Industry & Trade Summary

Natural Rubber

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PREFACE

In 1991 the United States International Trade Commission initiated its current *Industry and Trade Summary* series of informational reports on the thousands of products imported into and exported from the United States. Each summary addresses a different commodity/industry area and contains information on product uses, U.S. and foreign producers, and customs treatment. Also included is an analysis of the basic factors affecting trends in consumption, production, and trade of the commodity, as well as those bearing on the competitiveness of U.S. industries in domestic and foreign markets.[1]

This report on natural rubber covers the period 1988-92 and represents one of approximately 250 to 300 individual reports to be produced in this series during the first half of the 1990s. Listed below are the individual summary reports published to date on the chemicals and textiles sectors.

USITC publication number	*Publication date*	*Title*
Chemicals:		
2458	November 1991	Soaps, Detergents, and Surface-Active Agents
2509	May 1992	Inorganic Acids
2548	August 1992	Paints, Inks, and Related Items
2578	November 1992	Crude Petroleum
2588	December 1992	Major Primary Olefins
2590	February 1993	Polyethylene Resins in Primary Forms
2598	March 1993	Perfumes, Cosmetics, and Toiletries
2736	February 1994	Antibiotics
2739	February 1994	Pneumatic Tires and Tubes
2741	February 1994	Natural Rubber
Textiles and apparel:		
2543	August 1992	Nonwoven Fabrics
2580	December 1992	Gloves
2642	June 1993	Yarn
2695	November 1993	Carpets and Rugs
2702	November 1993	Fur Goods
2703	November 1993	Coated Fabrics
2735	February 1994	Knit Fabrics

[1] The information and analysis provided in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under statutory authority covering the same or similar subject matter.

CONTENTS

INTRODUCTION

This report covers natural rubber for the 5-year period, 1988 through 1992. Natural rubber was not commercially produced in the United States during this period.[1] The United States was the largest world importer of natural rubber in 1992, importing 930,543 metric tons (mt) that year. Securing a consistent supply of natural rubber for the United States has been a high priority of the rubber industry and the U.S. Government[2] because there is no synthetic alternative that possesses the specific qualities found in natural rubber.

This summary of industry and trade information on natural rubber is organized into four main sections: industry profile, foreign industry profile, trade measures, and markets. The profile of the foreign industry examines the differences and similarities of the rubber industry in the three major producing countries—Indonesia, Malaysia, and Thailand.

The trade of natural rubber is an important part of the world rubber industry. Most natural rubber is produced in developing Asian and African countries, while most is consumed in developed Western countries. The negotiation of the International Natural Rubber Agreement in 1979 was seen as an important step towards improving production capacity and increasing export earnings of developing countries. The establishment of downstream rubber industries in Asian countries, especially Malaysia, has decreased reliance by those countries on rubber as the primary source of export currency and promoted growth in the industrial sector. A profile of the natural rubber industry is depicted in figure 1.

BACKGROUND

The origins of the natural rubber industry can be traced to South America where rubber trees grew in the wild. The native Indians would cut down *Hevea brasiliensis* (Hevea) trees, extract the rubber latex, and use it to make bouncing balls and shoes. During the mid-1800s exports of rubber boots and other rubber items to the United States and Europe piqued an interest in the little-known rubber tree. In 1876, a British explorer, Sir Henry Wickham, exported the rubber tree seeds from Brazil and cultivated them in Kew Gardens, London. From here, seedlings were transported to British-controlled Malaya[3] and Ceylon,[4] where rubber plantations were established.

By the late 1930s, the growth of rubber production in Asian and African plantations (mainly European colonies) had practically eliminated the need for South American wild rubber. The production of natural rubber climbed from 4 mt in 1899 to 1.4 million mt in 1940.[5] This increase in output was largely attributable to the cross-breeding of different strains of Hevea to obtain high-yield varieties and to the efficiencies obtained from plantation growing methods. The establishment of the Malaysian Rubber Producers' Research Association (MRPRA) in 1938 to develop the science of natural rubber was seen as another important step in the development of the natural rubber industry.

The beginning of World War II brought significant changes to the natural rubber industry. Rubber supplies to consuming countries, most importantly the United States, were disrupted by the Japanese invasion of Southeast Asian countries, which then accounted for 96 percent of world production. Since rubber was deemed a raw material vital to the U.S. industrial sector and also to the war effort, the U.S. Government began investigating alternative sources of supply. Four major strategies were implemented to secure a supply of rubber for the United States—the development of commercial-size synthetic rubber facilities, the harvesting of guayule rubber in the Southwestern United States and Mexico, the creation of a government stockpile of rubber, and the increase of rubber imports from African sources.[6]

INDUSTRY PROFILE

Product Description and Attributes

Natural rubber is a subset of a larger group of materials known commonly as rubbers or elastomers.[7] Rubbers are commonly classified by the industry on the basis of their derivation. Natural rubbers are those extracted from plant material, while synthetic rubbers are those obtained from petrochemicals by chemical synthesis. Both types of materials have many similarities that classify them as rubbers; these include elasticity, a highly polymerized structure, and vulcanizability. But differences exist in production methods and extent of properties—heat resistance, tear strength, flexibility, and wear resistance.

The basic polymer referred to as natural rubber is known chemically as cis-1,4-polyisoprene. However, during the biosynthesis of rubber in the plant, proteins, carbohydrates, resins, mineral salts, fatty acids, and other impurities are also produced. There are reportedly over 200 species of plants from which natural rubber can be obtained, but Hevea accounts for more than 99 percent of world production of natural rubber.[8]

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[1] The Standard Industrial Classification (SIC) code for natural rubber plantations is 0831.

[2] The U.S. Government stockpiles natural rubber to protect the nation against foreign dependence during periods of national emergency.

[3] Malaya was the predecessor of present-day Malaysia.

[4] Ceylon was the predecessor of present-day Sri Lanka.

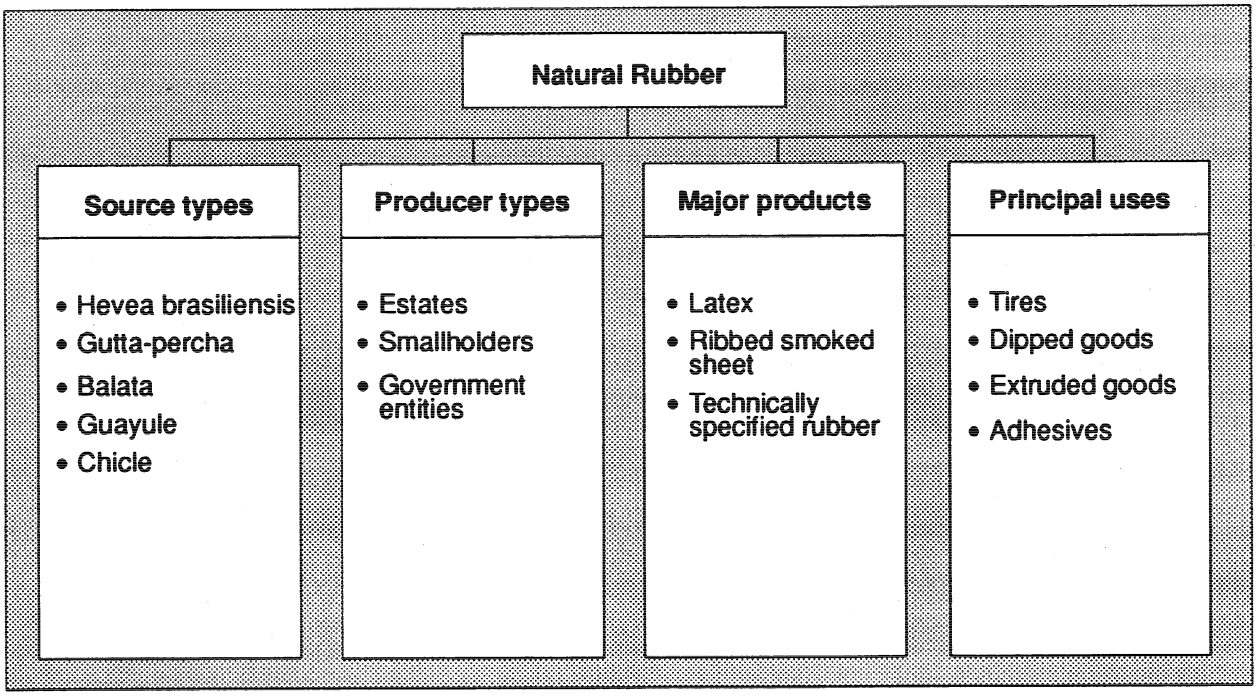
[5] Raymond E. Kirk and Donald F. Othmer, eds., *Encyclopedia of Chemical Technology*, vol. 11 (New York: Interscience Publishers, Inc., 1954), p. 811.

[6] A.D. Roberts, ed., *Natural Rubber Science and Technology* (New York: Oxford University Press, 1988), pp. 9-10.

[7] Elastomers refer to natural and synthetic vulcanizable products, which reveal elastic properties after crosslinking, can be stretched to at least double their length at room temperature and, on removal of the tension, quickly return to their original length. K.F. Heinisch, *Dictionary of Rubber*, (New York: John Wiley & Sons, 1974), p. 189.

[8] Martin Grayson and David Eckroth, eds., *Kirk-Othmer Encyclopedia of Chemical Technology*, 3d ed., vol. 20 (New York: John Wiley & Sons, 1981), p. 468.

Figure 1
Natural rubber industry: Principal raw materials, source types, producer types, major products, and principal uses



Source: Compiled by the USITC staff from various sources.

Production Process

The production of natural rubber begins with the breeding and planting of Hevea. Some of the earliest scientific work on natural rubber involved selective breeding practices in the early 1900s. Various strains of Hevea were crossed to obtain new strains that contained the optimal mix of properties such as high yields, resistance to disease, and high growth rates. The best strains are most often bud grafted to produce clones.

One of the most significant aspects of this agricultural crop is the long cycle time from rubber planting to rubber harvesting. The economic life of the tree begins in approximately the 6th year after planting and lasts for typically 25 to 30 years. Once the tree reaches maturity, it is tapped to obtain the raw rubber latex, which is contained in capillary vessels throughout the plant. The tapping of trees is performed by skilled tappers who slice into the tree bark to a certain depth to obtain optimal flow without creating long-term damage to the tree. Recent developments in the industry have incorporated automatic tapping equipment, reducing the need for skilled labor.

The liquid obtained from tapping is commonly referred to as field latex; it is described as a milky liquid containing 30 to 40 percent rubber on average. Field latex is subsequently processed in the producing country into a liquid latex concentrate or dry rubber. Approximately 10 percent of all rubber sold is in the form of latex.

Natural rubber is grown under two basic types of land schemes—estates and smallholdings. Although there is no official definition of estates or smallholdings, it is generally agreed that holdings of 100 acres or more are referred to as estates, whereas those smaller than 100 acres are smallholdings. Estates are large organizations often founded by European interests who colonized the major Southeast Asian producing countries. Today the estates display a wide variety of arrangements—they are owned by individuals, partnerships, and companies (both domestic and foreign). Smallholders are typically self-employed subsistence farmers who tap their own few acres of rubber and sell it to middlemen or organizations. Another less typical smallholder arrangement exists when the owner pays a tenant to tap his trees.

Types of Natural Rubber

Today natural rubber is synonymous with Hevea rubber, the rubber extracted from the *Hevea brasiliensis* species of tree. There are, however, more than 200 different types of plant species that produce rubber hydrocarbons, but most are of minimal commercial significance.[9] Guayule, balata, gutta-

[9] Werner Hofmann, *Rubber Technology Handbook* (New York: Hanser Publishers, 1988), p. 11.

percha, and chicle rubbers are some of the other types of rubbers produced from different plant species. Table 1 outlines the differing characteristics of the various rubber-producing plant species. Most of these rubbers, often termed wild rubbers, have little industrial use today because of the development of synthetic rubbers.[10] Guayule was an important source of natural rubber for the United States during the early 1900s; it accounted for 50 percent of U.S. rubber consumption in 1910.[11] The use of guayule quickly declined as large harvests depleted the supply and drops in natural rubber prices made guayule uneconomical[12] to produce in comparison to Hevea rubber.

Forms of Natural Rubber

Natural rubber enters commerce in one of three basic forms—latex, sheet or crepe, and technically specified blocks. Liquid latex is obtained by concentrating field latex to a minimum of 60-percent, dry-rubber content by weight.[13] The addition of a preservative, usually ammonia, at an early stage is important to prevent enzyme and bacterial attack. Latex is graded for quality based on three principal criteria—mechanical stability, potassium hydroxide number,[14] and volatile fatty acid number.[15]

The production of sheet or crepe rubber begins with field latex (or field scrap for some forms of crepe), which is transformed to a coagulum with the addition of a coagulant, usually formic acid or acetic acid. The coagulum is then processed by passing it through rollers or mills to compress it into sheet form. After forming, it is smoked and dried to produce smoked sheet or air dried to produce crepe.[16] The conventional type of rubber, ribbed smoked sheet (RSS), is visually graded on a scale from 1 to 5 on the basis of color, clarity, and the absence of bark, blisters, and holes.[17]

[10] Principal uses for balata and gutta-percha rubbers were in golf ball covers and cable coverings. The development of styrene-butadiene rubber has displaced much of the former markets for these rubbers.

[11] A.D. Roberts, ed., *Natural Rubber Science and Technology*, p. 10.

[12] The production of natural rubber from guayule shrubs is much more complicated than tapping Hevea trees. The guayule shrub is uprooted and the rubber is removed by a mechanical process; it then must be deresined, which is reportedly a fairly expensive process. U.S. Tariff Commission, *Crude Rubber*, Nov. 1940.

[13] Martin Grayson and David Eckroth, eds., *Kirk-Othmer Encyclopedia of Chemical Technology*, 3d ed., vol. 20, p. 482.

[14] The potassium hydroxide (KOH) number is the number of grams of KOH required to neutralize the acids present in 100g of latex solids.

[15] Volatile fatty acids (e.g.: formic, acetic, and propionic) refer to the presence of acids formed by the action of bacteria.

[16] Werner Hofmann, *Rubber Technology Handbook*, pp. 12-13.

[17] Martin Grayson and David Eckroth, eds., *Kirk-Othmer Encyclopedia of Chemical Technology*, 3d ed., vol. 20, p. 474.

The invention of technically specified rubber (TSR) in 1964 was viewed as a major advancement to the natural rubber industry. Prior to the development of TSR, sheet and crepe rubber were graded for quality, but processibility and cure rates differed among countries and plantations. Malaysia pioneered the development of TSR with Standardized Malaysian Rubber (SMR). SMR is graded for dirt content, ash content, nitrogen content, volatile matter, Mooney viscosity[18], cure, color, and plasticity retention index.[19] Other countries have been encouraged to follow Malaysia's lead and, thus, have developed their own TSRs. The following TSRs have been developed by other major producing countries: SIR—Standard Indonesian Rubber and TTR—Thai Tested Rubber.[20]

International Agreements

The United Nations Conference on Trade and Development (UNCTAD), formed in 1964 by the United Nations General Assembly, has been the primary organizational forum for negotiation of international commodity agreements. Under the auspices of UNCTAD, the Integrated Program for Commodities (IPC) was formed to expand and diversify the trade of developing countries, and increase their productivity and export earnings. The International Natural Rubber Agreement (INRA) was the first international commodity agreement concluded within the framework of the IPC; its goals were to stabilize natural rubber prices without distorting the long-term market trends and to foster the expansion of natural rubber supplies at reasonable prices.

INRA was negotiated in 1979 but did not enter into force in the United States until May 1981;[21] it had a term of 5 years that continued until the second INRA (INRA II)[22] was negotiated in 1987.[23] The United

[18] Mooney viscosity is a measure of elastomer plasticity.

[19] The plasticity retention index is the ratio of plasticity of rubber before and after it has been heated for 30 minutes at 140 degrees Celsius multiplied by a factor of 100. Werner Hofmann, *Rubber Technology Handbook*, p. 17.

[20] Werner Hofmann, *Rubber Technology Handbook*, p. 18.

[21] The agreement did not enter into full force until April 15, 1982, when it was ratified by the required number of net importing and exporting member countries.

[22] Most of the same structures and provisions of the first agreement were incorporated in the second agreement; changes included more frequent and automatic adjustment of prices to reflect market trends, a cap on individual member contributions, and prohibitions against manipulating rubber prices and restricting rubber supplies.

[23] INRA II was negotiated in March 1987 at the Fourth U.N. Conference on Natural Rubber convened by UNCTAD. The agreement was signed on behalf of the United States on Aug. 28, 1987, but was not ratified by the U.S. Government until Nov. 1988. INRA II also has a term of 5 years with provision for a possible 2-year extension. For further information, see USITC, *Operation of the Trade Agreements Program*, 1991, USITC publication 2554, Aug. 1992, p. 64; and USITC, *Operation of the Trade Agreements Program*, 1992, USITC publication 2640, July 1993, pp. 41-43.

Table 1
Natural rubber: Characteristics of natural rubber types

Characteristics	Balata	Chicle	Guayule	Gutta-Percha	Hevea
Scientific name	*Mimusops globosa*	*Achras chicle*	*Parthenium argentatum*	*Sapotaceae* family	*Hevea brasiliensis*
Plant type	tree	tree	bush	bush	tree
Obtained from	trunk	trunk	roots, bark, wood	leaves	trunk
Obtained by	tapping	tapping	destroying bush	leaf harvesting	tapping
Chemical configuration	trans	[1]	cis	trans	cis
Rubber hydrocarbon percent	40	17.2	70	70-80	96
Indigenous to	South America	Central America	Mexico, SW USA, Russia	East Asia	South America

[1] Not available.

Source: Martin Grayson and David Eckroth, eds., *Kirk-Othmer Encyclopedia of Chemical Technology*, 3d ed., vol. 15 (New York: John Wiley & Sons, 1981), pp. 468-91; Raymond E. Kirk and Donald F. Othmer, eds., *Encyclopedia of Chemical Technology*, vol. 11 (New York: Interscience Publishers, Inc., 1954), pp. 810-26; and K.F. Heinisch, *Dictionary of Rubber*, (New York: John Wiley & Sons, 1974).

States is currently an active member of INRA II and was also active in the previous agreement. The present agreement was set to expire on December 28, 1993, but the International Natural Rubber Council decided to extend the 1987 agreement for one year to renegotiate a new agreement. A United Nations Conference on Natural Rubber is to be held under the auspices of UNCTAD during April 5-15, 1994 to negotiate the successor agreement.[24]

The provisions of the INRA established the International Natural Rubber Organization (INRO) to supervise the operations and administer the provisions of the agreement. The INRO comprises importing and exporting members, each group having 50 percent of the voting rights[25] and financing responsibilities. In 1992, INRO membership comprised 6 exporting members, 20 importing members, and the European Union. The agreement also established the International Natural Rubber Council as the highest authority in the organization; the Council includes one delegate from each member country.

The most important aspect of the INRA is the operation of the Buffer Stock, which is the sole market intervention mechanism for price stability. Buffer Stock capacity is set at 550,000 mt by the agreement. Additions to the buffer stock or sales from the buffer stock are performed by the Buffer Stock Manager (BSM), who is guided by a price range scheme. The agreement establishes a reference price, upper and lower intervention prices, upper and lower trigger action prices, and upper and lower indicative prices.[26] During 1988-92, the reference price was revised twice to reflect the long-term trends in the marketplace.[27] The Daily Market Indicator Price (DMIP) is used to show the situation in the marketplace. It is a composite, weighted average of daily official current-month prices of RSS 1, RSS 3, and TSR 20 rubber on the Kuala Lumpur, London, New York, and Singapore markets quoted in Malaysian/Singapore currency. Figure 2 shows the movement of the DMIP, reference price, and the corresponding movement of the intervention and trigger action prices during 1988-92.[28]

Product Applications

Natural rubber is a raw material used in a diverse group of industries. The most important end-use application, in terms of value and quantity consumed, is the tire industry. The latest available data, 1990, indicate that 655,000 mt, or 80 percent of total U.S. natural rubber consumption, was used in tire production.[29] The United States is the largest world tire producer; production in 1992 totaled 230 million car and truck tires.[30]

The remainder of natural rubber is used mainly to produce footwear, gloves, contraceptives, thread, adhesives, foam, medical devices, hose and belting, and automotive goods. Many of these traditional applications for natural rubber have been replaced by synthetic rubbers and thermoplastic elastomers in recent years, because these latter materials offer a better variety of properties such as durability and chemical resistance. The consumption of natural rubber in the rubber glove and contraceptive industries has increased recently with the spread of Acquired Immune Deficiency Syndrome (AIDS). However, the overall demand for natural rubber is expected to be affected minimally by the AIDS epidemic, because gloves and contraceptives are a low-volume end use of natural rubber.[31] The demand for tires will continue to be the dominant force behind the demand for natural rubber for the foreseeable future.

Market Structure

U.S. consumers of natural rubber obtain their supply by various means. Large tire producers such as Goodyear, Bridgestone/Firestone, and Michelin have a high degree of vertical integration. Operation of their

[24] U.S. Department of State, "United Nations Conference on Natural Rubber," telegram, message reference No. 00667, prepared by U.S. Embassy, Kuala Lumpur, Jan. 26, 1994.; U.S. Department of State, "INRO Renegotiation and Price Range," telegram, message reference No. 08802, prepared by U.S. Embassy, Kuala Lumpur, Nov. 5, 1993; and U.S. Department of State, "UNCTAD: Dates Set for U.N. Conference on Natural Rubber," telegram, message reference No. 00060, prepared by U.S. Embassy, Geneva, Jan. 4, 1994.

[25] Exporting members hold 1,000 votes and importing members hold 1,000 votes. Distribution of these votes among the importing members is based on the average level of net imports during a 3-year period; for exporting members, on the average level of net exports during a 5-year period. *International Natural Rubber Agreement, 1987*, treaty document 100-9, 100th Cong., 1st Sess., Oct. 20, 1987, art. 14.

[26] The reference price was initially fixed at 201.66 Malaysian/Singapore cents per kilogram. Revisions to the reference price are based on market trends and/or net changes in the Buffer Stock. The upper and lower intervention prices are calculated at plus and minus 15 percent of the reference price, the upper and lower trigger action prices are calculated at plus and minus 20 percent of the reference price, and the upper and lower indicative prices were initially fixed at 270 and 150 Malaysian/Singapore cents per kilogram, respectively.

[27] Under INRA II, revisions to the reference price are based on market trends and net changes to the Buffer Stock. These revisions can occur by special vote of the INRO Council or automatically as the result of movement in the Daily Market Indicator Price (DMIP). *International Natural Rubber Agreement, 1987*, arts. 31-32.

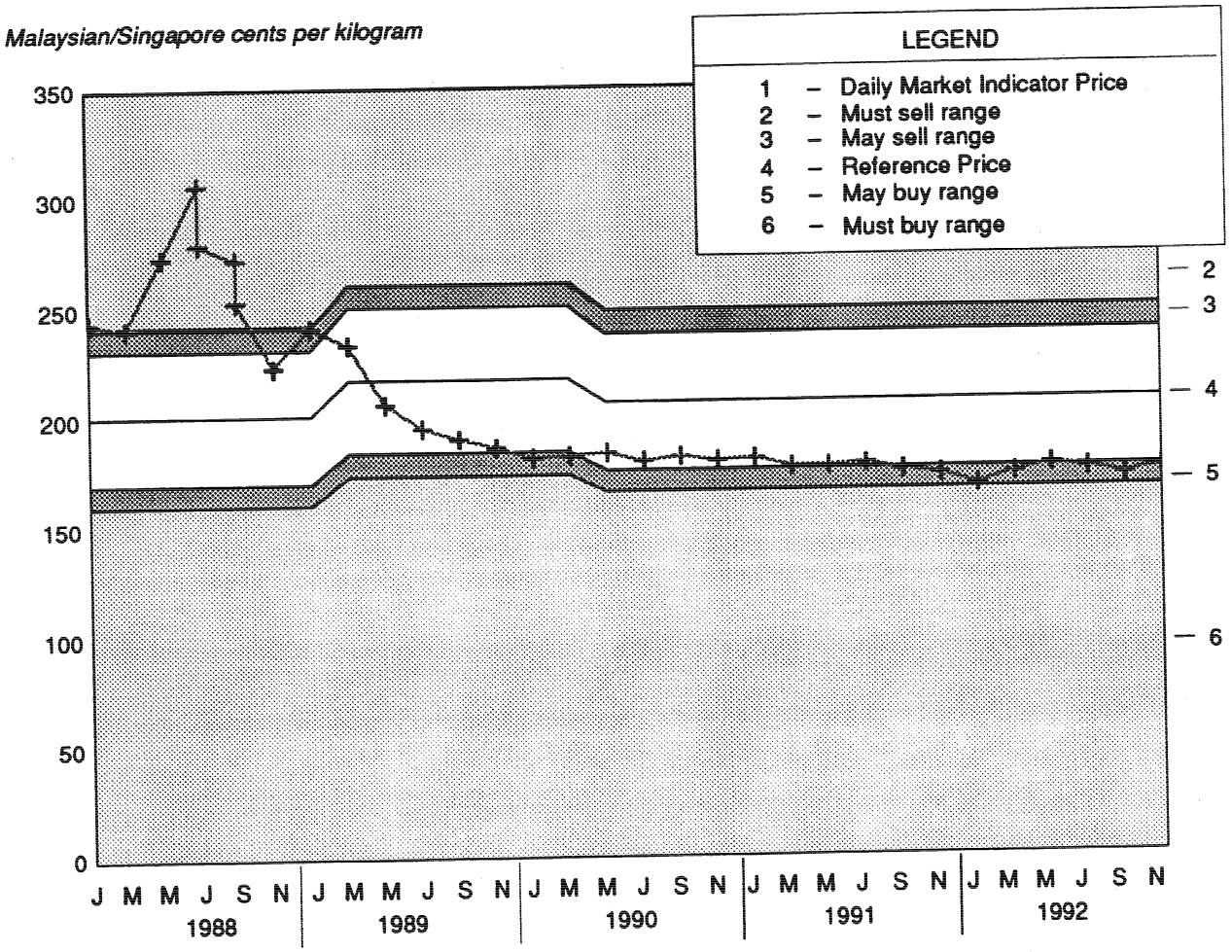
[28] The upper and lover intervention prices, and the upper and lower trigger action prices guide the purchases and sales of natural rubber by the BSM. If the DMIP rises above the upper intervention price or falls below the lower intervention price, the BSM may sell or buy rubber respectively to defend the price. When the DMIP rises above the upper trigger action price, or falls below the lower trigger action price, the BSM must sell or buy rubber respectively to defend the price until it falls below or rises above the trigger action price. *International Natural Rubber Agreement, 1987*, arts. 29-30.

[29] International Rubber Study Group (IRSG), *Rubber Statistical Bulletin*, Wembley, United Kingdom, vol. 47,(Jan.) No. 4, p. 39.

[30] International Rubber Study Group, *Rubber Statistical Bulletin*, pp. 40-41.

[31] For comparison, one truck tire uses the same amount of dry rubber as 21,000 condoms or 3,000 examination gloves. Nick Seaward, "A helping hand: AIDS fears fuel Malaysian rubber glove boom," *Far Eastern Economic Review*, Jan. 5, 1989, p. 57.

Figure 2
Natural rubber: INRA reference price, intervention prices, trigger action prices, and Daily Market Indicator Price (DMIP), 1988-92



Explanation—When the DMIP moves into the may by range, as it did in late 1989, early 1990, and during most of 1992; the Buffer Stock Manager may purchase rubber in the market place according to provisions in the International Natural Rubber Agreement. During most of 1988, the DMIP was in the must sell range— the Buffer Stock Manager is required to sell rubber from stocks in this situation.

Source: The Economist Intelligence Unit, Rubber Trends, (London), numerous issues; and International Rubber Study Group (IRSG), Rubber Statistical Bulletin, Wembley, United Kingdom, Vol. 48, (Nov.) No. 2, p. 45.

own rubber plantations in producing countries guarantees a steady supply of rubber, removes the middleman, and reduces price volatility. The other types of structures involve some type of middleman. A number of rubber dealers have offices in the United States for the sale of rubber. Some of these dealers are representatives of large plantations or marketing organizations of producing countries. Some large consumers of rubber purchase the material from the exporting companies, wholesalers, or associations in the producing country.

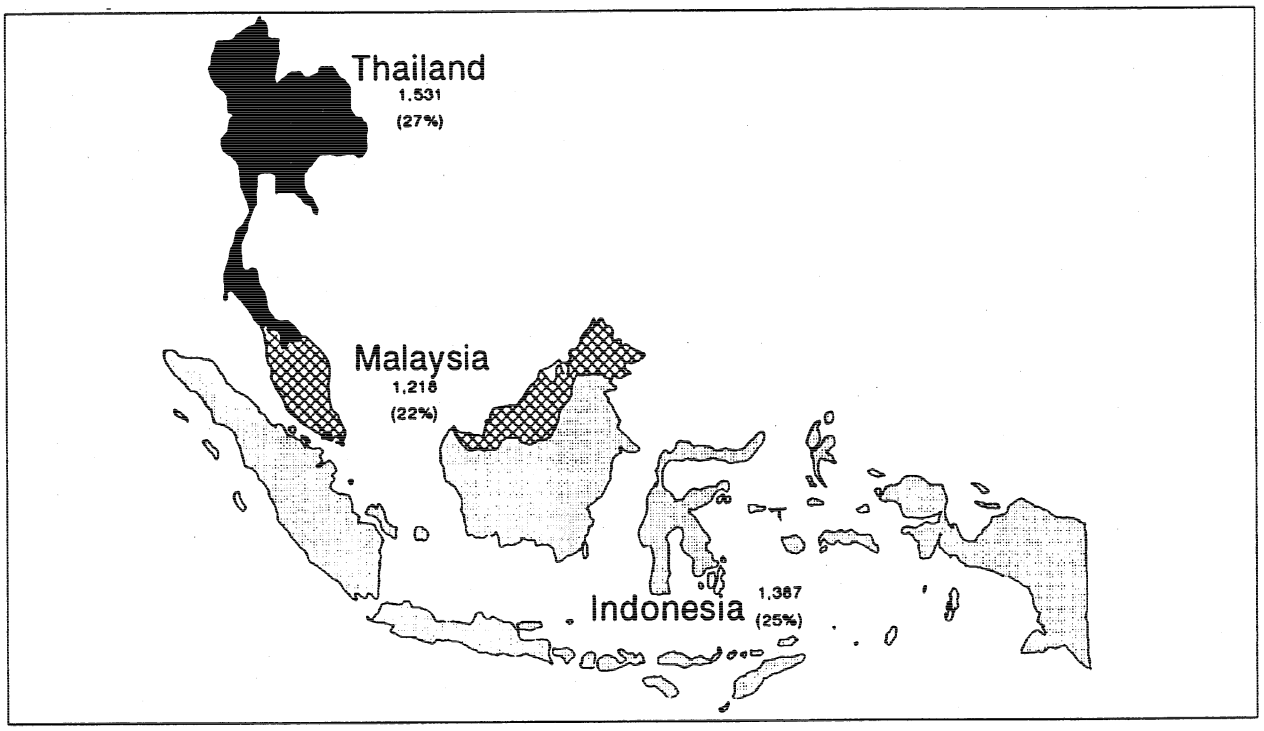
FOREIGN INDUSTRY PROFILE

Overview

World production of natural rubber is concentrated in East Asian countries. Malaysia, Indonesia, and Thailand together accounted for almost 74 percent of world production in 1992 (figure 3). Other notable producing countries are Liberia, India, China, Sri Lanka, and the Ivory Coast. The majority of rubber plantations are within 15 latitude degrees north or

Figure 3
Major natural rubber producing countries: 1992 production and shares of world total

(Thousand metric tons)



Source: International Rubber Study Group (IRSG), *Rubber Statistical Bulletin*, Wembley, United Kingdom, vol. 48, (Nov.) No. 2, pp. 9-10; and *Collins World Atlas*, New Edition 1990 (Glasgow: William Collins Sons & Co. Ltd., 1990), p. 27.

south of the equator because rubber tree productivity is greatest in this climate zone. A relatively small amount of rubber is produced in Central and South America.

One of the most significant events in the natural rubber industry during the past 5 years has been the displacement of Malaysia as the largest world rubber producer. Malaysian output has steadily declined during the period, while output of Indonesia and Thailand has steadily increased. Production in Thailand and Indonesia surpassed that in Malaysia for the first time in 1991, and the margin widened further in 1992 when Thailand (largest producer) produced 313,000 mt more than Malaysia. World production and consumption trends are depicted in figure 4, and a comparison of the major producing countries is shown in table 2.

Malaysia

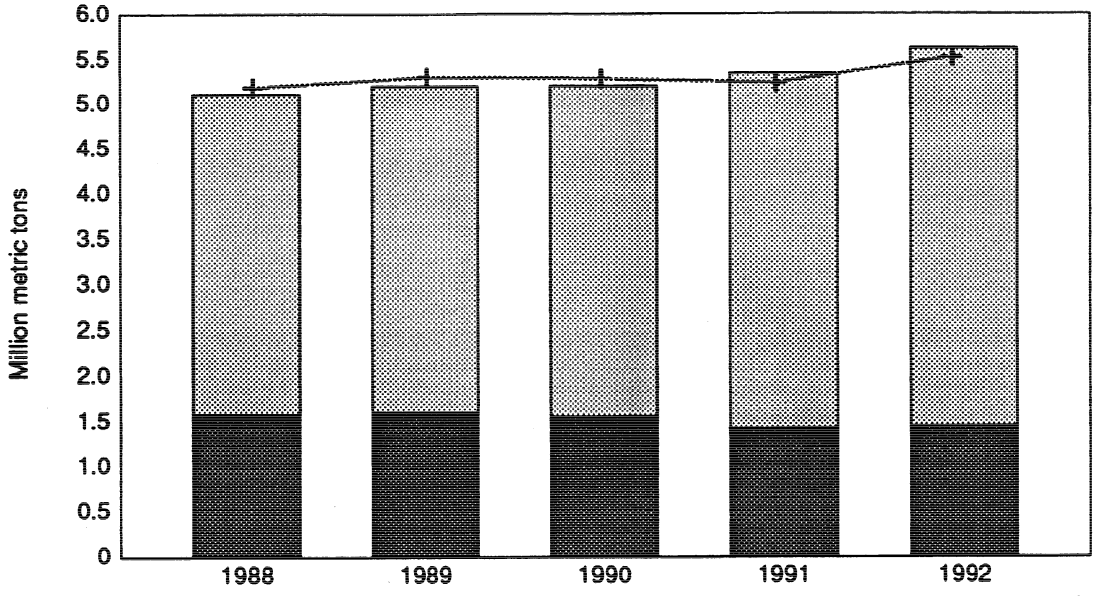
Rubber trees were introduced to Malaya by the British in the late 1800s. By 1888, there were a reported 1,000 trees growing in Malaya.[32] The planting of rubber trees expanded in the late 19th century and early 20th century as the price of coffee (one of the major crops in Malaysia) declined and the demand for rubber grew with the invention of the pneumatic tire. In 1992, there was a total of 4.5 million acres planted with rubber in Malaysia.

Malaysia has always been the world technical and scientific leader in the natural rubber industry. Major technological and organizational developments such as high-yield plant breeding, a centralized marketing scheme, and TSR can all be attributed to Malaysia. Most recently, the government has taken on ambitious programs to promote the manufacture of rubber goods in Malaysia. Consequently, the amount of domestically consumed rubber has more than doubled during the past 5 years.

Natural rubber is produced by three main entities in Malaysia—smallholders, estates, and Federal land schemes. Smallholdings and estates follow the typical role of each of these entities, but the Federal land schemes are unique to that country. After Malaysia gained independence in the mid-1950s, the government began to take an active role in developing rubber farming. It established the Federal Land Development Authority (FELDA) to open new tracts of land for agricultural development, and the Federal Land Consolidation and Rehabilitation Authority (FELCRA) to redevelop or rehabilitate state land to acceptable

[32] Martin Grayson and David Eckroth, eds., *Kirk-Othmer Encyclopedia of Chemical Technology*, 3d ed., vol. 20, p. 469.

Figure 4
Natural rubber: Production and consumption trends, 1988-92



	1988	1989	1990	1991	1992
Consumption	5.18	5.3	5.28	5.23	5.52
Prod.-Smallholders	3.53	3.6	3.65	3.92	4.18
Prod.-Estates	1.59	1.61	1.56	1.43	1.45

Source: International Rubber Study Group (IRSG), *Rubber Statistical Bulletin,* Wembley, United Kingdom, Vol. 48 (Nov.) No. 2, p. 2.

Table 2
Natural rubber: Comparison of major producing countries

Factor	Malaysia	Indonesia	Thailand
Area under rubber (1,000 acres)	4,525	7,512	4,556
Estates	870	1,233	232
Smallholdings	3,655	6,279	4,324
Production, 1992 (1,000 metric tons)	1,218	1,387	1,531
Net exports, 1992 (1,000 metric tons)	939	1,268	1,413
Principal export markets:			
	Rep. of Korea	U.S.	Japan
	U.S.	Singapore	China
	Japan	Japan	U.S.
Type and grade of gross exports, 1992 (1,000 metric tons):			
Ribbed Smoked Sheet (RSS) 1/1X	17	103	17
RSS 2	9	7	15
RSS 3	41	5	845
RSS 4	7	7	164
RSS 5	1	(1)	29
Technically Specified Rubber (TSR) 3	(1)	47	(1)
TSR 5/5L/L	66	3	7
TSR 10	212	81	(1)
TSR 20	358	972	223
TSR 50	(1)	(1)	(1)
TSR CV	60	(1)	(1)

[1] None reported.

Source: International Rubber Study Group (IRSG), *Rubber Statistical Bulletin*, Wembley, United Kingdom, vol. 48, (Nov.) No. 2, pp. 9-13, 21-23, and 46.

levels of output.[33] In 1992, approximately 13 percent of Malaysia's natural rubber was produced under FELDA, 59 percent by smallholders, and 28 percent by estates.

A number of other governmental organizations have been instrumental in promoting the natural rubber industry in Malaysia. The Malaysian Rubber Research Development Board (MRRDB) was established to exercise control over the research, technical development, and promotion work of the Malaysian rubber industry. THe MRRDB functions as the policy maker by determining the plan of action, which is then passed to the operating organizations and agencies such as the Rubber Research Institute of Malaysia (RRIM), the Malaysian Rubber Development Corp. (MARDEC), and Rubber Industry Smallholders' Development Authority (RISDA). RRIM is responsible for research to improve rubber productivity, development of new forms of rubber, and technological advancement. The responsibility of marketing and processing smallholder rubber is commissioned to MARDEC, and RISDA is mainly involved in replanting schemes. The MMRBD is credited with the development of the Standard Malaysian Rubber (SMR) Scheme that established technical specifications for the classification of rubber.

One of the most recent changes in Malaysia's rubber sector has been the decrease in production. This decrease has been attributed to the rapid industrialization of the country, which has created a labor shortage.[34] The rubber industry is reported to be affected the most because it is one of the most labor-intensive and has some of the lowest profit margins.[35] An increasing number of plantation workers have moved to better paying, fixed-income manufacturing jobs in the cities, leaving some estates in a crisis. It has been suggested that a virtual restructuring of the industry is necessary to stop or reverse the present trend.

Thailand

The natural rubber industry in Thailand reportedly began around 1900, when Hevea was introduced. The rubber industry grew steadily throughout the century as rubber became a major export product of Thailand. By 1990, 4.6 million acres of land were planted with rubber. Today, rubber plantations are concentrated in the southern panhandle region, which accounts for approximately 90 percent of production, and the eastern seaboard region, which accounts for the remaining 10 percent of production.

The structure of the Thai rubber industry is heavily weighted on the role of smallholders instead of estates. In terms of area under plantation, estates account for only 5 percent in Thailand compared with 19 percent of this area in Malaysia and 16 percent in Indonesia. This reliance on smallholders reportedly has inhibited the growth of the industry because of inefficiencies, lack of infrastructure, and inadequate investment. In the mid-1900s an ambitious program of replanting was launched by the Thai Government to increase rubber yields. The Office of the Rubber Replanting Aid Fund was established to implement the replanting scheme by providing smallholders higher yield varieties of Hevea, modern production inputs, and monetary grants. Thailand's jump to being the largest world producer of rubber is largely attributed to this ambitious replanting regime that targeted 124,000 acres a year of rubber to be replanted in the 1970s and 1980s.

The processing, marketing, and distribution of rubber in Thailand can be characterized as primitive compared with those of Malaysia and Indonesia. After rubber is tapped by the smallholder, it will pass through on average four layers of middlemen before exportation with each of these steps adding costs, time, and confusion to the process. The rubber will often pass through village collectors (more than 10,000 in number, estimated), local dealers (6,000), provincial dealers (400), and finally to exporters (5 major) who make the final transaction in Thailand.[36] The processing of rubber occurs among these various intermediaries as well. Villagers and local dealers typically perform some drying and preliminary processing, while the majority of rubber processing occurs at the provincial level and above. The majority of natural rubber exported from Thailand is of the sheet type; this is in sharp contrast to the trend towards TSR in Malaysia and Indonesia. The visually graded sheet rubber is generally not used anymore by major tire producers in the United States and Europe, but is still used extensively in Japan. As a result, Japan accounts for approximately 40 percent of Thailand's rubber exports.

Indonesia

The natural rubber industry in Indonesia commenced around the same time as those in Malaysia and Thailand. Hevea was reportedly introduced by the Dutch and further developed by European and U.S. interests.[37] Most of the rubber produced in Indonesia is on the island of Sumatra (70 percent).[38] The other major areas of production are on the islands of Kalimantan and Java.

Indonesia, at one time, was the largest world producer of natural rubber, but disruptions caused by the Second World War and the subsequent political and economic instability took its toll on the industry. To combat this decline in Indonesia's rubber industry, the government began developing projects to increase the production of natural rubber in the late 1970s. The Project Management Unit and Nucleus Estate and Smallholder schemes were established to coordinate rubber replanting and to increase the planting of new rubber acreage for smallholders. The country is still reaping the benefits from these planting schemes.

[33] The Economist Intelligence Unit, *Rubber Trends*, (London), No. 113 (Mar. 1987), p. 30.
[34] Brian Caplen, "Plantations Under Siege," *Asian Business*, Oct. 1990, p. 54.
[35] Ibid.
[36] The Economist Intelligence Unit, *Rubber Trends*, (London), No. 121, (Mar. 1989), p. 47.
[37] The Economist Intelligence Unit, *Rubber Trends*, (Dec. 1989), p. 36.
[38] Ibid., p. 39.

During 1988-92, smallholder production increased 22 percent, while estate production declined by 13 percent. In 1991, Indonesia surpassed Malaysia to take the second position among world natural rubber producers.

U.S. TRADE MEASURES[39]

As shown in table 3, there are no duties applied to imports of natural rubber. For import and export purposes, natural rubber is classified by type and form. The major categories of classification include latex, smoked sheet, technically specified, and other natural gums. There are no known domestic nontariff import restrictions. No statutory investigations involving these products have been instituted during the past 5 years.

FOREIGN TRADE MEASURES

Imports of natural rubber by U.S. trading partners are generally duty-free for countries that do not produce natural rubber and are relatively high for countries that produce natural rubber. The tabulation at the bottom of the page lists the corresponding duty rates for major importing and exporting countries.[40]

U.S. MARKET

Consumption

Apparent U.S. consumption of natural rubber, in terms of value, is shown in table 4. The United States is the largest world consumer of natural rubber, with 1992 consumption reaching 911,000 mt. In 1992, other significant consumers of natural rubber were Japan (685,000 mt), China (610,000 mt) and India (405,000 mt).[41] In terms of volume, apparent U.S. consumption of natural rubber fluctuated irregularly during the past 5 years; consumption was lowest in 1988 (758,000 mt) and reached its highest level in 1992 (917,000 mt).

[39] See app. A for explanation of tariff and trade agreement terms.

[40] Information obtained from country tariff schedules and U.S. Department of Commerce.

[41] Rubber Statistical Bulletin, vol. 47, (Jan.) No. 4, pp. 17-19.

Imports

Imports are the sole source of natural rubber in the United States. During 1988-92, U.S. imports decreased steadily before increasing in 1992. Imports in 1992 were valued at $770 million, a 16-percent increase over the value of 1991 imports (table 5). In 1992, the United States relied on the three principal producing countries for the majority (94 percent) of its imports—Indonesia accounted for 61 percent, Thailand for 17 percent, and Malaysia for 16 percent. During the 5-year period, trade patterns among countries changed moderately—imports from Thailand grew by 36 percent, imports from Nigeria grew by more than 200 percent to $15.7 million, and imports from Malaysia decreased by 38 percent.

Trends in the composition of natural rubber imports are displayed in figure 5. The majority of imports were of the TSR 20 type. Other significant developments in the composition of trade include increased importation of some types of smoked sheet (grade 3 and other), and decreased importation of latex, and grade 2 smoked sheet. There are two main groups of U.S. importers of natural rubber: intermediaries (commodity wholesalers) and end users (tire manufacturers and rubber product manufacturers).

FOREIGN MARKETS

Foreign Market Profile

The United States traditionally has re-exported only a small percentage (less than 5 percent) of total imports of natural rubber and does not actively pursue foreign markets for this product.

U.S. Exports

During 1988-92, U.S. exports of natural rubber annually averaged $40 million. These exports constitute re-exports, since there is no domestic production. U.S. exports of natural rubber declined irregularly during the period from $50 million in 1988 to $31 million in 1992, or by 37 percent (table 6). The majority of these exports are believed to be intracompany transfers among multinational tire companies. Companies such as Goodyear, Bridgestone/Firestone, Michelin, and Continental/General Tire have tire production operations in

Nation/Area	Average rate of duty on natural rubber
Importing countries:	
Canada	Free; except on certain fabricated sheet
European Communities	Free
Japan	Free
Exporting countries:	
Indonesia	5 to 20 percent
Malaysia	Free to 35 percent
Thailand	Free to 50 percent

Table 3
Natural rubber: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1993; U.S. exports, 1992; and U.S. imports, 1992

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1993		U.S. exports, 1992	U.S. imports, 1992
		General	Special	*Million dollars*	
4001.10.00	Natural rubber latex, whether or not prevulcanized	Free		20	73
	Natural rubbber in other forms:				
4001.20.00	Smoked sheets	Free		1	169
4001.22.00	Technically specified natural rubber	Free		7	470
4001.29.00	Other	Free		3	54
4001.30.00	Balata, gutta-percha, guayule, chicle and similar natural gums	Free		(1)	4

[1] Less than $500,000.

Source: U.S. exports and imports compiled from official statistics of the U.S. Department of Commerce.

Table 4
Natural rubber: U.S. production, exports (reexports of imported natural rubber), imports for consumption, and apparent consumption, 1988-92

Year	U.S. Production[1]	U.S. Exports	U.S. Imports	Apparent U.S. consumption	Ratio of imports to consumption
	Million dollars				*Percent*
1988	0	50	1,025	975	105
1989	0	50	958	908	106
1990	0	33	707	674	105
1991	0	36	663	627	106
1992	0	31	770	739	104

[1] There is no commercial production of natural rubber in the United States.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5
Natural rubber: U.S. imports for consumption, by principal sources, 1988-92

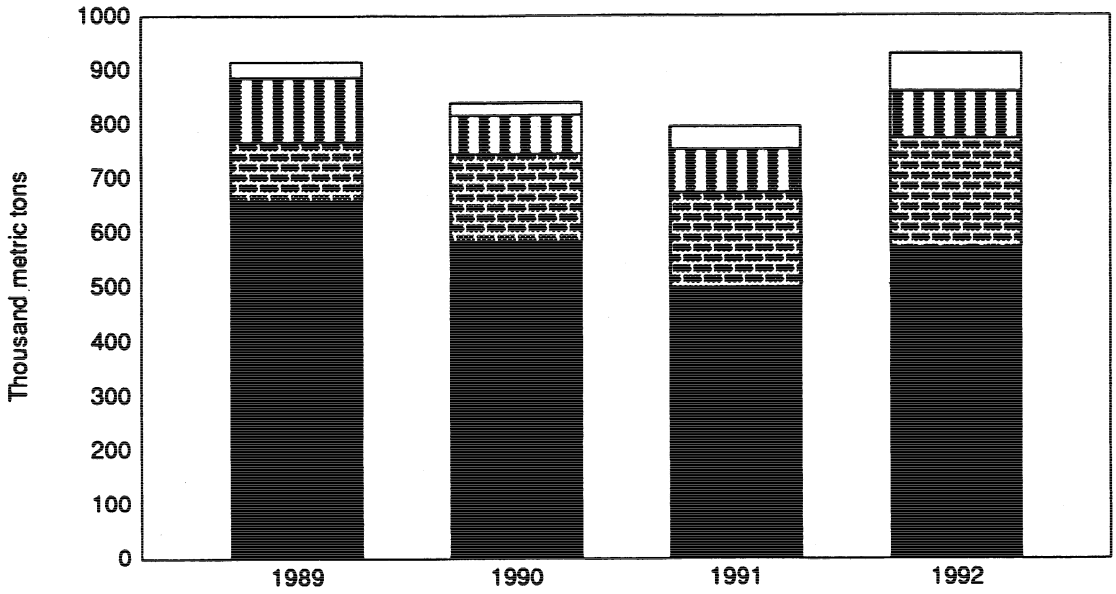
Source	1988	1989	1990	1991	1992
		Quantity *(1,000 kilograms)*			
Indonesia	(1)	569,386	519,582	504,349	569,461
Thailand	(1)	95,647	95,658	102,984	155,564
Malaysia	(1)	152,544	141,940	128,111	143,194
Nigeria	(1)	5,960	10,767	15,561	20,374
Liberia	(1)	55,350	36,740	9,398	14,259
Ivory Coast	(1)	5,620	5,582	7,122	7,559
Sri Lanka	(1)	7,712	9,393	5,585	5,845
Singapore	(1)	11,936	9,151	12,296	4,937
Philippines	(1)	3,859	4,260	3,429	3,568
Cameroon	(1)	2,236	2,318	1,899	2,332
All other	(1)	7,210	4,363	7,045	3,450
Total	780,035	917,460	839,754	797,779	930,543
		Value *(1,000 dollars)*			
Indonesia	(1)	541,721	422,107	400,411	467,393
Thailand	(1)	97,116	82,495	89,881	131,757
Malaysia	(1)	197,253	130,135	118,440	121,809
Nigeria	(1)	5,240	7,759	10,884	15,745
Liberia	(1)	68,461	26,358	6,289	9,341
Ivory Coast	(1)	5,525	4,721	6,684	5,549
Sri Lanka	(1)	8,808	8,529	4,918	5,335
Singapore	(1)	15,949	12,968	13,919	4,164
Philippines	(1)	3,322	3,213	2,713	2,803
Cameroon	(1)	2,033	1,897	1,749	1,903
All other	(1)	12,307	6,886	7,360	4,245
Total	1,024,868	957,735	707,068	663,248	770,045
		Unit value *(dollars per kilogram)*			
Indonesia	(1)	0.95	0.81	0.79	0.82
Thailand	(1)	1.02	0.86	0.87	0.85
Malaysia	(1)	1.29	0.92	0.92	0.85
Nigeria	(1)	0.88	0.72	0.70	0.77
Liberia	(1)	1.24	0.72	0.67	0.66
Ivory Coast	(1)	0.98	0.85	0.94	0.73
Sri Lanka	(1)	1.14	0.91	0.88	0.91
Singapore	(1)	1.34	1.42	1.13	0.84
Philippines	(1)	0.86	0.75	0.79	0.79
Cameroon	(1)	0.91	0.82	0.92	0.82
All other	(1)	1.71	1.58	1.04	1.23
Average	1.31	1.04	0.84	0.83	0.83

[1] Country-level detail is provided only for years in which there are actual trade data under the Harmonized Tariff Schedule of the United States (HTS).

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Figure 5
Natural rubber: Comparison of U.S. import, 1989-92



	1989	1990	1991	1992
Other	29	23	43	69
Latex	120	72	79	87
Smoked sheets	108	161	174	200
Tech. specified	660	585	501	574

Source: Compiled from official statistics of the U.S. Department of Commerce.

neighboring countries—Canada, Mexico, and other Central and South American countries. Most U.S. exports of natural rubber during the period went to Canada, Mexico, and Italy.

U.S. TRADE BALANCE

The United States experienced a $785 million average annual trade deficit for natural rubber during 1988-92. As shown in figure 6, the U.S. trade balance during this period decreased from $975 million in 1988, to $739 million in 1992. This decrease of the trade deficit can be attributed to decreasing imports because of lower production levels of end-use rubber products such as tires and other rubber goods.

Table 6
Natural rubber: U.S. exports of domestic merchandise, by principal markets, 1988-92[1]

Market	1988	1989	1990	1991	1992
			Quantity *(1,000 kilograms)*		
Mexico	(2)	1,945	2,281	5,090	3,781
Italy	(2)	1,161	910	773	1,077
Canada	(2)	22,668	5,153	4,494	3,384
Spain	(2)	52	58	152	381
Argentina	(2)	164	76	504	642
Hong Kong	(2)	70	100	196	277
Chile	(2)	276	189	612	136
Venezuela	(2)	10,034	4,658	4,209	684
Japan	(2)	284	716	715	727
Germany	(2)	207	266	409	181
All other	(2)	2,967	2,870	3,210	1,810
Total	21,852	39,828	17,277	20,364	13,080
			Value *(1,000 dollars)*		
Mexico	(2)	2,892	2,850	7,444	7,908
Italy	(2)	4,509	4,517	3,468	5,045
Canada	(2)	15,856	7,461	5,873	4,712
Spain	(2)	383	267	850	2,225
Argentina	(2)	561	222	1,773	1,701
Hong Kong	(2)	526	617	1,114	1,510
Chile	(2)	805	544	1,205	1,019
Venezuela	(2)	16,067	6,890	5,154	888
Japan	(2)	596	1,293	732	1,005
Germany	(2)	322	348	661	799
All other	(2)	7,849	8,297	7,927	4,508
Total	49,690	50,366	33,306	36,201	31,320
			Unit value *(dollars per kilogram)*		
Mexico	(2)	1.49	1.25	1.46	2.09
Italy	(2)	3.88	4.96	4.49	4.68
Canada	(2)	0.70	1.45	1.31	1.39
Spain	(2)	7.37	4.60	5.59	5.84
Argentina	(2)	3.42	2.92	3.52	2.65
Hong Kong	(2)	7.51	6.17	5.68	5.45
Chile	(2)	2.92	2.88	1.97	7.49
Venezuela	(2)	1.60	1.48	1.22	1.30
Japan	(2)	2.10	1.81	1.02	1.38
Germany	(2)	1.46	1.03	1.26	4.41
All other	(2)	2.66	2.96	2.56	2.49
Average	2.27	1.26	1.93	1.78	2.39

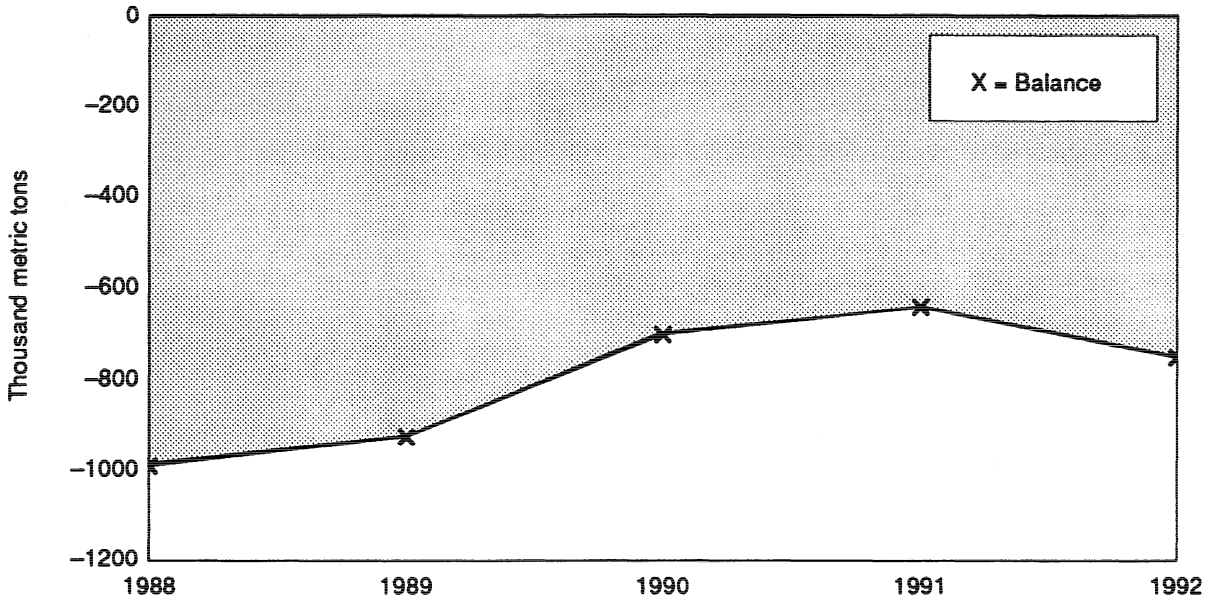
[1] U.S. trade with East Germany is included in "Germany".

[2] Country-level detail is provided only for years in which there are actual trade data under the the new Schedule B (based on the Harmonizeed Tariff Schedule of the United States).

Note.—Because of rounding, figures may not add to the totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Figure 6
U.S. trade balance: Natural rubber, 1988-92



Source: Compiled from official statistics of the U.S. Department of Commerce.

APPENDIX A
EXPLANATION OF TARIFF AND TRADE AGREEMENT TERMS

APPENDIX A
TARIFF AND TRADE AGREEMENT TERMS

The ***Harmonized Tariff Schedule of the United States*** (HTS) replaced the *Tariff Schedules of the United States* (TSUS) effective January 1, 1989. Chapters 1 through 97 are based upon the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description, with additional U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classification provisions and temporary rate provisions, respectively.

Rates of duty in the ***general*** subcolumn of HTS column 1 are most-favored-nation (MFN) rates; for the most part, they represent the final concession rate from the Tokyo Round of Multilateral Trade Negotiations. Column 1-general duty rates are applicable to imported goods from all nonembargoed countries except those enumerated in general note 3(b) to the HTS plus Serbia and Montenegro, whose products are dutied at the rates set forth in ***column 2***. Goods from Albania, Armenia, Belarus, Bulgaria, the People's Republic of China, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Turkmenistan, Ukraine, and Uzbekistan are currently eligible for MFN treatment, as are the other republics of the former Socialist Federal Republic of Yugoslavia. Among articles dutiable at column 1-general rates, particular products of enumerated countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs. Such tariff treatment is set forth in the **special** subcolumn of HTS column 1. Where eligibility for special tariff treatment is not claimed or established, goods are dutiable at column 1-general rates.

The ***Generalized System of Preferences*** (GSP) affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974 and renewed in the Trade and Tariff Act of 1984, applies to merchandise imported on or after January 1, 1976 and before September 30, 1994. Indicated by the symbol "A" or "A*" in the special subcolumn of column 1, the GSP provides duty-free entry to eligible articles the product of and imported directly from designated beneficiary developing countries, as set forth in general note 4 to the HTS.

The ***Caribbean Basin Economic Recovery Act*** (CBERA) affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67, implemented by Presidential Proclamation 5133 of November 30, 1983, and amended by the Customs and Trade Act of 1990, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; this tariff preference program has no expiration date. Indicated by the symbol "E" or "E*" in the special subcolumn of column 1, the CBERA provides duty-free entry to eligible articles, and reduced-duty treatment to certain other articles, which are the product of and imported directly from designated countries, as set forth in general note 7 to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "IL" are applicable to products of Israel under the ***United States-Israel Free Trade Area Implementation Act*** of 1985 (IFTA), as provided in general note 8 to the HTS. Where no rate of duty is provided for products of Israel in the special subcolumn for a particular provision, the rate of duty in the general subcolumn of column 1 applies.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn of column 1 followed by the symbol "J" or "J*" in parentheses is afforded to eligible articles the product of designated beneficiary countries under the ***Andean Trade Preference Act*** (ATPA), enacted in title II of Public Law 102-182 and implemented by Presidential Proclamation 6455 of July 2, 1992 (effective July 22, 1992), as set forth in general note 11 to the HTS.

Preferential rates of duty in the special subcolumn of column 1 followed by the symbol "CA" are applicable to eligible goods of Canada, and those followed by the symbol "MX" are applicable to eligible goods of Mexico, under the **North American Free Trade Agreement**, as provided in general note 12 to the HTS, effective January 1, 1994.

Other special tariff treatment applies to particular ***products of insular possessions*** (general note 3(a)(iv)), goods covered by the ***Automotive Products Trade Act*** (APTA) (general note 5) and the ***Agreement on Trade in Civil Aircraft*** (ATCA) (general note 6), and ***articles imported from freely associated states*** (general note 10).

The ***General Agreement on Tariffs and Trade*** (GATT) (61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786) is a multilateral agreement setting forth basic principles governing international trade among its signatories. The GATT's main obligations relate to most-favored-nation treatment, the maintenance of scheduled concession rates of duty, and national (nondiscriminatory) treatment for imported products; the GATT also provides the legal framework for customs valuation standards, "escape clause" (emergency) actions, antidumping and countervailing duties, and other measures. Results of GATT-sponsored multilateral tariff negotiations are set forth by way of separate schedules of concessions for each participating contracting party, with the U.S. schedule designated as Schedule XX.

Officially known as "The Arrangement Regarding International Trade in Textiles," the ***Multifiber Arrangement*** (MFA) provides a framework for the negotiation of bilateral agreements between importing and producing countries, or for unilateral action by importing countries in the absence of an agreement. These bilateral agreements establish quantitative limits on imports of textiles and apparel, of cotton and other vegetable fibers, wool, man-made fibers and silk blends, in order to prevent market disruption in the importing countries—restrictions that would otherwise be a departure from GATT provisions. The United States has bilateral agreements with many supplying countries, including the four largest suppliers: China, Hong Kong, the Republic of Korea, and Taiwan.