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PREFACE

The *Industry, Trade, and Technology Review* (*ITTR*) is a quarterly staff publication of the Office of Industries, U.S. International Trade Commission. The opinions and conclusions it contains are those of the authors and do not necessarily reflect the views of the Commission or of any individual Commissioner. The report is intended to provide analysis of important issues and insights into the global position of U.S. industries, the technological competitiveness of the United States, and implications of trade and policy developments.

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COMPUTER SERVICES: EXAMINATION OF COMMITMENTS SCHEDULED UNDER THE GENERAL AGREEMENT ON TRADE IN SERVICES

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The General Agreement on Trade in Services (GATS) established during the Uruguay Round of negotiations under the General Agreement of Tariffs and Trade is the first multilateral, legally enforceable agreement covering trade and investment in service industries. As such, it has the potential to affect future trade in computer services. This article discusses the nature of computer services trade and assesses the effects on U.S. computer services firms of the GATS commitments scheduled by those countries that are currently the principal markets (European Union and Japan), and the expected growth markets (Australia, India, New Zealand, and Singapore) for computer services.

Revenues from computer services become more and more important to computer firms as profits decine in the price-sensitive computer hardware market. IBM is typical of a hardware firm whose service revenues grow faster than its hardware sales. IBM's computer service revenues increased by nearly 19 percent in 1995, and accounted for 29 percent of IBM's total revenues.[1] The global market for computer services[2] increased by an average annual rate of more than 10 percent during 1991-95, reaching an estimated $230 billion in 1995, and is expected to expand at an average annual rate of over 11 percent during the next 4 years.[3]

The GATS is an integral component of the Agreement Establishing the World Trade Organization (WTO) and it reflects the growing importance of services in the global economy. The WTO estimates that global trade in services is valued at over $4 trillion annually. Despite the considerable volume of trade in services, multilateral disciplines were not applied to service transactions until the GATS took effect on January 1, 1995. This agreement includes specific commitments by WTO member countries to restrict their use of barriers to trade and investment in services. The GATS commitments scheduled by Australia, the European Union (EU), India, Japan, New Zealand, and Singapore[4] are examined in this article as they affect the computer services industry.

Explanation of the General Agreement on Trade in Services

There are essentially three key elements in the text of the GATS: (1) a framework of general obligations and disciplines for government regulation of trade and investment in services; (2) a set of national schedules wherein each country commits itself to apply the rules to specific industries, subject to defined exceptions; and (3) a series

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[1] IBM's computer service revenue, excluding computer maintenance, increased by nearly 31 percent in 1995. IBM Corp., *IBM Announces Fourth Quarter, Full-year 1995 results*, press release, Jan. 18, 1996.

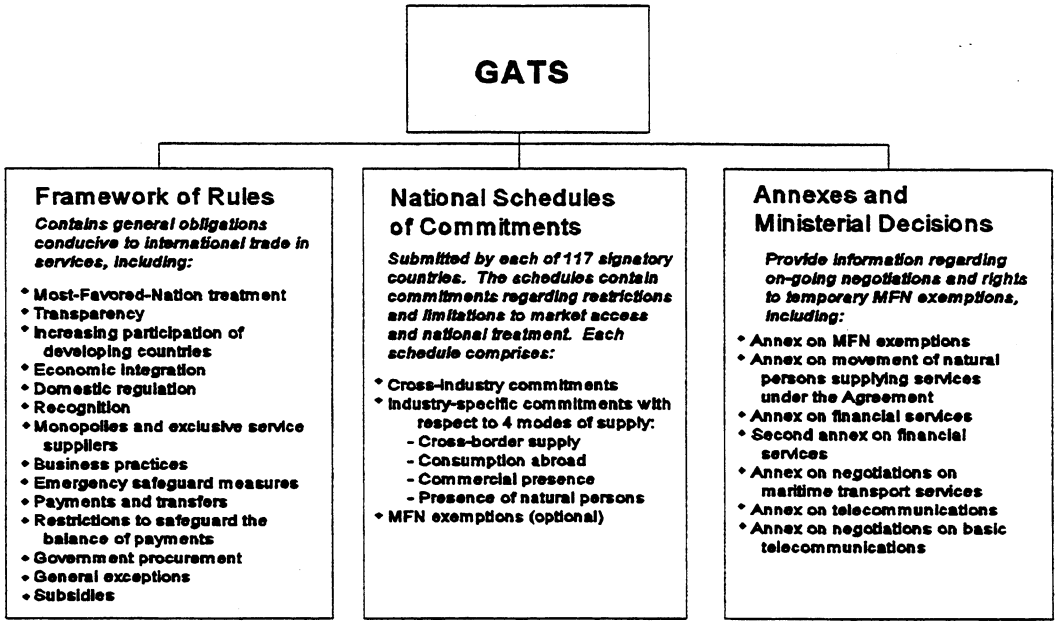
[2] For this report, the term computer services refers to all services that are provided for computer hardware or software implementation, computer maintenance, or computer processing services. These range from simple consulting services to computer outsourcing services that replace entire in-house computer processing facilities.

[3] Based on data provided by INPUT, Inc.

[4] The commitments of Mexico and Canada under the North American Free-Trade Agreement are more extensive than those under the GATS, and therefore, are not addressed because of diminished importance of the GATS for trade with these two countries.

of annexes and ministerial decisions that supplement rules found in the framework and provide for follow-up activities or additional negotiations. Figure 1 lists several of the provisions that fall within each of these three elements. The framework of rules provides for most-favored-nation (MFN) treatment for all signatory countries,[5] as well as regulatory transparency, safeguards on monopolies, and dispute settlement.[6] Ministerial decisions specify terms for continued negotiations concerning services for which no agreement was reached, including financial services, basic telecommunication services, and maritime services.[7] One key annex contains instructions regarding the rights of signatory countries to list temporary exemptions to MFN treatment.[8]

Figure 1
Structure of the General Agreement on Trade in Services



Source: Compiled by the staff of the U.S. International Trade Commission.

Each WTO-member country submitted a schedule of commitments in the Uruguay Round to identify the barriers to trade in at least one service sector. Although the scope of the GATS includes all services, a country is committed only to the limitations it lists in selected service sectors. Therefore, if a country lists commitments only for data processing services, limitations on all other computer services are unbound, meaning that the country has reserved the right to impose or increase limitations as it deems necessary. This "positive" listing approach

[5] Most-favored-nation status accords to one trading partner terms and conditions of trade that are no less favorable than those accorded to any other trading partner. See article II of the GATS.

[6] Regulatory transparency, safeguards on monopolies, and dispute settlement procedures are addressed in GATS articles III, VIII, and XXIII, respectively.

[7] Negotiations on financial services, basic telecommunication services, and maritime transport services were not concluded during the Uruguay Round, but provisions were made for them to continue.

[8] MFN exemptions list those countries that may be accorded preferential treatment in all or some service industries. For example, the EU schedule provides preferences to European countries for audiovisual services.

requires a country to provide market access and national treatment[9] only in sectors that are specifically identified and only to the extent that the listed limitations allow. Therefore, as new computer services are developed, their regulatory treatment is not bound under the terms of the GATS, and countries are free to impose trade restrictions as they deem appropriate.

Trade in Computer Services

Trade as Defined in the GATS

Trade data pertaining to services are reported under two broad headings: cross-border transactions and sales through affiliates located in foreign markets. The GATS identifies four narrower channels, or "modes," of supplying services to foreign consumers. Figure 2 shows the relationship of these four modes of supply to the balance of payments entries for cross-border and affiliate trade. The modes of supply listed in the GATS comprise cross-border supply, consumption abroad, commercial presence, and presence of natural persons.

Sales by Affiliates

Computer services are traded primarily through sales by foreign affiliates, which involves the sale of a service to a foreign person through a foreign affiliate of a domestic firm. An example of such trade (a U.S. export) is the purchase of payroll data processing services by an European firm from the Italian affiliate of the U.S.-based Electronic Data Systems (EDS).

U.S. exports of computer services through sales by majority-owned affiliates reached $12.9 billion in 1993, growing at a 23 percent average annual rate during 1989-93 (figure 3). Europe accounted for about 74 percent of these exports, followed by Asia with 19 percent (figure 4).[10] Industry representatives note that the Asian market for computer services is relatively young, and growth rates are expected to be much higher in Asia than in Europe over the next few years.[11]

Affiliate sales are the most common way to trade computer services because governments and customers favor local establishment by foreign firms.[12] Foreign governments prefer a local presence because it usually requires a monetary investment by the foreign firm, involves hiring local labor, and suggests a long-term interest in the country. U.S. firms acknowledge that a commercial presence helps them establish a rapport with foreign customers and provides a greater understanding of local customs and culture.

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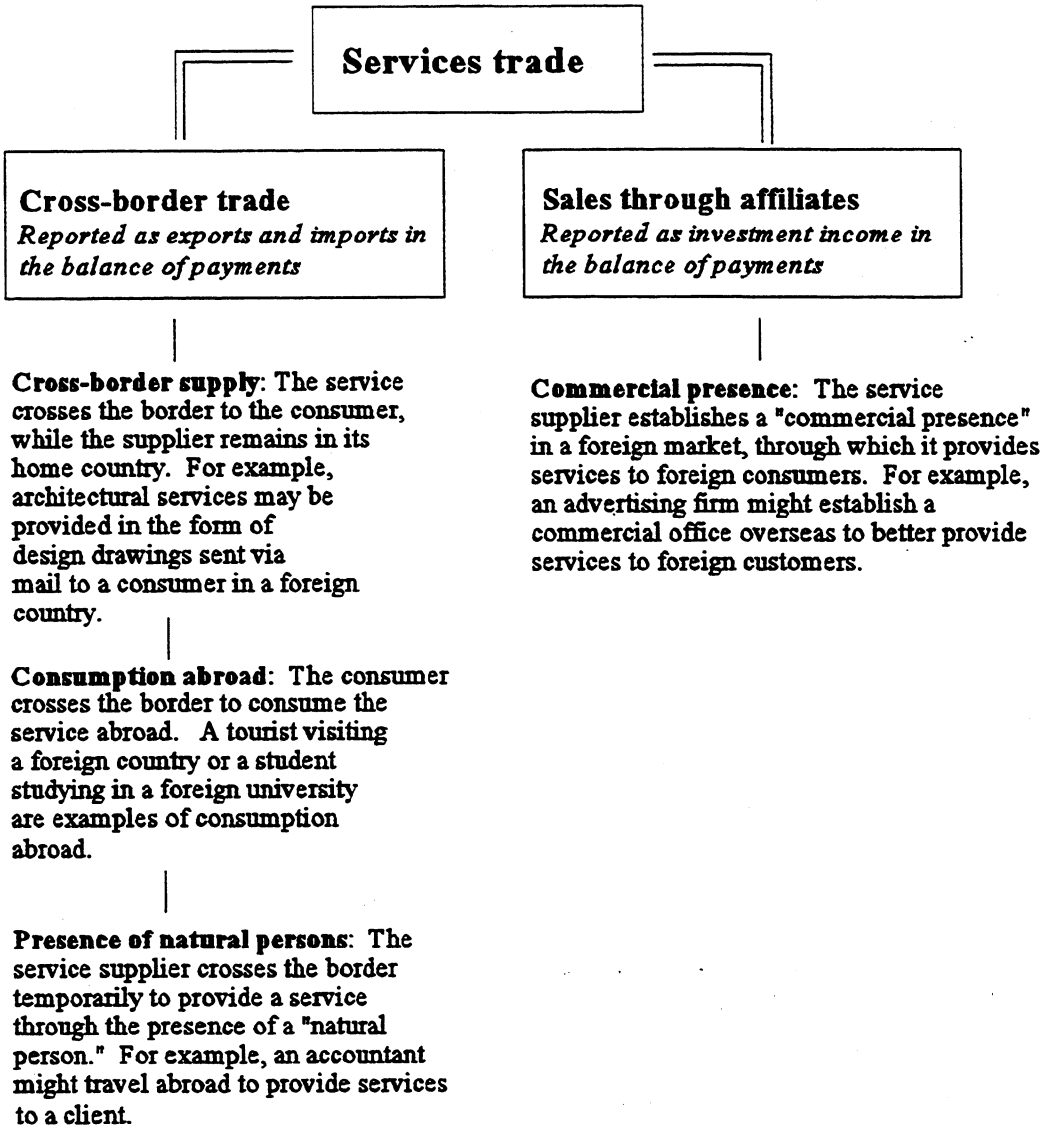
[9] National treatment is the treatment of a foreign service supplier that is no less favorable than that accorded to domestic service suppliers.

[10] U.S. Department of Commerce (USDOC), Bureau of Economic Analysis (BEA), *Survey of Current Business*, Sept. 1992, p. 129; and Sept. 1995, p. 104.

[11] Industry representatives, interviews by USITC staff, Washington, DC, Feb. 20, 1996.

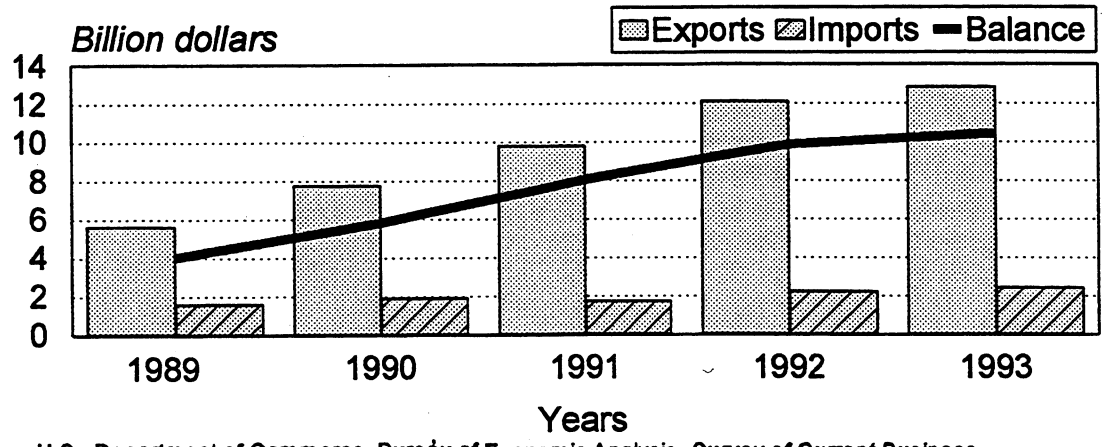
[12] *World Trade in Services: A new Agenda to Ensure Continuing Expansion*, Conference of the American Foreign Service Association, May 2, 1995; and industry representative, interview by USITC staff, Washington, DC, Feb. 20, 1996.

Figure 2
Modes of supply for international delivery of services



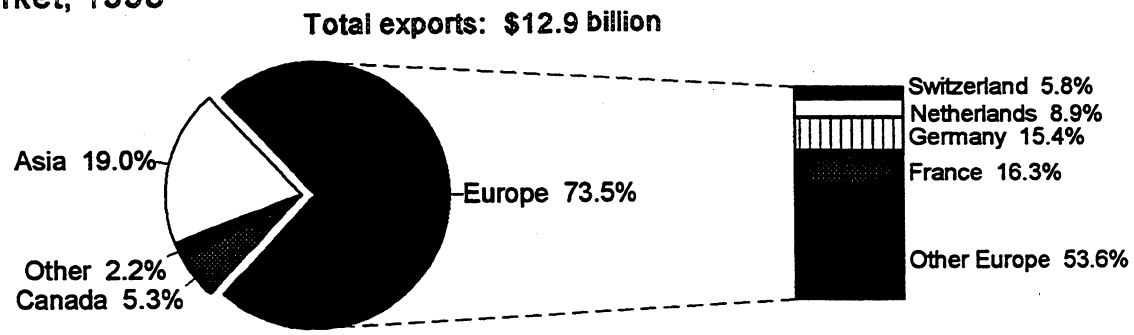
Source: Compiled by the staff of the U.S. International Trade Commission.

Figure 3
Computer service sales by majority-owned affiliates: Exports, imports, and trade balance, 1989-93



Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business* Sept. 1992; and Sept. 1995.

Figure 4
Computer service exports: Sales by majority-owned U.S. firms by principal market, 1993

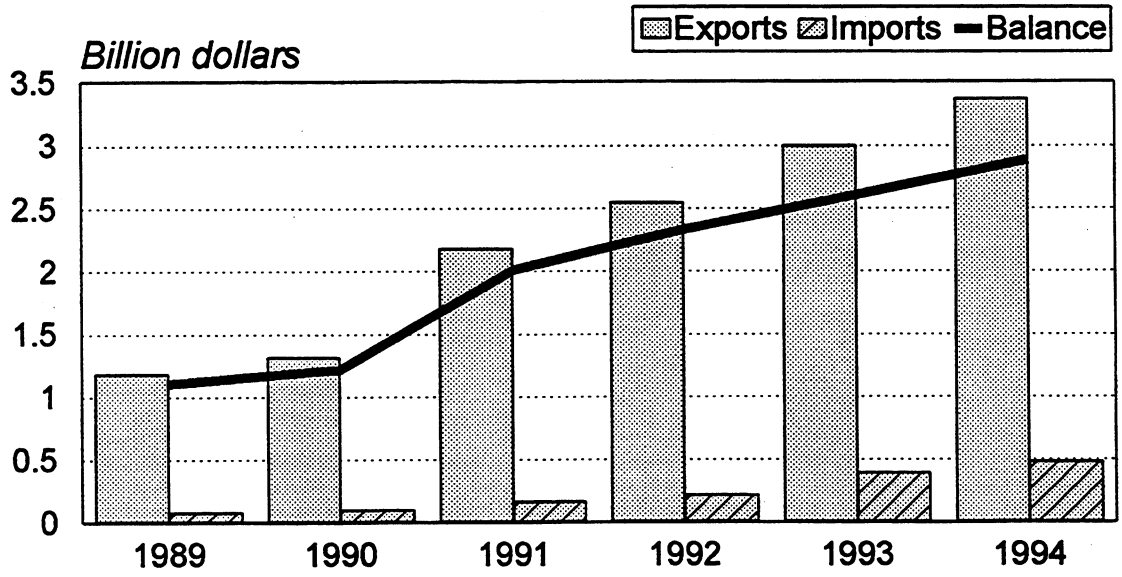


Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Sept. 1992; and Sept. 1995.

Cross-border Trade

U.S. cross-border exports of computer services increased at a 26-percent average annual rate during 1989-93, reaching $3.4 billion in 1994 (figure 5). The most common type of cross-border trade, cross-border supply, involves the transmission of information across borders, such as the purchase of payroll data-processing services by a Japanese firm from EDS's facilities in the United States. In this instance, the computer processing is done in the exporting country--the United States--and the information is sent across borders to and from Japan via mail or telecommunications. Although this type of cross-border computer service trade may seem ideal, providing computer services through telecommunication lines is often hampered by inadequate telecommunication infrastructure and stringent telecommunication regulations that are slowly being reformed.[13]

Figure 5
Computer services: Cross-border exports, imports, and trade balance, 1989-94



Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Sept. 1992; and Sept. 1995.

[13] For more information on the effects of telecommunication policy on supplying computer services, see "Computer Outsourcing Services: Telecommunication Regulation Affects Global Competitive Position of U.S. Firms," *Industry Trade and Technology Review*, Aug. 1994, p. 1. While extended negotiations pertaining to basic telecommunication services were scheduled to conclude in Apr. 1996, the negotiations have been extended until Feb. 1997.

There are two, less typical methods of cross-border trade in computer services. The first, consumption abroad, involves sales to persons who consume the service abroad. An example of consumption abroad is a French computer firm fixing the notebook computer of a U.S. citizen who is traveling in Europe (a U.S. import). The last type of cross-border trade involves the temporary entry of a service supplier across the border to provide a service. This type of trade is demonstrated by a Canadian computer repairman who enters the United States to maintain a mainframe computer in New York (a U.S. import), and then returns to Canada after the job is completed.

Barriers to Trade in Computer Services

GATS commitments scheduled by foreign countries suggest that commercial presence restrictions are most likely to effect U.S. firms. There are few limitations on cross-border supply, although obstacles to computer service trade do exist in the form of restrictive telecommunication regulations.

Computer Services and the GATS

Industry-specific Commitments

The computer services generally covered by the GATS commitments include hardware installation consultancy, software implementation, data processing, data base services, maintenance, and other computer services (table 1). The EU,[14] India,[15] Japan, Australia, and New Zealand made commitments on all of these services. Finland made commitments only on hardware installation consultancy services, leaving all other computer services with unbound restrictions.[16] In contrast, Singapore scheduled unbound limitations on hardware installation consultancy services but specified no other limitations on trade in computer services.

Cross-industry Commitments

In addition to sector-specific commitments, many countries submitted a list of general commitments called horizontal, or cross-industry commitments. These commitments apply across all industries found in a schedule and usually appear at the beginning of a country's schedule to avoid excessive repetition in the sector-specific commitments. An example of such a cross-industry commitment by the European Union is that prior authorization is required for investment in Spain by foreign governments or public entities. Although signatory countries were not obligated to schedule cross-industry commitments and no guidelines were established for scheduling such commitments, cross-industry commitments generally address investment, taxation, real estate transactions, government subsidies, and the temporary entry and stay of foreign workers.[17] The cross-industry commitments also follow a "positive" listing approach; cross-industry trade restrictions are assumed to be

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[14] The EU submission includes commitments made by the EU as a whole and singly by any of the 12 member states. The EU schedule also will ultimately incorporate the schedules of Austria, Finland, and Sweden, which formally acceded to the EU on January 1, 1995. This article analyzes the commitments from all 15 member states.

[15] Although India addressed all of the services, most of its commitments listed unbound limitations.

[16] The EU schedule that incorporates the acceding nations of Austria, Finland, and Sweden is expected to be released this spring. It is uncertain whether Finland's commitments will change as a result of the combined schedules.

[17] Some countries varied from this general structure. Japan only offered cross-industry commitments on the temporary entry and stay of personnel.

Table 1
Computer services included in commitments

Description of service
Consultancy services related to the installation of computer hardware
Software implementation services *Systems and software consulting services* *Systems analysis services* *System design services* *Programming services* *Systems maintenance services*
Data processing services *Input preparation services* *Data processing and tabulation services* *Time-sharing services* *Other data processing services*
Data base services
Maintenance and repair services
Other computer services *Data preparation services* *Other computer services not elsewhere classified*

Source: GATT Secretariat's *Services Sectoral Classification List* (MTN/GNS/W/120).

unbound unless foreign service providers are explicitly accorded market access and national treatment in a country's schedule.[18]

Most commitments on the temporary entry and stay of foreign service providers[19] appear in cross-industry (table 2) rather than the sector-specific commitments. Singapore, Japan, and India allow intracorporate transferees to stay for 5 years, while Australia and New Zealand allow somewhat shorter stays. The commitment from the EU is confusing because permissible lengths of stay vary by member state, minimizing the benefit of a combined EU schedule. An important point is that, in the absence of a binding, member states can change regulations pertaining to foreign workers as they please. Singapore is the only trading partner of these six countries that leaves limitations on the length of stay of business persons unbound.

[18] Cross-industry commitments do not apply to industries for which no industry-specific commitments were scheduled or where unbound limitations are explicitly scheduled without qualification.

[19] Definitions of foreign service providers are relatively similar between countries. Intracorporate transferees usually include persons that have been employed by the foreign firm for one year or more and are entering the country to manage a commercial presence or supply a specific technical skill at the company's local affiliate. Business persons, on the other hand, enter the country for a short period of time to establish a commercial presence or negotiate contracts.

Table 2
Commitments on lengths of stay permitted to foreign service providers

Trading partner	Intra-corporate transferees[1]	Business persons[2]
Australia	4 years for executives and managers, 2 years for specialists	6 months to negotiate at sale or 2 years to establish a presence
New Zealand	3 years	3 months
European Union	Varies by member state	Varies by member state
India	5 years	90 days
Japan	5 years	90 days
Singapore[3]	5 years	Unbound limitations

[1] Typically defined to be executives, managers, and specialists (individuals with technical expertise).
[2] Typically defined to be persons negotiating sales contracts and establishing a commercial presences.
[3] Singapore's commitments on the entry and stay of foreign persons are not applicable to hardware installation consultancy services. In addition, Singapore's commitments on the entry and stay of foreign persons only apply to market access.

Source: Compiled by the staff of the U.S. international Trade Commission.

In addition, cross-industry commitments on investment and real estate supplement the commitments on commercial presence that are listed in the sector-specific commitments. Because investment laws are often not industry-specific, cross-industry commitments address issues such as equity limitations and management requirements that are not addressed in the sector-specific commitments. Countries that do not offer cross-industry commitments on investment and real estate may change their laws and regulations, which could affect the ability of a U.S. computer service firm to establish a foreign commercial presence.

Issues Not Resolved in the GATS

While professional requirements and the mutual recognition of certificates and degrees are not discussed in the commitments, they remain important issues to computer service providers.[20] In response to concerns by many professional service industries, the World Trade Organization (WTO) established a Working Party on Professional Services in April 1994. The working party will first look at the accounting industry, but it is expected that the group will eventually explore mutual recognition of most professional qualifications.[21]

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[20] *World Trade in Services: A new Agenda to Ensure Continuing Expansion*, Conference of the American Foreign Service Association, May 2, 1995.
[21] EU Commission officials, interviews by USITC staff, Brussels, July 19, 1995; Organization for Economic Cooperation and Development (OECD) representatives, interviews by USITC staff, Paris, July 19, 1995; and WTO officials, interviews by USITC staff, Geneva, July 24-25, 1995.

GATS Commitments by Selected Trading Partners

The trading partners covered in this article are the principal and emerging growth markets for U.S. computer service firms. The markets range from being relatively open, such as Australia and New Zealand, to being relatively restrictive, such as India. The commitments are useful in that they codify existing restrictions and help make existing policies transparent. By contrast, where unbound limitations exist, the schedules offer no information on the types of barriers that may be present.

Japan listed no industry-specific limitations to computer services trade, making it appear to have the most open market for computer services (table 3). However, Japan declined to offer any cross-industry commitments on commercial presence, retaining the ability to restrict foreign firms' establishment and investment. The Japanese market for computer services is relatively small, accounting for only 4 percent of total U.S. exports through sales by affiliates in 1992, the last year that data are available.[22] Most Japanese companies historically have handled services in-house or have purchased them together with a hardware system from one of the large computer manufacturers such as NEC or Fujitsu. Industry representatives attribute the relatively small presence of U.S. computer service providers in Japan to the reluctance of Japanese companies to embrace third-party suppliers of computer services.[23] Dominant Japanese computer hardware firms continue to supply most computer services in Japan because the computer services most in demand continue to be associated with maintaining and writing custom software for mainframe computers supplied by the Japanese firms.

In contrast, the EU appears to have a relatively open market despite listing limitations that could restrict trade in computer services. In fact, U.S. service providers are active participants in the EU market for computer services. The EU cross-industry commitments state that it may grant monopolies for public utilities, including consulting services. In addition, a company may receive less favorable treatment if its registered office, central administration, or principal place of business is not in the EU. Despite the EU's relatively unrestricted commitments, additional cross-industry commitments on commercial presence vary among member states. Differing investment rules and regulations among the member states make the overall EU's schedule of commitments less informative.

New Zealand and Australia list very few trade limitations, and both markets are expected to grow rapidly. Currently, U.S. firms' sales through Australian-based affiliates account for almost 16 percent of total U.S. computer service exports to Asia.[24] Neither country scheduled limitations on cross-border supply of computer services. However, customers in New Zealand prefer local firms,[25] which encourages partnerships and a commercial presence. In the cross-industry commitments, Australia does not have equity limitations or require an economic needs test, while New Zealand only requires approval for investments of $NZ10 million or more.

Although Singapore did not offer commitments on hardware installation consultancy services, it lists few limitations on other types of computer services. However, companies have reported problems transmitting data outside of Singapore's borders despite its commitment to unrestricted cross-border trade of computer services.[26]

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[22] USDOC, BEA, *Survey of Current Business*, Sept. 1994, p. 136.
[23] Industry representative, interview by USITC staff, Washington, DC, Feb. 20, 1996.
[24] USDOC, BEA, *Survey of Current Business*, Sept. 1995, p. 104.
[25] INPUT, Worldwide Information Services Forecast 1993-1998 (Washington, DC: Input, 1994), p. VIII-168.
[26] IBM internal report, May 1995.

Table 3
Highlights of specific and cross-industry commitments pertinent to computer services

	Mode of supply	
Country	Cross-border supply	Commercial presence
Australia	No limitations	Notification and examination of investment are necessary. However, demonstration of economic benefits and equity limitations only apply when national interests are concerned. At least two directors must be residents of Australia.
European Union[1]	No limitations	Public utilities, including consulting services, may be subject to government monopolies, or to exclusive rights granted to private operators. Subsidiaries of foreign companies must have a registered office, central administration, or principal place of business in the EU. Others may be granted treatment equivalent to that accorded in the other EU member states, unless prohibited by law. Less favorable treatment may be given to subsidiaries with only their registered offices in the EU. Other limitations vary by member state.
Finland	Hardware installation consultancy services have no limitations. All other computer services have unbound limitations.	Hardware installation consultancy services have no limitations except for the following: Finnish authorities can deny foreign acquisition of over one-third of the voting rights in major Finnish companies if an important national interest is jeopardized. At least 50 percent of the board of directors or all managing directors of limited companies must be Finnish citizens and residents. In addition, foreign organizations need permission to establish a branch or to found a limited company. All other computer services have unbound limitations.
India	Unbound limitations	Incorporation is required and foreign equity is limited to 51 percent. In addition, in the public sector market, preference will be based on which firms offer the best terms for transfer of technology.
Japan	No limitations	No limitations
New Zealand	No limitations	Approval from the Overseas Investment Commission is necessary in most cases when the value of the investment exceeds $NZ10 million.
Singapore	Hardware installation consultancy services have unbound limitations. All other computer services have no limitations.	Hardware installation consultancy services have unbound limitations. All other computer services must have a local manager. At lease one director and one manager must be local residents, and all branches of foreign companies must have at least two local resident agents.

[1] Finland was the only EU-member state to offer commitments on computer services that differ from the EU commitments. However, Austria, France, Germany, Ireland, Italy, Portugal, Spain, and Sweden list additional limitations on the establishment of a commercial presence. For further details on these limitations, see the appropriate country schedules.

Source: World Trade Organization, General Agreement on Trade in Services (GATS), Australia: Schedule of Specific Commitments (GATS/SC/6), Apr. 1994; GATS, European Union: Schedule of Specific Commitments (GATS/SC/31), Apr. 1994: GATS, Finland: Schedule of Specific Commitments (GATS/SC/33), Apr. 1994; GATS, India: Schedule of Specific Commitments (GATS/SC/42), Apr. 1994; GATS, Japan: Schedule of Specific Commitments (GATS/SC/46), Apr. 1994; GATS, New Zealand: Schedule of Specific Commitments (GATS/SC/62), Apr. 1994: GATS, Singapore: Schedule of Specific Commitments (GATS/SC/76). Apr. 1994; GATS, Sweden: Schedule of Specific Commitments (GATS/SC/82), Apr. 1994; Negotiating Group on Movement of Natural Persons, *Communication by Australia*, June 30, 1995; and Negotiating Group on Movement of Natural Persons, *Communication by the European Union*, June 30, 1995; and Negotiating Group on Movement of Natural Persons, *Communication by India*, June 30, 1995.

The reason for this is that Singapore considers limitations on data flow as part of basic telecommunication services, which are closely regulated.[27] As a consequence, U.S. computer service providers are prohibited from providing many services through telecommunication networks. Singapore's cross-industry commitments state that a foreign firm in Singapore must have a manager and a director that are local residents and have at least two agents that are local residents.

India's commitments appear most stringent, with unbound limitations on cross-border supply of all computer services and numerous limitations on commercial presence. Although U.S. firms dominate the global computer services market, domestic firms supply most computer services in India.[28] It is evident in the cross-industry commitments, which emphasize technology transfer as a stipulation to obtaining public contracts, that India is aggressively pursuing high-technology industries. Regardless of its unbound limitations on the cross-border supply of computer services, a lack of telecommunication infrastructure in India hampers cross-border trade. India has an average of only two telephone lines for every 100 people.[29] Notwithstanding its limitations, India has loosened some limitations. The 51-percent limit on equity ownership of local firms is an improvement because it allows foreign-majority ownership.[30] In addition, the commitments do not reflect that India currently allows 100-percent equity ownership for firms that export 100 percent of their services.[31]

The Effect of GATS on Computer Service Providers

There are relatively few barriers to trade in computer services that significantly affect market access. The most common limitations to trade in computer services include limitations to the movement of personnel among countries and ceilings on foreign investment. To a more significant extent, stringent regulations on telecommunications pose a major challenge to computer service firms.

Although industry representatives generally see the GATS as a positive step toward liberalization of trade limitations on computer services, many feel that the approach to computer services is too narrow. Industry representatives claim that computer services are too closely linked with telecommunication services to keep them separate and distinct in each country's schedule of commitments.[32] The difficulties resulting from separating these two industries are evident in the problems noted with cross-border data flow in Singapore. In addition, the positive listing approach of the GATS does not minimize limitations that countries potentially can place on newly developing computer services. These services account for a larger portion of computer service sales each year and their exclusion from the GATS diminishes the trade-liberalizing aspects of the agreement.

Because computer service markets are relatively unrestricted, the greatest benefit of the GATS is that each country's schedule of commitments makes the rules and regulations pertaining to computer service trade more transparent. The global industry will likely benefit from ongoing and future GATS negotiations not directly related to computer services. Future liberalization in telecommunications, investment, and the movement of personnel may offer the most opportunities to computer service providers worldwide. ■

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[27] Singapore is not a participant in the extended telecommunication negotiations and its policies are not expected to change. United States Trade Representative, *1995 National Trade Estimate Report on Foreign Trade Barriers*, 1995, p. 278.

[28] INPUT, *Worldwide Information Services Forecast 1993-1998* (Washington DC: Input, 1994), p. VIII-116.

[29] "Cellular Phone Boom is Hitting India," *Electronic Business Today*, Feb. 1996, p. 16.

[30] INPUT, p. VIII-111.

[31] USDOC, International Trade Administration, "Computer Software and Related Services," *Market Research Reports - India*, Jan. 2, 1996. However, because this policy is not stated in the commitments, India is free to change it.

[32] *World Trade in Services*, conference paper, May 2, 1995.

THE GLOBAL POSITIONING SYSTEM ADVANCES TOWARD UNIVERSAL ACCEPTANCE

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Since its creation by the U.S. Department of Defense to enhance the accuracy of traditional navigation systems, the global positioning system (GPS) has evolved into a wide range of new technologies used in civil, scientific, and commercial applications. This evolution is illustrated by its expanding global use in navigation, automotive tracking systems, and survey and mapping operations. This article examines the expanding role of GPS, the technology gaining international acceptance, the effects of global adoption on U.S. sales and exports, and the industry's outlook by the end of the century.

The United States is the world leader in developing and implementing the most advanced navigation systems. Several of these systems, however, have limitations that have generated concern among military, commercial, and civilian users. For example, the VOR/DME[1] radio beacon navigation system used widely in aviation, has only an effective range of about 50 to 150 miles line-of-sight from a transmitter.[2] Given these limitations, operators of aircraft are frequently required to make directional adjustments before reaching final destinations. Although the accuracy of the VOR/DME system is adequate for two-dimensional navigation (i.e., longitude and latitude), data regarding altitude, time information, and pinpoint accuracy are not available.[3] "LORAN" and "DECCA," which are radio-based systems used on air and marine craft, also have limited navigation capabilities. Users of these systems occasionally contend with distortions created by electrical interference and geographic variations.[4]

Accuracy in determining locations both on and above the earth's surface has always been important to the U.S. Department of Defense (DOD), with its research and development programs aimed to improve navigation capabilities. The DOD invested $12 billion[5] during the past 20 years to develop the GPS as a worldwide navigation and positioning system for military, commercial, and civilian use.[6] The GPS uses 24 orbiting "Navstar" satellites in six orbital planes as reference points from which specifically designed GPS receivers "triangulate" their positions. These satellites continuously transmit precisely timed radio signals to a receiver by using extremely accurate atomic clocks. The receiver calculates distances to the satellites by determining the

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[1] VOR is an abbreviation for "VHF omnirange." The effectiveness of this radio navigation system is limited in mountainous terrain where some interruption of its signal can be expected at lower altitudes. DME, which stands for "distance measuring equipment," provides the navigator with accurate knowledge of distance from the ground station to which the radio equipment is tuned. For more information regarding these systems, see Van Sickle's *Modern Airmanship*, fifth edition, pp. 633-636.

[2] Line-of-sight refers to a straight line connecting two points (signals from aircraft radio and ground- stationed transmitter) sufficiently high and near one another so that the line is entirely above the surface of the earth. USITC staff interview with industry representatives, Anaheim, CA, Apr. 1995.

[3] USITC staff interview with industry representatives, Anaheim, CA, Apr. 1995.

[4] Ibid.

[5] *GPS, A Guide to the Next Utility*, "GPS - A Global Navigation System Everyone Can Use," Trimble Navigation, 1989, p. 7.

[6] The GPS evolved from two U.S. military satellite navigation programs developed during the early 1970s--a Navy program known as "Timation" and an Air Force program called "621B." For information regarding these programs, see *Air & Space*, "You Are Here," June/July, 1992, p. 2.

travel-time to the satellite signals. The GPS receiver then triangulates its position using its known distance from the various satellites and calculates latitude, longitude, altitude, course, and speed.[7] Unlike previous navigation systems, the GPS is capable of determining locations anywhere on earth with almost pinpoint accuracy. Therefore, the GPS is supplementing or replacing traditional radio navigation systems in many applications. The National Aeronautical Association has determined that the GPS is the most significant development for safe and efficient navigation and surveillance of air and spacecraft since the introduction of radio navigation.[8]

Tactical advantages that hostile forces could gain by using the system's precise navigation data are neutralized by the DOD's "selective availability" operational program. This program enables DOD to degrade the accuracy of GPS signals to such an extent that the most precise signals emitted from the satellite can be read only by using specially designed GPS receivers.[9] The degraded signals or "standard positioning service," which is available to any worldwide user on a continuous basis, have a horizonal positioning accuracy of 100 meters. The standard unaltered signals or "precise positioning service," which is reserved for U.S. and allied military and government users, provide a horizonal positioning accuracy of 21 meters.[10]

GPS Systems Attracting Global Attention

The United States is the global leader with respect to production of GPS receiver products, product design, and technology advancements.[11] U.S. leadership stems from several factors, including large capital expenditures on research and product development,[12] advancements in satellite communications, and continuing improvements in computer software and systems integration technologies. The ability to produce and market high-quality products in a relatively short period of time also is a critical asset of U.S. producers, given the increasing rate of change in product technology. For example, new GPS product cycles of 12 to 18 months are typical for certain applications,[13] whereas product cycles for new innovations of radar and other traditional navigation products are far less frequent.

The rapid pace of U.S. innovations of GPS products, which continue to attract international attention, represent some of the most significant technological developments within the global navigation industry during the last decade. Most recently, the Federal Aviation Administration (FAA) adopted the GPS as the future standard for U.S. aviation navigation. As a result of GPS capabilities, the FAA initiated the Wide Area Augmentation System

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[7] For a more precise description of the operation of the GPS, see GPS, "How GPS Works," A Guide to the Next Utility, Trimble Navigation, 1989, pp. 12-13.

[8] USITC staff interview with industry representatives, Sunnyvale, CA, Apr. 1995.

[9] The President of the United States has approved a comprehensive national policy on the future management and use of the GPS and related U.S. Government augmentations. The policy specifies that "selective availability" will be discontinued within a decade in a manner that allows adequate time and resources for military forces to prepare fully for operations without "selective availability." See *The White House Fact Sheet*, "U.S. Global Positioning System Policy," Mar. 29, 1996.

[10] U.S. Department of Transportation, U.S. Coast Guard, *Announcement of Global Positioning System (GPS) Initial Operational Capability (IOC) and Its Impact on Vessel Carriage Requirement Regulations*, 1993.

[11] Major U.S. producers of GPS products include the following companies: Rockwell International Corp.; Trimble Navigation Ltd.; Allied-Signal Inc.; Ashtech Inc.; Leica; Magellan Systems Corp.; Motorola, Inc.; Interstate Electronics, Inc.; Martin Marietta Astor Space; and Navstar Systems. These producers carry a broad range of high-tech GPS products for military, commercial, and civilian applications.

[12] Industry sources indicate that research and development investment totaled approximately $90 million in 1994.

[13] See publication *United States GPS Industry Council*, "Maintaining the U.S. Lead," p. 2.

(WAAS) to allow the GPS to be used for primary navigation and precision approaches by 1998.[14] With implementation of the WAAS, the GPS will be available as a primary means of navigation within North America for all en route Category I precision aviation approaches.[15] Several major producers of GPS receivers maintain that implementation of the WAAS is the most efficient and least expensive method of designing a fool-proof air collision avoidance system. Industry sources indicate that implementation of the WAAS also will enhance the navigation and tracking of remote-controlled aircraft used for military reconnaissance and delivery of payloads.

With respect to water transportation, the U.S. Coast Guard announced in 1993 that the GPS meets carriage requirements for position-fixing equipment for use in U.S. waters.[16] The announcement makes GPS an officially supported navigation aid in U.S. coastal waters and inland waterways and will likely encourage other countries to adopt its application in water transportation.[17]

Another GPS development that has generated substantial international interest is the in-vehicle or mobile navigation system. This system uses advanced GPS technology for precise automotive navigation, which includes detailed digital moving maps and a "yellow pages directory" of instantly accessible travel information concerning restaurants, hotels, entertainment, and shopping.[18] Some GPS products are capable of directing the driver of a vehicle to a preselected destination by use of satellite information fed into an onboard computer.[19] Other automotive GPS products have mapping capabilities that provide the driver with information regarding one-way streets, traffic congestion, and road construction. Manufacturers in France, Germany, Italy, and Japan are installing various types of GPS products incorporating these capabilities into automotive products.

Foreign Competition

The basic technology required to manufacture GPS products is well known among countries with modern electronics industries. Given the growing popularity of the GPS system, an increasing number of countries have become producers of GPS products largely for home-market applications. Japan, the largest of these producers,[20] currently manufactures approximately 20,000 GPS products per month.[21] In comparison, U.S. production reportedly totals over 50,000 units per month with approximately one-half of such production destined for export markets.[22]

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[14] The WAAS consists of approximately 35 ground stations designed to improve the accuracy of GPS signals by use of differential GPS (DGPS) corrections. The DGPS corrections enhance the accuracy of GPS signals by using a local reference receiver to correct errors. The inaccurate signals are noted and sent to a central station for processing and then forwarded to the aircraft for appropriate corrections. Although basic GPS signals give 100-meter accuracy in three dimensions 95 percent of the time, the use of WAAS will improve the signal accuracy to 7 meters. Under the DOD's "selective availability" program, the accuracy of signals received by WAAS can be degraded. Based on information provided by officials of FAA, see *Air Transport World*, "What WAAS Will Be," Sept. 1995, pp. 51-55 and *Aviation International News*, "GPS Satnav Era Beckons As FAA Contracts For WAAS Net By '97," Sept. 1, 1995, pp. 81-82.

[15] Category I precision approaches are generally made in clear weather or ideal landing conditions, whereas aircraft making approaches under Category II and III must have special authorization and instrument landing equipment.

[16] U.S. Department of Transportation, U.S. Coast Guard, *Announcement of Global Positioning System (GPS) Initial Operational Capability (IOC) and Its Impact on Vessel Carriage Requirement Regulations*, 1993.

[17] See 33 Code of Federal Regulations, 164.41 (a) (2).

[18] *Supplement to Engineering News-Record*, "The Art of In-Vehicle Navigation," Nov. 28, 1994, p. 6.

[19] Information obtained from industry representatives, Apr. 1995.

[20] Other foreign producers of GPS products include Taiwan, the United Kingdom, France, Germany, Israel, and Italy.

[21] See publication United States GPS Industry Council, "GPS, A Global Technology Serving Global Markets", p. 4.

[22] Ibid.

Russia has developed an alternative satellite navigation system called GLONASS (global navigation sputnik system). Both the GPS and GLONASS accomplish similar missions, but differ in their policies regarding the accuracy of the data available to civilian users. Whereas data made available by the GPS for nonmilitary use is degraded by the DOD, data emanating from the GLONASS has no user restrictions. Another difference between these respective systems involves the orbits in which they are launched. The orbit of the GPS provides better coverage of latitudes closer to the equator, whereas GLONASS is most effective in relatively higher latitudes.[23] It is anticipated the GPS is likely to be more acceptable internationally than GLONASS, given the technological advancements of GPS products. Industry sources, however, indicate that future GPS receivers will likely incorporate technology capable of using data from both systems.[24]

Expanding Global Demand

The cost savings and safety benefits to aircraft manufacturers, airlines, and air-traffic- control systems have contributed to the growing global acceptance of the GPS. Aircraft manufacturers maintain that the use of GPS would revolutionize air-traffic-control systems and save airlines approximately $5 billion annually in fuel and other operational costs.[25] International use of the system also would permit safe and effective navigation to remote parts of the world without the cost of installing expensive traditional ground based navigation and approach aids in those areas. In addition, the reluctance of European countries to rely on a navigation system that is controlled by the DOD is softening due to strong support of FAA for the highly effective WAAS program and the increasing number of demonstrations and promotional programs advocating the advantages of GPS navigation.[26]

Global demand for GPS products increased significantly during 1993-95, with estimated worldwide sales of such products increasing from $510 million to $1.3 billion.[27] U.S. producers' sales of GPS products, which accounted for 70 percent of global sales during the period, increased from $357 million in 1993 to $886 million in 1995. U.S. exports of such products, which accounted for an estimated one-half of total U.S. sales,[28] increased by 149 percent from $178 million to $443 million during the period (figure 1). According to industry sources, U.S. exports consisted largely of products used in car and marine navigation.[29] Car navigation and integration of GPS into cellular phones and portable units for outdoor recreation and similar activities accounted for almost 40 percent of the global market in 1995 (table 1). GPS products used in survey and mapping, and OEM applications in the auto industry represented 27 percent of the market during that year.

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[23] *Aviation Week & Space Technology,* "Growing Demand Boosts GPS Progress," Sept. 19, 1994, p. 62.

[24] USITC staff telephone interview with industry representative, Mar. 15, 1996.

[25] *Air Transport World,* "Navigation Systems," Sept. 1993, pp. 36-38.

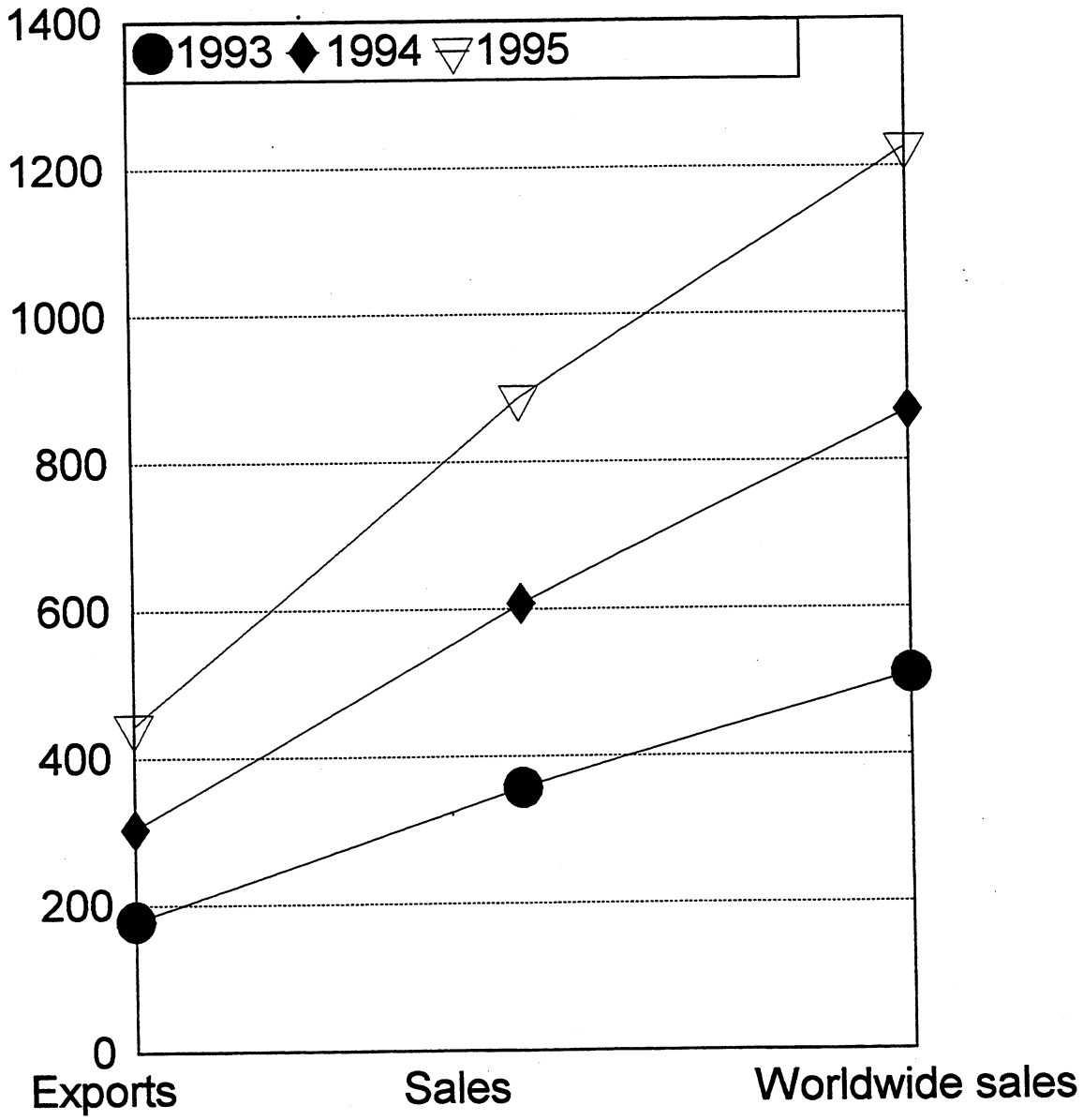
[26] USITC staff telephone interview with industry representative, Mar. 15, 1996.

[27] According to the United States GPS Industry Council, the estimated data represent a consensus of the principal U.S. GPS receiver manufacturers and serve as an important benchmark for corporate business and investment decisions.

[28] Sales of GPS products are generally made through domestic and foreign affiliated dealers, distributors, or other authorized representatives. Prices vary, depending on effective range of products, accuracy, style, finish, warranties offered, and other factors.

[29] USITC staff telephone interview with industry representative, Mar. 15, 1996.

Figure 1
GPS products: U.S exports, sales, and worldwide sales, 1993-95



Source: Worldwide sales are estimates provided by the United States GPS Industry Council (USGIC); U.S. sales and U.S. exports are estimated by the USITC staff based on USGIC data.

Table 1
Worldwide sales of GPS products, 1993-95

(Million dollars)

	1993	1994	1995
Car navigation	100	180	310
Consumer/cellular	45	100	180
Tracking	30	75	112
OEM	60	110	140
Survey & mapping	100	145	201
GIS	25	35	50
Aviation	40	62	93
Marine	80	100	110
Military	30	60	70
Total	510	867	1,266

Source: Estimated by the United States GPS Industry Council.

Outlook

Rapidly expanding GPS technology will continue to provide both U.S. and foreign users of the system with tremendous capabilities in commercial, consumer, and military applications. Growing worldwide acceptance, coupled with the proliferation of GPS receivers and product price reductions, will place GPS technology within reach of millions of consumers in the near future. Worldwide sales of GPS products are projected at more than $8 billion by the year 2000, with U.S.-made products accounting for more than one-half of these sales.[30] The global market for products used in car navigation, which is currently receiving high visibility, is expected to record a growth rate of 10 times the 1995 level by the end of the century and account for approximately 35 percent of global demand for all GPS products.[31] With worldwide ownership totaling an estimated 350 million automobiles in 1995[32] (the United States accounted for roughly one-half of the total), car navigation will represent one of the largest and fastest growing markets for GPS products. In addition, varied commercial applications in aviation, pleasure boating, marine navigation, land surveying, cellular communications, and other areas also will prove to be expanding markets for this highly effective technology.

International acceptance of the GPS will have a positive impact on both the U.S. trade balance and employment by increasing significantly U.S. exports of GPS products. It is projected that by the year 2000, exports will have increased by about $3.2 billion from the 1995 level, while new manufacturing positions created from GPS applications will total about 80,000 to 100,000 jobs.[33]■

[30] Estimated by the United States GPS Industry Council.
[31] Ibid.
[32] Estimated by USITC staff from data published in *Satellite Communications,* "GPS In The Driver's Seat," Sept. 1993, p.4A, and telephone interview with industry representative, June 13, 1996.
[33] See publication United States GPS Industry Council, "The Market For GPS," pp. 2-3.

REFORMULATED GASOLINE PROGRAM ACHIEVES SMOOTH TRANSITION

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The reformulated gasoline (RFG) program is the latest in a series of environmental programs, dating back to the introduction of unleaded gasoline in 1973, designed to make petroleum products less polluting. The introduction of RFG to consumers on January 1, 1995, went smoothly in the first year as industry faced multiple challenges in meeting complex program requirements, and delivered the product where it was needed; about 25-27 percent of gasoline sold in the United States that year was RFG. This article discusses the RFG supply/demand balance and highlights the effects of the RFG program on gasoline markets.

The RFG program,[1] at the retail level, is the most complex in a series of environmental initiatives to reduce pollution associated with petroleum products. At the start of the program, RFG was required in extreme and severe ozone nonattainment areas,[2] and in any areas that voluntarily opted into the program,[3] mostly concentrated in the Northeast, Southern California, and around Chicago. In some regions, attainment areas are interspersed with nonattainment areas requiring use of RFG, thus making delivery complex. Also, the Northeast and Midwest are not self-sufficient in terms of RFG production and must rely on Gulf coast production and imports. The expansive coverage and complexity of the delivery system are among the reasons the transition to RFG[4] has been

[1] Gasoline encompasses many different formulations, grades and volatility classes. Prior to the Clean Air Act Amendments of 1990 (PL 101-546, 104 Stat. 2399 (1990) (1990 Amendments), gasolines were mainly distinguished by grade (octane rating) and by Reid Vapor Pressure (RVP). The Clean Air Act Amendments of 1990 added oxygenated gasoline for carbon monoxide control and, most recently, RFG for reduced ground-level ozone pollution. The basic differences between the production of RFG and conventional gasoline are the reduction of aromatics (particularly benzene) and the inclusion of oxygenates to enhance combustion and reduce evaporative emissions. RFG reduces volatile organic compound emissions and toxic air pollutants (TAPs) by 15 percent. It contains at least 2 percent oxygen by weight and no more than 1 percent benzene by volume. All lead and heavy metals have been removed.

[2] Nonattainment areas are those that do not meet the national primary or secondary ambient air-quality standards for a pollutant or pollutants as determined by the U.S. Environmental Protection Agency, or that contribute to unacceptable ambient air quality in a nearby area. These areas are Baltimore, Chicago, Hartford, Houston, Los Angeles, Milwaukee, New York City, Philadelphia, and San Diego.

[3] Areas opting into the program included sections of Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Wisconsin, and the District of Columbia.

[4] Regulations implementing the RFG program were issued as part of a two-phase program. Under phase I, use of RFG was required, as of Jan. 1, 1995, in a State's mandatory ozone nonattainment areas and in the opt-in areas. Phase II, which begins on Jan. 1, 2000 and covers the remainder of the United States, requires a 20-percent reduction in toxic air pollutants (TAPs) emissions and a 5-percent reduction in oxides of nitrogen (No_x) emissions as compared with the refiner's 1990 baseline gasoline. New baselines are required to establish further reductions in volatile organic compounds (VOC) emissions. All refiners producing RFG are required to certify that their gasoline meets the fuel content specifications and/or performance standards set forth in the Clean Air Act Amendments of 1990. The RFG regulations also require that the conventional gasoline sold by each refiner or importer must not increase certain emissions over the quantities produced on an average per gallon basis using their 1990 baseline.

so closely examined by both industry and government. Also, industry was apprehensive that the introduction of RFG would significantly raise gasolines prices.

The RFG transition was viewed with concern by industry, given the mixed results that have been associated with previous new product introductions. For example, the introduction of oxygenated gasoline in the fall of 1992 went smoothly because refiners had built up large stocks of methyl tertiary-butyl ether (MTBE) and other emission-reducing oxygenates prior to the start of the program.[5] In contrast, the introduction of low-sulfur diesel in the fall of 1993 posed a number of difficulties. Problems in California and the Midwest occurred for different reasons but yielded the same result--temporary product shortages with associated price increases. The low-sulfur diesel experience illustrated that transition periods for new products are vulnerable to unexpected supply disruptions.[6]

The introduction of RFG to consumers in the first year was accompanied by the absence of major refinery outages, and unexpected reductions in demand resulting from several areas leaving the program at late stages, which contributed to the petroleum refining industry's successful transition. Pollutants were reduced and the industry's experience in 1995 suggests that wider usage can be expected in 1996-97.

Complexity of RFG Operations

The complexity of the RFG program is derived from a combination of factors:

- Changes in certain refineries' production;
- Service of noncontiguous areas by these refineries; and
- Requirements of the delivery system, particularly pipelines.

While the wide-ranging areas to be served add some complications, the main features that make the RFG program more complex are new production processes and diminished flexibility in the delivery system. RFG is a new product, not just a slight change or addition to an existing production process, as in the case of oxygenated gasoline; new equipment for additional refining steps needed to be added to existing production facilities.

Fungibility of gasoline has always been an essential factor for the efficient operation of the fuel distribution system in the United States. Currently more than 250 possible types of conventional, oxygenated, and reformulated gasolines are produced. These different gasoline types must be segregated in the pipeline systems and storage facilities, many of which have not been modified to accommodate RFG gasolines.[7] As a result of this diminished delivery flexibility, numerous difficulties can occur, such as:[8]

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[5] "First Oxygenated Gasoline Season Shakes Out Differently Than Expected," *Oil and Gas Journal*, Oct. 25, 1993, pp. 66-75.

[6] Ibid.

[7] A number of modes are used to transport all types of gasoline to consumers, including pipeline, waterborne tanker and barge, rail, and tanker truck. Storage is required at various points in the distribution system. However, refiners, transporters, bulk storage terminal operators, and marketers must segregate RFG batches and assure its integrity by repeated testing as the batch moves from the refiner to the consumer. The RFG regulations require substantial paperwork to identify each batch of RFG produced. The majority of all types of gasolines is moved to market via pipelines, which operate throughout the country. The efficiency of pipeline operations is predicated on moving large volumes of fungible products. As segregated products, such as RFG, enter the system, more interfaces and transmixes are created and often a more valuable product is blended-down into a less valuable class of product. In addition to the interface problems, disruptions in pipelines operations can effect the ability to move product to market.

[8] USITC staff interviews with various industry sources, Dec. 1995.

- A slowdown in some pipeline flows;
- A reduced number of products being stored at some terminals because of tankage limitations resulting from reduced fungibility; and
- Increased re-supply lead times (the likelihood of local areas experiencing temporary shortages).

The chronology of the program implementation shows insight into the complexity of the program as well as difficulties and unexpected events that shaped the outcome. In November 1994, RFG production increased to 1.7 million barrels per day (b/d)[9] with about 33,000 b/d being imported to prepare for the December 1 wholesale production deadline (table 1). By December, RFG production reached 2 million b/d with imports at 125,000 b/d. Conventional gasoline stocks had been drawn down in October 1994, to make room in the delivery system for the RFG. Although gasoline stocks, including RFG, were building in November 1994, RFG stock levels at the end of that month remained relatively low. Low stocks coupled with projections of little stock building during December 1994 and January 1995 led to the conclusion that the supply/demand balance was tight, exposing the system to potential shortages. Since little excess RFG production capacity was available, it appeared that supply might not be available quickly in the event of increased demand. Although the balance was close enough that the loss of a single refinery in the northeast or west coast could create regional supply shortages, a more likely problem was the loss of flexibility in the delivery system, which would increase the potential for temporary shortages during the transition to RFG. A court-ordered delay and subsequent overturning in April 1995, of the Renewable Oxygenate Standard (ROS),[10] eased the anticipated transition problems.

RFG Demand and Supply Fall Short of Expectations

A relatively mild winter and a stronger-than-expected economy boosted demand for gasoline prior to the RFG start-up. Before December 1, 1994, RFG production generally was used to convert conventional gasoline tanks to RFG service and for building stocks. After December 1, regulations allowed RFG deliveries only in ozone nonattainment areas. RFG consumption by December 1994 reached 2.2 million b/d, but decreased to around 1.8 million b/d in January 1995 (table 1). Although RFG accounted for 26 percent of estimated gasoline consumption in Jan.-Oct. 1995, its average of more than 1.9 million b/d was considerably less than the 2.5 million b/d projected prior to the RFG start-up.

Although overall demand for all types of gasoline was high, RFG demand did not reach expectations. RFG production levels were lower than anticipated in December 1994 and January 1995 because an unforeseen number of regions opted out of the program. In December 1994, 28 counties in Pennsylvania and 11 in New York and Maine, all of which had voluntarily opted into the RFG program, unexpectedly withdrew because of concern about a higher cost differential between RFG and conventional gasoline. These counties believed that the costs of RFG to consumers outweighed the benefits. This action reduced consumption of RFG in January 1995 by an estimated 330,000 b/d.

To meet high gasoline demand during the 1994-95 winter, conventional gasoline production exceeded the previous winter and was much higher than the 5-year historical average. RFG production, which began in September 1994, to build stocks for the December 1 wholesale distribution startup, did not reach the desired level because of the Colonial Pipeline rupture in October 1994.[11] The resulting increased prices for conventional

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[9] Production data represent an average per day refinery yield for the stated period.

[10] The ROS was the Environmental Protection Agency's requirement that as much as 30 percent of the oxygenates in RFG come from renewable sources.

[11] The rupture of the pipeline resulted in a decrease in total refinery capacity utilization (for refineries in Texas, Louisiana, and others along the pipeline) to a low of 86.8 percent; however, once the pipeline was repaired and fully operational in late November/early December, capacity utilization rose to 95 percent.

Table 1
Conventional and reformulated gasoline: Production, imports, exports, and apparent consumption, Sept. to Dec. 1994, 1994 average, Jan. to Dec.1995, and 1995 average

(1,000 barrels per day)

Month	Production	Imports	Exports	Apparent consumption
Conventional:				
1994:				
Sept.	4,865	300	74	5,091
Oct.	4,625	263	110	4,778
Nov.	5,325	133	106	5,352
Dec.	5,236	132	228	5,140
Average	6,200	333	95	6,438
1995:				
Jan.	5,075	73	94	5,054
Feb.	5,110	79	78	5,111
Mar.	5,298	100	70	5,328
Apr.	5,372	135	135	5,372
May	5,519	174	56	5,637
June	5,727	227	91	5,863
July	5,669	188	86	5,771
Aug.	5,532	157	96	5,593
Sept.	5,427	96	94	5,429
Oct.	5,000	134	115	5,019
Nov.	5,209	142	111	5,240
Dec.	5,293	145	140	5,298
Average	5,335	146	99	5,382
Reformulated:				
1994:				
Sept.	21	0	0	21
Oct.	260	0	0	260
Nov.	1,712	33	0	1,745
Dec.	2,036	125	0	2,161
Average	337	13	0	350
1995:				
Jan.	1,729	102	0	1,831
Feb.	1,805	112	0	1,917
Mar.	1,830	100	0	1,930
Apr.	1,868	100	0	1,968
May	1,858	112	0	1,970
June	1,826	120	0	1,946
July	1,842	102	0	1,944
Aug.	513	120	0	633
Sept.	1,890	124	0	2,014
Oct.	1,932	120	6	2,046
Nov.	1,948	100	8	2,040
Dec.	1,995	108	2	2,101
Average	1,861	112	3	1,970

Source: Official statistics of the U.S. Department of Energy.

gasoline relative to RFG reduced the incentive for refineries to switch to RFG production. Once the break was repaired, however, RFG production surged. The peak production level of 2 million b/d of RFG was reached in December 1994 before the program opt-outs began to take their toll. Refiners began to reduce RFG production later in the month because of reduced demand and uncertainty about which gasolines would eventually be required in many areas.

Imports of both conventional gasoline and RFG satisfy short-term supply/demand imbalances, and are much more variable than production. Total imports of all types of gasolines were modest in 1995, reflecting relatively stable domestic stocks as well as insufficient incentive for European refiners to produce RFG. RFG, however, accounted for 43 percent of gasoline imports of all types; with Canada and the Virgin Islands each accounting for 43 percent of total imports of RFG, and Venezuela accounting for 14 percent.

Potential Price Disruptions Prove More Moderate

Annually, the principal factors influencing retail gasoline prices[12] remain constant, with the exception of crude prices; the major influence on gasoline prices over time is the price of crude petroleum to refiners, which is determined in the global market. In the case of RFG, the separate costs of oxygenates, such as MTBE, blended into the fuel for emission control purposes is also a significant added factor affecting prices;[13] higher estimated RFG production costs were expected mainly because of increased use of oxygenates, particularly MTBE.[14]

Concern had been expressed by industry, Government, and consumer groups that the introduction of RFG would significantly increase gasoline prices. Higher production and distribution costs were expected to create a price premium for RFG of 4 to 6 cents above conventional gasoline, depending upon refinery configurations. In turn, RFG was expected to cost consumers 10 cents per gallon more at retail than conventional gasoline. Additionally, any local or regional supply disruptions were expected to result in even larger temporary price increases.

The price of RFG relative to conventional gasoline reached its peak of 8 cents per gallon in September and October 1994, prior to the rupture of the Colonial pipeline (figure 1). During November and December 1994, the average price differential between RFG and conventional gasoline receded to 4 cents per gallon following the opt-outs of nine additional counties in New York and two in Maine. During January-April 1995, the average price differential stabilized at approximately 5 cents per gallon as refiners adjusted to the opt-out situation. Although initially the opt-outs negatively affected suppliers who built inventories for anticipated requirements that did not materialize, they alleviated what could have been a tight supply later in the 1995 driving season. In this peak period of demand, the differential decreased to between 2 and 2.5 cents per gallon during May-September. The average price differential reached a low of about 1.8 cents per gallon during October-December 1995.

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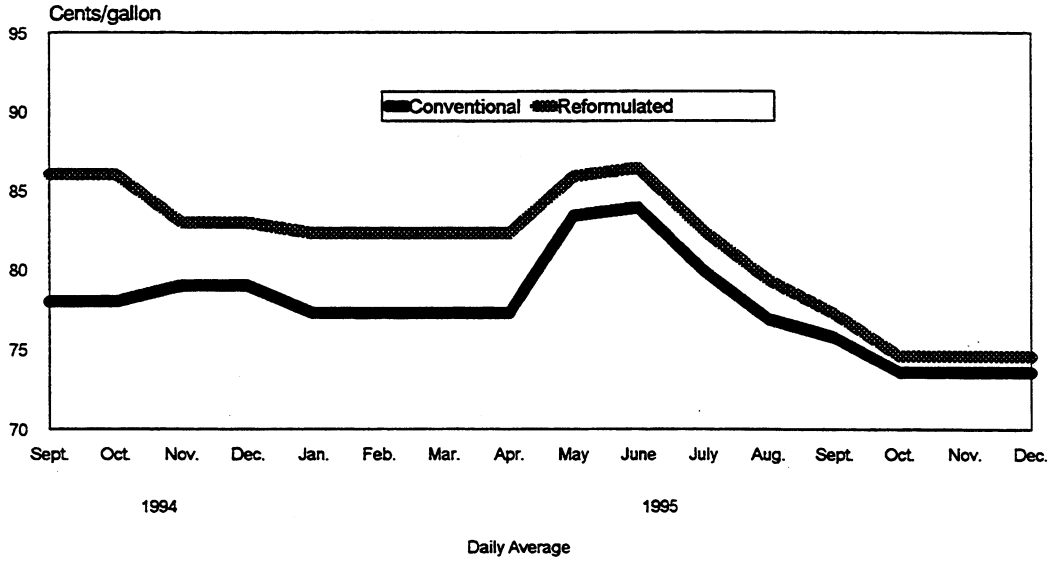
[12] Retail gasoline prices, as seen by consumers at the pump, are the product of a variety of influences, including crude petroleum prices; refining, transportation, and marketing costs; Federal, State, and local taxes; and profit margins at all levels of the industry. During the course of the year, seasonality is also a significant influence, with gasoline prices tending to rise in the summer, due to higher demand, and fall in the winter.

[13] As a result of simultaneous sales of both RFG and oxygenated gasolines, the increased demand for MTBE is reflected in higher prices. Spot prices for MTBE rose to over $1 per gallon during the third quarter of 1994 as compared with 50 cents per gallon the previous year. Methanol, a major feedstock for MTBE production, was in tight supply during the summer of 1994; prices increased sharply in June 1994, rising from about 75 cents per gallon to about $1.20 per gallon by August, triple what they were the previous year.

[14] MTBE is sometimes used in conventional gasoline to improve the octane rating in addition to reducing pollutants.

Figure 1
Average price and cost differential of conventional and reformulated gasolines, Sept.-Dec. 1994 and Jan.-Dec. 1995



Source: Derived from official statistics of the U.S. Department of Energy.

Outlook

Despite initial concerns associated with the implementation of the RFG program during 1995, events indicated that production and imports were able to meet demand without potential supply dislocations. At the time the Clean Air Act was passed, many forecasters and industry planners were projecting that RFG prices would be 10 cents above conventional gasoline, which led to opt-outs from the program; instead the differential has been about 3 cents.

From the industry perspective, refiners still face several challenges. Stocks are only at about 20 days of supply for conventional gasoline, compared with the 5-year average of 25 days.[15] Motor gasoline demand was strong in the summer of 1995 and the higher demand was met by increased production, imports, and stock draws of conventional gasoline.[16] Refiners continue to run plants at high utilization rates to meet the demand for gasoline and accompanying distillates, such as RFG.

In the year 2000, U.S. refiners will be required to sell an even cleaner burning, more costly phase II RFG. It will reduce summertime volatile organic compound emissions by at least 25 percent and nitrogen emissions by 5

[15] U.S. Department of Energy, Energy Information Administration, *1995 Motor Gasoline Assessment, Petroleum Marketing Monthly*, DOE/EIA-0380(95/05), May 1995.

[16] USITC staff interviews with various industry sources, Dec. 1995.

percent; however, refiners have stated that they have enough lead time to gear up refineries for the 2000 deadline.

One issue of concern to the refining industry is that the RFG program might be expanded. The Ozone Transport Commission (OTC)[17] is investigating methods by which 38 States in the Eastern United States could voluntarily attain air-quality standards while considering the effects of interstate airborne emissions. Some of the avenues being studied include lower volatility fuels and lower sulfur fuels. There is concern that if areas other than nonattainment areas opt-in the RFG program, refiners would be forced to make additional investments to increase production. The OTC recently stated that RFG was created for nonattainment areas where air quality was a problem and that the choice of fuel in a given area should be driven by the air quality situation and cost-efficiency of that area.■

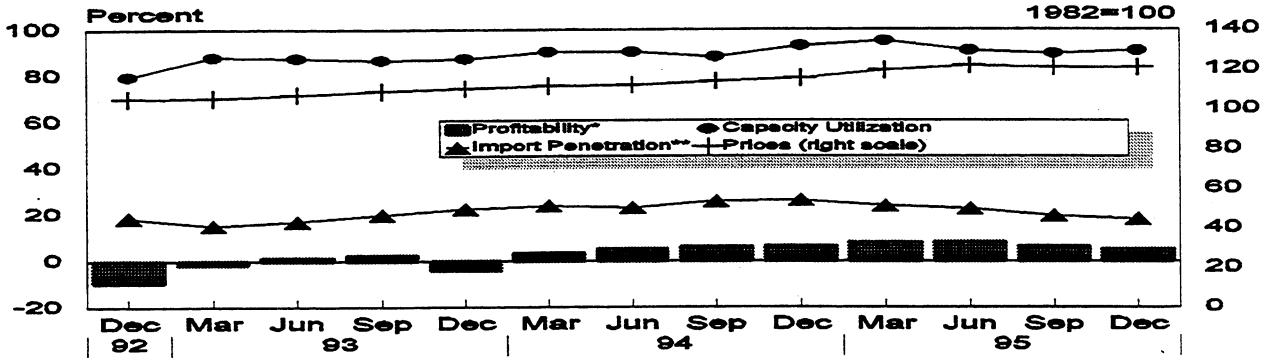
[17] The OTC represents 12 Northeastern States and provides air-quality data to the EPA.

APPENDIX A
KEY PERFORMANCE INDICATORS OF SELECTED INDUSTRIES

- ☐ **STEEL** (Felix Bello, 202-205-3120/fbello@usitc.gov)
- ☐ **AUTOMOBILES** (Laura A. Polly, 202-205-3392/polly@usitc.gov)
- ☐ **ALUMINUM** (Karl S. Tsuji, 202-205-3434/tsuji@usitc.gov)
- ☐ **SERVICES** (Christopher Melly, 202-205-3461/melly@usitc.gov)
- ☐ **SEMICONDUCTORS** (Douglas Puffert, 202-205-3402/puffert@usitc.gov)
  (Sylvia McDonough, 202-205-3393/mcdonough@usitc.gov)

STEEL

Figure A-1
Steel mill products, all grades: Selected Industry Conditions



* Operating income as a percent of sales for companies representing about 65 percent of production.
** Import share of apparent open market supply.
Source: American Iron and Steel Institute, U.S. Bureau of Labor Statistics

- Demand in steel consuming industries rebounded in the fourth quarter, as reflected by an increase in shipments of 1.0 percent, following a 2.3 percent decline in the third quarter. For the year, shipments reached 96.9 million tons, rising 1.9 percent over 1994. Despite the increase in demand, prices were flat when compared with the third quarter, and fell 0.9 percent from the second quarter. Capacity utilization for the quarter rose 1.5 percent, following a 1.6 decline in third quarter. Further indication of domestic market weakness and price softening are the declining and rising levels of imports and exports, respectively, against an strengthening dollar.
- Imports in the fourth quarter were 7.1 percent lower than the all-time high of 8.3 million tons in the fourth quarter of 1994. Imports have fallen for four consecutive quarters, trending toward historical levels. For the year, imports reached 24.4 million tons, an 18.8 percent decline from the previous year. Import penetration in the fourth quarter fell to 18.3 percent from 19.7 percent in the third quarter. Exports, after rising for three consecutive quarters, fell 8.3 percent in the fourth quarter. For the year, however, exports reached a historical high of 7.1 million tons, almost doubling the previous year's levels.
- For the fourth quarter, despite sales of $8,567 million[1] and strong demand from the automotive, construction, and service centers, U.S. steelmakers operating income fell 16.1 percent from the previous quarter to $458 million. For all of 1995, sales rose to $34.6 billion from $33.6 billion in 1994, while operating income rose to $2.4 billion from $1.8 billion.

[1] Based on financial data reported to the American Iron and Steel Institute by producers accounting for approximately 65 percent of domestic shipments.

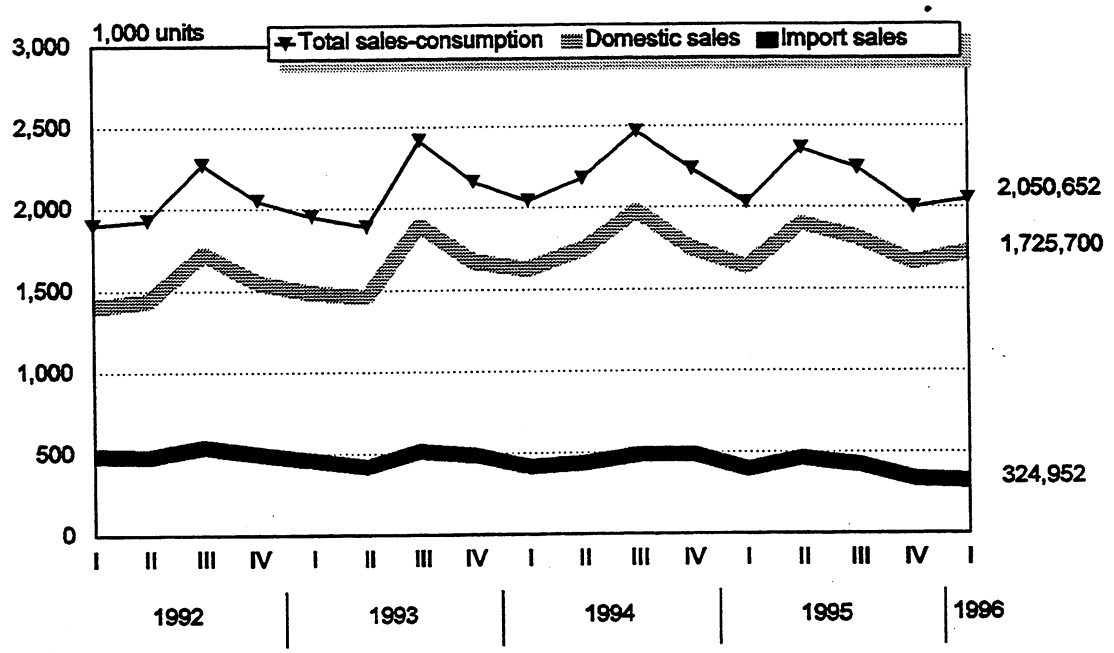
Table A-1
Steel mill products, all grades

Item	December 1995	Percentage change, December 1995 from September 1995[1]	January-December 1995	Percentage change, Jan.-Dec. 1995 from Jan.-Dec. 1994[1]
Producer's shipments (1,000 short tons)	7,494	1.0	96,859	1.9
Imports (1,000 short tons)	1,633	-7.1	24,409	-18.8
Exports (1,000 short tons)	685	-8.3	7,080	85.1
Apparent supply (1,000 short tons)	8,442	0.2	114,187	-5.9
Ratio of import to apparent supply (percent)	19.3	[2]0.1	21.4	[2]-1.4

[1] Based on unrounded numbers.
[2] Percentage point change.
Note.--Because of rounding, figures may not add to the totals shown.
Source: American Iron and Steel Institute.

AUTOMOBILES

Figure A-2
U.S. sales of new passenger automobiles, by quarter



Note.–Domestic sales include all automobiles assembled in Canada and imported into the United States under the United States-Canadian automobile agreement; these same units are not included in import sales.

Source: *Automotive News; prepared by the Office of Industries.*

Table A-2
U.S. sales of new automobiles, domestic and imported, and share of U.S. market accounted for by sales of total imports and Japanese imports, by specified periods, Jan. 1995-Mar. 1996

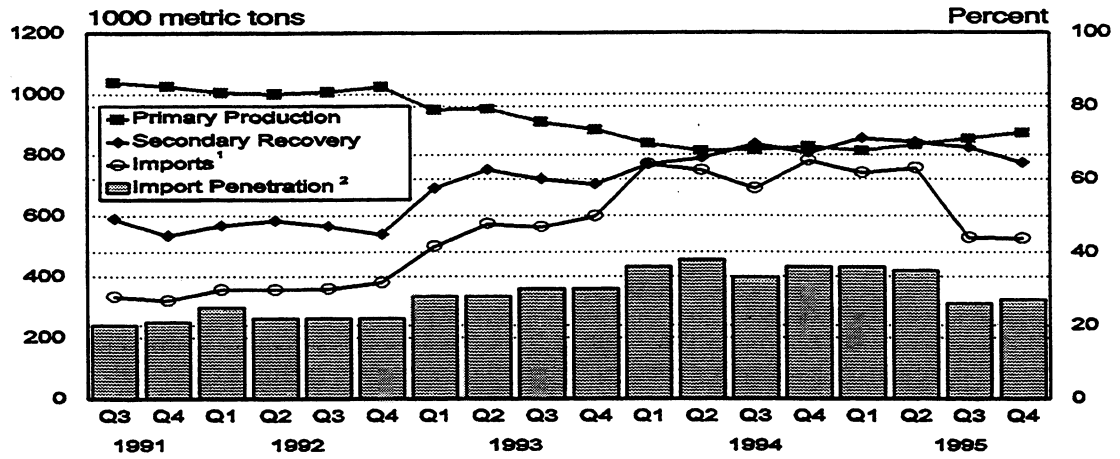
Item	Jan.-Mar. 1996	Percentage change– Jan.-Mar. 1996 from Oct.-Dec. 1995	Jan.-Mar. 1996 from Jan.-Mar. 1995
U.S. sales of domestic autos (*1,000 units*)[1]	1,726	3.6	5.5
U.S. sales of imported autos (*1,000 units*)[2]	325	-3.0	-17.6
Total U.S. sales (*1,000 units*)[1,2]	2,051	2.5	1.0
Ratio of U.S. sales of imported autos to total U.S. sales (*percent*)[1,2]	15.8	-5.3	-18.4
U.S. sales of Japanese imports as a share of the total U.S. market (*percent*)[1,2]	8.9	-10.4	- 26.9

[1] Domestic automobile sales include U.S.-, Canadian-, and Mexican-built automobiles sold in the United States.
[2] Does not include automobiles imported from Canada and Mexico.

Source: Compiled from data obtained from *Automotive News.*

Aluminum

Figure A-3
Aluminum: Selected U.S. industry conditions—



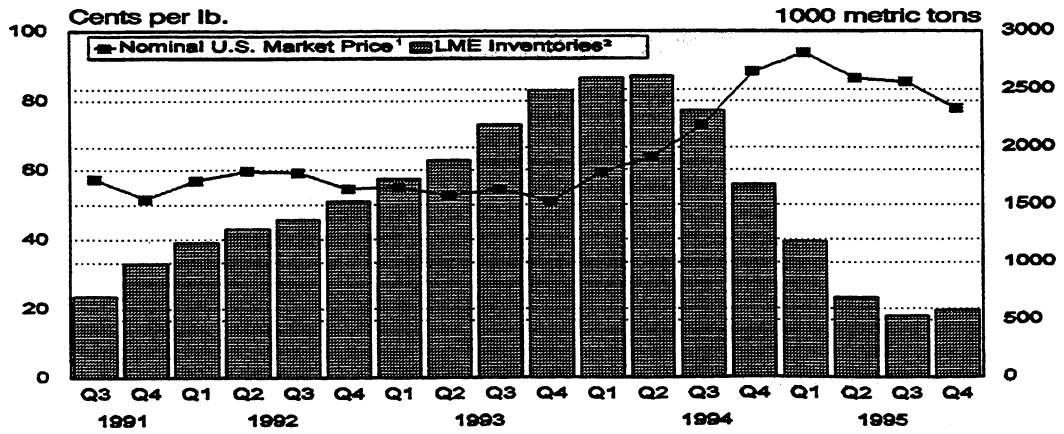
[1] Crude (metals and alloys) and primary (e.g. plates, sheets, and bars) forms for consumption.
[2] Percent share of imports to apparent domestic supply.

Source: U.S. Geological Survey.

- Production of primary aluminum in the 4th quarter 1995 by the six signatory nations to the 1994 Memorandum of Understanding reached 97 percent of the pre-pact level (from a low of 93 percent in July 1994), despite pledges by some producers to maintain reduced levels. The trend in drawdown of primary aluminum from LME inventories since May 1994 reversed in October 1995, resulting in a slight inventory rise to 584,000 metric tons by year end. Demand recovery was slowed by continued drawdown of industry inventories in most end-use sectors.

- U.S. production dropped slightly to 1.6 million metric tons. Although primary smelter production increased 19,000 metric tons as previously idled capacity was brought back on line, secondary recovery decreased 50,000 metric tons due to scrap being withheld from the market in anticipation of higher prices. Demand continued to recover from the seasonally low 1995 summer levels. Prices for primary aluminum reached a new 14-month low; the quarterly average market price dropped by 9 percent to 77.8 cents per pound. Factors influencing North American producers to cut their prices for ingot and billet included relatively quick settlement of the mid-October 1995 strike in Quebec, greater flexibility in procuring electric power for Pacific Northwest smelters, and competitors' confirmation of restarts of idled capacity. Despite slightly lower domestic output, continued drawdown of domestic inventories lead to slightly lower U.S. imports (526,000 metric tons), although import penetration remained around 27 percent.

Figure A-4
Aluminum: Price and inventory levels—

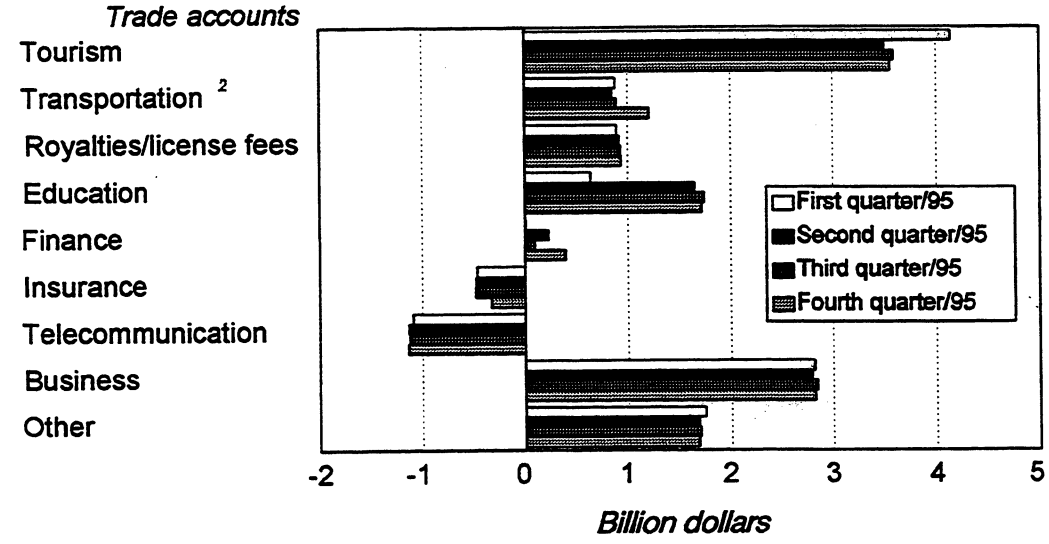


[1] Quarterly average of the monthly U.S. market price of primary aluminum ingots.
[2] End of quarter inventories.

Sources: U.S. Geological Survey, World Bureau of Metal Statistics, Metals Week, and U.S. Bureau of Economic Analysis.

SERVICES

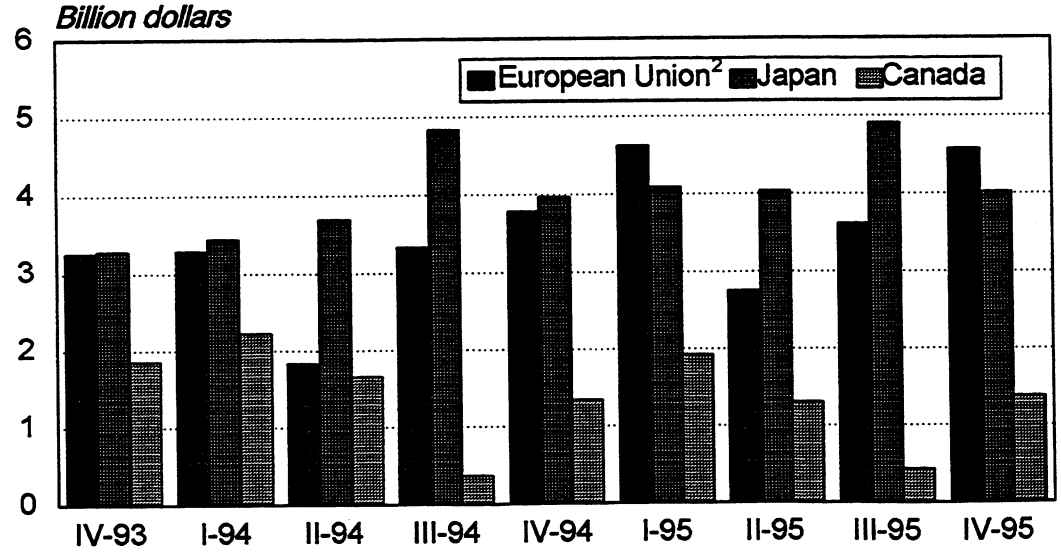
Figure A-5
Balances on U.S. service trade accounts, [1] first quarter 1995 through fourth quarter 1995



[1] Figures reflect trade among unaffiliated firms only.
[2] Includes port fees.

Source: Bureau of Economic Analysis, Survey of Current Business.

Figure A-6
Surpluses on cross-border U.S. service transactions with select trading partners, [1] by quarter, 1993-95

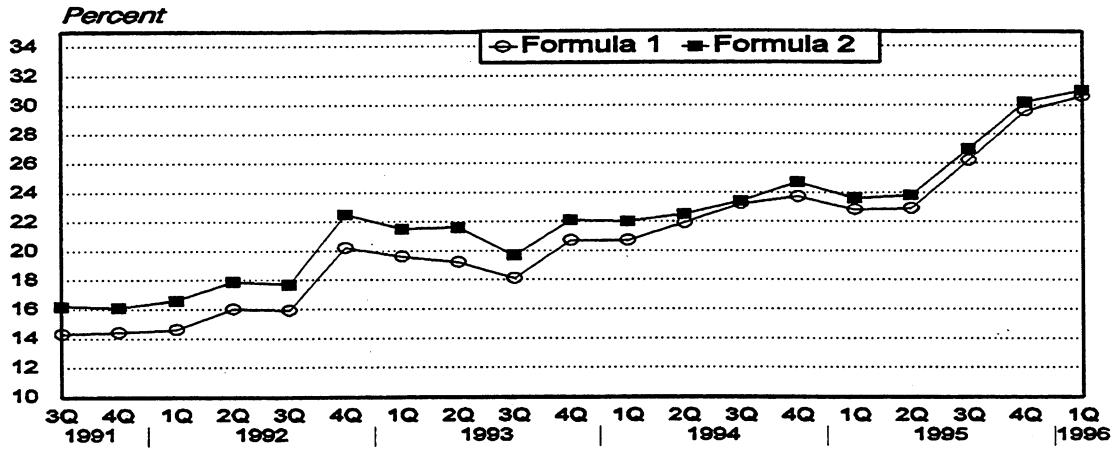


[1] Figures reflect private-sector transactions only; military shipments and other public-sector transactions have been excluded.
[2] Beginning with the first quarter of 1995, the European Union also includes Austria, Finland, and Sweden.

Source: Bureau of Economic Analysis, Survey of Current Business.

SEMICONDUCTORS

Figure A-7
Foreign market share in Japan under the 1991 U.S.-Japan Semiconductor Arrangement



Sources: United States Trade Representative and Electronic Industries Association of Japan.

- Foreign market share in Japan's semiconductor market rose in the first quarter of 1996 for the fourth consecutive quarter. The share reached a level of 30.6 percent as computed under formula 1 (see April 1996 ITTR) by the U.S. Trade Representative (USTR) and 31.0 percent under formula 2 used by Japan's Ministry of International Trade and Industry (MITI).
- The United States and Japan remain in disagreement over extension of the U.S.-Japan Semiconductor Arrangement, which expires July 31, 1996. The Arrangement was instituted in 1986 and renewed in 1991 in response to the U.S. belief that the Japanese semiconductor market was largely closed to foreign products and that Japanese manufacturers were selling certain semiconductor devices below fair market value in both the United States and third-country markets. The Arrangement expressed the "expectation" that the share of foreign semiconductors in the Japanese market would rise above 20 percent. The share has remained above that level in each quarter since the end of 1993. The Arrangement also provided for the gathering of data that would enable the U.S. Government to conduct a rapid investigation in the event of new allegations of unfair Japanese trade practices.
- The USTR and the U.S.-based Semiconductor Industry Association (SIA) favor extension of the Arrangement. They contend that Japan's semiconductor market is not yet as open to imports as the United States and third-country markets. By contrast, MITI and the Electronic Industries Association of Japan (EIAJ) assert that the Arrangement has already served its purpose and that the Japanese market is as open as any other. The United States Senate passed a resolution calling for renewal of the Arrangement.
- During industry-level discussions this spring, EIAJ and SIA officials agreed that there is a role for international cooperation within the industry in order to assure the openness of national semiconductor markets to imports, but the EIAJ argued against a role for the national governments in this process. Since mid-June, the two governments have held a series of meetings to resolve their differences. During the recent meeting of the G-7, President Clinton and Japanese Prime Minister Hashimoto agreed to achieve a resolution before the current Arrangement expires.
- Officials of the European Union (EU) have expressed a desire to be included in a multilateral agreement. Japanese officials urged the EU to abolish its semiconductor tariffs before being included in negotiations. U.S. officials are taking up concerns of the EU separately from resolution of the U.S.-Japan Arrangement.