Economic Analysis of the Rubber Tire Manufacturing MACT

Final Report

Prepared for

Lillian G. Bradley
U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Innovative Strategies and Economics Group (ISEG)
(MD-15)
Research Triangle Park, NC 27711

Prepared by

Subhrendu K. Pattanayak
Brooks M. Depro
Tayler H. Bingham
Research Triangle Institute
Center for Economics Research
Research Triangle Park, NC 27709

with input from Abt Associates

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This report contains portions of the economic impact analysis report that are related to the industry profile.

SECTION 2

INDUSTRY PROFILE[1]

2.1 Background

The rubber tire manufacturing industry is the subject of a New Source Performance Standard (NSPS) published in 40 CFR Part 60 Subpart BBB, and promulgated on September 15, 1987. EPA is in the process of developing a regulation that would establish limits on the HAPs emitted from the rubber tire manufacturing process. These emission limits reflect the MACT. This section presents an industry profile developed to support an EIA for the rubber tire manufacturing industry MACT rule.

Industry profiles provide a general understanding of the affected industry and a basis for the EIA. This profile contains information, gathered from various sources, on key characteristics that are crucial to understanding the rubber tire manufacturing industry. This section describes the source category, environmental concerns associated with the manufacturing process, and the industry's current situation.

Section 2.2 focuses on the producers of rubber tires, the production process for rubber tires, and the costs associated with rubber tire production. Section 2.3 describes consumers of rubber tires and the product characteristics they value. Section 2.4 presents the organization of the industry by using information both at the industry and facility levels. Section 2.4 also contains information on the specific facilities identified in the presumptive maximum control technology (P-MACT) document. The market for rubber tires is described in Section 2.5. This section includes information on market volumes and prices, production and consumption, international trade, and future projections for the industry.

2.1.1 Category Description

The rubber tire manufacturing source category includes any rubber tire manufacturing facility, or any facility that manufactures rubber tire components directly associated with rubber tire production, that is a major source or is located at a major source

[1]This industry profile was prepared by Abt Associates in April 1999.

facility site. The tires can be solid or pneumatic (filled with air) and made with natural or synthetic rubber. Component facilities can include facilities that produce rubber compound that is used in making rubber tires at another manufacturing facility. A major source is defined as any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit, considering controls, in the aggregate, 10 tons per year of any HAP or 25 tons per year of any combination of HAPs. The primary product of the industry is rubber tires of any size or shape.

The primary Standard Industrial Classification (SIC) code associated with the rubber tire manufacturing industry is 3011. This category includes establishments primarily engaged in manufacturing: pneumatic casings, inner tubes, and solid and cushion tires for all types of vehicles, airplanes, farm equipment, and children's vehicles; tiring; camelback; and tire repair and retreading materials. Establishments primarily engaged in retreading tire services are classified in a different industry. The MACT rule is currently focused on tire manufacturing facilities. As a result, much of the information from this profile reflects this focus. Some data are presented for the entire 3011 SIC category, and other data deal specifically with tire manufacturing facilities, particularly those facilities identified in the draft P-MACT. The coverage of different data sources is noted throughout the profile.

Facilities manufacturing three components of tires are also potentially affected by the MACT regulation. These facilities produce tire cord, inner tubes, and retreading materials. Tire manufacturing companies might have their own tire cord or inner tube manufacturing facilities or may purchase cord or tubes from another company that makes only tire cord or inner tubes. It is estimated that approximately 90 percent of tire cord produced is from facilities owned by tire manufacturing companies (EPA, 1998). EPA has not yet determined whether tire cord or inner tube manufacturing are significant sources of HAPs.

Retread facilities are believed to operate in much the same way as tire manufacturing facilities and are believed to be major sources of HAPs. There are two types of retread facilities: those that make only tread and those that put the tread around a re-ground tire carcass. The facilities that put tread around a re-ground tire carcass are smaller facilities. The Rubber Manufacturers Association (RMA) believes that these facilities are not likely to be major sources (EPA, 1998).

2.1.2 Environmental Concerns

In any type of rubber product manufacturing (including tires), the primary environmental concerns are fugitive air emissions, solid wastes, wastewater, and hazardous

wastes. Fugitive air emissions can be released from the compounding areas, where dry chemicals are weighed and put into containers prior to mixing. Most facilities have eliminated this problem, however, by purchasing their chemicals in small, pre-weighed, sealed polyethylene bags. Emissions are also generated from the rubber compounds themselves and from solvents that are added for cement, inks, and lubrication (EPA, 1995).

Several other environmental concerns are also associated with rubber product manufacturing facilities. Solid waste is generated from the mixing, milling, calendering, and extruding processes. Most of this solid waste is recycled or sold to companies who use the rubber for some other type of product. Waste water is generated from the cooling, heating, vulcanizing, and cleaning operations (EPA, 1995).

Two kinds of HAP emissions from rubber product manufacturing are the subject of the MACT standard: particulate matter hazardous air pollutants (PMHAPs) and volatile organic hazardous air pollutants (VOHAPs). PMHAPS result mainly from the production processes of mixing, milling, and grinding. VOHAPs are emitted when the mixing and milling of rubber compounds generate heat, when solvents and cementing liquids are incorporated on components for tire building, and when solvents are used in lubricating the uncured (green) tire (EPA, 1998).

2.1.3 Current Industry Status

The mid- to late 1980s were difficult times for the world tire industry. Tire manufacturers faced declining demand for new cars, declining tire prices, a record high U.S. currency, and record high tire imports. As a response to this market distress, the industry went through a period of significant restructuring and consolidation. Foreign firms bought out several American firms, leaving the world tire industry with nine ultimate parent companies that have annual sales in excess of $1 billion each. These nine companies account for 80 percent of world tire sales (Ita and Gross, 1995). Four of the nine companies have their headquarters in Japan (Bridgestone Corporation, Sumitomo Rubber Industries Ltd., Yokohama Rubber Co. Ltd., and Toyo Tire and Rubber Co. Ltd.), three are based in Europe (Groupe Michelin, Continental A.G., and Pirelli), and two are headquartered in the United States (Goodyear and Cooper).

Despite the extensive merger and consolidation activity triggered by the difficult market conditions in the late 1980s, the industry continued to experience economic pressures into the 1990s. In the mid-1990s, raw material prices were increasing, plants were closing, and companies were competing in price wars. In more recent years, some of the economic

pressures on domestic producers have declined. While labor relations remain a problem for the industry, sales and profitability are improving in both North America and Western Europe. Tire companies are striving to control costs without raising prices by increasing output per man-hour worked. This trend, coupled with a decline in tire industry real wages of 0.7 percent in the last decade (Walters, 1995), prompted strikes at several plants. The labor unrest can be seen in the strike of the Continental General Tire plant in Charlotte, NC, in November 1998 and the strike at Titan Tire in Des Moines, IA (Rubberworld, 1999; Titan International, 1999).

2.2 The Supply Side

The process of manufacturing rubber tires is complex and capital intensive. As a result, facilities that produce rubber tires tend to be specialized and produce only tires. Facilities generally specialize both by the tire product (e.g., passenger car, light truck) and the type of tire (bias or radial) produced. This section describes the process used by tire manufacturers to produce tires and the costs associated with this production process. Also described are the products, by-products, and co-products produced by rubber tire manufacturers.

2.2.1 Production Process[2]

The rubber tire manufacturing process consists of 11 steps:

1. **Mixing** involves weighing and combining various ingredients (natural and synthetic rubbers, oil, carbon black, zinc oxide, sulfur, and other chemicals) to create a homogenous rubber compound that is discharged to a drop mill.

2. **Milling** creates warm malleable sheets that are cooled and coated with an "anti-tack solution." These sheets are then fed into an extruder.

3. **Extruding** forces the rubber compound through a shaped slot called a die that forms the compound into various shapes.

4. **Calendering** involves coating fibers of cloth or steel with a rubber compound, and then curing it in an irradiation oven that bevel cuts it to a desired length, width, and angle.

5. **Bead making** involves the creation of beads that provide a proper seal between the tire and the wheel rim when a tire is mounted on the rim and inflated. In the

[2]The description here relies heavily on the production process presented in the P-MACT.

bead building process, bundles of wire are passed through an extrusion die where a coat of rubber is added, and the wires are then wound into a hoop.

6. **Cementing and marking** processes are used at various stages throughout the tire building process. **Cements** (adhesives or solvents) are added to improve the adhesion of different components to each other throughout the process. Cement usage can vary significantly among facilities depending on the type of tire being manufactured and the process being used. **Marking inks** are used to aid in identifying the components being managed. Typically they are applied to extruded tread stocks to aid in identifying and handling cured tires. Marking practices can also vary significantly among facilities.

7. The various tire components go through **cooling** and **culture** prior to tire building. From the milling and extruding operations, the rubber sheets are placed onto long conveyor belts that, through the application of cool air or cool water, lowers their temperature.

8. The two main components of the **tire-building** process are the tire carcass build-up drum and the tread application drum. These drum machines assemble the cut carcass plies and belts plus the extruded tread, sidewall, and beads into tires. The process begins with the application of a thin layer of rubber compound, the inner liner, to the innermost carcass ply. The carcass plies are placed on the drum one at a time, after which the beads are set in place and the plies (reinforcing layers of cord and rubber) are turned up around them. At this stage the belts and tread rubber are added.

9. **Lubricating** involves preparing the uncured (green) tire for curing. The green tire may be coated with a lubricant (green tire spray). The function of the green tire spray is to ensure the cured tire does not stick to the curing mold during extraction of the tire after curing.

10. **Curing** involves collapsing the drum and loading the green tire into an automatic tire press to be cured (vulcanized) at high temperature and pressure. The vulcanization process converts the rubber and also bonds the various parts of the tire into a singular unit.

11. **Tire finishing** may involve some of the following processes: trimming, white sidewall grinding, buffing, balancing, blemish painting, whitewall/raised letter protectant painting, and quality control inspections. Some facilities also apply a puncture sealant during production.

2.2.2 Major By-products and Co-products

There are generally no by-products or co-products associated with rubber tire manufacturing. The Census of Manufactures calculates a primary products specialization ratio on an industry-wide basis. For SIC 3011, this ratio is 98, which represents a highly specialized industry at the manufacturing level. The primary products specialization ratio is the primary products' value of shipments divided by the sum of the primary products' value of shipments plus secondary products' value of shipments (U.S. Department of Commerce, 1992).

A 1996 survey of tire manufacturing facilities conducted by the RMA asked respondents to identify what type of tires they produce and what percentage of their production is accounted for by tire production. Most facilities surveyed responded that they only produce tires. A few facilities listed a percentage of their production as "Other." However, the percentage was so small that it is of no economic significance.

2.2.3 Types of Products and Services

Tires are distinguished by end use, type of construction, and performance characteristics (EPA, 1998). Tires are produced for

- passenger cars;
- light, medium, and heavy duty trucks;
- cycles/motorcycles;
- go-carts;
- racing cars;
- industrial rolling stock;
- buses;
- off-the-road and all-terrain vehicles;
- aircraft;
- graders/earthmovers/loaders;
- mining/logging equipment;
- high performance or speed-rated tires for passenger cars; and

- agricultural and forestry equipment.

There are also different types of tire construction. Bias-ply constructed tires use plies that run diagonally from one bead to the other. One ply is set on a bias in one direction, and succeeding plies are set alternately in opposing directions crossing each other. Radial constructed tires use plies that run radially from bead to bead under the tread. This construction requires a belt to stabilize the tread and define the tire diameter (dunloptire.com). Radial tire construction and tread design permit more tread contact with the road surface during hard cornering for a safer ride and also provide less forward rolling resistance, thereby improving fuel economy. Most tire production in the United States is now of radial-ply construction: virtually all car tires (with the exception of the temporary spare) and more than 80 percent of truck and bus tires are of radial-ply construction. More than 90 percent of tractor and farm implement tires as well as automobile temporary spares are of bias-ply construction. Section 2.5 contains an in-depth description of the U.S. tire market.

2.2.4 Costs of Production

Table 2-1 presents 1996 annual production cost information from the Annual Survey of Manufactures for all establishments in SIC 3011 (U.S. Department of Commerce, 1996). The table breaks down the costs of production into capital expenditures, raw material costs, labor costs, electricity costs, and fuel costs. The cost of production combining all of these inputs totals approximately $10.1 billion, which is 71 percent of the value of shipments for 1996. The largest input to the cost of production is raw materials, as shown in Table 2-1. Table 2-2 lists the raw materials.

There are certain input substitutions for the production process available to tire manufacturing. The clearest input substitution is to use synthetic rubber instead of natural rubber. Many manufacturers now use synthetic rubber in addition to natural rubber. Synthetic rubber has not completely replaced natural rubber, however, because natural

Table 2-1. Annual Production Costs, 1996

Category	Costs of Production (10^3)	Percentage of Total Production Cost	Percentage of Value of Shipments
Capital expenditures	578,500	5.7	4.1
Raw material costs	7,091,400	70.3	49.9
Labor costs	2,140,400	21.2	15.1
Electricity costs	191,300	1.9	1.3
Fuel costs	86,000	0.9	0.6
Total	$10,087,600	100	71

Source: U.S. Department of Commerce. 1985-1996. *Annual Survey of Manufactures, Statistics for Industry Groups and Industries*. Tables 2 and 4. Washington, DC: Government Printing Office.

Table 2-2. Raw Material Consumed By Kind[a]

Latex and dry natural rubber	Reclaimed rubber
Inorganic pigments	Rubber compounds and mixtures purchased
Plastic resins consumed in the form of granules, pellets, powders, liquids, etc.	All other fabricated rubber products
Synthetic rubber	Nylon, polyester, and metallic tire cord
Rubber processing chemicals	Polyester tire cord
Plasticizers	Fabricated metal products
Carbon Black	Castings
Other chemical and allied products	Forgings
Steel wire	Paper and paperboard containers
Nonferrous shapes and forms	

[a] Data on value of materials consumed not available in consistent reporting terms.

Source: U.S. Department of Commerce. 1992. *Census of Manufactures—Rubber Products: Industry Series*. Table 7. Washington, DC: Government Printing Office.

rubber is a necessary input in the production of radial tires (RMA, 1997). Whether to use cement and how much to use is another substitution possibility. The cement can be

reformulated or eliminated altogether, reducing or eliminating the HAPs associated with its use (EPA, 1998).

2.3 The Demand Side

This section describes the characteristics of tires, the major uses and consumers of tires, and the substitution possibilities that exist for tires. This information supports analysis of the demand for tires in the economic analysis.

2.3.1 Product Characteristics

In 1975, tire demand began to switch significantly from bias-ply tires to radial tires. This switch is now almost complete in the passenger tire market and nearing completion in the light truck market. Nearly all passenger car tires and more than 80 percent of highway truck tires are radials. Radial tires have a longer life than bias-ply tires, and the switch to radials has been a factor in reducing growth in domestic demand for replacement tires.

Using industry standards, tire performance is rated on qualities such as speed, tread wear, traction, and temperature grade. For tires within the same category that have similar ratings, there is little product differentiation between tire producers; thus, price is the main distinguishing characteristic for consumers of tires within the same category of tires.

There has been continuing improvement in tire technology and tire performance over time. Tread longevity, reduced rolling resistance, improved handling, durability, and safety are key characteristics consumers value in tires. Typical warranties on tires have increased to 80,000 miles from 20,000 miles just a few decades ago. The newest attribute that attracts customers is the run-flat tire. This type of tire can continue to operate safely with a flat for up to 200 miles. Most manufacturers have already introduced this product line. Goodyear and Michelin lead the development and Continental is set to launch its line soon.

2.3.2 Uses and Consumers

There are two distinct markets for tires: the original equipment market and the replacement tire market. Original equipment (OE) tires are the tires that come as equipment on a new vehicle. The initial purchasers of OE tires are vehicle manufacturers. Replacement tires are sold to vehicle owners through tire dealerships, chain stores, service stations, department stores, and warehouse and discount clubs. The tires sold in the two markets are generally the same.

Brand loyalty is exhibited by car owners who often replace tires on their cars with the same brand as originally installed. As a result, tire manufacturers strive to obtain original equipment contracts. Original equipment contracts are also attractive to tire companies because they save on distribution expenses and advertising costs (Standard & Poor's, 1998).

The two separate markets, original equipment and replacement tire, are expected to have somewhat distinct demand functions.[3] Estimated demand functions for tires have not been identified. Generally, it is expected that both markets have inelastic demand functions overall. For example, every new car and light truck require four tires and a spare tire, and there are no substitutes for this standard equipment. Tires also make up an insignificant portion of the cost of a new automobile or light truck. Market volumes for original equipment tires are closely tied to the demand for new automobiles and light trucks, and the demand for new automobiles tends to follow the general economic cycle of the United States. For these reasons, the overall demand for tires is expected to be relatively inelastic with respect to price. The new run-flat tires could eventually eliminate temporary spare tires, a component of the original equipment market.

The overall market demand for replacement tires is also relatively inelastic, because tire replacement is not an option that can be deferred for long, particularly when a tire is damaged. Further, the cost of replacement tires makes up a small percentage of the operating cost of a car. Market volumes for replacement tires are closely related to tread wear and vehicle miles driven. Technological improvements in durability and life have decreased the overall rate at which replacement tires are being purchased.

While we expect inelastic demand for tires at the market level, individual producers' ability to raise prices without losing market share is limited by competition among tires with similar characteristics. Some flexibility in pricing may be allowed by brand loyalty, but producers are not likely to be able to deviate much from the competitive price without losing sales. Section 2.5 presents detailed information on market volumes for the different types of tires.

2.3.3 Consumer Substitution Possibilities

Although there are no real substitutes for tires, consumers have choices with respect to replacement tires that can affect the demand for specific types of replacement tires. They

[3]Because passenger car and light truck tires typically account for about 90 percent of total tire sales, the discussion of demand is focused primarily on information about these two types of tires.

can choose to purchase new tires or used tires, have their tires retreaded, or purchase high-performance tires. At this level, the demand for a specific type of tire is probably elastic and more dependent on price. Specifically, higher prices for new replacement tires may lead some consumers to postpone replacing worn tires or to purchase used or retreaded tires.

Vehicle manufacturers and consumers of replacement tires have several options as to the type of tire they put on a vehicle. They can choose from different qualities of tires, including high-performance and speed-rated tires, and they can also choose among different brands.

High-performance and speed-rated tires have been increasing in popularity recently. These premium-priced tires, which produce wider profit margins for tire companies, now account for 36 percent of all original equipment passenger car tires and about 34 percent of all replacement passenger car tires. Although these premium tires are of radial design, they tend to wear out much faster than conventional radials and thus increase the frequency at which tires are replaced (Standard & Poor's, 1998). This change in consumers' preferences contributes to the demand for replacement tires.

2.4 Facilities and Ownership

This section describes the manufacturing plants that were identified in the draft P-MACT, including the capacity utilization and employment of these facilities, trends for the overall industry, characteristics of the firms that own the facilities potentially affected by the regulation, and information on vertical and horizontal integration in the industry.

2.4.1 Manufacturing Plants

The entire domestic rubber tire industry, including all establishments in SIC 3011, is composed of 104 companies owning 152 establishments (U.S. Department of Commerce, 1992) and employing 64,800 people (U.S. Department of Commerce, 1996). The draft P-MACT identifies 14 companies and 43 facilities that manufacture tires.[4] Figure 2-1 shows

[4] *Rubber and Plastics News* (1998) identifies 16 companies operating 53 tire manufacturing facilities in the United States. Most of these ten additional facilities are very small or have very recently begun operations.

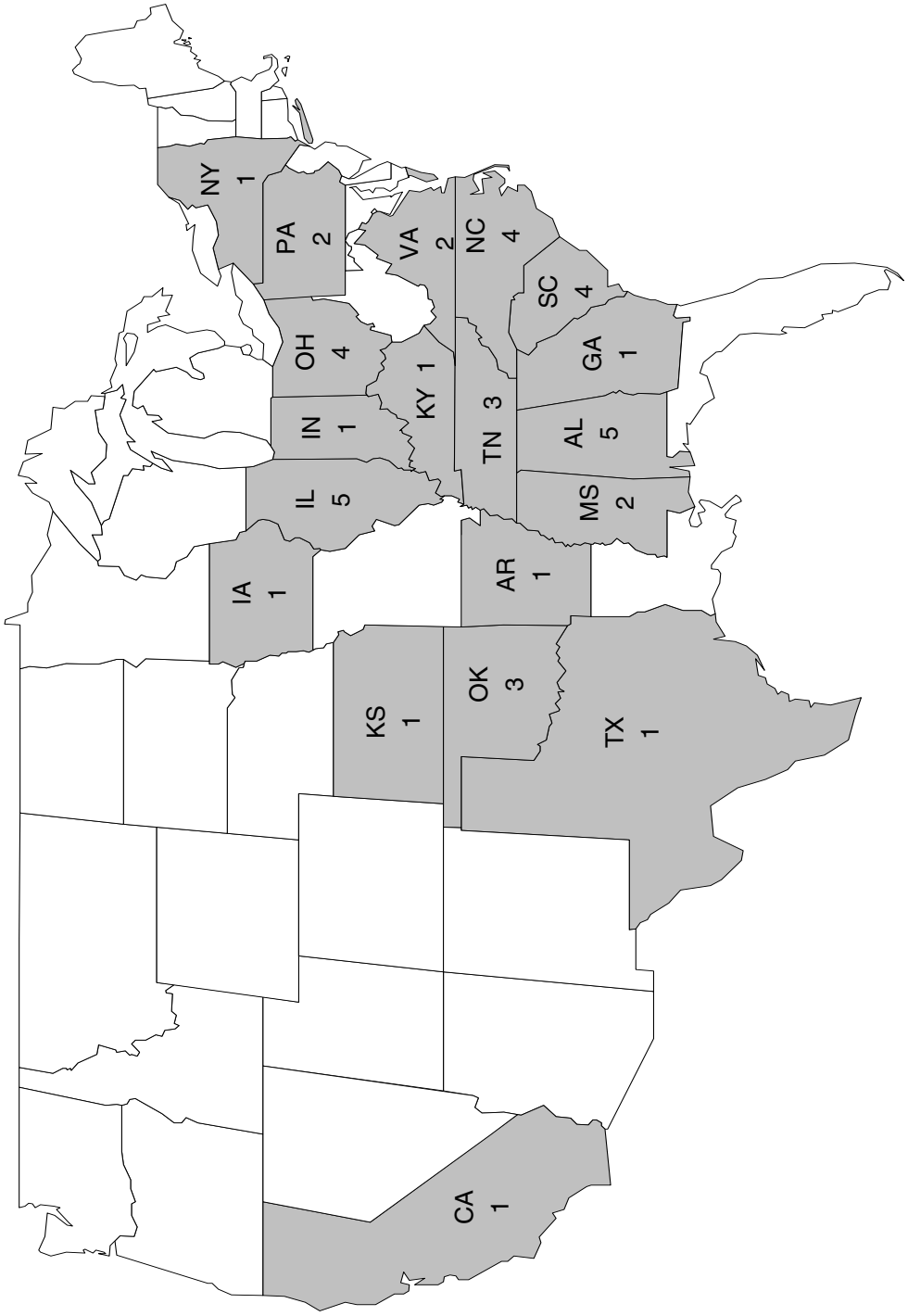

Figure 2-1. Rubber Tire Plants in the United States, 1998

Source: U.S. Environmental Protection Agency (EPA). June 1998. *Draft Presumptive Maximum Achievable Control Technology (P-MACT) for the Rubber Tire Manufacturing Source Category*.

the distribution of these facilities throughout the United States. The facilities identified in the draft P-MACT are found in 19 states. Twenty-two of the 43 identified facilities are located in Alabama, Illinois, North Carolina, South Carolina, and Ohio.

2.4.1.1 Tire Manufacturing Facilities

The group of tire manufacturing facilities examined in this profile consists of 43 manufacturing facilities owned by 14 companies. The MACT regulation will affect only those U.S. facilities that are major sources. Table 2-3 lists the rubber tire manufacturing facilities that the regulation will potentially affect, their location, the year they opened, their employment, the type of tire they produce, and their estimated capacity. The average age of the tire manufacturing facilities identified in the draft P-MACT is 35 years (*Rubber and Plastics News*, 1998).

2.4.1.2 Capacity Utilization

The measure of capacity utilization is based on output, measured in tires per year. *Rubber and Plastics News* reported the total U.S. industry is currently capable of producing 961,780 tires per day.[5] Annually, this amounts to a capacity of 344.3 million units, assuming the facilities are open for 51 weeks a year. The RMA reported 1997 total domestic production for its membership as 286.4 million tires. Because the RMA membership represents 90 percent of the total domestic shipments, EPA inflated the number of tires members of the RMA produce to provide an industry total. The estimate of total domestic production is 318.2 million units per year. EPA derived capacity utilization for the entire domestic tire industry by dividing the estimate for actual production of 318.2 million tires by total production capacity 344.3 million, or 96 percent.

2.4.1.3 Manufacturing Facility Employment

Rubber and Plastic News reports the total employment of all U.S. tire manufacturers as 59,700. Assuming the firms are using the same reporting basis, the facilities identified in the draft P-MACT account for 56,352 of these employees, or 94 percent of total industry employment. Table 2-3 shows the number of employees at each of the tire manufacturing facilities identified in the draft P-MACT.

[5]This figure is missing data for five facilities.

Table 2-3. U.S. Tire Manufacturing Facilities Identified in Draft P-MACT

Company Name	Facility Location	Year Facility Opened	Employment	Tire Type	Estimated Capacity (units/day)
Bridgestone/ Firestone	Decatur, IL	1963	2,100	Passenger, light truck	24,000
	La Vergne, TN	1972	1,800	Passenger, light truck, truck	18,500
	Warren County, TN	1990	885	Truck, bus	5,500
	Wilson, NC	1974	2,140	Passenger, light truck	41,000
	Oklahoma City, OK	1969	2,050	Passenger, light truck	43,500
	Des Moines, IA	1945	1,777	Passenger, truck, bus, large OTR	12,100
	Bloomington, IL	1965	525	Large OTR	300
Carlisle	Carlisle, PA	1917	735	Light truck, industrial	22,000
Continental/ General Tire	Bryan, OH	1966	350	Farm, large OTR, industrial	300
	Charlotte, NC	1967	1,848	Passenger	29,000
	Mount Vernon, IL[a]	1991	431	Truck, bus	2,700
	Mayfield, KY	1960	350	Passenger, truck, bus, farm	5,000
Cooper Tire and Rubber	Albany, GA	1991	900	Passenger, light truck, truck, bus	22,000
	Findlay, OH	1919	1,000	Passenger, light truck, truck, bus	25,000
	Texarkana, AR	1964	1,250	Passenger, light truck	39,000
	Tupelo, MS	1984	1,100	Passenger	40,000
Denman Tire	Leavittsburg, OH	1919	340	Passenger, light truck, truck, bus, farm, large OTR, industrial, racing	2,600
Dunlop Tire	Buffalo, NY	1923	1,000	Passenger, light truck, truck, bus, motorcycle	10,700
	Huntsville, AL	1969	1,640	Passenger, light truck	27,000
Fidelity	Natchez, MS	1986	200	Passenger, light truck, truck, bus, farm	10,000
Goodyear Tire	Akron, OH	1983	600	Racing	2,000
	Topeka, KS	1944	2,000	Truck, bus, farm, large OTR	8,100
	Danville, VA	1966	2,300	Truck, bus, aircraft	13,000
	Gadsden, AL[b]	1929	2,300	Passenger, light truck	33,000
	Lawton, OK	1978	2,300	Passenger	63,000
	Union City, TN	1968	3,000	Passenger, light truck	55,000
Kelly-Springfield Tire (a subsidiary of Goodyear Tire)	Fayetteville, NC	1969	2,900	Passenger, light truck	64,000
	Freeport, IL	1964	1,700	Passenger	30,000
	Tyler, TX	1962	1,500	Passenger	37,500

(continued)

Table 2-3. U.S. Tire Manufacturing Facilities Identified in Draft P-MACT (continued)

Company Name	Facility Location	Year Facility Opened	Employment	Tire Type	Estimated Capacity (units/day)
Michelin	Greenville, SC	1975	2,000	Passenger	23,000
	Anderson, SC Lexington, SC	1997	400	Large OTR	NA
	Spartanburg, SC	1978	1,400	Truck, bus	6,000
	Dothan, AL	1979	600	Light truck	5,500
	Lexington, SC	1981	1,300	Passenger	20,000
	Norwood, NC	1987	500	Aircraft	640
Michelin[c]	Ardmore, OK	1969	1,700	Passenger, light truck	33,000
	Fort Wayne, IN	1961	1,500	Passenger, light truck	29,000
	Opelika, AL	1963	1,450	Passenger, light truck	20,400
	Tuscaloosa, AL	1945	1,900	Passenger, light truck	23,700
Pirelli Tire	Hanford, CA	1962	630	Passenger, light truck	12,000
Specialty	Indiana, PA	1915	300	Passenger, light truck, farm, industrial, racing, aircraft	3,300
Titan	Des Moines, IL	1943	820	Light truck, farm	13,000
Yokohama Tire	Salem, VA	1968	831	Passenger, light truck	25,000
Total		1963 (Avg)	56,352		900,340

[a] This plant is a joint venture between Continental/General Tires, Toyo, and Yokohama. The plant is managed by Continental/General Tires.

[b] Goodyear announced on February 3, 1999, that this facility will cease tire manufacturing by the end of 1999. The plant will continue to mix rubber for other manufacturing plants.

[c] These facilities were listed in the draft P-MACT as owned by Uniroyal/Goodrich, which is now owned by Michelin.

Source: *Rubber and Plastics News*. September 7, 1998. "The World's Tire Production Facilities: North American Tire Production Facilities."

Table 2-4. General Trends, SIC 3011, 1985–1996

Year	Value of Shipments[a] ($1996 10^3)	Employment	Value of Shipments/ Employee ($1996 10^3)	Capital Expenditures ($1996 10^3)[a]
1985	$14,643,200	70,300	$208	$697,100
1986	$13,553,300	65,200	$208	$533,300
1987	$13,835,800	65,400	$212	$446,800
1988	$14,389,300	67,800	$212	$534,900
1989	$14,347,800	68,000	$211	$963,900
1990	$13,965,600	67,700	$206	$768,200
1991	$13,456,300	65,500	$205	$572,900
1992	$13,015,800	64,600	$201	$557,800
1993	$13,530,600	65,100	$208	$525,700
1994	$13,825,200	65,100	$212	$542,800
1995	$14,393,900	65,700	$219	$525,200
1996	$14,209,300	64,800	$219	$578,500

[a] Constant 1996 dollars adjusted by GDP deflator, obtained from the Economic Report to the President (1998).

Source: U.S. Department of Commerce. 1985-1996. *Annual Survey of Manufactures, Statistics for Industry Groups and Industries*. Table 2. Washington, DC: Government Printing Office.

2.4.2 Trends

The data contained in Tables 2-4 and 2-5 are for all establishments in SIC 3011. Table 2-4 shows trends in constant dollar value of shipments, employment, value of shipments per employee, and capital expenditures. Table 2-5 shows productivity trends. These trends are discussed in more detail below.

2.4.2.1 Value of Shipments

The constant dollar ($1996) value of industry shipments for the U.S. rubber tire industry was $14.2 billion in 1996. This represents a real decrease of 3 percent from 1985. Constant dollar values of shipments varied from 1985 to 1996, reaching a low of $13.0 billion in 1992, and a high of $14.6 billion in 1996.

Table 2-5. Productivity Trends, SIC 3011, 1988–1996

Year	Annual Output per Hour	Annual Output per Employee
1988	$102.9	$104.7
1989	$103.8	$103.5
1990	$103.0	$101.1
1991	$102.4	$99.1
1992	$107.8	$109.3
1993	$116.5	$116.0
1994	$124.1	$125.0
1995	$131.1	$131.9
1996	$138.8	$136.8
Percentage Change	35%	31%

Source: Bureau of Labor Statistics, Office of Productivity and Technology. January 1999. *Industry Productivity Index and Producer Price Index,* "Labor Productivity Tables, 1987 Forward, All Published 4-Digit Industries." <http://www.bls.gov/iprdata1.htm#Industry>.

2.4.2.2 Employment

Table 2-4 shows industry employment for the years 1985 through 1996. Employment fell sharply from 1985 to 1986 and since then has fluctuated, rising somewhat in the late 1980s, and remaining between 64,600 and 65,700 through 1996. In 1996 employment levels were 7.8 percent lower than 1985 levels (U.S. Department of Commerce, 1996). This decline began as a result of the adverse market conditions in the mid- to late 1980s when the industry experienced severe competitive pressures, excess capacity, and low prices. These conditions made it necessary for companies to cut costs, eliminate plants, and avoid pay increases (Sawinski, 1995). This, as mentioned earlier, has created labor relations problems in the industry and has led to several strikes.

2.4.2.3 Productivity

The efficiency of both facilities and workers has increased over the past decade. The average number of workers per factory has decreased over the years because of increased productivity and automation (Sawinski, 1995). Table 2-4 shows trends in labor productivity by using the average constant dollar value of shipments per employee from 1985 through 1996, which has increased in real terms from $208,000 to $219,000, or 5.3 percent over this

time period. Although the number of employees has decreased during these years, constant dollar value of shipments have increased, indicating more productive workers, more efficient processes, or both.

Productivity can also be examined with a few key ratios. These ratios are output per hour and output per employee. For SIC 3011, both the ratios of output per hour and output per employee have increased from 1988 through 1996, by 35 percent and 31 percent, respectively (see Table 2-5).

2.4.2.4 Capital Expenditures

Another trend of importance to the industry is the amount of money spent on capital investments. Table 2-4 lists annual capital expenditures for SIC 3011 from 1985 through 1996, in 1996 dollars. These include expenditures for "(1) permanent additions and major alternations to manufacturing establishments and (2) machinery and equipment used for replacement and additions to plant capacity if they were of the type for which depreciation accounts are ordinarily maintained" (U.S. Department of Commerce, 1992).

Over this time period, annual capital expenditures decreased (in real terms) by approximately 17 percent, from around $697 million to $579 million. Capital expenditures peaked in 1989, reaching nearly $964 million (U.S. Department of Commerce, 1996). Since August 1997, Bridgestone/Firestone, Goodyear, and Michelin have all invested to expand their capacity at several facilities and to construct a few newer ones. While most of the expansion is at existing facilities, some new U.S. facilities are under construction.

A few examples of new investments for the rubber tire industry include a $435 million plant currently under construction by Bridgestone/Firestone for passenger and light truck tires. Bridgestone/Firestone also completed a $110 million expansion of its Warren County, TN, plant in 1994. In June 1998, Dunlop Tire Corporation also announced plans for a $25 million expansion at its Buffalo, NY, plant.

2.4.2.5 Technology

As described in the introduction, the rubber tire manufacturing industry has gone through a major restructuring over the last decade or so. There have also been major changes in tire production itself. Most, if not all, manufacturing plants for passenger and light truck tires have switched from bias-ply design to radial-ply design technology. This technological change in production has been nearly universally implemented by this time. Over 90 percent

of the passenger tires shipped in 1997 were radial (RMA, 1997). No other technology-driven changes in manufacturing processes have been identified at this time.

2.4.2.6 Number of Establishments

Table 2-6 contains information gathered from the *Statistics of U.S. Businesses* on the number of new and terminated establishments and information on establishments that continued operation but either expanded or contracted their employment levels during the years 1989 through 1995. The number of establishments includes all of SIC 3011. During this time period, more establishments were opened than closed, and more establishments expanded rather than contracted their employment.

Table 2-6. SUSB Data on 3011 Establishment Changes, 1990–1995

Current Year	New Establishment Since Previous Year[a]	Terminated Establishments Since Previous Year[a]	Net Change[a]	Continuing Establishments Expanding Employment[a]	Continuing Establishments Contracting Employment[b]
1990	7	13	–6	58	41
1991	12	3	+9	40	69
1992	10	7	+3	58	60
1993	8	8	0	62	42
1994	11	5	+6	56	49
1995	10	3	+7	63	54

[a] Represents new or terminated establishments at any time during current year.
[b] Represents activity from March of previous year to March of current year.

Source: U.S. Small Business Administration, Office of Advocacy. January 1999. "Dynamic Firm Size Data for SIC 3011." *Statistics of U.S. Businesses.* <http://www.sba.gov/ADVO/stats>.

2.4.3 Firm Characteristics

The information contained in this section focuses on both the domestic parent companies that own the facilities potentially affected by the regulation, and their ultimate corporate parents. This section describes the ownership pattern of the firms and their employment size distribution, respectively; explains patterns of vertical and horizontal integration of the rubber tire industry; and discusses financial conditions in the rubber tire industry.

2.4.3.1 Ownership

Fourteen parent companies own the 43 facilities identified in the draft P-MACT. Sales and employment data for domestic parent companies of the identified facilities are important for the EIA, in particular for identifying affected small businesses. The information on domestic parents contained in Table 2-7 was obtained from Dun & Bradstreet. Table 2-7 also lists information on the ultimate corporate parent for information purposes only. Data on ultimate parents were gathered from *Rubber and Plastics News* and corporate websites. Goodyear and Sumitomo Rubber Industries, Ltd announced a series of joint ventures in February 1999. The operating joint ventures in North America and Europe will be owned 75 percent by Goodyear and 25 percent by SRI. In Japan, SRI will own 75 percent of two joint ventures and Goodyear will own 25 percent.

2.4.3.2 Size Distribution

The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires federal regulatory agencies to determine whether a proposed or final regulation will have a significant impact on a substantial number of small entities. For SIC 3011, a small entity is defined by the Small Business Administration as a firm with 1,000 or fewer employees. This cut-off is made based on domestic parent employment; therefore, it is necessary to obtain employment information at this level. At this time, there are no domestic parent companies identified that have fewer than 1,000 employees. Table 2-7 provides employment information from Dun & Bradstreet for both the domestic parent companies and the ultimate parents of the identified facilities.

2.4.3.3 Vertical and Horizontal Integration

For the purpose of this profile, the Agency examined vertical integration of the corporate parents. Vertical integration is the concentration of multiple stages of production within a single firm. The rubber tire manufacturing parent companies tend to be highly vertically integrated. For example, many tire companies own and operate their own distribution systems.

Table 2-7. Domestic and Ultimate Parent Employment and Sales

Domestic Parent	Facilities	Domestic Parent Sales[a]	Domestic Parent Employment[a]	Ultimate Parent	Ultimate Parent Sales[b]	Ultimate Parent Employment[b]
Bridgestone/ Firestone Inc.	**Bridgestone/Firestone** Decatur, IL La Vergne, TN Warren County, TN Wilson, NC Oklahoma City, OK	$6.5 billion	45,000	Bridgestone Corporation, Japan	$17.9 billion	96,200
Carlisle Companies Inc.	**Carlisle Tire and Wheel** Carlisle, PA	$1.3 billion	8,500	Carlisle Companies Inc., U.S.	$1.3 billion	8,500
Continental General Tire	**Continental/General Tire** Bryan, OH Charlotte, NC Mayfield, KY Mount Vernon, IL[c]	$1.4 billion	7,000	Continental A.G., Germany	$6.62 billion[d]	44,800
Cooper Tire and Rubber Co.	**Cooper Tire and Rubber** Findlay, OH Texarkana, AR Tupelo, MS	$1.8 billion	10,456	Cooper Tire and Rubber Co., U.S.	$1.8 billion	10,456
NA	**Denman Tire** Leavittsburg, OH	NA	NA	NA	NA	NA
Dunlop Tire Corp.	**Dunlop Tire** Buffalo, NY Huntsville, AL	$751 million	3,276	Sumitomo Rubber Industries, Japan	NA	NA
Goodyear Tire and Rubber Company	**Goodyear Tire** Akron, OH Danville, VA Gadsden, AL Topeka, KS Lawton, OK Union City, TN	$13.2 billion	91,310	Goodyear Tire and Rubber Co., U.S.	$13.2 billion	91,310
Goodyear Tire and Rubber Company	**Kelly-Springfield Tire** Fayetteville, NC Freeport, IL Tyler, TX	$13.2 billion	91,310	Goodyear Tire and Rubber Co., U.S.	$13.2 billion	91,310

(continued)

Table 2-7. Domestic and Ultimate Parent Employment and Sales (continued)

Domestic Parent	Facilities	Domestic Parent Sales[a]	Domestic Parent Employment[a]	Ultimate Parent	Ultimate Parent Sales[b]	Ultimate Parent Employment[b]
Michelin North America	Michelin Anderson / Lexington, SC Ardmore, Ok Dothan, AL Fort Wayne, IN Greenville, SC Lexington, SC Norwood, NC Opelika, AL Spartanburg, SC Tuscaloosa, AL	NA	NA	Groupe Michelin, France	$13.9 billion	119,800
Pirelli Tire Corporation	**Pirelli Tire** Hanford, CA	$104.7 million	1,011	Pirelli Group, Italy	NA	NA[c]
Polymer Enterprises Inc.	**Specialty Tires of America** Indiana, PA	$55 million	500	Polymer Enterprises Inc., U.S.	$55 million	500[e]
Titan International Inc.	**Fidelity Tire Mfg. Co., Titan Tire Corp.** Natchez, MS Des Moines, IL	$690 million	4,100	Titan International Inc., U.S.	$690 million	4,100
Yokohama Corp. North America	**Yokohama Tire Corp.** Salem, VA	$171 million	1,651	Yokohama Rubber Co. Ltd., Japan	NA	NA

[a] Dun & Bradstreet Marketing Identifier File, January 1999.
[b] Corporate websites.
[c] Reported 1,500 employees in *Rubber and Plastics News*.
[d] Converted to U.S. dollars using a currency exchange rate of 0.5912 $/DM (www.x-rates.com, January 1999).
[e] Reported 1,450 employees in *Rubber and Plastics News*.

In addition, many tire companies own their own rubber manufacturing

plants and therefore do not need to purchase rubber from independent rubber manufacturers. For example, Goodyear Tire and Rubber Company is investing over $600 million over the next 3 years for two new synthetic rubber plants. There is also a growing trend in the industry to own rubber plantations because it creates a strong competitive advantage (Goodyear, 1999). Michelin is following this trend by owning and operating six rubber plantations.

Horizontal integration measures the extent to which corporations engage in diversified product lines. The corporations owning tire manufacturing plants do engage in activities other than tire manufacturing. However, the majority of their sales comes from the sale of tires. In 1997, the top nine tire producers averaged 78 percent of their corporate sales through tire sales. Several firms engage in activities other than tire manufacturing. For example, Bridgestone Corporation manufactures a wide range of diversified products, including industrial rubber and chemical products and sporting goods. Seventy-two percent of Bridgestone Corporation's corporate sales come from the sale of tires. Groupe Michelin also manufactures other products, but to a lesser extent than Bridgestone. Tire sales make up 93 percent of Groupe Michelin's total corporate sales. Goodyear has other lines of business in chemicals and engineered products, but their tire line accounts for 85 percent of sales (Tirebusiness, 1999).

2.4.3.4 Financial Condition

The financial condition of the industry's firms will affect the incidence of impacts associated with the costs of implementing the requirements of the MACT regulation. Each year, Dun & Bradstreet publishes *Industry Norms & Key Business Ratios*, which reports certain financial ratios for a sample of firms for different industries. Tables 2-8 and 2-9 present an analysis of selected solvency and profitability ratios for 21 establishments that manufacture tires and inner tubes included in the 1997 Dun & Bradstreet study.

Table 2-8. Solvency Ratios for SIC 3011, 1997

Ratios	Description	1997 Median for Tire and Inner Tube Manufacturing[a]
Cash + receivables to current liabilities (quick ratio)	Indicates the protection afforded short term creditors by revealing the size of liquid assets available to cover debt that falls due within one year.	1.0 Analysis: This industry is in a liquid position.
Current assets to current liabilities (current ratio)	Measures the degree to which current assets cover liabilities, indicating the ability to retire current liabilities and cover any possible shrinkage in the value of current assets.	2.0 Analysis: This industry has adequate coverage.
Current liabilities to net worth	Shows the level of risks creditors are assuming with funds that the owners have used to make permanent investments.	51.1% Analysis: This industry poses a low level of risk.

[a] Analysis provided by Abt Associates based on Dun & Bradstreet guidelines for interpreting financial ratios.

Table 2-9. Profitability Ratios for SIC 3011, 1997

Ratios	Description	Median for Tire and Inner Tube Manufacturing[a]
Return on sales (profit margin)	Reveals the profits earned per dollar of sales as a measure of the efficiency of the operation. Indicates the firms' ability to achieve satisfactory profits for owners and withstand adverse business conditions.	2.5% Analysis: The industry's profitability is low, indicating a low tolerance for business downturns.
Return on assets	Indicates firm profitability by matching operating profits with assets available to earn a return. Shows if firms are using their assets efficiently.	3.6% Analysis: Indicates a low level of operating profits relative to investment.
Return on net worth (return on equity)	Analyzes the ability of management to realize an adequate return on owners' investments.	4.6% Analysis: The industry's best measure of return, but quite low relative to other industries.

[a] Analysis provided by Abt Associates based on Dun & Bradstreet guidelines for interpreting financial ratios.

Table 2-10. Net Earnings, 1996

Ultimate Parent Company	1996 Net Earnings (10^6)
Bridgestone	646.3
Michelin	609.0
Pirelli	300.0
Continental	128.3
Cooper	107.9
Goodyear	101.7
Sumitomo	43.0
Yokohama	34.5
Toyo	9.8
Total: Nine firms	3,976.5

Source: Tirebusiness. January 1999. <http://www.tirebusiness.com> and <http://www.tirebusiness.com/subscriber>.

Solvency, or liquidity, measurements are significant in evaluating a company's ability to meet short- and long-term obligations. These figures are of prime interest to credit managers of commercial companies and financial institutions. Table 2-8 presents three solvency ratios for SIC 3011 and includes a brief analysis of these ratios developed by Abt Associates.

Profitability ratios show how successful a business is in earning returns on invested equity and assets. Table 2-9 presents three profitability ratios for SIC 3011 and includes a brief analysis of these ratios developed by Abt Associates.

The rubber tire manufacturing industry profits are considered modest by other industry standards. Within the rubber tire industry, profits for original equipment tires are considerably lower than profits for replacement tires (Griffiths, 1997b). Recent reports of corporate net earnings indicate that, for the last 3 years, the U.S. divisions of the major rubber tire manufacturing companies have earned positive profits (Tirebusiness, 1999). Table 2-10 shows positive recent net earnings for all the major producers.

Anecdotal information reported by the major tire producers indicates that the companies are currently experiencing modest increases in various measures of profitability and financial health. The examples below use data reported by the firms themselves, and no attempt has been made to standardize the information, making comparisons difficult.

Goodyear reported a 4.4 percent increase in operating income from its tire business in the first 9 months of 1998 over the same period in 1997. The company characterized this as a sluggish performance relative to its competitors and attributed it to lower sales caused by the strong U.S. dollar. Goodyear stated that increases in operating income are due to lower raw material costs, improved productivity, and cost containment measures.

Bridgestone/Firestone, Inc., the U.S. subsidiary of Bridgestone Corporation, reported that its net earnings for the first half of 1998 reached $149 million, a substantial increase over the earnings of $101.3 million in the same period the prior year. The company forecast its year-end net earnings to reach $300 million, up from $200 million in 1997 and $172 million in 1996.

In 1998, Continental reported that it experienced an increase in corporate profits for the fifth year in a row, with a significant increase in after-tax profits over 1997. The U.S. division, Continental General Tire, saw its 1998 earnings improve by 20 percent over the previous year, despite the GM strike and a strike at their Charlotte plant.

2.5 Markets

This section discusses market structure; provides background on current market volumes, prices and international trade; and presents information on future market volumes, prices, and international trade. This section describes the current status of the industry and supports the development and implementation of the EIA.

2.5.1 Market Structure

The global rubber tire manufacturing industry is fairly concentrated, dominated by large multinational companies. This market concentration is most likely due to barriers to entry such as the influence of brand loyalty, capital requirements related to building or modernizing manufacturing facilities, and maintaining highly advanced research and development facilities. However, anecdotal information and price data indicate that the industry does behave competitively. The industry has several characteristics that classify it as competitive:

- Manufacturers have relatively low profit ratios.

- Manufacturers compete to secure desirable original equipment contracts with auto manufacturers.
- Consumers of replacement tires have numerous choices.
- Price is the main characteristic of tires within the same category.
- Overcapacity exerts downward price pressure.

The 11 largest tire manufacturers accounted for about 81.5 percent of the world's tire sales in 1996 (Tirebusiness, 1999). The leading three companies, Michelin, Bridgestone/Firestone, and Goodyear, accounted for 53.5 percent of sales in 1996. Figure 2-2 shows the breakdown of 1996 market share according to global tire sales.

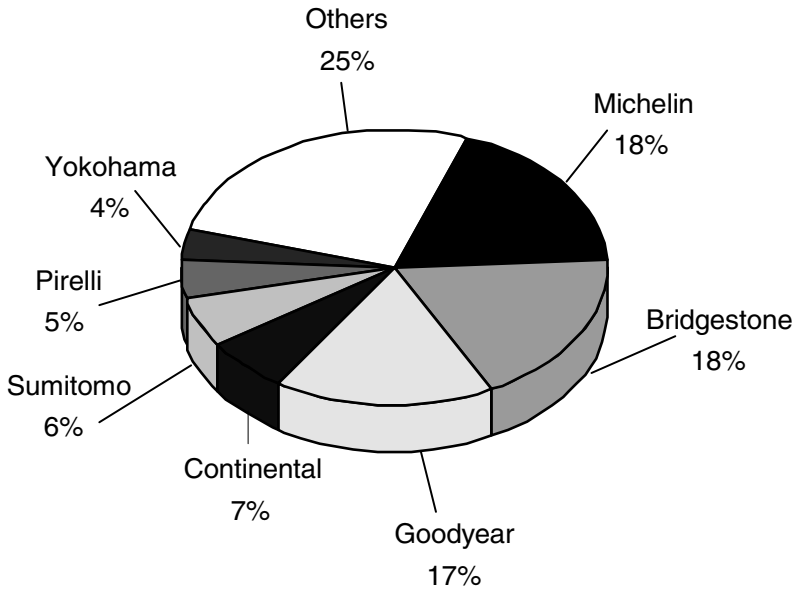

Figure 2-2. Global Tire Sales, 1996

Source: Tirebusiness. January 1999. <http://www.tirebusiness.com> and <http://www.tirebusiness.com/subscriber>.

In terms of market share, the "Big Three" of the tire industry (Bridgestone, Michelin, and Goodyear) are twice as large as the next three largest companies—Continental, Pirelli, and Sumitomo (owner of Dunlop-Europe). A study published in 1995 by Economist Intelligence Unit reported that the Big Three had an average operating margin of 7.8 percent, compared to an operating margin of 4.7 percent for the next smallest three firms (Griffiths,

1997b). The study authors reported that, with the exception of Cooper and Pirelli, it has become more and more difficult over time for smaller manufacturers to earn profit margins comparable to the Big Three. To compete with the Big Three, smaller manufacturers have tended to focus on a specific niche (high performance or premium tires) or in regional markets. Moreover, the report suggested this trend will continue. The Big Three are expected to continue their acquisition activities and aggressive pricing strategies geared toward increasing market share and profits (Griffiths, 1997b).

2.5.2 Current Market Volumes

The following section describes current market volumes in terms of domestic production, domestic consumption, and international trade. The rubber tire market consists of six production classifications:

- passenger tires;
- light truck tires;
- medium, wide base, heavy and large-off-the-road tires (M/WB/H/LOR);
- front farm implement tires;
- rear farm implement tires; and
- industrial, garden tractor, and utility tires.

Two subclassifications exist within each production classification: original equipment tires and replacement tires.

In 1997, replacement tires of all types accounted for about 76 percent of the value of domestic market shipments (RMA, 1997). In recent years, most of the growth in tire shipments has come from the replacement tire market. Over time, technology improvements resulting in greater tire durability may reduce consumer demand for replacement tires.

The annual growth rate for original equipment tire shipments has steadily dropped from 13.9 percent in 1994 to 2.4 percent in 1997 with a low of –1.8 in 1996. It is also expected that a small component of the original equipment market, the spare tire market ("doughnuts"), will eventually diminish over the next few years if run-flat tires gain market share. Table 2-11 presents total U.S. shipments by end-use market from 1993 to 1997. The table also presents growth rates for the original and replacement markets, the total market, as well as each market segment's share of total market growth.

Table 2-11. Total U.S. Shipments by End-Use Market, 1993–1997 (10^3)[a]

	Replacement Tires			Original Equipment Tires			Total Tires	
Year	Tires Shipped	Market Sector Growth	Percentage of Total Growth	Tires Shipped	Market Sector Growth	Percentage of Total Growth	Tires Shipped	Total Growth
1993	200,659			60,840			261,499	
1994	209,040	4.2%	3.2%	69,283	13.9%	3.2%	278,323	6.4%
1995	204,570	–2.1%	–1.6%	68,514	–1.1%	–0.3%	273,084	–1.9%
1996	214,932	5.1%	3.8%	67,283	–1.8%	–0.5%	282,215	3.3%
1997	221,289	3.0%	2.3%	68,924	2.4%	0.6%	290,213	2.8%
Average			2.7%			1.2%		2.7%

[a] Represents 100 percent of U.S. domestic market excluding exports. Includes tires for passenger vehicles, light trucks and medium, wide base, and heavy trucks only.

Source: Rubber Manufacturers Association. 1997. *Tire Industry Facts, 1997.* Washington, DC: Rubber Manufacturers Association.

2.5.2.1 Domestic Production

In its 1997 publication, *Tire Industry Facts*, the RMA reported domestic production (including production for exports) for its members. According to the RMA, its members represent 90 percent of domestic tire production. From 1985 to 1997, the RMA report shows domestic production of tires grew by almost 28 percent, from 207.0 million tires to 286.4 million tires. Over this time period, the production of passenger tires grew by 24 percent, from 163 million units to 216 million units and accounted for 78 percent of the industry's total growth. Domestic production was at its lowest point in 1986 because the industry responded to the declining demand for new tires and declining tire prices with major capacity cutbacks during the 1980s.

In 1997, passenger tires comprised 76 percent of domestic production volumes, light truck tires represented 12 percent, and the remaining four tire types made up the remaining 12 percent of the production volumes (RMA, 1997). Table 2-12 presents tire production data by product classification from 1985 through 1997 as reported by RMA. Figure 2-3 presents total production for the same period.

Table 2-12. U.S. Annual Production, 1985–1997 (10^3 units produced)[a]

Year	Tire Category						
	Passenger	Light Truck[b]	M/WB/H/ LOR[c]	Front Farm Implement[c]	Rear Farm Implement[c]	Ind/Gard/Util[c]	Total Tires
1985	162,584	23,294	10,097	1,668	1,086	8,297	207,026
1986	159,350	22,046	8,894	1,697	1,007	7,447	200,441
1987	167,522	26,202	9,253	1,944	1,111	9,201	215,233
1988	174,341	26,636	10,374	2,036	1,237	7,908	222,532
1989	175,026	27,074	10,770	2,194	1,337	8,870	225,271
1990	174,859	25,855	9,948	2,085	1,299	10,822	224,868
1991	169,580	23,014	9,796	1,906	1,144	9,360	214,800
1992	192,725	26,738	10,787	1,923	1,179	11,358	244,710
1993	197,520	27,826	12,101	2,030	1,310	11,510	252,297
1994	201,113	29,310	13,273	2,345	1,310	13,798	261,149
1995	210,127	30,897	14,497	2,367	1,436	14,794	274,118
1996	210,329	31,371	15,080	2,460	1,480	15,830	276,550
1997	216,236	33,459	15,680	2,550	1,530	16,930	286,385
Percentage of Total 1997 Production							
	75.5%	11.7%	5.5%	0.9%	0.5%	5.9%	100.0%

[a] Includes shipments for domestic consumption and exports using RMA member production data only, which represents approximately 90 percent of industry production.
[b] Includes estimated data provided by RMA for production from non-RMA facilities.
[c] Includes estimates for 1996 and 1997 using average annual growth rate for 1985–1995.

Source: Rubber Manufacturers Association. 1997. *Tire Industry Facts, 1997.* Washington, DC: Rubber Manufacturers Association.

In 1998, the 7-week General Motors strike temporarily slowed overall production for the original equipment tire market segment. However, since most of the growth in the rubber tire industry came from the replacement tire market, manufacturers generally experienced increased sales in 1998. For example, during the first 9 months of 1998, Goodyear's domestic tire production increased by 2.4 percent over 1997. Contending with a labor strike at one of its own facilities, Continental General still increased its overall gross sales revenues by 2.5 percent over 1997 by increasing passenger tire sales revenues by 2 percent and truck tire sales revenues by 15 percent.

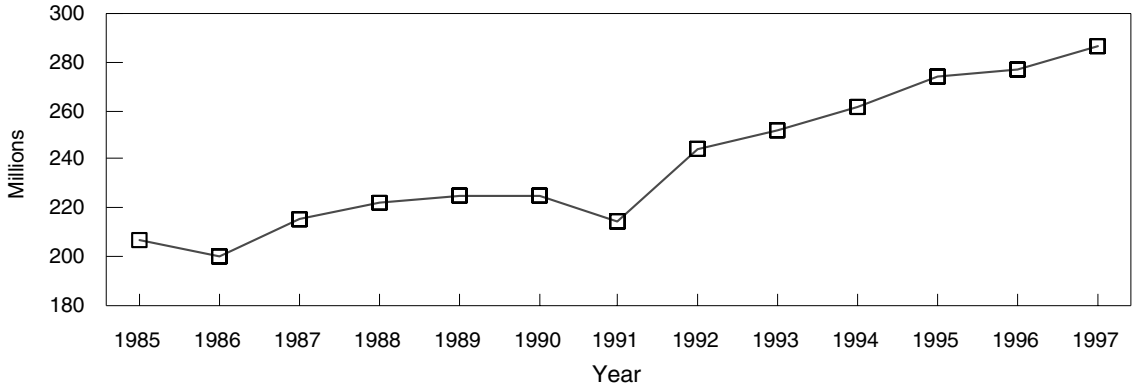

Figure 2-3. Total Domestic Tire Production, 1985–1997 (number of tires)

Source: Rubber Manufacturers Association. 1997. *Tire Industry Facts, 1997.* Washington, DC: Rubber Manufacturers Association.

Foreign investment in U.S. production grew in recent years. As of 1994, foreign-based tire manufacturers acquired almost one-half of U.S. production capacity, and some have built or are building their own new facilities in addition to those they acquired. Factors contributing to the increase in foreign investment include the efficient performance of U.S. production facilities and the devaluation of the U.S. dollar in the mid-1980s. This development eliminated the previous price advantage foreign producers had exporting to the United States when the dollar was stronger.

2.5.2.2 Domestic Consumption

Table 2-13 and Figure 2-4 present consumption of tires from 1985 through 1997 by product classification as reported by RMA.[6] The data presented include RMA member shipments plus imports. Between 1985 and 1997, domestic consumption of tires grew by just over 25 percent, from 246.9 million tires to 309.2 million tires. Over this time period, the consumption of passenger tires grew by 21 percent and accounted for 66 percent of the industry's total growth. In 1997, the consumption of passenger tires consisted of 77 percent of domestic consumption, the consumption of light truck tires represented 11 percent of the

[6]RMA typically uses the term "shipments" to represent domestically produced and imported tires, called consumption here.

Table 2-13. U.S. Annual Consumption, 1985–1997 (10^3 units)

	Tire Category						
Year	Passenger	Light Truck[b]	M/WB/H /LOR[c]	Front Farm Implement[c]	Rear Farm Implement[c]	Ind/Gard/Util[c]	Total Tires
1985	196,294	23,800	15,996	1,936	1,055	7,810	246,891
1986	198,659	23,900	15,352	1,860	971	8,205	248,947
1987	204,805	26,026	16,333	2,161	1,104	9,349	259,778
1988	209,425	26,777	15,943	2,266	1,149	7,299	262,859
1989	202,326	26,430	15,109	2,342	1,213	6,318	253,738
1990	199,450	26,544	14,714	2,291	1,213	9,269	253,481
1991	197,259	24,761	13,296	1,943	1,089	9,484	247,832
1992	212,101	26,332	14,462	1,969	1,059	10,270	266,193
1993	217,481	28,198	16,076	2,033	1,210	11,762	276,760
1994	228,431	31,240	17,887	2,172	1,257	13,072	294,059
1995	223,809	31,579	17,914	2,133	1,304	13,350	290,089
1996	232,420	33,439	18,180	2,150	1,330	14,250	301,769
1997	237,272	35,079	18,160	2,160	1,360	15,220	309,251
Percentage of Total 1997 Consumption							
	76.7%	11.3%	5.9%	0.7%	0.4%	4.9%	100.0%

[a] Includes RMA member shipments plus imports for domestic consumption only, which represents approximately 90 percent of industry shipments.
[b] Includes estimated data provided by RMA for production from non-RMA facilities.
[c] Includes estimates for 1996 and 1997 using average annual growth rate for 1985 through 1995.

Source: Rubber Manufacturers Association. 1997. *Tire Industry Facts, 1997.* Washington, DC: Rubber Manufacturers Association.

market, and the consumption of the remaining four tire types made up the remaining 12 percent of the consumer demand for rubber tires.

Table 2-14 and Figure 2-5 present the value of shipments for SIC 3011 from 1985 to 1997 expressed in both current and real 1996 dollars, using the rubber tire producer price index.

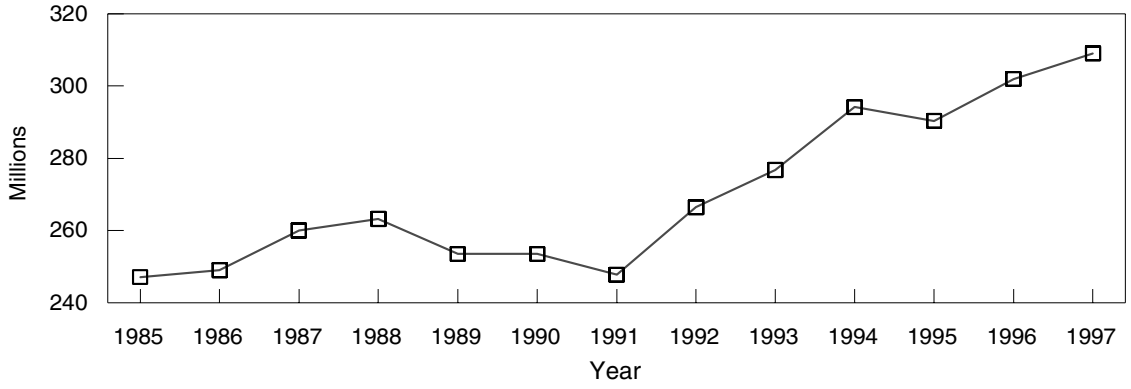

Figure 2-4. Total Domestic Tire Consumption, 1985–1997 (number of tires)

Source: Rubber Manufacturers Association. 1997. *Tire Industry Facts, 1997.* Washington, DC: Rubber Manufacturers Association.

2.5.2.3 World Production and International Trade

The Global Market. Overall, the 1996 global rubber tire production reached 73 million units (Table 2-15). Non-U.S. producers accounted for 65 percent of this production. Most of the growth in global production has been from increases in replacement tire production. In absolute terms, global production of replacement tires has increased by 249 million replacement units over the 25 year period ending in 1996, compared to 90 million OEM units. As an example of annual growth rates, in 1996, world rubber tire production for passenger and truck/bus tires increased by about 2.8 percent over 1995 production levels.

Recently, weak economic conditions, troubled financial markets, and disadvantageous currency exchange rates resulted in a drop in 1998 rubber tire sales volumes in Asia and South America. Some companies recouped their losses through increasing sales in the mature markets of North America and Europe and expanding production in developing countries where production costs are lower. Table 2-15 presents tire production for the passenger and truck/bus categories for the United States and the rest of the world in 1996.

Table 2-14. Value of Shipments, 1985-1997

Year	Current Value of Shipments[a] (10^6)	GDP Price Deflator[b]	1996 Real Value of Shipments (10^6)
1985	10,434.0	78.53	14,643.2
1986	9,909.5	80.58	13,553.3
1987	10,427.4	83.06	13,835.8
1988	11,240.1	86.09	14,389.3
1989	11,680.3	89.72	14,347.8
1990	11,860.8	93.60	13,965.6
1991	11,882.5	97.32	13,456.3
1992	11,810.0	100.00	13,015.8
1993	12,601.2	102.64	13,530.6
1994	13,182.9	105.09	13,825.2
1995	14,073.9	107.76	14,393.9
1996	14,209.3	110.21	14,209.3
1997	14,013.2	112.40	13,740.2

[a] U.S. Department of Commerce. 1985–1996. *Annual Survey of Manufactures, Statistics for Industry Groups and Industries.* Table 2 and Table 4. Washington, DC: Government Printing Office.
[b] Obtained from *Economic Report of the President*. 1998. Washington, DC: Government Printing Office.

Some company-specific examples are provided below to illustrate their roles in the global market.

- **Goodyear (U.S.)**. In 1996, reported tire sales for Goodyear rose by 7.2 percent. During the first 9 months of 1998, the Goodyear Company experienced weak original equipment sales in Asia and South America but increased its worldwide sales volume by 1 percent through increased sales to North America and Europe.

- **Bridgestone/Firestone (Japan)**. Bridgestone/Firestone reported that it experienced significant increases in its domestic market share since 1992 and as a result built a new plant to meet this increased demand and to reduce its reliance on Japanese imports.

- **Continental General (Germany)**. In 1996, Continental General reported a 24 percent increase in net profits, in part by transferring production from Germany to

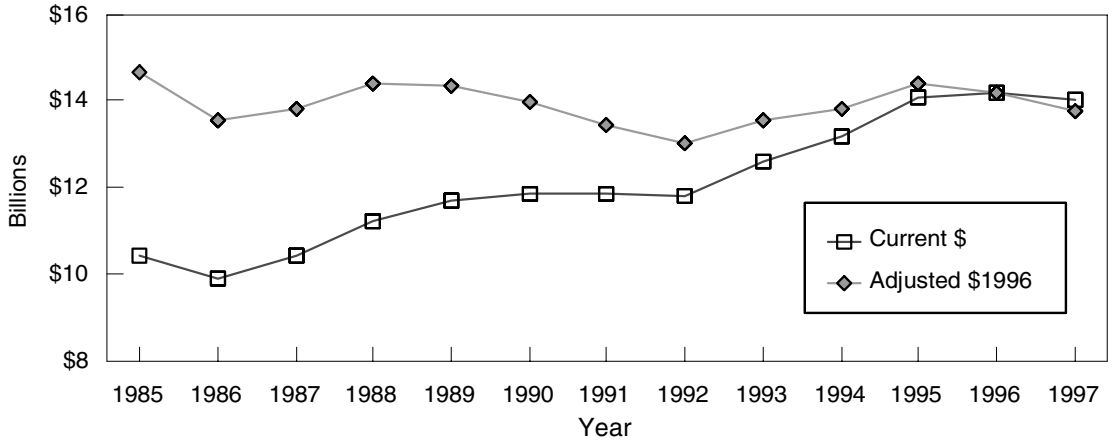

Figure 2-5. Value of Shipments, 1985–1997

Base year = 1982.

Source: U.S. Department of Commerce. 1985–1996. *Annual Survey of Manufactures, Statistics for Industry Groups and Industries.* Table 2 and Table 4. Washington, DC: Government Printing Office.

Table 2-15. Global Rubber Tire Production, 1996 (passenger and truck/bus 10^3 units)

Product Category	U.S.	Rest of World[a]	Total
Passenger	210,329	356,761	567,090
Truck/bus	44,987	124,666	169,653
Total	255,316	481,427	736,743

[a] Values contain estimates from several countries

Source: Tirebusiness homepage. January 1999. <http://www.tirebusiness.com> and <http://www.tirebusiness.com/subscriber>. (primary sources: International Rubber Study Group, individual national trade associations, World Service, Goodyear, Smithers Scientific Services Inc).

the Czech Republic and Portugal. During the first 9 months of 1998, Continental General's passenger tire market volumes in Europe rose by 10 percent over 1997, which increased their gross sales revenues by 7 percent. Also in 1998, Continental acquired controlling interest in a South African tire manufacturer that exports 3.5 million tires a year and supplies both replacement and original equipment car and truck tires to domestic auto manufacturing plants. Continuing to invest in developing markets, Continental also bought two plants in Mexico and entered into a joint venture in Slovakia, where it is planning to increase the

annual capacity of a truck tire manufacturing facility from 0.5 million units to 1.5 to 2.0 million units.

- **Pirelli (Italy)**. In 1996, Pirelli reported that its tire sales fell by 4.6 percent due to a strong lire, but operating profits rose by 6.9 percent.
- **Sumitomo/Dunlop-Europe (Japan).** In 1996, Sumitomo/Dunlop-Europe reported that its sales revenues rose by 6.1 percent and consolidated profits rose by 29 percent, with a forecast for further gains in 1997.

U.S. Imports and Exports. U.S. imports of rubber tire products exceed its exports. Table 2-16 presents a summary of the U.S. trade balance for SIC 3011, along with selected trade ratios. These ratios show that while imports' share of U.S. apparent consumption has remained virtually the same (20 percent) from 1989 to 1996, exports' share of shipments has doubled, causing the ratio of imports to exports to decline by over 50 percent. It has not yet been determined if the import data reflect original equipment tire imports that are installed on new imported vehicles, tires shipped directly to domestic vehicle manufacturers for installation on new vehicles, or replacement tires.

Imports and exports of both passenger and light truck tires increased between 1996 and 1997 and are expected to increase again in 1998. Table 2-17 summarizes the imports and exports of passenger and light truck tires from 1996 through 1998.

U.S. Trading Partners. The United States engages in trading with Japan, Mexico, South Korea, and Canada. The United States has the largest trading deficit with Japan, followed by Canada and then South Korea. Recently, Canada has been the United States' largest trading partner. Table 2-18a and 2-18b present the 1996 value and share of tire imports and exports by region and by major trading partner for SIC 3011, as well as the change between 1992 and 1996 for each trading partner's share.

2.5.3 Prices

Table 2-19 shows that the average price per tire received by the seven largest manufacturers. This price was derived by dividing the manufacturer's total tire sales by the estimated number of tires produced by each company. The weighted average price received by the manufacturer for the top eight companies in 1996 was $66. Prices for individual tire categories are not currently available.

Table 2-16. U.S. Trade Balance and Selected Statistics (1989–1996) (current 10^6)

Year	Value of Shipments	Imports	Exports	Trade Deficit/ Surplus	Apparent Consumption	Ratio of Imports to Consumption	Ratio of Exports to Product Shipments	Ratio of Imports to Exports
1989	$11,680	$2,644	$812	–$1,832	$13,512	0.20	0.07	3.26
1990	11,861	2,522	1,097	–$1,425	13,286	0.19	0.09	2.30
1991	11,883	2,275	1,282	–$993	12,876	0.18	0.11	1.77
1992	11,810	2,470	1,418	–$1,052	12,862	0.19	0.12	1.74
1993	12,601	2,685	1,473	–$1,212	13,813	0.19	0.12	1.82
1994	13,183	2,985	1,630	–$1,355	14,538	0.21	0.12	1.83
1995	14,074	3,095	1,901	–$1,194	15,268	0.20	0.14	1.63
1996	14,209	3,030	2,004	–$1,026	15,235	0.20	0.14	1.51
Average	12,663	2,713	1,452	–$1,261	13,924	0.19	0.11	1.98
Percentage change 1989–1996	21.7%	14.6%	146.8%	–44.0%	12.8%	0.0%	100.0%	–53.7%

Source: U.S. Department. of Commerce, Bureau of the Census, International Trade Administration. www.ita.doc.gov/industry/otea/usfth/t26.pm.

Table 2-17. Imports and Exports, 1996–1998

	Passenger Tires (10^3)		Light Truck Tires (10^3)	
Year	Imports	Exports	Imports	Exports
1996	42.6	23.7	4.8	3.5
1997	47.8	27.7	5.7	3.8
1998[a]	53.0	31.0	7.5	4.0

[a] Forecast.

Source: Rubber Manufacturers Association. RMA Website. <http://www.rma.org>.

Table 2-18a. Exports by Region and Major Trading Partner, 1996

Trade Areas	1996 Value (10^3)	Percentage of 1996 Share	Percentage Change from 1992
NAFTA	1,039	53.2	9.0
Latin America	223	11.4	16.1
Western Europe	239	12.2	2.5
Japan/Chinese Economic Areas	257	13.2	7.0
Other Asia	51	2.6	18.2
Rest of world	146	7.5	10.5
World total	1,955	100	8.8
Top five countries			
Canada	746	38.1	7.6
Mexico	294	15	13.1
Japan	235	12	7.4
Germany	71	3.6	6.6
Netherlands	40	2	–2.8

As Figure 2-5 demonstrates, beginning in 1985, the producer price index for rubber tires subcategory within SIC 3011 fell sharply for 2 years. Tire prices reached their lowest level in 1987 over the 1985-1997 period. After 1987, prices rose until 1995 when they reached their highest point in the previous 10 years. Tire prices have declined by 5.5 percent in the last 2 years, returning to levels roughly the same level as in 1985. One analyst

Table 2-18b. Imports by Region and Major Trading Partner, 1996

Trade Areas	1996 Value (10^3)	Percentage of 1996 Share	Percentage Change from 1992
NAFTA	1083	35.8	8.5
Latin America	158	5.2	5.2
Western Europe	419	13.9	–0.3
Japan/Chinese Economic Areas	972	32.2	5.9
Other Asia	327	10.8	2.8
Rest of world	62	2.0	–0.5
World total	3020	100.0	5.2
Top five countries			
Canada	977	32.3	6.7
Japan	758	24.9	4.5
South Korea	202	6.7	–0.7
Brazil	130	4.3	4.0
Taiwan	123	4.1	–1.6

Source: U.S. Department of Commerce/International Trade Administration, DRI/McGraw-Hill and Standard & Poor's. 1998. *U.S. Industry and Trade Outlook '98: Plastics and Rubber*. Washington, DC: Government Printing Office.

attributed this drop in prices to Bridgestone/Firestone's recent capacity additions in the

Table 2-19. Average Passenger Tires Prices Received by the Manufacturer, 1996

Company	Unit Sales (10^3)	Average per Unit ($1996)
Goodyear	178.6	$66
Michelin	171.3	$76
Bridgestone	169.0	$73
Continental	76.1	$61
Sumitomo	61.5	$65
Pirelli	48.0	$65
Cooper	37.0	$43
Total	762.5	
Wtd Average		$66

Source: Tirebusiness. January 1999. <http://www.tirebusiness.com> and <http://www.tirebusiness.com/subscriber>.

United States (Griffiths, 1997a).

2.5.4 Market Forecasts

This section presents available information regarding forecasts of domestic consumption and production, international trade, and market prices.

2.5.4.1 Domestic Consumption

According to the RMA's Tire Market Analysis Committee, U.S. manufacturing consumption[7] in the passenger tire category is forecasted to reach 182.5 million tires in 1998 and 185.8 million in 1999. Passenger car replacement tires have an expected long-term growth rate of 1.57 percent annually, which would bring consumption to 198 million tires by 2003. Passenger car original equipment consumption is projected to reach 56.1 million tires in 1998, and at least 58.4 million in 1999 surpassing the peak in 1994. It is expected that the increase in original equipment passenger car tire consumption will continue into the future, reaching 59 million in 2002.

Light truck replacement tire consumption is expected to reach 30.5 million tires in 1998, and 31.5 million in 1999. A forecast for the 2002-2003 period was not provided. Light truck original equipment consumption is forecasted to be 6.4 million in 1998, to increase to 6.6 in 1999, and then dip to 6 million a year and remain constant through 2003.

Replacement highway truck tire consumption is expected to increase to 13 million and 13.2 million units in 1998 and 1999, respectively, and to remain constant through 2002. Growth in highway truck original equipment consumption is expected to continue into 1998 where shipment are forecasted to peak at 5.8 million. In 1999, OEM consumption of highway truck tires is expected to decline slightly and then remain constant at about 5 million through 2003. Table 2-20 presents the forecast consumption data described above for the three categories of tires and for both the OEM and replacement markets.

[7]RMA typically uses the term shipments to represent domestically produced and imported tires, called consumption here.

Table 2-20. Projected U.S. Tire Consumption (10^3 units)

Year	Passenger Tires		Light Truck Tires		Highway Truck Tires		Total		
	Original Equipment	Replacement	Original Equipment	Replacement	Original Equipment	Replacement	Original Equipment	Replacement	Original Equipment + Replacement
1998	56.1	182.5	6.4	30.5	5.8	13.0	68.3	226.0	294.3
1999	58.4[a]	185.8	6.6	31.5	5.7[a]	13.2	70.7	230.5	300.5
2002/2003	59.0	198.0	6.0	NA[a]	5.0	13.2	70.0	NA	NA

NA = not available.

[a] Specific value not reported.

Source: Rubber Manufacturers Association. RMA Website. <http://www.rma.org>.

One source forecasts that the value of tire shipments for SIC 3011 will increase by 4.2 percent in current terms. Table 2-21 presents the forecast of the value of rubber tire shipments for the 1998–2000 period.

Table 2-21. Projected Value of U.S. Rubber Tire Shipments (10^3)

Year	Value
1998	$14,321
1999	$14,629
2000	$14,937

Source: Darnay, Arsen J. 1998. *Manufacturing USA, 3011 Tires and Inner Tubes.* 6th Edition. Detroit, MI: Gale Research Inc.

Short-term prospects for demand growth of the original equipment market are forecasted to be poor due to expected drop-offs in new car purchases (U.S. Department of Commerce/International Trade Administration, 1998). Conversely, this decline will contribute to increased demand for replacement tires for an aging national automobile fleet. Growth in vehicle miles traveled is also expected to contribute to increased demand for replacement tires. Demand growth is also expected in both the light truck and the truck and bus markets. Near-term growth in demand during 1997 and 1998 was expected to be between 1 and 1.6 percent. Long term growth in demand for all three main tire groups is expected to be correlated to overall GDP growth, closer to 2 percent.

2.5.4.2 Domestic Production

In recent years, the major driver for increased domestic production has been growth in exports and, to a lesser extent, domestic demand. This is evidenced by the doubling in exports' share of the value of shipments between 1989 and 1996, while the total value of shipments decreased in real terms and imports' share of value of shipments remained the same.

Domestic production is expected to continue to increase to meet domestic demand and export demand to the extent that

- there is sufficient capacity,
- domestic production efficiencies continue to result in competitively priced products, and

- domestic and export demand increases.

At this time, domestic production capacity is being increased by current capacity additions. The recently announced plans to close Goodyear's Gasden plant will probably offset this trend somewhat. It is assumed that current production efficiencies of the new capacity will meet or exceed current those of existing production.

2.5.4.3 International Trade

Demand in the global tire market is expected to rise by almost 20 percent from 1997 to 2005. Most of the growth is predicted to occur in developing countries, while demand in North America and Europe are only forecasted to grow by 8 percent from 1997 to 2005 (Griffiths, 1997b). In the world market for tires, companies are seeking increased shares of the growing market by cutting costs, investing in new technologies and efficiency gains, and aggressively acquiring plants in countries such as Mexico and South Africa.

The factors that are expected to affect the future levels of international trade by U.S. tire manufacturers are the relative strength or weakness of the world and regional economies and currency exchange rates between the dollar and currencies of U.S. trading partners. Despite the forecasts for growth in the world market, should the economic problems some countries are experiencing continue or worsen, the tire manufacturing industry could again face a crisis like the one in the early 1980s that led to price wars, plant closures, and consolidation.

While the U.S. tire manufacturing industry sells primarily to the domestic market, the United States has increasingly depended on the export tire market for growth. Since the early 1990s, the ratio of exports to tire product shipments has grown by 100 percent. By contrast, imports' share of total consumption has remained steady at around 20 percent and is not expected to change. By 2003, the long-term trade balance is expected to decrease to net imports of about 10 million for passenger car tires and to net imports of 1 million for light truck tires (RMA, 1999). Imports are also expected to decrease because foreign-owned tire manufacturers are adding capacity in North America to reduce their exports to the United States from their non-U.S. facilities.

2.5.4.4 Price Forecasts

While specific tire price forecasts are not available for this profile, the review of anecdotal evidence suggests that there will be continuing downward pressure on tire prices in the near term for several reasons. First, recent trends in the producer price index shown in

Figure 2-6 indicate falling prices over the last 2 years. In addition, it is expected that a strong dollar relative to Asian currencies combined with a dropoff in demand in the Asian and South American markets is likely to prompt overseas manufacturers to look to the United States and European markets to sell their relatively less expensive tires.

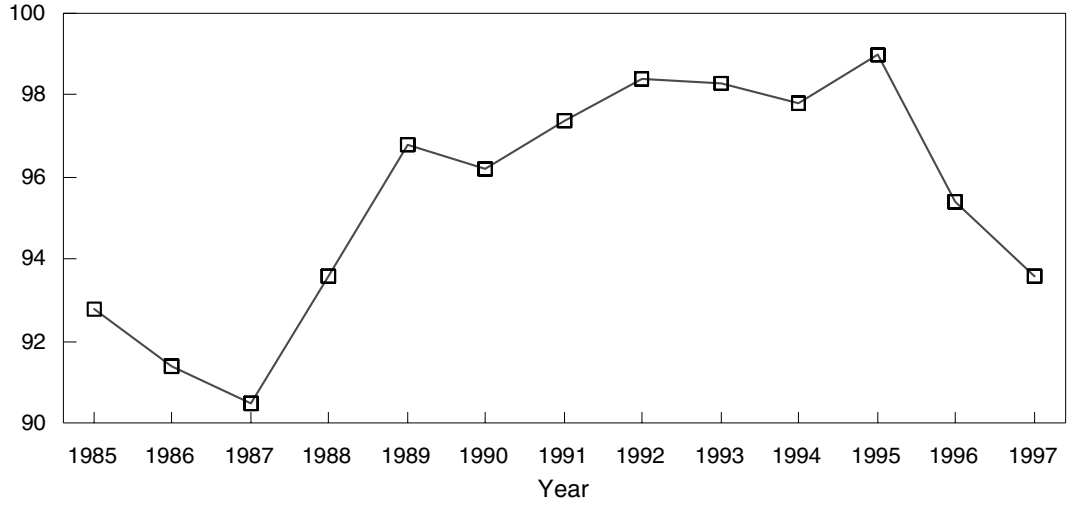

Figure 2-6. Producer Price Index

Base year = 1982.

Source: U.S. Bureau of Labor Statistics (BLS). Producer Price Index—Commodities: WPU071201, Tires: 1990–1998. <http://www.bls.gov>. Obtained January 20, 2000a.

A strong dollar relative to other currencies is also likely to reduce demand for U.S. exports. Some industry analysts expect U.S. firms to use near-term lower prices to gain domestic and international market share as a way of increasing profits in the long run. Finally, increasing efficiency and capacity of domestic production will also result in decreased cost of production. Given the competitive climate anticipated in the future, these conditions are expected to exert price pressure on domestic producers.

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