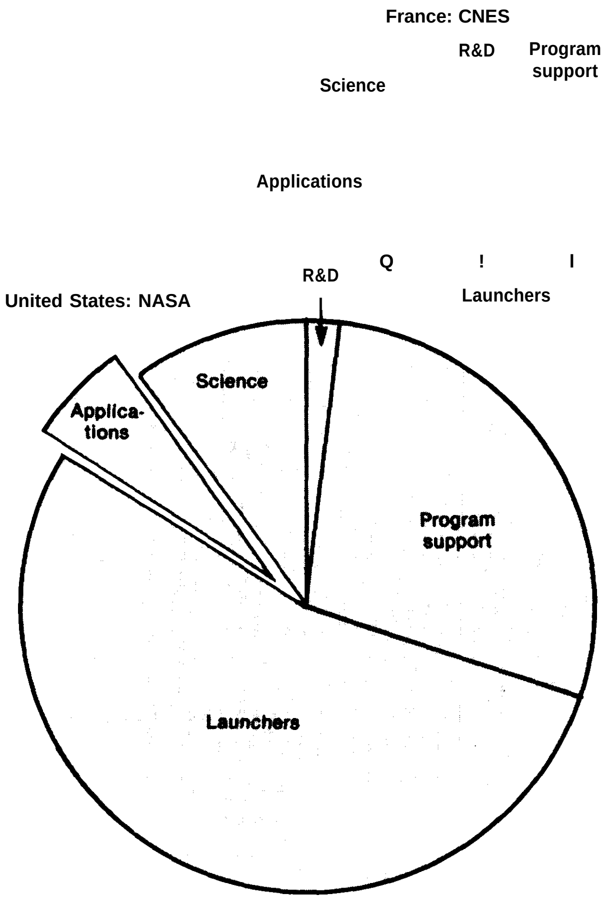
1990s, to participate in international research, and to maintain European solidarity and cooperation.

CNES is to work closely with other French Government agencies to respond to their special needs in such areas as meteorology, telecommunications, broadcasting, and national defense. At the same time its mission also includes "the encouragement of French industry to get full value, particularly in international markets, from the competence and methods acquired over 15 years."[25]

Although the French space program is generally justified in terms of its contribution to industrial competitiveness, two projects in particular have the flavor of the "national champion" appreach: they may be pursued as much for their

[25] Jean-Marie Luton, "Le C. N. E.S.," Ibid., p. 96.

Figure 4.3.—CNES and NASA Budgets Compared[a]



[a]Area of circle represents relative size of space budgets

SOURCE: Office of Technology Assessment

contributions to visibility and prestige as for their promise of economic return. One project is the Ariane rocket, formally an ESA program, but predominantly a French one. The other is the SPOT land remote sensing satellite, which France proceeded with independently when it was not accepted as an ESA project (see chs. 5 and 7).

West Germany

Unlike France, which seems determined to establish and promote particular space businesses (launch services and remote sensing) in the world market, West Germany seems more inclined to support space activities for more general purposes: to invest in basic scientific research, to enhance the overall technological capabilities of German industry, to be a cooperative trading partner and ally (e.g., Ariane and spacelab), and, in the case of communications satellites, to realize some of the benefits of space applications.

The German space budget of about $350 million a year is administered by the Ministry of Research and Technology (BMFT) (fig. **4-4).** An official BMFT document describes the purposes of the space program this way:

1. Advancement of basic research as a cultural contribution and basis of a longer run security and productivity of our economy. Germany belongs to the small circle of countries which have traditionally advanced fundamental research. These countries are the same that today possess the strongest economic power in the world and have reached the highest standard of living. Thanks to the advancement so far, the employment of space technology has become a firm component of the methods of basic research in the Federal Republic of Germany (FRG). This component should be secured and further developed.
2. Innovation through the application of space technology above all for public services, where satellite communication and Earth observation stand in the foreground. Further, with its extreme demands on scientific and technical creativity, the space program should stimulate motivation and productive readiness in all areas of science and economy.
3. Strengthening of the competitiveness of industry through direct commercial utilization of space technology. The industry should reach a level of accomplishment that allows it to achieve a share of the world market for space-technological products (table 4-4). Our own use of these products for public services will advance competitiveness in the world market,[26]

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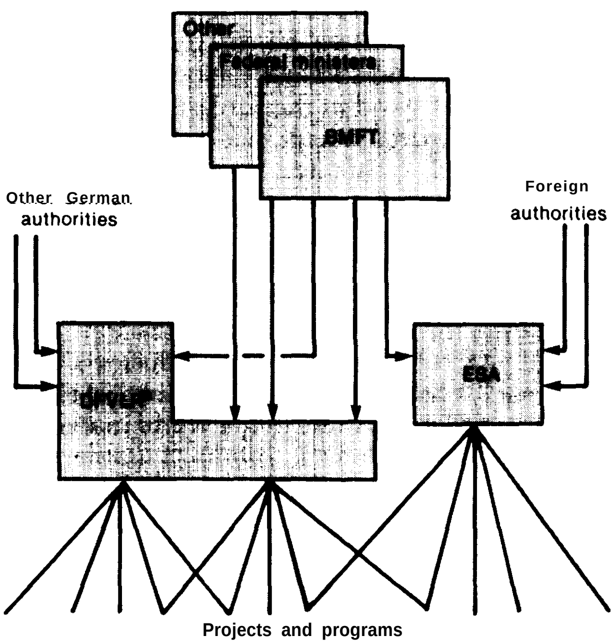
[26]Der Bundesminister fur Forschung und Technologies, *Viertes Weltraumprogramm, Bundesrepublik Deutschland* (Federal Republic of Germany: Ministry of Research and Technology, 1982) (OTA translation of quotation).

Table 4-4.—Turnover of Major French Space Firms
(millions of French francs)

	1978	1979	1980	1981
Aerospatiale				
Subtotal space and missiles	1,781	2,543	2,642	2,845
Total	9,500	11,400	13,200	16,500
Percent space and missiles	19	22	20	17
Matra				
Satellites	172	169	285	499
Launchers	67	85	55	152
Other				51
Total space	239	254	340	702
Total	2,249	2,939	2,903	4,501
Percent space	11	9	12	16
SEP				
Satellites	7	6	33	62
Launchers	344	291	244	342
Subtotal space	351	297	277	404
Total	854	773	908	1,055
Percent space	41	38	31	38
Thomson-CSF				
Satellites	53	53	13	250
Ground Equipment	219	275	421	NA
Space	272	328	560	NA
Total	6,955	9,440	12,794	NA
Percent space	4	3	4	

SOURCE: S.ES.T," "L'Industire Spatiale Dans Le Monde," vol. 1, Paris.

Figure 4-4.—Funding Organization of German Space Ac:tivities



ªGerman aerospace research establishment.
SOURCE: DFVLR.

Table 4-5.—Turnover in the Largest German Space Firms, 1981

Company	Personnel (space activities)	Turnover (million dollars)
Messerschmitt-Boelkow-Blohm/ERNO	1,200	177.60
Dornier	NA	88.80
AEG-Telefunken	600	39.96

NA—Not available,
SOURCE: S.E.S.T., "L'Industire Spatiale Dans Le Monde," vol. I, Paris.

Given the ability of the Spacelab to support manned experiments in orbit, materials processing in space is a logical field of interest for German research.[27] (See ch. 8, "Materials Processingin Space.) The FRG contributes well over 25 percent of the ESA microgravity research program, its share for 1984 being some $12 million.

[27]The German reason for building the Spacelab had moretodo with wanting toacceptthe partnership in advanced technology offered by the United States than it did with anya priori beliefin the usefulness of the Spacelab in developing a materials processing industry.

Recently, ESA approved Phase II of this program; it will run from 1985 to 1989 with a total budget envelope of some $170 million. Of this, the FRG has agreed to contribute 40 percent. Total FRG spending for MPS research totaled $28 million in 1984, a sum rivaled only by NASA's 1984 expenditure of about $25.6 million.

Japan

Over the past several decades, Japan has evolved a variety of mechanisms by which the government—particularly through the Ministry of international Trade and Industry (MITI)—influences private businesses so as to try to shape the national economy along planned lines. These mechanisms have included:

> . . . selective access to governmental or government-guaranteed financing, targeted tax breaks, government-supervised investment coordination in order to keep all participants profitable, the equitable allocation by the state of burdens during times of adversity , . . . , governmental assistance in the commercialization and sale of products, and governmental assistance when an industry as a whole begins to decline, [28]

There is considerable debate about whether MITI has enforced a strategic "industrial policy" which successfully picks and promotes "winners" in international economic competition.[29] Whatever the actual effectiveness of MITI, its economic planners did design a new strategy they hoped would adapt the Japanese economy to the new conditions encountered in the 1970s and expected in the 1980s.

The current Japanese declaratory strategy stresses growth of "knowledge-based" industries and the development of Japan as a "high-technology" society, one less dependent on the import of raw materials for re-export as manufactured goods and more dependent on the export information and technology produced in Japan. Consistent with this approach is an emphasis on strengthening Japanese science and technology.

JAPANESE SCIENCE AND TECHNOLOGY POLICY

The Japanese are fully aware of their national weaknesses in science and technology (compared with, for example, the United States). Their government has outlined policies to build on Japanese strengths and remedy their weaknesses. Japanese research expenditures account for about 10 percent of the world's total, as does the Japanese GNP. Japan also possesses about 12 percent of the world's researchers.[30] It exports about 12 percent of the world's technology-intensive products. Using a mix of indexes of technological "power," the Japanese Science and Technology Agency found Japan to be relatively high in current technological capability, but lower than desirable in the potential for developing new technology. In terms of royalties paid for the licensed use of foreign technology, Japan is still a net importer of technology. Even so, when *new* annual licensing only is measured, Japan has already begun to export more technology than it imports.

The Japanese Government wants to reinforce this trend. It has concluded that in order to do so it will have to increase government support of the basic research that can lead to new technology in the longer run. As other observers have noted:

> . . . there is a distinct bias in Japan's overall research expenditures toward applied research and prototype development—a bias reflected both in government-supported R&D and private sector research expenditure. [31]

In the latter months of 1980, the ministers whose tasks related to science and technology met and agreed on a set of policies intended to "make Japan into a so-called science and technology-oriented country, " The first measure in this new set of policies was to increase govern-

[28] Chalmers Johnson, *MITI and the Japanese Miracle: the Growth of Industrial Policy, 1925-1975* (Stanford, CA: Stanford University Press, 1982), p. 311.

[29] Cf. Roberts, Op. cit.; Philip Trezise, "Industrial Policy Not the Major Reason for Japan's Success, " The Brookings Review, spring 1983, pp. 13-18; Gary Saxonhouse, "Japanese High Technology, Government Policy, and Evolving Comparative Advantage in Goods and Services" (University of Michigan, Department of Economics: photocopy, Apr. 1, 1982.); Jimmy Wheeler, Merit E. Janow, and Thomas Pepper, *Japanese Industrial Development Policies in the 1980s: Implications for U.S. Trade and Investment* (Croton-on-Hudson, NY: The Hudson Institute, 1982), p. 138.

[30] Much of the following taken from "Science & Technology White Paper '81 Released," *Science & Technology in Japan,* January 1982, pp. 6-14.

[31] Wheeler, Janow, and Pepper, op. cit.

ment investment in research and development (R& D),[32] and thereby increase the proportion of national income devoted to R&D to 2.5 percent and eventually to 3 percent. [33] The government undertook to improve the coordination of national R&D policy among several ministries and agencies. In fiscal year 1981 it appropriated a special "Science and Technology Promotion Coordination Fund" to be managed by the national Council for Science and Technology. (This fund went from about $14 million in fiscal year 1981 to about $25 million in fiscal year 1982.)

Although the Japanese Government has recognized the need to increase basic research, it has also selected some specific areas of applied research that it thinks will help advance the goal of becoming a "technology-oriented country. " One such area, a highly visible one, has been that of industrial robotics. Japan has already assumed world leadership both in the use and the export of computer-controlled machines in manufacturing.[34] Another well-known project is the "Fifth Generation Computer Project," a research effort on which Japanese Government and industry will spend about $500 million over 10 years.

THE JAPANESE SPACE PROGRAM

The Japanese space program, although not explicitly a part of this "high-tech" emphasis, seems to be consistent with it. About 16 percent of all Japanese Government research and development expenditures is space-related. In 1968 Japan formed a Space Activities Commission (SAC) to formulate space policy (fig. **4-5).** The chairman of this five-man Commission is the Minister of the Science and Technology Agency; the STA provides the Commission staff. In October 1969, the SAC put together the first "Space Development Program, " a plan it reviews annually. 35

In 1978 the SAC issued an "Outline of Japan's Space Development Policy," enunciating "principles" and "priorities" for the long term. Although the policy statement holds as a priority goal "keeping Japan's level of science abreast with international standards, " the key words are probably " . . . promoting the development of science and its application in ways suitable to Japan."

- **Space science:** Japan has launched several scientific satellites for observing astronomical, near-Earth space, ionospheric, and atmospheric phenomena. They will send their first interplanetary satellite, PLANET A, to study Halley's Comet this year. They built hardware for the joint U.S.-Japan Space Experiments with Particle Accelerators aboard the Space Shuttle's first spacelab mission in 1983. Pursuing space science is consistent with the Japanese goals of promoting basic research in Japan and partaking of the benefits of international scientific cooperation.
- **Meteorological satellites:** In 1984, Japan launched its third geostationary meteorological satellite. (It should be noted that Japanese meteorological satellites have relied heavily on American suppliers of key technology.) The weather information provided to Japan is obviously of benefit to the Japanese economy, particularly because Japan is so fully a maritime nation. But by beaming its images to 13 other Asian and Pacific nations, the satellite also reinforces Japan's efforts in international cooperation.

  The program contributes to Japanese international policy in other ways as well. The first Japanese weather satellite, launched in 1977, was a part of the World Weather Watch program of the First GARP (Global Atmospheric Research Program) Global Experiment. In 1978, Japan held a Joint U.N./WMO Training Seminar on the Interpretation and Analysis and Use of Meteorological Satellite Data for Asia

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[32] " Science & Technology White Paper '81 Released," op cit., p. 11.

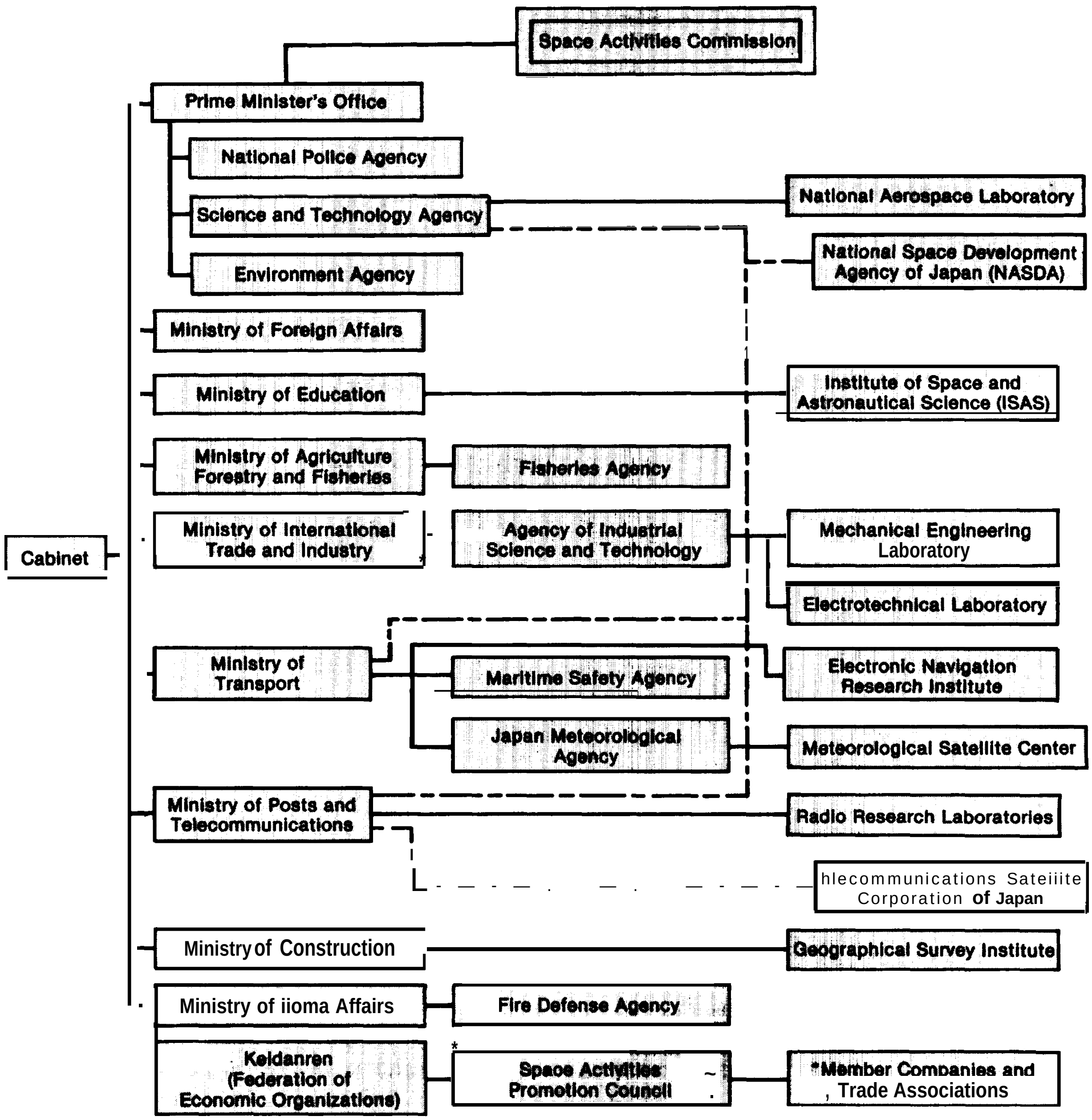
The other elements of the policy for promoting science and technology were as follows:
- Expansion and improvement of evaluation systems;
- Establishment of an organic system for coordinating activities among academic, industrial and government circles;
- Promotion of original scientific and technological development;
- Recruitment and training of science and technology personnel;
- Promotion of international cooperation' in science and technology.

[33] The United States already was spending about 2.5 percent, but about a quarter of that went to military research, while much less Japanese research is military.

[34] See, for example, Computerized *Manufacturing Automation: Employment, Education, and the Workplace, OTA-CIT-235* (Washington, DC: U.S. Congress, Office of Technology Assessment, April 1984).

[35] Masao Yoshiki, "Japan's Space Programs, " *International Aerospace Symposium,* Paris, June 2-3, 1981, p. 1.

Figure 4-5.—Schematic Chart of Organization for Space Activities



NOTES: — . — . Government funded special organization.

● Member companies and trade associations include: C. Itoh & Co., Ltd./Daicel Chemical Industries, Ltd./Daido Oxygen Co., Ltd./The Dai-Ichi Kangyo Bank, Ltd./The Fuji Bank, Ltd./Fujitsu Limited./Hitachi, Ltd./Ishikawajima-Harima Heavy Industries Co., Ltd./Iwatsu Electric Co., Ltd./Japan Aircraft Mfg. Co., Ltd./Japan Aviation Electronics Industry, Ltd./Japan Broadcasting Corporation/Japan Propellent Industry Co., Ltd./Japan Radio Company Ltd./Kawasaki Heavy Industries, Ltd./Kokusai Denshin Denwa Co., Ltd./Kokusai Electric Co., Ltd./Kyokuto Boeki Kaisha, Ltd./The Kyowa Bank, LTD./Kyushu Electrical Construction, Ltd./The Long-Term Credit Bank of Japan, Ltd./Marubeni Corporation/Matsushita Communication Industrial Co., Ltd./Meisei Electric Co., Ltd./Mitsubishi Corporation/Mitsubishi Electric Corporation/ Mitsubishi Heavy Industries, Ltd./Mitsubishi Precision Company, Ltd./Mitsubishi Space Software Co., Ltd./Mitsui & Co., Ltd./Mitsui Engineering & Shipbuilding Co., Ltd./NAC Incorporated/NEC-Honeywell Space Systems, Ltd./Nippon Electronics Development Co., Ltd./Nippon Electric Company, Limited (N EC)/Nippon Oil & Fats Co., Ltd./Nippon Sanso K,K./Nippon Steel Corporation/Nippon Telegraph and Telephone Public Corporation/Nissan Motor Co., Ltd./Nissho Iwai Corporation/Oki Electric Industry Company, Ltd./Okura and Company, Ltd./Remote Sensing Technology Center of Japan/The Sanwa Bank Ltd./Sharp Corporation/The Society of Japanese Aerospace Companies, Inc./Sumitomo Corporation/Sumitomo Precision Products Co., Ltd./System Development Corporation of Japan, Ltd./TEISAN K. K./Tokyo Aircraft Instrument Co., Ltd./Toray Industries Inc./Toshiba Corporation/Tokyo Communication Equipment Co., Ltd./The Yokohama Rubber Co., Ltd.

SOURCE: National Space Development Agency of Japan.

Official Japanese Space Policy

Japanese officials have summarized their national space policy as follows:

A. Basic principles of space development policy

(a) Social needs and available national resources

Japan's space development should be confined to peaceful purposes, be able to respond fully and effectively to the various social needs, and aim at producing a system which is suitable for widespread utilization when space is opened up for general use.

Reviewing constantly the necessity, urgency and economics of each program, the various programs should be carried out systematically and effectively in response to national resources.

(b) Autonomy in space development

Japan is striving to improve its technological standard so that it will be able to carry out its space development activities steadily.

(c) International cooperation

Japan's space development will be advanced maintaining as much cooperation as is possible with other activities around the world. In addition to making the most of its homemade launch vehicles, Japan will also use the space shuttle and other means when necessary so that its overall performance in space development will be up to world standards. Based on these results, the country will do its share and cooperate in international activities on a scale commensurate with its capabilities.

B. Priority goals in space activities

Japan's scientific research on space has been producing internationally recognized achievements. Emphasis will be placed on keeping such abreast with the international standard, contributing to the intellectual progress of mankind, and promoting the development of science.

In the field of applications, efforts will be made to establish technical stability in the area of communications, broadcasting, meteorological observation, and ionospheric observation where technical development has been in progress. At the same time, by taking advantage of the characteristics of space, various applications will be actively exploited in the areas of navigation, geodesy, ocean observation, survey of resources, the environment, manufacturing of materials, life sciences, etc. Programs will also emphasize miniaturization of ground equipment, increased sophistication of space missions, lower costs, etc.

SOURCE: See "National Paper: Japan," prepared for the UNISPACE '82 conference in Vienna, U.N. document A/CONF.101/NP/39, Sept. 9, 1981. See also "Situation of Space Development in Japan," *Science & Technology in Japan*, July/September 1982, pp. 4-5 and Yoshiki, op. cit.

and the West Pacific, bringing together 32 representatives of 19 countries.[36]

- **Launch vehicles:** Building on American technology (licenses to make the McDonnell Douglas Delta), Japan is developing its own stable of launch vehicles, to culminate in the H-1 and H-11. The former will be capable of delivering 55o kilograms of payload to geosynchronous orbit. (See ch. 5 for more details.) The Japanese launch vehicle program is consistent with the principle of "autonomy." It also opens up the possibility that someday Japan will enter the international competition in launch vehicle services. But that day is not on the immediate horizon: the modest payloads deliverable by the H-1 will not match the capabilities of the Ariane series, let alone that of the Space Shuttle. Indeed, a major communications satellite planned for the late **1980s** by Nippon Telegraph & Telephone (NTT) will be far too heavy for the Japanese launcher.
- **Satellite communications:** Satellite communications has offered one promising avenue along which Japan can pursue its goal of developing a high-technology, information-based economy. NEC—with technical assistance from

[36] "National Paper: Japan, " op. cit., p. 25.

Hughes Aircraft Corp.–has become the leading manufacturer of INTELSAT satellite transponders and ground terminals.[37]

In February 1983, Japan launched the world's first operational Ka-band (30/20 GHz) communications satellite. Japan plans a series of direct broadcast satellites and is conducting research on mobile satellite communications. They reportedly intend to begin launching multi-beam communications satellites in 1988, as a part of NTT's "Information Network System."[38]

Satellite communications will allow Japan to improve its domestic communications networks and no doubt contribute in that way to the advancement of Japanese technology. But presumably the industry will also more directly draw on and stimulate Japanese strengths in electronics technology. As the first, or close to the first, operators of a Ka-band satellite communications system, Japanese firms may be in a position to compete more fully in any international satellite market that develops for advanced satellites of this type.

Remote sensing: In 1975, the Science and Technology Agency formed the Japan Remote Sensing Technology Center (RESTEC). Since 1979, Japan has had an operational Landsat receiving station, In 1981, the Machinery and information Industry Bureau of MITI created a public nonprofit corporation (with funds from 27 firms), the Earth Resources Satellite Data Analysis Center. One objective of the ERS-DAC is to help locate mineral resources (the President of ERS-DAC is Director of the Japan Petroleum Exploration Co.). Another seems to be to lay the groundwork for marketing remote sensing services.[39]

The Japanese National Aeronautics and Space Development Agency (NASDA) plans to launch the first of a series of ocean and land remote sensing satellites in 1986 (see ch. 7), Meanwhile, remote sensing is one of a handful of fields selected by the Council for Science and Technology as a "new vital research theme" to receive support from the Science and Technology Promotion Coordination Fund.[40] One reason for Japanese Government support of supercomputer technology is the large-scale computing capacity useful for remotely sensed image processing.[41]

The Japanese Government has not stated an intention to make Japan an active competitor in the international remote sensing market. Even so, the Japanese program could put Japan in a position to:

—satisfy future Japanese remote sensing needs without dependence on foreign satellites or image processing facilities;

—enter the market for image-processing equipment and software;

—enter the market for remotely sensed data, image processing, and image analysis; and

—offer remote sensing services to less developed countries in exchange for special consideration in supplying nonrenewable resources.

As an especially knowledge-intensive, high-technology industry, remote sensing seems to be a natural choice as a small element in the stated Japanese industrial strategy for the 1980s and 1990s.

In sum, the Japanese have been making steady progress in space, but their program has, for the past several years, maintained a level budget (fig. 4-6), which means that their real effort has declined after inflation.[42] Like the other space

[37] See U.S. Congress, House Committee on Science and Technology, *Science, Technology, and Energy: Report of a Congressional Study Mission,* 97th Cong., 1st. sess., Serial Q, May 1981, p. 19. See also Neil Davis, "First Japanese Mass Production Satellite Plant Completed," *Space World,* January 1983, p. 33.

[38] "Japan to Launch a Multi-Beam Communications Satellite," *Aerospace Daily,* Aug. 24, 1982, p. 301.

[39] ERS-DAC activities include the following: contracting for research and development in computer image processing and analysis software; contracting for research and development on the geologic applications of remote sensing for finding nonrenewable resources; engaging in foreign market research on user needs and the technical state of the art; exploring foreign technology transfer and liaison with foreign remote sensing organizations; sponsoring symposia and publishing documents for internal dissemination of remote sensing analysis techniques. Source: 1982 ERS-DAC brochure.

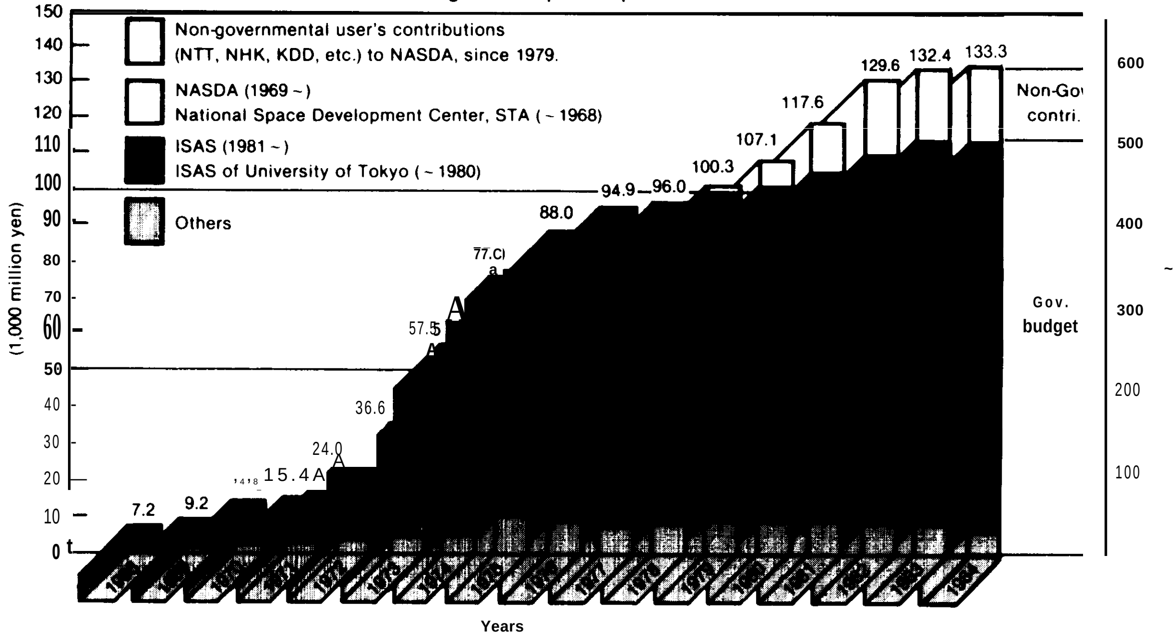
[40] "New Fund for Coordination and Promotion of Science and Technology Policies, "Science & *Technology in Japan,* January 1982, p. 21.

[41] See Buzbee, et al., op. cit., p. 1189.

[42] Takashi Yamada, "Japan's National Space Program–Current Programs and New Directions," *Space: The Next Ten Years,* TMSA Symposium Proceedings, 1984, p. 324.

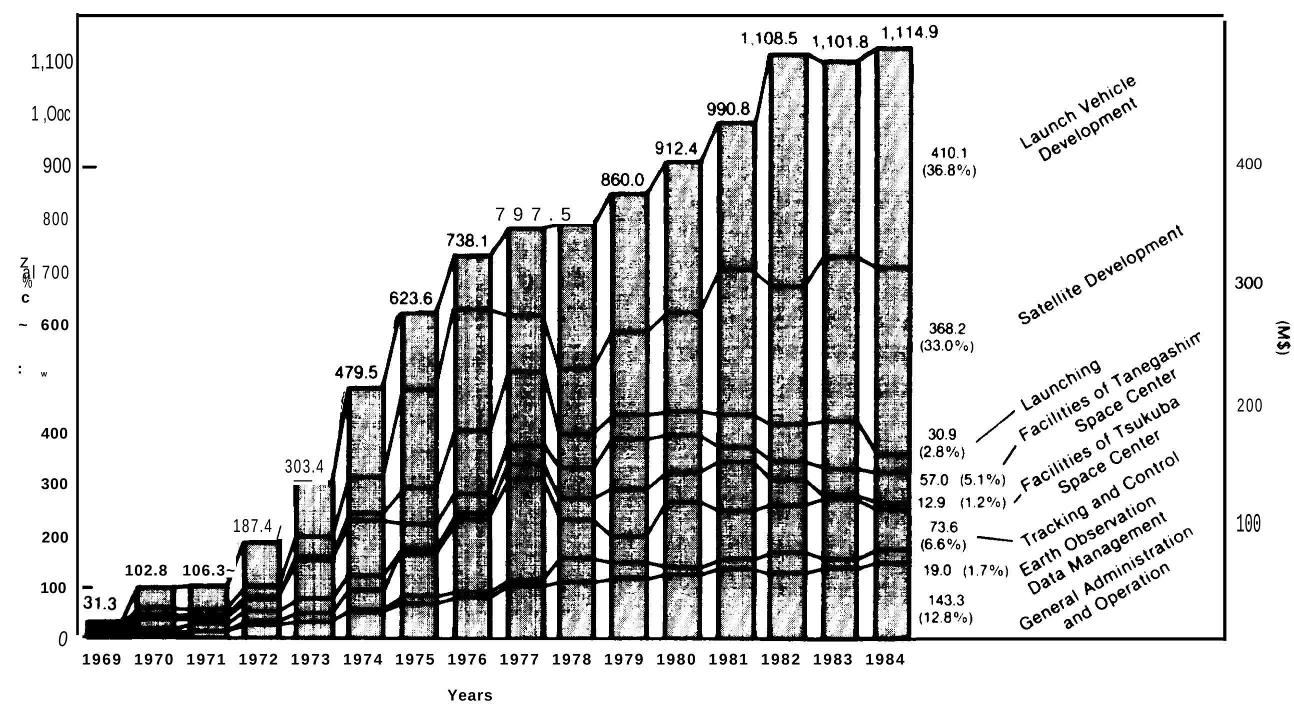
Figure 4-6.—Japanese Space Budget

Budget for Japan's space activities



NOTE: Since 1981, the proportion of GNP and the national budget devoted to space developments has remained constant at 0.2% and 0.040/. respectively.

Growth of NASDA'S budget



NOTE: The figures in parenthesis are the percentages of the total budget.

• Dollar figures calculated, for Information only, at rate of 240 yen to the dollar (U.S.).

SOURCE: National Space Development Agency of Japan.

powers, Japan has accepted the assumption that a government space program will ultimately contribute to national economic well-being. Japan has not specifically identified space industries as "targeted" for special emphasis in export competition. The Japanese space program instead seems aimed at developing space technology—and doing so with increasing independence from U.S. technology and equipment. Whether they are to become major competitors in the international markets for space-related equipment (beyond the electronic components and ground stations they now sell) and for services will probably not be apparent until the 1990s.

THE WORKABILITY OF COMPETITION IN SPACE-RELATED MARKETS

As space applications become more commercial, questions of industrial organ ization—competition, monopoly, regulation—and of international trade assume a greater role in discussions of space policy, At the same time, debates over competition and protection are staples of public policy in many other areas of the general economy; much of this wider debate is relevant to the emerging space industries. Moreover, some policies in the space arena may be determined by broad existing U.S. policies governing competition and international trade in the general economy.

Space transportation and satellite communications are two technology sectors that provide examples of this shift of focus of the space policy discussion onto questions of industrial organization and international trade. As private sector and foreign space transportation firms challenge the position of NASA as the U.S. Government space transportation "firm," the question of whether or not the industry can be organized competitively—or should be—revolves around the questions of Shuttle pricing, government procurement, and U.S. and foreign government subsidization. In international satellite communications, which has traditionally been organized noncompetitively, technological changes, the newly competitive long-distance telephone industry in the United States, and the Government's drive for a broad agreement on international trade in services are among the elements forcing the focus of the space policy debate to change.

International Commerical Competition in Space-Related Markets

As the earlier part of this chapter has demonstrated, the space arena has been and continues to be the scene of political competition among space powers. It is also the scene of growing commercial competition in most space-related sectors. The competing enterprises may be private firms or governmental organizations. They are subject to greater or lesser coverage of general international trading rules that govern commerce among nations in today's world.[43] In certain in-

[43] App. 4A surveys the international trading rules applicable to space commerce.

Competition and Regulation in the American Economy

The competitive organization of industry is well entrenched in the United States as the normal mode of industrial organization, even though this has not been the case in space industries. Most U.S. industries are considered to be workably competitive, in the sense that, whatever the departures from perfect competition, we rely on competition to keep the firms in these industries from earning significant monopoly profits and thus misallocating society's resources. The rationale for this reliance is that competitive firms will bid for customers by reducing prices and in the long run will earn only normal profits over the course of the business cycle.*

*"Over the business cycle" is an average concept. There's no expectation that prices will ever be such that normal profits will be earned at any one time. When there is overcapacity, competitive firms may reduce prices below long run average cost until the overcapacity is worked off, and when there is a shortage of capacity, prices may be above long-run average cost until capacity increases.

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stances they are also governed by domestic and international regulation.

The International Trading Regime in Space-Related Equipment

The current structure of international trading rules is primarily designed to regulate trade in commodities rather than services. Although the multilateral rules and understandings that have been negotiated through GATT[44] and OECD[45] do have a significant effect on international trade in equipment in general, especially when the stakes are relatively small, the many exceptions, exclusions, escape possibilities, etc., that have been built into the rules can be used by sovereign governments to avoid effective trade discipline when the stakes are large or when political considerations dominate.

Since France and Japan, and to a lesser extent other industrial countries, have made the decision to join the United States as space powers, it would be wishful thinking to believe that they will fully abide by the trade rules i n competition for sales of space-related equipment. In most areas they would probably lose out to U.S. suppliers in open competition, as a result of the price-quality dominance of the latter.

From the point of view of U.S. space-related equipment suppliers, perhaps the most damaging exclusion in the trade rules is the exclusion of the major non-American buyers of satellite communications equipment from the list of government organizations covered by the GATT Government Procurement Code. These organizations are the European and Japanese PTTs (post, telephone, and telegraph organizations) that have communications monopolies (or near monopolies) in their respective countries. The code document, which has been signed by most of the industrial countries, specifies which government agencies in each country are covered, and the European countries and Japan have specifically excluded their PTTs from coverage. Because the PITs largely follow "buy-national" procurement policies, American aerospace and telecommunications equipment firms are systematically excluded from a significant share of the international trade in satellites and ground-segment equipment.

Under considerable pressure from the United States, Japan agreed in a 1981 bilateral agreement to open up government procurement for the NIT to American equipment suppliers.[46] This agreement was also extended to the suppliers of all other countries and in 1984 was extended to December 31, 1986. U.S. observers currently disagree about whether enough progress in opening up NTT procurement occurred to justify renewing the agreement or not. No important progress has taken place in opening up European telecommunications equipment markets.

In third-country markets, the GATT Subsidies Code, a second major multilateral trade agreement, in theory, limits all kinds of subsidized export competition. In practice, however, it has not been used to cover the important types of subsidies in space-related equipment exports, such as R&D subsidies and the subsidized operation of government space organizations. Although these types of subsidies affect export competition, they also have justifications unrelated to international trade that are within the sovereign powers of individual nations. Separating the effects of these subsidies on trade from other effects has not yet been attempted to any extent in the case of R&D subsidies.

The OECD Arrangement on Officially Supported Export Credit, a third major multilateral trade agreement among the industrial countries, is designed to eliminate one particular type of export subsidy—subsidized credit. It applies to sales by both private and governmental organizations and is effective to a degree in preventing competition for third-country markets using subsidized export finance. Perhaps the heart of the arrangement lies in the elimination of credit subsidies that are relatively small. In instances where exporter govern-

[44] General Agreement on Tariffs and Trade. The name refers both to a treaty adhered to de jure and de facto by 117 countries and to an organization, which has a permanent staff, the GATT Secretariat.

[45] Organization for Economic Cooperation and Development. Membership includes the United States, Canada, Japan, Australia, New Zealand, and the governments of all Western European industrial market economies.

[46] "NTT Pact Extended for Three Years, Abe Holds Trade Talks With U.S. Official," *U.S. Export Weekly*, Jan. 31, 1984, pp. 580-581.

ments do not choose to make large credit subsidies, the arrangement now keeps them and their competitors from offering interest rates substantially below commercial interest rates and in this way lessens "unfair" competition .47 A special OECD arrangement exists for satellite ground stations; among other things, it limits the duration of export credit for ground stations to **8** years.[48]

There are limits, in practice, to this discipline in the use of export credit. Despite the arrangement, governments find ways to subsidize large-ticket, high-technology sales to less developed countries, both for political reasons and to promote exports. No existing multilateral agreement disallows credit subsidies with a *large* grant element in sales to less developed countries; they are simply given the label of "official development assistance" when the credit subsidy exceeds a 25 percent grant element.

Space-related transactions—e.g., the sale of a satellite communications system—are often large and politically significant to exporter countries. Hence, large credit subsidies appear to be the norm rather than the exception in sales of space-related equipment to less developed countries. The other industrial countries have justified the trade restrictions they have erected for space-related equipment and services and for subsidizing competition in third-world markets by arguing that they are simply countervailing against the strong subsidy and industrial-policy support the United States gives to its aerospace industry through the defense budget.

International Trading Regimes in Space-Related Services

General international trading rules do not as yet exist for trade in services of any kind (with the one important exception that export credit for services is covered by the OECD arrangement). Thus, different international trading regimes exist for each different service industry. in the four space-related service industries discussed in this report-space transportation, remote sensing, materials processing, and satellite communications—only the latter has a well-defined international trading and regulatory regime. Space transportation and remote sensing have only begun to glimpse real commercial competition and international trading regimes have not been developed for these industries. The materials processing industry (as well as its international trading regime) does not yet exist.

The questions of industrial organization and international trading regime are discussed in the following section in the context of each of the service industries, but we note here that the international trading regime in international satellite communications has largely eliminated international competition in both the sale of services and the ownership of facilities. International trading regimes in finance and other auxiliary services important for international trade in large, risky, and long-lived space-related ventures, are also highly anticompetitive in many countries because of restrictive national regulation and constitute an important non-tariff barrier to the sale of U.S. space-related services and equipment in these countries.[49]

Competitive Analysis of International Space-Related Service and Equipment Industries

Space Transportation Services

The space transportation services industry has recently passed from infant industry status, where to all intents and purposes there was only one

[47] For an extensive treatment of the subsidy issue see Gary Clyde Hufbauer and Joanna Shelton Erb, *Subsidies in International Trade* (Cambridge, MA: MIT Press, 1984).

[48] Unpublished document, supplied by the U.S. Treasury.

[49] By "anticompetitive" trading regimes, we mean that in the markets involved, firms (particularly foreign firms) are significantly restricted in entering the market, in offering products or services at their discretion, in pricing these products and services, and in investing in facilities. The International Banking Act of 1978 established a U.S. Federal regulatory framework giving "national treatment" to foreign banks (i.e., nondiscriminatory treatment of foreign banks vis-a-vis U.S. banks). U.S. banks and other financial institutions, however, are not accorded national treatment in many other countries. In a recent survey for the Senate Committee on Banking, Housing, and Urban Affairs, the Controller of the Currency found that significant progress had been made since an earlier 1979 survey in securing national treatment for U.S. banks in six of the seven OECD countries surveyed (Canada, Finland, Norway, Portugal, Spain, and Sweden, but not Australia); Department of the Treasury, "Report to Congress on Foreign Government Treatment of U.S. Commercial Banking Organizations, 1984 Update, " submitted July 5, 1984.

producer carrying commerical payloads, to a more complex competitive status. NASA is still the dominant producer and still receives annual congressional appropriations for space transportation, but there are now four additional actual or potential major competitive carriers, Arianespace [Ariane], Transpace Carriers, Inc. [Delta], General Dynamics IAtlas-Centau r], and Martin Marietta Titan].

In addition to these major carriers or potential carriers, several specialty carriers now offer or may soon offer minor or specialized services, such as low-earth-orbit and sub-orbital space transportation. Identified in this report are Space Services, Inc., Starstruck, Inc., Orbital Sciences Corp., OTRAG (Germany), and Bristol Aerospace, Ltd. (Canada), but other firms are likely to enter this specialty market in the future.

Two classes of ***potential*** competitors are government launch agencies (in the U. S. S. R.,[50] India, China,[51] Brazil, and Japan), which so far have not indicated a commercially important desire to compete in the general international space transportation market, and the large U.S. aerospace firms that do not currently maintain launch capability but are well entrenched in one or another aspect of space (e.g., Hughes Aircraft Co. or British Aerospace).

Whether or not the fringe of the space transportation services industry develops or aerospace firms enter the market will depend primarily on future demand for space transportation and the pricing of services by established subsidized providers like NASA and Arianespace.

By far the largest current demand for commercial space transportation comes from the communications industry. This demand for placing communications satellites in orbit is relatively well known for the next 5 years, but becomes highly uncertain thereafter. [52] This uncertainty arises because satellite and fiber-optic cable technologies will be active technological alternatives in volume long-distance communications in the 1990s. With the greater integration of space-related commerce into the economy, economic events far from space will strongly influence the market for space transportation.

Other civilian demand for space transportation—for materials processing, remote sensing, space station activities, space science and space R&D–is even more uncertain. Complicating everything will be military demand for both NASA Shuttle bay capacity and, perhaps, for expendable launch vehicles (E LVs).[53]

Under continuing high demand, the space transportation industry could mature rapidly in the late 1980s and early 1990s. NASA, or private sector descendants, would be providing Shuttle services to space stations and to firms parking free- flyers in space or sending communications satellites on "upper stage" rockets to geostationary orbit. ELV operators, Arianespace and a number of U.S. firms, would probably be providing an array of tailored services primarily to the communications industry. Firms providing specialty services might be competing for a variety of low-mass communications and materials processing payloads. The space transportation industry could develop vigorously in the normal competitive mode.

Under low demand, however, the industry structure would be far different. There might be an excess supply of Shuttle services. Arianespace might be the only ELV operator, with most or all U.S. aerospace firms either definitively discarding plans to offer ELV services on current-generation vehicles or simply continuing to hold back. Some specialty firms might die out. NASA and Arianespace might continue to provide commercial launches in protected home markets and engage in subsidized export competition in international markets.

Of several key decisions that will affect competition in space transportation, the first concerns whether competition can be the preferred industrial organization in this industry, as it is in American industry in general, or whether there are special characteristics in the industry that make an

[50] The U.S.S.R. has offered its Proton launcher to INMARSAT in what may be called international competitive behavior.

[51] China has recently offered to sell lau nch services to other nations. See "China Offering Launch Services to International Users," *Aviation Week and Space Technology,* Apr. 8, 1985, pp. 25-26.

[52] See chs. 5 and 6.

[53] See ch. 5 for a more extensive discussion of space transportation.

organization based on regulation necessary. Recently, the theory that transportation industries, absent special circumstances, operate more efficiently under competitive conditions has been widely put into practice. In the face of this general practice, proponents of regulating space transportation would have to argue that special circumstances do indeed obtain .54 Their argument might emphasize the political and military aspects of space, the large investments often necessary and the need for special institutions to accomplish national objectives.

The essence of competitive organization in any industry is freedom of pricing and entry.[55] in space transportation, pricing freedom would apply to both private and government entities. In the United States, space transportation is far from being a perfectly competitive industry. Firms are free to enter, but may face subsidized price competition from Government-owned systems (e.g., the Shuttle). But attempting to make it more competitive by establishing price controls, allowing price fixing, or maintaining entry restrictions would be contradictory. Workable competition depends on firms having sufficient freedom of both entry and pricing that customers will have full freedom of choice. In this, as in many other industries, regulating imperfect competition in order to improve it may prove to be counterproductive.[5G]

A second important decision affecting competition in space transportation concerns the amount of subsidy that will be provided to NASA in the future to provide commercial space transportation services. If it is not Congress' intention to subsidize these services, NASA would have to earn a market return on its investment in facilities to provide them. Measurement of NASA's rate of return on investment in these facilities is not a trivial exercise, and key accounting determinations would need to be made (beyond those now provided by NASA) as to what facilities should be counted and how much of their services should be ascribed to civilian launches.

Large new investments (e.g., the purchase of additional orbiters) in a program to carry commercial cargoes would make the subsidy question salient. Under these circumstances, Shuttle prices that did not take account of capital costs related directly to commercial cargoes and did not reasonably allocate costs of all kinds between commercial and government business, would constitute the subsidization of one competitor (NASA) in a mixed public-private international industry.[57]

A third important decision affecting competition will be what stance the United States should take toward international competition. It should be clear that, in addition to developing other space-related industries, France, Japan, and other countries are convinced that they must have a space transportation capability. This commitment has been based on various theories about leading-sector industries, but it is undoubtedly also grounded in straightforward considerations of national pride.

Given their commitment to developing launch capability, it appears inevitable that they will also practice restrictive procurement when their space-related industries might not otherwise develop the minimum level of sales to justify operations. Open access of U.S. producers to these

54The Department of Transportation (DOT), with the demise of the Civil Aeronautics Board at the end of 1984, now has full responsibility for both economic and safety regulation of the airline industry; it also has recently been given the lead responsibility for regulating the space transportation industry. The recent history of regulation of the airline industry may offer some guidance to what form regulation of space transportation may take; in recent years, economic regulation of entry, price, and capacity for both passenger and cargo has largely been removed for domestic but not for international air transportation.

55It also needs to be specified that in space transportation or any other market where the buyers may be government entities, "free entry" has to mean more than just the freedom for sellers to offer price-service combinations at their discretion. There must also be buyers willing to purchase the best price-service offering, rather than be constrained to purchase only from certain sellers because of political directions.

56Mixed public/private industries are a' particular case in point. Aside from advantages in government procurement, public firms are likely to have an advantage in their cost of capital and in their de facto insurance against bankruptcy due to losses. Conversely, they are likely to suffer from the disadvantage of being used as an employment utility and, generally, from political interference. Thus, there is usually no shortage of imperfections in competition involving such firms. Nevertheless, the use of regulation to cure such conditions may often be a cure worse than the disease, if imperfect competition is replaced by a government-managed cartel.

57Similar questions concern Arianespace, but since an important current subsidy of international launches comes from discriminatory pricing in favor of non-European cargoes, a more conventional international trade approach against "dumping" is possible if services should come to be covered by U.S. antidumping statutes.

markets and full coverage of their space industries by liberal international trade principles do not, therefore, appear to be possible in the near future. Rather than attempting to prevent trade restrictions in the international market for launch services, the United States could try to minimize their impact and scope.

Continued efforts to get a multilateral code on trade in services,[58] to make general progress on government procurement and subsidies, to achieve an agreement on mixed credits in trade with developing countries, and to make sure that space industries are not systematically removed from coverage would probably help to achieve this objective. In addition to multilateral trading rules, bilateral negotiations and reciprocity legislation have also been advocated as mechanisms for securing access of U.S. firms to foreign markets.

How open the U.S. market should be to space transportation firms from countries that exclude U.S. firms and how to counteract subsidized competition in the U.S. market and in third-country markets are related questions. The use of U.S. trade law and administrative procedures to impose countervailing penalties has been the traditional U.S. method of ensuring that competition is fair in the U.S. market. Transpace Carriers, the U.S. space transportation company offering the Delta launcher, has attempted to use them and has asked the Administration to penalize Arianespace and the European governments subsidizing it, if negotiations fail to ameliorate any unfair competitive practices in space transpoftation.[59]

[58]In the case of services (space transportation included), the only multilateral agreement of any substance that currently applies is the OECD Arrangement on Officially Supported Export Credit, but the United States is leading a campaign to start multilateral negotiations for a GATT code on services.

[59]In its June 1984 petition, filed with the U.S. Trade Representative's Office, Transpace Carriers, Inc., charged European Space Agency member states (particularly France) with subsidizing Arianespace in its provision of expendable launch services. The Transpace complaint objected to Arianespace's two-tiered pricing structure (lower for non-European buyers); the subsidized provision of launch and range facilities, services, and personnel; the subsidized provision of Centre National d' Études Spatiale personnel; and the subsidization of mission insurance rates for Arianespace customers. The complaint asks the President to negotiate for an end to such practices, in the meantime to bar Arianespace from marketing its services in the United States, and to impose economic penalties against ESA-country imports under Sec. 301 of the Trade Act of 1974. *(U.S. Export Week/y,* June 12, 1984.)

Satellite Communications Services

The satellite communications industry is the most mature of all the space-related industries and has been big business since the late 1960s. If we define the international satellite communications industry to be the firms that sell international communications services using communications satellites, the major U.S. industry participants are AT&T, Western Union, RCA, IBM (through SBS), ITT, GTE, MCI, McDonnell Douglas, United Brands,~ and COMSAT. These are the large, basic U.S. long-distance telecommunications firms.[61]

After a decade of deregulatory action in long-distance domestic communications, culminating with the AT&T divestiture, these firms are now vigorously competing in the various domestic communications/basic communications submarkets. In addition, other U.S. firms specialize in various types of enhanced communications and distribute them over circuits leased from the basic communications carriers. A number of such firms are those whose business has primarily been in the information industry but which, because of the merging of the data processing and telecommunications industries, are now offering satellite communications services of various sorts in competition with traditional communications firms. Private corporate networks are also a significant element in the domestic market, since they provide excess communications capacity from their private communications networks for resale. Hence the U.S. domestic market is now vigorously competitive.[62]

[60]The involvement of these firms in international telecommunications is not well known. McDonnell Douglas participates through its FTC Communications, Inc., Tymshare, Inc., and Tymnet, Inc. subsidiaries. United Brands participates through its TRT Telecommunications Corp. subsidiary, and its ownership interest in International Satellite, Inc.

[61]For a more complete list of firms that sell or intend to sell basic international communications services, see ch. 6.

[62]In recent years both the information and communications industries have seen substantial technological changes that make it impossible to draw a clear boundary between them. Digital and other communications transmissions in communications networks can be made more efficient with computer processing (e. g., packet switching), and computer networks also require special communications facilities and software to optimize their use. Particular users, such as banks, may benefit when their computer and communications hardware and software are designed as an integrated system. The manufacture of specialty components for such communications/computation systems is now a major economic activ-

Overseas, most countries have governmental communications monopolies, for instance the post, telephone, and telegraph organizations (PTTs) of Germany and France, and these are often very large firms. As regulated monopolies, they typically handle all the telecommunications of their countries—satellite and terrestrial, domestic and international. Although this is the dominant pattern, there is some institutional variation. In Britain, the government monopoly, British Telecom, has recently given way to an industry with two major firms, and both have now been privatized. In Japan and Canada, the international satellite communications firms are regulated private rather than public monopolies.

In all industrialized countries, regulatory authorities have been and will increasingly be facing the need to decide: 1) where the regulated domestic "network" (carrier-owned equipment) ends and what customer-owned equipment can be connected to it; and 2) where the precise dividing line between regulated communications and unregulated data processing is. The need to make and revise these determinations has already brought large regulatory changes in U.S. domestic communications and will almost certainly do so in other countries. At a minimum, competition will develop in the equipment and enhanced services industries at the fringes of the governmental telecommunications monopoly. The new fringe competitors, along with firms from other countries, will, in turn, seek entry into international communications and create pressure for regulatory changes there as well. The countries that are experimenting with or about to experiment with competition in long-distance domestic communications will also be adding potential competitors and stimuli to change to the international communications industry.

This is a process that is only beginning. Competition among carriers in international communications is still highly constrained by regu lation. The carrier selected by a consumer to initiate a communication is almost never able to deliver it internationally over its own facilities or more generally to optimize an international network for the use of its customers. Instead, because of U. S., foreign, and international organization regulatory restrictions, it must hand off the communications to other entities at some point in its journey with the result that linkage through a whole chain of entities is typical of international communications transmissions,

Little competition takes place between the entities in this chain. In all major countries, entry, prices, service offerings, and facilities in the international satellite communications industry are highly controlled. International competition between service sellers from different countries does not yet exist to any extent. Even connection rights to other countries' networks currently are severely limited for all but a handful of traditional U.S. carriers.

Despite the complexity of international interconnection, a number of large multinational firms, such as Citicorp (connecting 1,400 offices in 93 countries), Merrill Lynch, Texas Instruments, General Electric, Shell Oil, etc., have developed their own private international communications networks.[63] At the present time, these networks are the closest that international communications come to being handled by a single entity. Facilities outside their premises are typically not owned by the communicating firm, but the network is functionally controlled by it from initiation to completion of communication. These corporate networks are beginning to constitute a challenge to the international regulatory regime as it is now constituted, because excess capacity on these networks (including that on U.S. domestic satellites) is potentially resalable to those who now use international common carrier facilities. If large-scale competition among resellers were permitted internationally as it is within the United States, the competitive situation in international communications services would be very different. Hence, the issue of resale of capacity reaches to

ity. The communications service and equipment firms are entering various information lines, and computer firms are entering various communications service and equipment lines. The recent AT&T divestiture decision was predicated, among other things, on the idea that it is no longer possible to draw a definitive line between the two industries.

[63] U.S. Department of Commerce, *U.S. Industrial Outlook 1984*, pp. 46-48; "Multilevel Network Connects Worldwide Workstations," *Telecommunications*, North American Edition, August 1984, pp. 41-45.

the heart of the current international regulatory regime.

To date, INTELSAT, an international satellite consortium owned by the PITs (or other telecommunications organizations designated by its 109 member governments), provides most of the transponders used **in intercontinental civilian communications.**[64] However, competitive pressures may change this situation in the next few years.

Technological developments and market growth have created competitive pressures that are likely to reduce the dominance of INTELSAT in coming years. First, a number of regional international systems have come into existence in recent years. Second, since the AT&T divestiture and the privatization of the British telecommunications industry, a number of private U.S. and British firms are poised to construct satellite or fiber-optic undersea cable facilities in competition with INTELSAT and the traditional cable consortia, which have been dominated by AT&T and the European PTTs.

Under stringent limitations to safeguard INTELSAT'S revenue base, the Reagan Administration at the end of 1984 urged the Federal Communications Commission to process favorably the applications of five U.S. corporations wishing to launch satellites for transatlantic communications.[65] The FCC, for its part, in early 1985 recommended that the State Department approve the application of a British carrier's U.S. partner to land a high capacity U. S.-U. K. undersea fiber-optic cable.[66]

If some or all of the alternative satellite and cable systems come into being, as now seems likely, both the operations of INTELSAT and the international communications regime will be altered significantly. At present, it is not clear how the foreign satellite link will be arranged. The alternative satellite proposals are not definitive on the terms of interconnection with the very same foreign telecommunications entities that are the part owners of INTELSAT with whose facilities theirs would be competing.

As it attempts to allow greater competition generally in international telecommunications, the FCC should analyze whether the incentives U.S. and foreign carriers will operate under will result in overcapacity in U.S. international telecommunications. One element in this determination involves the amount of capacity to be provided by the potential new satellite firms. Another involves the planned capacity of INTELSAT'S VI and VII series satellites. A third involves the capacity to be provided by the proposed transatlantic fiber-optic cables and the similar cables that have been proposed for transpacific communications. If open facilities competition should lead to overcapacity in international communications that resulted in higher rather than lower rates through service regulation, continued facilities regulation to avoid the overcapacity might be justified even in a partially deregulated market. (See ch. 6 for a discussion of competition between satellites and fiber-optic cables.)

The FCC has regulatory authority over both the construction and use of U.S. international telecommunications facilities. The prevailing *pattern* of FCC facilities approvals in international (but not in domestic) communications has been to approve the investment of U.S. carriers in international facilities owned by consortiums of carriers—COMSAT in INTELSAT for satellites and AT&T and the other international service carriers in cable consortiums with European PTTs. The

[64] COMSAT, a Private firm, which functions as an intermediary in virtually all U.S. intercontinental civilian satellite communications, is the U.S. representative.

[65] Intersputnik, an international satellite organization with mostly East bloc countries as members, INMARSAT, an international satellite organization of which the United States is a member handling marine communications, and the "domestic" satellites of countries that send communications to territories on other continents (e.g., France's Telecom I or U.S. COMSAT satellites transmitting to Pacific territories), are the other elements in intercontinental communications at the present time. See ch. 6 for further information.

[65] Other systems from the United States and other countries would seem to be in the wings, as well, if the applications of the first five are affirmatively acted on. For instance, France's Telecom 1, designed for satellite communications with its overseas territories in the Americas, has a reception "footprint" that covers large parts of the United States and could be used for transatlantic communications to the United States.

[66] FCC News, **"Preliminary Action on Tel-Optic and SLC (Submarine Lightwave Cable Co.) Cable Landing Applications, Report No. 30992, Mar. 4, 1985.**

current exceptions to this involve North American regional use of U.S. domestic satellites owned by single carriers in communications with certain Western Hemisphere destinations. The Commission has also in the past regulated the relative use of existing satellite and cable facilities for transatlantic service and is investigating what its policy toward facilities competition should be in the North Atlantic during the 1986-91 period.

The market for international satellite communications services is part of the total market for international telecommunications, which has been growing rapidly since 1970 and will probably continue to do so. The fraction of this growing total that will be carried by satellite (and consequently the demand for satellites for this purpose) is difficult to predict. Among other factors, it will depend on the relative cost of satellite and fiber-optic cable capacity, which remains uncertain because technological developments are extremely difficult to predict. The decisive factor, however, is likely to be the facilities regulation policies of the FCC and other governments.

In formulating U.S. policy regarding competition in international communications, policymakers should realize how much the market would have to be liberalized before it could be regarded as competitive, A not very likely competitive scenario can be specified as a standard for comparison to make this point. In a fully competitive industry, hundreds or thousands of communications firms from many countries would offer various kinds of international voice, data, and TV services to individual consumers and businesses around the globe. Unrestricted leased circuits and lines would be freely available from a variety of large and small satellite and cable owners. In most places local telephone service would still be provided by regulated common-carrier monopolies, but access by long-distance communications firms would be on a nondiscriminatory basis, regardless of their nationality and the destination of the communication. Regulatory problems would be transmuted into problems of trade-in-services, with governments negotiating about subsidies, nontariff barriers, and discrimination in government's procurement of communications services, rather than regulating the prices, entry, and investment of carriers.

This portrait of a fully competitive telecommunications industry is probably unrealizable in the next decade, because the current structures of international telecommunications regulation are firmly entrenched in many countries, and the United States cannot unilaterally alter them even if it would like to. The policy questions that arise, therefore, will most usefully be cast in terms not of the general wisdom of competition vs. regulation, but rather whether the particular partial moves toward deregulation under consideration will produce economically and/or politically effective outcomes within the time-frame envisaged. This stance is particularly useful since many of the proposed future actions in U.S. international communications are likely to be reactions to developments in technology or in domestic telecommunications markets, and the issue will be how most effectively to secure their benefits in international communications in the context of continuing restrictions.

Remote Sensing Services

Remote sensing from space provides data relating to the Earth's atmosphere, land masses, and oceans. In all three cases, these data have "public-good" characteristics.[67] Different governmental responses to their public good aspects, depending on whether they originate from meteorological, land, or oceans remote sensing systems, have resulted in different industry structures and different competitive patterns from those characterizing the other space applications technology sectors.

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[67] "Public good" is used here in the technical sense used in formal economic theory to refer to those goods or services like national defense, city parks, and public health services, where the cost of servicing an additional consumer (marginal cost) is negligible and where it is often impossible or undesirable to charge consumers for the service they consume. The general principle that economic efficiency is served when consumers pay just the extra cost of servicing them is only approximately honored in most industries, but in the case of industries producing public goods, it is either impossible, infeasible, or undesirable even to approximate it. Hence, alternative arrangements are common in the provision of "public goods, " often involving government subsidy and production. Although consumers who do not pay for the data may be excludable from consumption (e.g., by coded signals), the transactions costs of excluding them may be large compared with marginal cost of servicing them. See app. 4A, for a fuller treatment of public goods.

In the United States and other countries, the public benefits of having a meteorological remote sensing capability have been considered large enough to justify subsidized Government production. Accordingly, industry participants in the United States and elsewhere have been governmental organizations producing meteorological data and distributing them free or at the cost of reproduction.[68] Currently, both the geostationary and the polar-orbiting meteorological satellite systems are operated by the National Oceanic and Atmospheric Administration. NOAA provides free direct data transmission to Earth receivers around the globe and a variety of data products which can be purchased for the cost of reproduction.

Commercial operation of the meteorological remote sensing system might be both possible and profitable for private firms, but because of the public good aspects of the industry, the level of operation and the pattern of distribution of benefits that would result would not be economically efficient. Congress, in fact, acted in 1983 to prevent transfer of the U.S.-owned meteorological satellites to the private sector (Public Law 98-166) for this and other reasons.

Land remote sensing shares some of the public good characteristics of meteorological remote sensing[69] but there are two important differences in how the government and the public at large regard it. First, the public interest in assuring that the land remote sensing industry operates efficiently (in the sense that additional users pay only the extra cost of servicing them) is not as great as in weather remote sensing where universal access to the data is an important public goal. Second, fewer citizens benefit directly from land remote sensing data than from meteorological data. Moreover, the few users there are can sometimes use alternative aerial-photogram metric and ground-observation data sources. Hence, U.S. policymakers have chosen to attempt to transfer the Government's Landsat system to the private sector (Public Law 98-365).

The difficulties in implementing this policy stem primarily from the fact that the market for land remote-sensed data is not currently large enough to sustain a single, unsubsidized, self-sustaining private enterprise, let alone a competitive industry. Only small amounts of land remote-sensed data have actually been sold to private sector buyers in either raw or analyzed form. At present most of the consumers of land remote-sensed data are governmental agencies.

Private sector users are either firms that process the data for their own use, principally petroleum or other minerals firms, or "value-added firms," such as Earthsat Corp. and ERIM, Inc., which purchase raw data from the U.S. Government, analyze them and convert them *to* information suitable for clients. These companies are essentially in the information business. Such firms, for example, offer enhanced data for sale to agribusiness, forestry, and mineral-exploration companies.

Much of the potential demand for satellite remote sensing that has been identified is price sensitive and will not materialize at high prices.[70] Data consumers will continue to use photogrammetric data when they are inexpensive enough, or do without.

Despite the current meager prospects for commercialization, international competition has nevertheless emerged. SPOT IMAGE, S. A., a French Government-owned remote sensing company, will soon begin offering remotely sensed data to customers in the United States and elsewhere in the world.

Because of the characteristics of the two systems, data from SPOT and from the Landsat system are not perfect substitutes. The SPOT system,

[68] Although it would be possible to charge for weather-related satellite data, the costs of doing so are disproportionately large. First of all, the cost to NOAA of supplying data transmission to one more receiving station is zero. Society would also suffer an extra cost if data leading to weather forecasts were subject to user charges. If the general public were not informed about weather dangers, society as a whole would suffer avoidable costs from weather disasters.

[69] Ocean remote sensing also shares public good characteristics but will not be discussed here. The United States is planning an ocean remote sensing system to be operated by the Navy; the Navy Remote Ocean Satellite System (N ROSS) is scheduled for deployment in 1987. NOAA is planning to distribute data from NROSS to civilian users.

[70] The steep decline in sales of multispectral data after the Price increased in October 1982 is evidence of such price sensitivity. The availability of aerial photogrammetry and ground observation are one reason for this price sensitivity. See *Remote Sensing and the Private Sector: Issues for Discussion*, op. cit., ch. 5.

for instance, provides relatively high resolution data (20 meters) in three color bands (or 10 meter resolution in black and white). It also provides quasi-stereo, an important feature for mineral exploration and mapmaking. The U.S. Landsat system has two instruments providing data: relatively low resolution data (80 meters) in four wavelength bands; and higher resolution data (30 meters) in six wavelength bands. Given these factors, and the current uncertain state of private sector entry into land remote sensing in the United States, exactly how the competition will develop is a matter of conjecture. SPOT IMAGE, nevertheless, has already embarked on an aggressive data marketing effort in the United States.

The present inadequate size of the market leads to the question of how much subsidy, if any, is desirable for this infant industry and how long it should be maintained. Both the United States and France will have to answer this question on a continuing basis; both currently are providing significant subsidies to establish the firms. The inadequate size of the market and other considerations also lead to the question of how much regulation should be imposed on the U.S. private satellite operator or operators.[71] (See ch. 7 for a fuller discussion of these issues.)

Materials Processing Services

Whether or not an industry processing materials in space will come to exist for any substantial volume or value of materials processed is still highly uncertain. The industry analyzed in this section, therefore, should be thought of as a potential industry rather than an actual one.

The set of firms likely to be processing materials in space is potentially a diverse one. Two main groups of firms will probably be, first, large pharmaceutical, metallurgical, electronics, or ceramics firms processing materials for themselves; and, secondly, specialized firms selling materials processing services, such as unmanned orbital processing units ("free-flyers"), special metallurgical furnace services, or microgravity processing facilities. The large cost of establishing a credible space processing facility will limit entry to existing firms or entrepreneurial groups that can marshall substantial resources. Joint ventures, like the one already in existence between McDonnell Douglas, Ortho Pharmaceutical, and NASA might be common as the industry gets underway. Although the cost of entry may be high, there appear to be a large number of firms in materials-using industries and aerospace firms able to deploy sufficient resources, particularly if NASA offers subsidized shuttle services to them.

It is uncertain whether the relatively high expense of processing materials in space will substantially deter their marketability. Even if a material were produced in space, and marketed in sufficient volume, there would always remain the possibility that the space-based operation could be undercut by terrestrial production of an adequate and less costly substitute.

The industry, it should nevertheless be emphasized, is poised for rapid development if the risks are reduced and if a high value material is found that can be produced most efficiently in space. For example, if the McDonnell Douglas electrophoresis process should efficiently produce high-purity interferon in space and if interferon should prove to be the wonder drug of the decade, a number of pharmaceutical firms and aerospace firms catering to the pharmaceutical industry would be able to enter rather quickly. Such a development would also produce increased demand for space transportation and materials processing capacity.

Among U.S. pharmaceutical, metallurgical, and other manufacturing firms which might manufacture materials in space for their own use, competition is now the organizing principle in most cases and would undoubtedly continue to be, as long as firms were allowed nondiscriminatory access to space processing facilities. Competition will probably also be the organizing principle of the processing services industry. However, if as seems likely, the market for processing is both small and broken up into specialized segments, society will have to rely on potential rather than actual new entrants to contest the several little monopoly markets and keep prices down.

There would probably be few barriers to international competition in the materials processing

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[71] The Department of Commerce currently has regulatory responsibility.

industry. Materials processed by a French firm, for example, and brought down from space in France could be imported into the United States, subject, presumably, to whatever tariffs were applicable. The principal, and probably the only important, barrier to free international competition in materials processing, will be the question of foreign access to the NASA Shuttle, as it is currently the most practical way to retrieve processed materials from orbit.

The Transition From Political to Economic Competition

In this chapter we have looked at the various political and economic aspects of international competition in civilian space activities. With the increasing commercialization of space, a number of space-related activities are caught between the political competition of "national space programs" and the economic competition of international commerce.

Prior to the development of vigorous commercial civilian space activities, the arguments in favor of continued support of space activities are usually scientific and political, although they usually also include subsidiary industrial-policy reasoning. Congress supports the national space program both for national pride and also for technological development that may lead to later economic growth and exports.

As commercial activities develop, however, the arguments used to justify government space activities begin to be measured against general concepts of international trade. Previously unfettered national space policy—in its competitive aspects–becomes challenged as to its fairness and consistency with general international trading rules. Appropriations for the national space program in areas of commercial activity are now characterized by some as subsidies against which countervailing duties can in principle be assessed or against which other retaliatory measures can be taken. The government space agency now becomes a government entity covered or potentially covered by the GATT government-procurement agreement. Assistance to developing countries in satellite communications or launch services, previously seen as an essential part of bringing the benefits of space technology to all mankind, now becomes the subject of international negotiations on export credit subsidies. And trade negotiators have to deal with whether or not space-related services should be included among those to be covered by potential future agreements on international trade in services.

This process is actually the natural outgrowth of successful commercialization and the beginnings of healthy international trade, rather than a threat to them. In space-related equipment the process has been clearly underway for some time. Trade restrictions and subsidies in space-related equipment manufacturing industries are increasingly seen as part of industrial policy in these industries and referred to as "targeting." As in other industrial contexts, government-supported R&D in early phases of an industry are difficult to deal with under the international trading rules, but insofar as the targeting takes the form of large current subsidies or trade restrictions, it becomes the subject of trade negotiations, like those, for instance, that have taken place with Japan on space-segment satellite communications equipment.

In space-related services, the process is less clear, mainly because general international trading rules on services have not yet been agreed on even within the industrialized countries, and each trade sector currently has its own rules. international satellite communications services, for instance, are subject to the unique regulatory regime that governs international telecommunications services generally.

What this implies for an understanding of competition in international civilian space activities is that as each space sector matures commercially, it becomes subject not only to the international politics of space but also to the broader and more complex politics of international trade and regulation. A national political commitment to space—and to competition for leadership in space activities—may come into conflict with another national commitment to fair competition within an open world trading system.

APPENDIX 4A.–THE MAIN INTERNATIONAL TRADING RULES OF RELEVANCE TO INTERNATIONAL COMPETITION IN CIVILIAN SPACE ACTIVITIES

The general international trading rules have been the subject of extensive negotiation in recent years. Trade specialists generally agree that the rules are having a significant effect on the sales of equipment, but that this effect is somewhat hard to quantify. With respect to services, general international trading rules do not yet exist to any extent, although informal negotiations are currently underway to explore the possibility of a services code.

Three major trading rules affect "unfair" competitive practices in international trade in equipment, in addition to the general GATT principles of equal access and equal treatment:

1. the OECD Arrangement on officially supported export credits,
2. the GATT code on subsidies, and
3. the GATT code on government procurement.

These three codes fill gaps in the GATT treaty but do not have universal coverage. They are largely restricted to the industrial countries, but a few developing countries are signatories.

in their present form they are quite new. Although the OECD Arrangement has existed since the early 1970s, the minimum interest rate levels allowed for official export finance had until recently been so much lower than commercial interest rates that a large subsidy element remained. However, starting in 1982, the minimum rates have been close to commercial rates. When they are adhered to, these minimum rates now serve effectively to discipline export finance subsidies in equipment sales. The new GAIT codes on subsidies and government procurement are also quite recent; they entered into effect only in 1980 and 1981, respectively, and experience with them is still limited.

in addition, because of incomplete country coverage, specific exclusions, ease of escape, differences in interpretation, and ineffective enforcement, the trading rules are observed, when they are observed, through a combination of deterrence and negotiation. Essentially they set a standard that can be followed voluntarily or against which deviations can be measured.

The deterrence effect probably constitutes the major effect of the rules. Governments comply voluntarily with the rules because they want to avoid being confronted by other governments asserting that they have violated agreed trade rules and threatening retaliation.

The trade rules also set the standard for negotiation, which is the predominant way that they are "enforced." Although the term is used, enforcement is clearly the wrong concept. The conciliation and negotiation activity referred to as "enforcement" does not even approximately resemble an adjudicatory proceeding. It is primarily carried out on a bilateral basis but also takes place, on occasion, in the GATT multilateral framework, Bilateral negotiation (or negotiation among small groups of countries) may concern questions of compliance with the general trade rules, but often these negotiations will be sector-specific, e.g., for aircraft or satellite ground stations. Frequently, the participants in such negotiations hammer out sector-specific arrangements that may conflict significantly with the principles embodied in the general rules.

GATT dispute settlement panels complement bilateral negotiations in "enforcing" the trade rules in several ways. First, a GATT panel may award the right to take retaliatory action as "compensation" for a trade rule violation after conciliation has failed. Legitimizing retaliatory action in this way reduces the possibility that a generalized trade feud will result from retaliation against retaliation. Secondly, the possibility that a retaliatory action taken on the basis of a country's domestic law might subsequently be found by a GAIT panel to be itself a trade rule violation tends to lessen the incompatibility of these actions with the rules. The major limitation on the usefulness of the GATT panels is that panels in the past have typically decided cases on the narrowest of grounds.

The actual workings of the trade codes have not always been transparent. Only narrow specialists, in government agencies and in specialized private law firms, are fully aware of all the relevant provisions of the various agreements and statutes bearing on a particular problem area and how they work together. In a given case, these complexities may result in a determination quite different from what a nonspecialist might expect from a straightforward reading of the documents.

One topical example of the complexity of trade codes and laws is the question of how to classify a launched satellite under U.S. trade law. Suppose a French company offered to sell a satellite with subsidized financing to an American buyer delivered CIF space. Would imposition of a countervailing duty under section 301 of the Trade Law of 1974 be available as retaliation against such an unfair trade practice as it would be in the cases of other subsidized sales of equipment imported into the U.S. market?

Under U.S. trade laws, the satellite would be classified as an export from France but it could not be classified as an import into the United States, since it had not physically entered through customs. Because it was not an import, countervailing duties or charges therefore could not be levied under section 301. However, under section 1912 of the Export-Import Bank statute, the Secretary of the Treasury may direct the Em-Im Bank to subsidize the sale of an American product in the U.S. market in retaliation, if that product is competing with a subsidized foreign product. This action is available even when the equipment has not passed through customs.

It appears to be the consensus of the trade experts that the trading rules should be seen as "working" in the general international trade in equipment, primarily by their deterrence effect but also through negotiation. This is particularly true when the stakes are relatively small. When the stakes are large, however, the many exceptions, exclusions, and escape possibilities that have been built into the rules, can be used by sovereign governments to avoid effective trade discipline. Roughly speaking, where international trade per annum in a sector on the order of $1 billion or more is involved, the trade rules are likely to be seriously breached by governments.

Exclusions and Exceptions Keep Space-Related Equipment From Being Effectively Covered by the International Trading Rules

None of the three major codes referred to above effectively constrain "unfair" competition in space-related equipment because of exclusions and exceptions. Perhaps the most damaging exclusion involving space-related equipment is the exclusion of the major non-American buyers of satellite packages (satellites transported into space and insured) from the list of government organizations covered by the GATT government procurement code. These organizations are the PTTs (post, telephone, and telegraph organizations) that have communications monopolies in their respective countries.[1] The code document specifies which government agencies in each country are covered, and the European countries and Japan specifically excluded their PTTs. (Because of this refusal to include the PTTs, the United States, in retaliation, excluded the Corps of Engineers from its list. NASA, however, is included.) Because the PTTs do largely follow "buy-national" procurement policies, American firms are systematically excluded from a share of the international trade in satellites and communications equipment.

In practice, the subsidies code does not effectively cover the types of subsidies that are important in international sales of space-related equipment. Although the code contains broad language prohibiting unfair subsidies that affect international trade, it illustrates what a subsidy is only by a short list of examples, all of which relate directly to international trade except for a general "any other subsidy" category. Not by accident, none of the examples relates to research and development expenditures or generally to the subtle types of assistance included under the rubric of "industrial policy."

Whether or not the subsidies code will be of any use in disciplining international trade in space-related equipment is problematic, because R&D and industrial-policy subsidies frequently occur in the space sector, and they will be the hardest to bring effectively under the subsidies code. To be sure, the category including "any other subsidy," defined as "any subsidy . . . which operates directly or indirectly to increase exports of any product from, or to reduce imports of any product into, [the] territory" of a contracting party, is a very broad one which could easily be interpreted to cover R&D and industrial policy in general. It has not been effectively tested, however. The general impression among trade specialists is that it will be difficult to apply the subsidies code to those subsidies, whose focus is primarily domestic, even if their impact on international trade is substantial.

The United States has plainly been the country that has most heavily used R&D and other industrial-policy subsidies in the aerospace industry. This has not escaped the attention of other industrial countries and has been a point of contention in recent trade negotiations. It should also be noted that the process of countervailing against industrial policy measures is not a trivial technical problem; such things as "reasonable price," subsidy margin, and injury would be difficult to determine in a satisfactory way in order that an appropriate countervailing duty or other measured retaliation could be imposed.

The OECD Arrangement on export credits applies universally to the official export finance of 22 OECD signatories (excluding Turkey and Iceland), whether or not the exports are undertaken by a government entity or a private firm. Nevertheless, it has a big exception in it where sales to developing countries are concerned. Soft terms can still be offered on big-ticket items to developing countries with relative impunity, as long as they are called "official development assistance" (ODA) rather than "officially supported export

[1] See ch. 6 for discussion of recent events concerning transfer of some PTT ownership to the private sector and the introduction of limited competition in telecommunications in the United Kingdom and Japan.

credits. " There has to be a "grant element" of greater than 25 percent in order to escape into the ODA category and be free of the strictures of the export credit agreement.[2]

A separate OECD Arrangement on Mixed Credits has recently been discussed within a working group of the Development Assistance Committee of the OECD (as opposed to the Export Credit Committee), and it would supposedly further discipline the use of mixed credits (i.e., development assistance mixed with export credits). Disentangling true development assistance from commercially motivated sales would be desirable and is probably manageable in practice. How much success any ODA arrangement would have, though, is in doubt in the light of the demonstrated desires of some of the negotiating governments to subsidize exports to developing countries by granting aid. Subsidized credit to developing countries will therefore probably continue to be substantially undisciplined in high-cost items such as the sales of satellite packages and other space-related equipment. On the other hand, smaller sales of instruments and other equipment may well generally take place in conformance with the OECD guidelines and not be the occasion for heavy-handed official competitive jockeying.

To summarize this section on exclusions and exceptions, each of the three major trading rules has an important exclusion or exception that removes a large part of international trade in space-related equipment from its coverage.

International Trading Rules for Services

In the area of services, there have been indications, starting at the GATT ministerial talks in 1973 and extending to Economic Summit meetings since that time, that the major industrial countries might be willing to consider a code on services.

There are a number of barriers to an agreement on international trade in services, however. Europeans do not regard services as trade in the classic sense, are worried about cultural imperialism from the United States, and have service industries that are heavily regulated and not very entrepreneurial. In the area of telecommunications services, for instance, a complicating factor is the fact that revenues from the PITs often subsidize unrelated activities, including bus service. In this context it is unlikely that much will be accomplished for telecommunications services in multilateral negotiations.

What can be accomplished in the relatively near future, however, would nonetheless be useful. Removal of the nontariff barriers to the movement of commodities, such as insurance and banking industry restrictions, might be one accomplishment. Another would be to develop rules regarding competition with state-owned monopolies. A third would be to develop guidelines on the cost of capital that state-owned or regulated service enterprises must be charged.

Sovereignty Considerations Largely Dominate the General Trading Rules When They Are Applied to Space-Related Equipment

The international trading rules are not strong enough to restrain sovereign governments from taking action they deemed to be of substantial importance to sovereignty and defense, including certain actions in space with respect to goods and services. The escape clauses, exclusions and fuzzy areas built into the trade rules provide governments with plenty of opportunity, in cases of particular importance to them, to elude the bite of the trade rules. Because France and Japan, and to a lesser extent other industrial countries, have made the decision to develop wide-ranging space programs, it would be wishful thinking to believe that they would fully abide by the trade rules in competition for sales of space-related equipment or space transportation services, because for some time at least, they would probably lose out in open competition with American suppliers such as Hughes Aircraft.

However, the debate is not all one-sided. One justification other industrial countries have offered for the trade restrictions they have erected in the space area is that they are simply countervailing against the strong subsidy and industrial-policy support the United States gives to its aerospace industry.

How International Trading Rules Actually Affect Competition for U.S. Exporters of Space-Related Goods and Services

The question of whether or not the international trading rules affect competition at the level of the actual marketplace, of course, goes beyond the question of whether or not the general trading rules do or do not have effect. For one thing the recent exchange rate divergence of the dollar and other foreign cur-

[2]Grant element is defined as one minus the ratio of the present value of the stream of payments that are proposed divided by the present value of the stream that would occur if the Arrangement terms governed, both discounted at the appropriate Arrangement rate. Deals, with financing still labeled as officially supported export credits, with grant element between 20 and 25 percent are permitted, but there must be advance notification to the member governments adhering to the Arrangement.

rencies, has had a more damaging effect on the overall position of U,S. equipment exporters than all existing tariffs and quotas combined.

From the business point of view, the government decision to take complaints to bilateral negotiation or to GATT panels rests on a prior business decision "to fight this thing out through government channels," Considering that victories "through government channels" may be pyrrhic or much delayed or not valuable, the reality of engaging in competition in international markets is that competition takes place on many fronts, including price, quality, service, political connections, and regulatory action. Some markets will simply be off bounds to U.S. exporters no matter what general or special agreements exist. Others may, in fact, be penetrable despite supposedly formidable barriers.

One tactic that has been used by American equipment manufacturers, in the defense area and also in other equipment areas, is to develop non-U. S. component suppliers with the conscious purpose of obtaining political support for entering the market in the component supplier's country. In pursuit of this goal, the seller may acquiesce in or seek out offset arrangements that it would not otherwise consider. Formal international trading rules would have difficulty under the best of circumstances in countering such subtle trade restrictions.