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Precious Metals

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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 precious metals covers the period 1989 through 1993 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 minerals, metals, and miscellaneous manufactures sector.

USITC publication number	*Publication date*	*Title*
2426	November 1991	Toys and models
2475	July 1992	Fluorspar and certain other mineral substances
2476	January 1992	Lamps and lighting fittings
2504	November 1992	Ceramic floor and wall tiles
2523	June 1992	Prefabricated buildings
2546	August 1992	Agricultural and horticultural machinery
2570	November 1992	Electric household appliances and certain heating equipment
2587	January 1993	Heavy structural steel shapes
2623	April 1993	Copper
2633	June 1993	Textile machinery and parts
2653	June 1993	Glass containers
2692	November 1993	Refractory ceramic products
2694	November 1993	Flat glass and certain flat glass products
2706	April 1994	Aluminum
2738	February 1994	Structural ceramic products
2742	March 1994	Fiberglass products
2748	March 1994	Brooms, brushes, and hair-grooming articles
2756	March 1994	Air-conditioning equipment and parts
2757	March 1994	Builders hardware
2758	March 1994	Semifinished steel
2765	April 1994	Metalworking machine tools and accessories
2872	May 1995	Abrasives
2857	May 1995	Industrial food-processing machinery and related equipment
2858	May 1995	Precious metals

[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.

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INTRODUCTION

Despite their association with wealth, precious metals[1] have important commercial applications. For gold, jewelry manufacture has traditionally been the principal application, accounting for 84 percent of total world fabrication demand[2] in 1993.[3] Platinum is the most important and abundant metal of the platinum group metals (PGMs), and is principally used in *catalysts*[4] for the automotive industry, which accounted for about 42 percent of Western World[5] demand. Jewelry represented another 33 percent of Western World platinum demand.[6] Jewelry and silverware were the world's principal applications for silver in 1993, accounting for 33 percent of silver fabrication demand in 1993. Photography accounted for another 29 percent of silver demand.[7]

Unlike most other industrial commodities, however, these metals have also been regarded for centuries as a storehouse of value. The importance of these metals as financial instruments varies among cultures and countries, with their perceived value often reflecting the risks associated with economic volatility or political instability. In some less developed countries, for example, gold jewelry is commonly considered a more reliable source of wealth and financial independence than local paper currencies. In developed countries with established, stable monetary systems, gold is less likely to be perceived as an essential tool for financial security.

Metals in this group have other commonalities that influence and define their price and global supply. The price of precious metals often reflects global trends in supply and demand, not only of the metals themselves but also of other mineral commodities, as precious metals are often found in association with one another or with base metals in mineral deposits. In such cases, precious metals may be produced in conjunction with other metal ores in the deposit. As a result, the production of one precious or base metal may have an ancillary effect on the global supply of associated metals.

[1] Includes gold, silver, and platinum group metals.
[2] Demand by end-use fabrication industries (e.g., jewelry, electronics).
[3] *Gold 1994*, Gold Fields Mineral Services Ltd., May 1994.
[4] See glossary in appendix A for definition of italicized terms.
[5] For this summary, the term Western World excludes the former Comecon countries and China.
[6] Platinum 1994, Johnson Matthey, May 1994, p. 20.
[7] As represented by demand in the United States, Japan, European countries, and other developed countries. Countries for which data specific to end use are not available accounted for about 4 percent of fabrication demand in 1993. *World Silver Survey 1994*, The Silver Institute, p. 57.

In addition, political and economic stability of producing countries may also influence metal price and consequently the level of investment in the exploration and development of new deposits. Because of the importance of South Africa and the former Soviet Union to the global supply of gold and PGMs, the international market is sensitive to perceived political and economic turmoil in these countries. These concerns are often reflected in rapid and sometimes significant shifts in the price of these metals. A country's perceived instability and associated higher risk may also influence investment decisions by mining companies interested in expanding operations overseas.

In the United States, proposed revisions in procedures for hard rock mining on U.S. public lands would result in modifications in environmental permitting and required reclamation procedures, royalty and patenting requirements, and land access. These changes could affect the long-term viability and investment climate of the U.S. precious metals industries by directly impacting exploration and development activities (appendix B).

Because gold prices and demand are more responsive to investment and financial considerations than is the case for other base and precious metals, trade flows for precious metals as a group may show annual fluctuations driven largely by fiscal factors or other unique circumstances. These conditions may obscure the divergent factors influencing trade of individual precious metals,[8] as shown in the following tabulation:[9]

Product	1989	1993
	—Million dollars—	
Imports—		
Gold	1,498	2,015
Silver	707	437
PGMs	1,382	1,298
Total	3,587	3,750
Exports—		
Gold	2,408	9,034
Silver	274	344
PGMs	404	442
Total	3,086	9,820

[8] See U.S. International Trade Commission (USITC), *U.S. Trade Shifts in Selected Commodity Areas 1993 Annual Report* (investigation No. 332-353), USITC publication 2805, September 1994.
[9] Data reflect trade for refined precious metals and products.

For this reason, this report separately analyzes the competitive factors influencing the gold, silver, and PGM mining and semifabricating industries,[10] U.S. industry performance during 1989-93, and tariff and nontariff measures.

GOLD[11]

Gold is a heavy, soft, ductile, and malleable metallic element that is used primarily in jewelry, dental, and industrial applications and for investment. It is often alloyed with varying percentages of copper and silver; white gold is generally a gold-nickel alloy, and gold for dental applications is alloyed with platinum or palladium. Refined gold products include *bullion* and *dore*. Gold can also be manufactured into a variety of semifabricated products such as wire, tubing, and sheets. Gold for the jewelry industry is often supplied as granules of a designated *karat* content. Other gold products include monetary gold, medals, and coins such as the Canadian Maple Leaf and the South African Kruggerand.

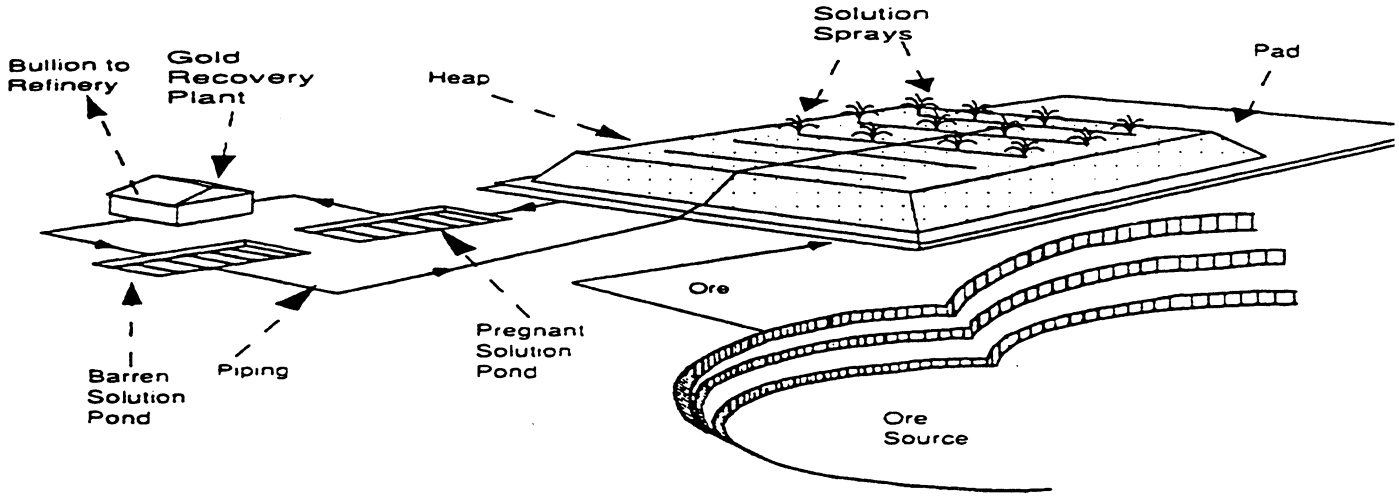
The most common types of gold deposits are *placers* that are often mined by large-scale, low-cost panning or dredging procedures, and *lodes* that can be mined by surface (open-pit) or underground methods. In either method, the gold ore is separated from its associated rock and earth by crushing and *sizing* the gold-bearing materials and then recovering (*refining*) gold by *cyanide leaching*, *amalgamation*, *flotation*, *gravity concentration*, or *smelting*, depending on the type of ore. Cyanide leaching is the most commonly used process throughout the world (figure 1). Residual materials, referred to as *tailings*, may be disposed of in *settling ponds* or recycled if the contained gold ore is determined to be economically recoverable. Gold is also recovered from scrap metal in secondary refining operations.

As the world's second-largest producing country and second-largest source of gold reserves, the United States is a significant supplier to the gold fabrication and investment markets. The United States is a net exporter of refined gold and is an important financial center for world flows of gold bullion. Because of uncertain U.S. environmental and mining regulations, however, the U.S. gold mining industry is looking more closely at overseas investment opportunities, particularly in Latin America, to expand its operations base and to benefit from more attractive regulatory climates.

[10] These industries produce ore and concentrates; nonmonetary metal such as bullion, dore, and semimanufactured forms; waste and scrap; and precious metals for monetary use (i.e., coins). See glossary in appendix A for definition of mining terms.

[11] Information for this section was derived principally from *Gold 1994*, Gold Fields Mineral Services Ltd., May 1994, *World Mine Production of Gold 1993-97*, The Gold Institute, May 1994, and *Mineral Commodity Summaries 1994* and *Gold Annual Report 1992*, U.S. Department of the Interior, Bureau of Mines, except as noted.

Figure 1
Heap-leach process components



Source: *Gold Annual Report 1992*, U.S. Department of the Interior, Bureau of Mines, Nov. 1993, p. 39.

U.S. Industry Profile

Industry Structure

The U.S. gold mining/fabricating industry[12] is currently confronting the challenges posed by relatively low gold prices, including declining profitability and reduced internal funds available for exploration/development. With fewer financial resources available and increasingly favorable investment climates in many gold producing countries, U.S. gold firms are increasing foreign investments. In response to these developments, the industry is consolidating, cutting employment, closing mines, shifting mining plans, and employing more cost effective technologies such as leaching with cyanide solutions.

The U.S. gold reserve base totals 5,000 metric tons (9 percent of world reserves) and is concentrated in the Western United States. Nevada and California accounted for more than 70 percent of production in 1993, with South Dakota and Montana secondary producers. Although several hundred operations mine gold in the United States, about 25 mines—most located in Nevada—account for over 75 percent of all U.S. gold production. Two of these mines, Homestake and Newmont's Carlin mine, are among the world's top 10 gold mines, producing 57 metric tons and 53 metric tons, respectively, in 1993. About 92 percent of lode gold produced in the United States is recovered by the cyanidation process. Less than 10 percent of domestic gold was recovered as a by-product of nonferrous metal mining, chiefly copper; one mine, Bingham Canyon (Utah), produces copper as its primary metal (table 1).

[12] Standard Industrial Classifications 1041, Gold Ores; 3339 (pt.), Primary Smelting and Refining of Nonferrous Metals, Not Elsewhere Classified; 3341 (pt.), Secondary Smelting and Refining of Nonferrous Metals; 3356 (pt.), Rolling, Drawing, and Extruding of Nonferrous Metals, Except Copper and Aluminum; and 3497 (pt.), Metal Foil and Leaf.

About 24 firms refined gold into commercial grades for use in jewelry, industrial, and dental applications, which accounted for 84 percent of 1993 U.S. fabrication demand. Refiners are generally concentrated close to end users in the Northeast States, California, and Texas. Refiners process both primary (from ore) and secondary (scrap) gold, producing an estimated 390 metric tons of gold in 1993. Six refiners represent about 75 percent of domestic refining capacity.[13] Approximately nine firms manufacture semifabricated gold products, such as wire, tubing, and foil.[14]

Another sector of the U.S. gold industry is coins, which includes those of legal tender as well as medals and commemorative coins (i.e., the American Eagle and the Bicentennial and Olympic commemorative coins). The U.S. Mint receives authorization from the President to initiate minting of gold coins, for which the Mint contracts with a gold supplier through a competitive bidding process. About 20 metric tons of gold were used in the production of U.S. gold coins in 1993.

Employment in the U.S. gold mining and milling industry totalled an estimated 14,500 workers in 1993, down from the 1989 level of 15,100 workers. Some gold companies have reduced employment in their administrative offices, generally the most labor intensive area of the industry, because of smaller operating margins and industry mergers and acquisitions. Some of these companies have also responded to continued low gold prices with cutbacks in exploration and mine development personnel.

Production technology and cost structure

Gold mining technology and methodology are long established and universally accessible, with the South African industry often leading technology develop-

[13] John L. Dobra and Paul R. Thomas, *The U.S. Gold Industry 1992*, Nevada Bureau of Mines and Geology, Special Publication 14, 1992, p. 13.

[14] U.S. Department of Commerce, *1987 Census of Manufactures.*

Table 1
Gold mine production: Ten leading U.S. gold-producing mines and location, operator, and source of gold, 1992

Mine and location	Operator	Source of gold
Carlin Mines Complex (Nevada)	Newmont Gold Co.	Gold ore
Goldstrike (Nevada)	Barrick Goldstrike Mines Inc.	Gold ore
Bingham Canyon (Utah)	Kennecott-Utah Copper Corp.	Copper ore
Homestake (South Dakota)	Homestake Mining Co.	Gold ore
Smokey Valley (Nevada)	Round Mountain Gold Corp.	Gold ore
Bullfrog (Nevada)	LAC Minerals	Gold ore
Jerritt Canyon (Nevada)	Independence Mining Co., Inc.	Gold ore
McCoy and Cove (Nevada)	Echo Bay Mining Co.	Gold ore
McLaughlin (California)	Homestake Mining Co.	Gold ore
Paradise Peak (Nevada)	FMC Gold Co.	Gold ore

Source: *Gold Annual Report 1992*, U.S. Department of the Interior, Bureau of Mines, Nov. 1993, p. 30.

ments because of its mines' greater depths and associated hazards. However, 84 percent of gold deposits in the United States are mined by open-pit techniques. These mines require less complex but large-scale technologies for efficient gold recovery and improved competitiveness. As ore grades decline and surface deposits are exhausted, an increasing share of the world's gold will likely be obtained from foreign underground mines that require more expensive and sophisticated technology. Although lode mining operations are more expensive, the overall cost of the operation may be lower because of the availability of higher grade, higher yield ores in such deposits. Simultaneously, improvements in mining technology and extraction techniques are making previously marginal gold mines or currently unproductive mining areas more economically attractive.

Declining extraction and processing costs[15] attributable, in part, to increased economies of scale afforded by the heap-leach production process, contributed to a slightly lower average cost of gold production at U.S. mines in 1993 versus the 1992 level. U.S. gold ores have been determined to average about 1.3 grams per metric ton or less, averaging cash production costs of $216 per ounce in 1993 compared with the Western World average of $233 per ounce.

Patents (claims for federal lands), environmental impact statements, and other compliance activities are both time-consuming and costly.[16] Environmental considerations influence the level of technology and equipment employed in mining/milling, as well as worker health and safety. Because of stringent U.S. environmental regulations, the U.S. gold mining industry is considered to be among the world's leaders in environmental technology and its applications. Environmental regulations imposed at the state and federal levels require extensive capital investment at mine sites. The type and extent of equipment required varies by mine location, but might typically include monitoring and leak detection systems for cyanide recovery and neutralizing processes for spent ore designated for disposal.

Capital expenditures[17]

Because of the substantial costs for exploration, acquisition, and start-up, and the financial risks entailed in mine development, these activities are usually undertaken with the prospect of high gold prices and healthy returns on investment. However, low gold prices have adversely impacted firms' ability to raise capital and have dampened profitability levels, with the result that total capital expenditures by the U.S. industry were expected to decline in 1993.

The ten leading gold producing companies[18] accounted for a significant portion of U.S. industry expenditures on plant, equipment, and development during the last 5 years. Capital expenditures[19] for the U.S. industry are estimated to have exceeded $1.4 billion during 1991-92. Expenditures on property, plant, equipment, and development by the 23 gold firms surveyed fell by 37 percent during 1989-92 to an estimated $551 million. Exploration expenditures by these firms remained fairly stable during 1989-92, ranging between $115 million and $136 million.

Pricing

Gold is traded 24 hours a day on a worldwide basis in such financial centers as London, New York, and Tokyo. Global gold prices reflect investor perceptions of the world's political and economic climate as well as fabrication supply and demand levels. On a local level, gold may be imbued with a higher value because of cultural traditions or economic and/or political instability. Gold prices generally trend inversely to the U.S. dollar's value, that is, if the dollar depreciates relative to other currencies, gold prices usually increase, and vice versa. Gold prices generally declined during 1989-93 because of relaxed international tensions, relatively low world inflation, the global economic slump, and oversupply conditions relative to fabrication demand (figure 2), although the price did increase slightly in 1993 to $360 per troy ounce.[20]

One measure gold producers employ to counter declines in the price of gold is sales in the *futures market* of a substantial portion of gold production, primarily at the London Metal Exchange, locking in sales at higher prices but also capping any potential price increases. Gold producers are active in these

[15] Extraction and processing reportedly accounted for 82 percent of the 1992 average cash cost of $254 per ounce for the 50 U.S. gold mines surveyed in *The U.S. Gold Industry 1992*, Nevada Bureau of Mines and Geology, Special Publication 14, 1992. This cost averaged $91 less than the 1992 average gold price of about $345 per ounce, a decrease in operating margin of 38 percent from 1990. As a result, U.S. mining companies operated with less discretionary profit.

[16] For example, for 18 months Battle Mountain has been trying to gain the necessary mining permits (56 permits from 32 different agencies) to proceed with its Crown Jewel gold mine in Washington, and expects the process to continue for at least another 6 months in the face of environmentalist opposition. The permitting process and the environmental impact statement are adding $5 million to the original $70-million development costs. "Going South: U.S. Mining Firms, Unwelcome at Home, Flock to Latin America," *Wall Street Journal*, June 18, 1993, p. A1.

[17] *The U.S. Gold Industry 1992* is the primary source of information for this subsection.

[18] Newmont Gold, Homestake Mining, Echo Bay Mines, American Barrick, Independence Mining, Pegasus Gold, Gold Fields, FMC Gold, AMAX Gold, and Santa Fe Pacific Minerals.

[19] Defined as property, plant, equipment, development, and exploration.

[20] Bar hoarding and net implied (dis)investment account for the difference between total private sector supply and fabrication demand.

hedging strategies, which provide a degree of insurance against losses. For example, American Barrick is probably one of the most successful U.S. gold companies employing hedging.[21] In 1992 the firm's hedging practice brought $422 per ounce compared to the average world price of $345 per ounce. Gold sales are currently hedged two years in advance, at prices exceeding $400, with the expectation that gold prices will be below the $400 level.[22]

Foreign investment

Relatively low gold prices have refocused U.S. industry investment strategy abroad as companies seek to improve their profit margins and reduce average costs by acquiring and developing higher grade, lower cost deposits. In addition, uncertain domestic environmental and tax/royalty regulations have reportedly deterred significant new investment in domestic gold reserves.

With the enactment of new mining laws in many Latin American countries,[23] this area is one of the most attractive for investment because of the availability of numerous untapped gold reserves, reduced political risk, and mining investment promotion by foreign government and business leaders.[24] During 1989-92, U.S. investment in Latin American gold exploration more than doubled to $35 million, representing 15 percent of the U.S. industry's 1992 exploration expenditures. During this period, the number of U.S. gold producers active in the Latin American gold industry rose from seven to fifteen firms. Recent projects include:

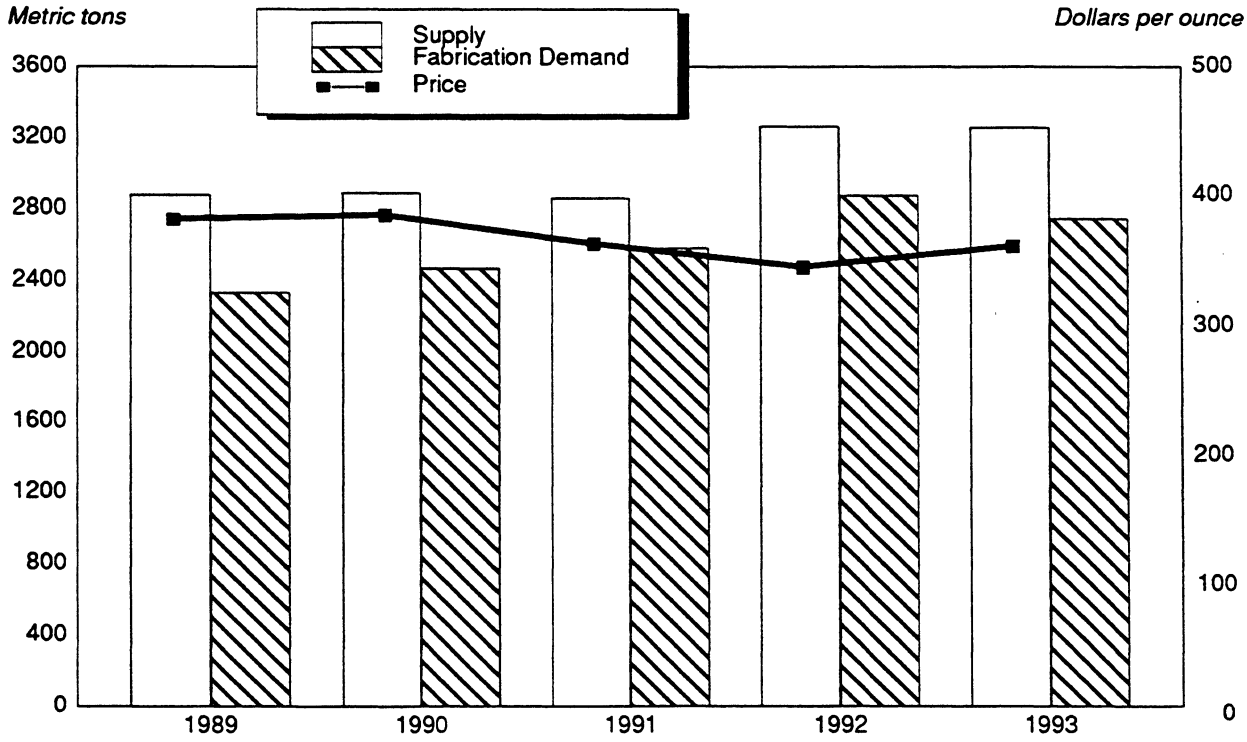
[21] "...but American Barrick celebrates a golden decade," *E&MJ Mining Activity Digest*, Mar. 3, 1993, p. 1.

[22] In such a scenario, American Barrick would be profiting in two years from the difference between the expected gold price of less than $400 and the gold contract price exceeding $400 per ounce. If the actual gold price exceeds the contract price, American Barrick still profits but at a lower margin, which is the "cost" of reducing the risk to losses.

[23] These laws have included measures to eliminate foreign ownership restrictions, to allow the repatriation of profits, to open public lands for minerals exploration, and to encourage joint ventures, for example. *The Search for Gold: U.S. Producers Look Abroad*, The Gold Institute, Feb. 1993, pp. 5-6.

[24] *The Search for Gold: U.S. Producers Look Abroad*, pp. 5-7.

Figure 2
Western world gold supply/demand, 1989-93



Note.—Supply includes mine production and old gold scrap; also includes official sales and bar hoarding and investment when acting as additions to supply.

Source: Gold Fields Mineral Services.

- the La Candelaria copper/gold project (Chile), with ore reserves of about 400 million tons containing an estimated 3 million ounces of gold, for which Phelps Dodge recently received $290 million in financing.[25]

- Battle Mountain's $235-million investment in the Kori Kollo gold mine in Bolivia with an estimated gold deposit of 4.7 million ounces.[26]

- AMAX Gold's acquisition in April 1992 of a 90-percent interest in the Guanaco mine (Chile), with annual production of 80,000 ounces of gold.[27]

U.S. investment in Mexico during the same period rose from less than $500,000 to roughly $12 million, about 5 percent of the U.S. industry's exploration budget.[28]

Foreign investment in U.S. gold production is dominated by Canadian and British interests. Estimates vary, but suggest that Canadian firms own 14 to 16 percent of domestic production whereas British interests account for 6 to 17 percent.[29]

The ownership of U.S. gold reserves is similar, with the United States owning the majority of reserves and Canadian and British investment secondary. Canadian mining companies, however, emerge as more significant players in the U.S. industry from this perspective, controlling roughly 25 percent of property associated with U.S. gold reserves.

The United States also serves as a major gold refining site. For example, gold from Canada is frequently processed by U.S. refiners because of their cooperative relationship and established linkages with Canadian companies.

[25] "Financing Pact Set for La Candelaria Project," *AMC Journal*, July 1993, p. 22.

[26] "Going South: U.S. Mining Firms, Unwelcome at Home, Flock to Latin America," *Wall Street Journal*, June 18, 1993, p. A1.

[27] *Mineral Industry Surveys, Gold and Silver April 1993*, U.S. Department of the Interior, Bureau of Mines, June 16, 1993, p. 2.

[28] For example, Hecla is developing the LaChoya gold mine near Hermosillo where reserves total 179,000 ounces. "Hecla Develops Au and Ag Mines," *Metals Week*, July 5, 1993, p. 3.

[29] In terms of total stock ownership of U.S. gold mining companies, about 58 percent of U.S. gold production is controlled by U.S. precious metals firms, compared to nearly 17 percent for British firms and 16 percent for Canadian mining companies. From the perspective of ownership of the controlling interest in U.S. gold firms (i.e., the number of firms majority-owned by U.S. or foreign companies), U.S. firms account for 76 percent of domestic gold production, Canadian firms 14 percent, and British companies 6 percent. *The U.S. Gold Industry 1992*, p. 25.

Consumer Characteristics and Factors Affecting Demand

Price is often the most important determinant affecting the quantity of gold demanded by the consuming industries such as dental, electronics, and jewelry industries, which accounted for 5 percent, 19 percent, and 60 percent, respectively, of U.S. fabrication demand in 1993 (figure 3). For example, in the case of gold jewelry, which is generally considered a luxury item, relatively higher prices and economic slowdowns can dampen the demand for gold. As a result, consumers may shift to less expensive gold jewelry options such as gold-plated or gold-filled pieces, or to other substitutes such as silver or costume jewelry.

In electronic applications such as plating contact points in switches and relays, where gold is valued because of its electrical conductivity, ductility,[30] and freedom from oxidation or tarnishing, substitution is more limited. Many end-users in the electronics and dental industries have made concerted efforts to reduce gold usage in response to previous periods of high prices. In dental applications, palladium-based alloys have been developed as a less expensive alternative to gold alloys in fillings.

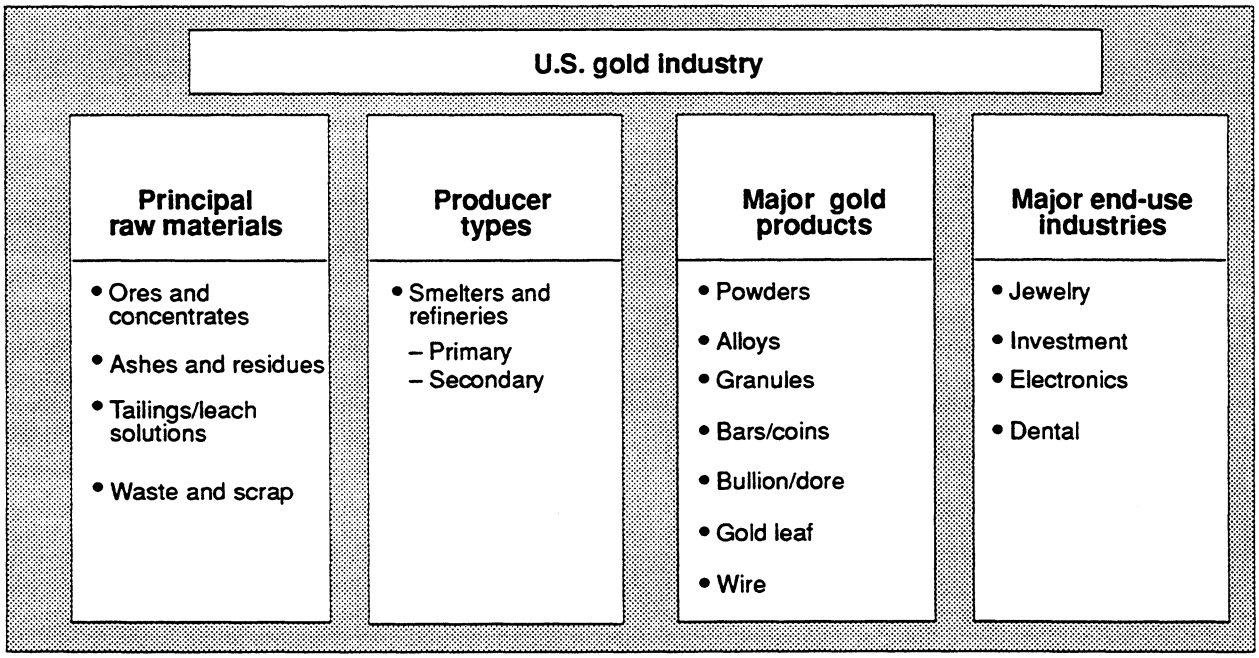
During the period, gold prices have performed more like "ordinary" commodity products, that is, they were generally more responsive to supply and demand conditions in fabricating end-use industries rather than political and financial determinants. As a result, gold prices stabilized within a low range and did not exhibit the volatility noted in previous years. Global demand for gold as an investment vehicle, however, is still strong. Gold's use as a financial instrument is tied closely to investor perceptions and the activity of central banks. Hedging has declined in recent years as inflation has remained relatively stable and international political and military tensions have eased. As a result, some investors have turned to other investment vehicles, such as foreign currencies, to generate risk-related profits.

Central banks, particularly those of developed countries, have traditionally been major holders of gold stocks as part of their official reserves, with approximately 29 percent (36,300 metric tons) of the world's above-ground gold stocks. The U.S. Department of the Treasury maintains bullion stocks that remained relatively unchanged during the period, amounting to nearly 8,150 metric tons in 1993. These stocks include gold held in the Exchange Stabilization Fund that is used to support the dollar's value on international exchange markets.

The actions of central banks in the gold market can be a powerful influence on the price of gold and

[30] The capacity of a metal to elongate without cracking or breaking when being drawn or pulled.

Figure 3
U.S. gold industry: Principal raw materials, producer types, major products, and major end-use industries



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

therefore the valuation of other banks' reserves and industry earnings. Several central banks' position in gold fluctuates with the gold price; that is, the value of their holdings changes with the price of gold.[31] Central bank sales and purchases are often conducted discreetly, with minimum market disturbance. These sales are often undertaken to improve asset flexibility for quicker reactions to currency exchange fluctuations or balance of payment requirements. For example, sales can be arranged with other central banks that are seeking to increase their reserve position in gold, or can be phased in over a period of years, such as Canadian gold sales during the last decade that reduced its reserve reliance in gold from 80 percent to less than 30 percent.

Although U.S. and foreign commodity exchanges are not consumers in the traditional sense of the word, the stocks held by these exchanges are part of the gold supply. These markets serve as warehouses and trading centers for physical gold, such as bullion bars and to a lesser extent coins, medals, and jewelry.

Foreign Industry Profile

As with most metal ores, the location, size, and grade of the deposits are the principal factors determining those countries that play an important role in gold mining and production. There are no significant technological differences that provide advantages to certain countries. The world gold reserve base totals about 57,000 metric tons (table 2). As the locations of sizeable gold reserves, South Africa, the former Soviet Union, Australia, Canada, and Brazil are among the world's largest gold producing countries apart from the United States, accounting for 59 percent of 1993 world mine production of 2,281 metric tons. Of these countries, only Australia and Canada are projected to increase gold mine production during 1993-97, when global mine production is projected to rise by 6 percent to 76.7 million troy ounces (2,386 metric tons).[32] Many of these mining industries confront the same price-related problems as those of the U.S. industry, including declining profitability, mine closures, and reduced exploration and development expenditures. In addition, many of these industries have other concerns that are unique to their particular political or geological situation, as discussed below.

South Africa

As the world's largest gold producing country with about 27 percent of world production, South African

[31] The United States, however, values its gold reserves at $42.22 per troy ounce.

[32] Global and individual country output projections represent an aggregate of individual companies' reported plans for gold mine production during 1994-97, as reported in *World Mine Production of Gold 1993-97.*

Table 2
Gold mine production: World reserves and mine production, by selected countries, 1989, 1993, and projected 1997

Country	Production		Projected	Reserve base[2]
	1989	1993	1997[1]	
	1,000 troy ounces			*(Metric tons)*
South Africa	19,530	19,917	17,436	29,000
United States	8,532	10,610	11,658	5,000
Australia	6,545	7,864	9,163	2,700
Former Soviet Union[3]	9,774	7,700	7,700	7,780
Canada	5,128	4,925	5,309	3,300
China	2,765	4,083	5,555	(4)
Brazil	3,307	2,251	2,251	1,200
All other	9,689	14,798	17,650	(4)
World total	65,270	72,148	76,722	57,000

[1] Projections based on numerous companies' mining plans for 1993-97; events such as strikes, closures, and floods not factored into projections.
[2] The reserve base includes demonstrated resources that are currently economic and marginally economic, as well as some reserves that are subeconomic. World total excludes China and other countries for which data are not available.
[3] Estimated.
[4] Not available.

Source: Production figures for 1989 from *Gold 1992*, Gold Fields Mineral Services Ltd., May 1992, and for 1993 and projected 1997 from *World Mine Production of Gold 1993*, May 1994, The Gold Institute, and reserve base figures from *Mineral Commodity Summaries*, Jan. 1994, U.S. Department of the Interior, Bureau of Mines, p. 73.

mine production was nearly double that of the second largest producer, the United States, despite the economic and financial pressures placed on South African mines because of low gold prices and high production costs. The nature of many South African ore deposits require deep underground mines, averaging 6,600 to 9,800 feet below the surface,[33] which increases health and safety risks. South African producers have been at the forefront of specialized equipment and technology improvements for use in deep underground mines, such as technologies to control *rockbursts* and stress, and new techniques of shaft sinking, mineral processing, and extraction. With the mining of some deeper reserves and higher grade ore deposits that will be depleted, insufficient capital expenditures on operating mines, and the closure of marginal mines, gold production is projected to decline by 12 percent during 1994-97.

South African mines belong to groups or "houses," such as Gold Fields of South Africa, Johannesburg Consolidated Investment Co. Ltd., Anglo American Corp., Anglovaal, Gencor Ltd., and Rand Mines Ltd. A trend within the South African industry has been to "unbundle" their business interests into smaller, more manageable and efficient operating units. The Chamber of Mines of South Africa represents about 36 mines from these groups. The South African gold mining industry is generally more labor intensive than those of other major gold producing countries because underground mines are not as easily mechanized as open-pit deposits. The industry employed an average of about 437,000 mostly low skilled or semiskilled workers in 1991, an 18-percent workforce reduction since 1988 in an effort to lower production costs and increase productivity.[34] Annual average employment in the South African gold industry is estimated to have fallen below 400,000 in 1992.[35]

Factors contributing to a 5-percent decline in production costs for the South African industry during the period include the mining of higher grade materials,[36] a weaker rand, stable capital expenditure levels, and industry rationalization. Despite the decline in production costs, South Africa remains one of the highest cost gold producing countries, averaging about $262 per troy ounce in 1993 compared to the average Western World cost of $233 per troy ounce.

Currency fluctuations play an influential role in determining the financial situation of South African gold producers, however. A decline in the value of the

[33] Future South African mining is intended in ultradeep mines at depths of about 15,000 feet below surface.

[34] *South Africa's Mineral Industry 1991/92*, Republic of South Africa's Department of Mineral and Energy Affairs, Minerals Bureau, p. 19.

[35] From the Chamber of Mines of South Africa as presented in "Gold Bust Strains South Africa Transition: The Poor Find Little Comfort in Promise of Democracy," *Wall Street Journal*, July 8, 1993.

[36] Average grade ore in 1992 was 5.37 grams per metric ton compared to 5.20 grams per metric ton in 1991.

South African rand versus the U.S. dollar diminishes the effect of low gold prices on the earnings of South African mining companies, and vice versa. The rand's weakness could also improve the status of marginal gold mines in South Africa. Since 1989, gold prices denominated in rand increased by an estimated 18 percent to R856 in 1993.[37]

As in all producing countries, however, the principal adversity that South African mines currently confront is the relatively low world price of gold, which has reduced industry profitability and heightened risk for mining investments. Although the 1993 average world price of $360 per ounce represents a reversal in the downward price trend, low gold prices during the period were below the production costs of many mines, compelling companies to close mines, layoff workers, reduce mine development and expansion, and initiate company reorganizations.

Political insecurity also adversely affects the South African mining industry. Although labor upheaval and political strife have been relatively isolated occurrences and official sanctions against South Africa have ended, the uncertain climate has inhibited foreign investment despite the apparent attractiveness of South African mining shares. Declining foreign investment has contributed to the lack of capital needed for the financing of future projects.

Australia

During the past decade when higher gold prices attracted investment, the Australian industry underwent considerable exploration and development, as reflected in increased production levels. As the world's third largest gold producer, Australia accounted for 11 percent of production in 1993 and 5 percent of world reserves. The State of Western Australia accounted for more than 70 percent of Australian gold production. Western Mining Corp., the largest gold producing company in Australia, accounts for more than 20 percent of Australian production from interests in nine Australian mines.

The weaker Australian dollar is believed to have influenced (U.S. dollar denominated) average cash production costs, which fell by 6 percent during 1989-93 to $231 per ounce, slightly below the world average. Because of lower production costs and increased exploration, Australian gold production is projected to increase by 17 percent during 1994-97 as larger mines are explored and developed.[38]

Recent changes in Australian tax regulations were also integral factors contributing to these production increases. Prior to January 1, 1991, mining companies were exempt from paying taxes on profits from gold production. As a result, in 1990 many Australian mining firms reportedly boosted production levels and mined higher grade ores to take advantage of the last year of the exemption. The repeal of this exemption also extends to byproduct gold production, which for some copper operations represents 40 percent of annual income.[39]

A recent issue affecting the Australian gold mining industry is land access. The Native Title Act was enacted in 1993, and allows aboriginals to claim title to land where continuous association is proved. This law could affect up to 30 percent of Australian land.

The Former Soviet Union

State financial support for gold mines in the former Soviet Union (FSU) has been reduced or suspended, a particularly debilitating action for those mines that are not considered economically viable, given the current low gold prices in tandem with low ore grades, concerns about environmental degradation, and high labor costs. This situation is exacerbated by wage and material cost increases resulting in part from price decontrol. Because of insufficient state financing and capital investment, lack of necessary supplies/equipment, general economic upheaval, and reduced military demand, industry sources estimate that production will likely remain unchanged from its 1993 level of 7.7 million troy ounces, which represents a 20-percent drop from the 1989 total.

Gold reserves in the former Soviet Union are estimated to represent 14 percent of the world total.[40] The FSU is believed to be the world's fourth largest producer of gold, with two-thirds of gold production mined in Russia; other FSU gold sources include Uzbekistan, Ukraine, and Kazakhstan.

The decentralization of the economic and political structures of the FSU eliminated the state monopoly on gold production and export, causing confusion and disorganization for suppliers and purchasers accustomed to working with known state authorities. As production and related decisions have shifted from the government to individual mines, RosAlmaZoloto, the former Soviet state monopoly producer of gold, has emerged as a mediator between these sectors.

Under the current system, all production of gold in the Russian Federation is supposed to be sold to the State Committee on Precious Metals (the authorized government purchaser) to be stockpiled; the Finance Ministry then decides how much to sell in domestic and export markets. The former Soviet Union traditionally sold gold on the world market to generate hard currencies, periodically contributing to lower

[37] *Gold 1990* and *Gold 1994*.

[38] The Kanowna Belle mine started production in 1993, for example, with output of 1.7 metric tons.

[39] *Gold Annual Report 1990*, p. 13.

[40] Because of the breakup of the Soviet Union and the limited availability of official production data from there, most figures provided by government and industry consultants are estimates and may vary from source to source.

world prices. The future of such sales by the Russian Federation is uncertain. Central sales may decline due to interest by some former Soviet republics in retaining future gold supplies as reserves for their newly formed central banks. Within Russia, for example, breakaway regions such as Magadan and Yakutia are exerting power to retain control of their mining operations and associated revenues. However, hard currency proceeds of gold are reportedly often maintained in foreign, rather than Russian, bank accounts, providing incentives for further sales of gold to increase overseas hard currency holdings beyond the reach of authorities. To encourage miners to sell gold to the official sector, miners received higher monthly adjusted prices (paid in part with hard currency) for their gold. However, payments fell behind by the end of 1993 and unofficial sales were on the upswing again.[41]

In response to these unstable economic conditions, many former Soviet republics have acted independently to attract the technological, economic, and managerial assistance of Western mining companies such as Cyprus Mines (United States), Newmont Mining (United States), and Goldbelt Resources (Canada) for joint mining ventures and mine rehabilitation. The issue of foreign investment has caused much dissension among a number of political factions in the different republics. Foreign investment in Russian precious metal mining entities has generally been limited to management of selected deposits and commissions.

Canada

Canadian gold production accounted for 7 percent of world mine production in 1993. Canada's mine output is projected to increase by about 8 percent through 1997 as at least two mines are expected to open during this period[42] despite a shift in Canadian investment to Latin America. Employment in Canadian gold mines was 10,937 workers in 1990, the latest data available. The provinces of Ontario and Quebec were the leading producing regions. Several of Canada's principal gold producing companies are shown in the following tabulation:[43]

Company name	Annual capacity
	Metric tons of ore
Placer Dome Inc (Ontario, Quebec, British Columbia)	7,100
Royal Oak Mines Inc (Northwest Territories, Ontario)	5,548
Hudson Bay Mining and Smelting Co (Manitoba)	2,412 plus 2,600 kgs. of metal

In response to depressed gold prices, numerous Canadian gold mines closed during the period because of the uneconomical mining conditions. However, other higher cost mines were able to reduce total production costs by employing more efficient mining technologies and exploiting higher grade ores. These cost reductions contributed to an overall 11-percent decline in the average Canadian cash production cost to $222 per troy ounce in 1993, about 5 percent below the world average.

U.S. investment in the Canadian industry remained relatively stable during the period, totalling $26 million in 1992. Declining prices and related profitability concerns, and more attractive investment sites such as those in Latin America, reduced the number of U.S. producers in Canada from 13 in 1989 to ten in 1992.[44] Despite this reduction, the U.S. and Canadian industries retain strong linkages, in part because of cross-border gold refining.

Brazil

Brazilian gold mine production is projected to remain unchanged during 1994-97 due primarily to the absence of any relaxation of Brazilian foreign investment laws. Because of the limitation on foreign ownership to minority status, lower than average cash production costs of $202 per ounce for Brazilian gold mines have not been sufficient to induce significant foreign investment.

Gold mine production declined by 32 percent during 1989-93 due to a decline in *garimpeiros'* (independent miners) gold production. Unlike other major producing countries, these independent miners have accounted for over one-half of Brazilian gold output in certain years. Garimpeiros' production was adversely affected by a variety of factors, including inclement weather conditions, stricter environmental regulations, reduced ore grades, and the government's relocation of one-quarter of garimperios from the Yanomami Indian reserve.[45]

[41] President Yeltsin decreed an end to the state monopoly of gold purchases in December 1993; its effect on future gold production is uncertain.

[42] The Eskay Creek gold/silver mine is expected to start up in early 1995, and the Colomac mine is being reopened by Royal Oak.

[43] *Mineral Industries of Latin America and Canada, 1992 International Review*, Bureau of Mines, U.S. Department of the Interior, 1994, p. 140.

[44] *The Search for Gold: U.S. Producers Look Abroad.*

[45] *Gold 1990*, p. 19 and *Gold 1992*, p. 24.

Major Brazilian gold producing companies include Mineracao Morro Velho S.A., Sao Bento Mineracao S.A., and Companhia de Mineracao e Participacoes.[46]

U.S. Market

Consumption

U.S. consumption levels of refined gold for fabrication rose slightly during the period, as shown in the following tabulation:[47]

Year	Quantity
	Metric tons
1989	230
1990	216
1991	202
1992	219
1993	233

The upturn in consumption of refined gold in 1992 corresponded with the decline of the price of gold to its lowest level (about $344 per ounce) during the 5-year period.

Traditional methods to measure consumption do not always accurately reflect U.S. market conditions. Investment and official sector (central banks)[48] gold contribute to the total supply, in addition to U.S. production, but are not actually consumed by industries or other end users. The use of fabrication demand as a measure of gold consumption by end-use industries reduces the duplication factor of gold ores/concentrates that are refined into gold products.

In addition, U.S. import and export data often include monetary bullion that is not for consumption in the U.S. market, and therefore is not considered when determining consumption levels. U.S. gold imports can be held as stocks which can be released from reserves at the request of foreign holders, or gold imports can be reexported after refining.

Production

Future U.S. primary gold production levels will likely reflect fluctuations in the world gold price and the status of the U.S. regulatory climate. Based on mining firms' current estimates, U.S. gold mine production is projected to grow by 10 percent during 1994-97 to 11.7 million troy ounces (about 363 metric tons).[49] However, a less favorable regulatory environment or lower world prices could lessen that level because of reduced exploration/development and closure of marginal mines. U.S. production of refined gold products will also be influenced by the condition of the global economy and consumer spending levels, and would likely benefit from lower world gold prices, unlike gold mine production.

U.S. gold mine production rose during 1989-1993 to 336 metric tons (about $3.9 billion) with the opening of new mines and the mining of higher grade ores, as shown in the following tabulation:

Year	Quantity	Value
	Metric tons	*Million dollars*
1989	266	3,258
1990	294	3,630
1991	296	3,445
1992	329	3,639
1993	336	3,889

With gold prices between $380 per ounce and $385 per ounce during 1989-90, domestic mining companies operated with a comfortable profit margin and were encouraged to invest in further exploration and development in the United States. These expansions have abated somewhat with lower gold prices, but contributed to a 14-percent production increase during 1991-93.[50]

Primary refinery production, which increased during 1989-92 to 284 metric tons, declined slightly in 1993 to an estimated 260 metric tons. Secondary refining, including *toll refining*, reached 130 metric tons.

Imports

Imports of gold ores and concentrates were negligible during the period; nearly all gold mined is processed at mills and refineries before shipment. As one of the world's leading financial centers, however, significant amounts of refined gold, particularly bullion, routinely enter the United States for account to other countries' central banks or for sale at commodity exchanges. The value of U.S. imports of refined gold during the period rose by 35 percent to $2.0 billion in 1993 (table 3); the quantity is also believed to have increased during this period, although data for 1993 are unavailable.[51]

Nonmonetary gold bullion, primarily from Canada, represented 74 percent of U.S. gold imports in 1993. Canada was the leading source of U.S. imports of

[46] *Mineral Industries of Latin America and Canada, 1992 International Review*, p. 74.

[47] These figures represent the amount of gold consumed in fabricated products only, and exclude monetary gold bullion.

[48] These gold sources include stocks held by U.S. industry and the Commodity Exchanges Inc., gold contained in imported coins, foreign gold stocks held by the Federal Reserve, and gold futures contracts.

[49] *World Mine Production of Gold 1993-97*, p. 2.

[50] Expansions at the Goldstrike and McCoy/Cove mines in Nevada contributed 13.2 metric tons to U.S. gold production in 1993. *Gold 1994*, p. 21.

[51] According to the Bureau of Mines, gold imports (excluding monetary gold and gold fabricated products) totalled 174 metric tons in 1992, up from 153 metric tons in 1989.

Table 3
Refined gold and gold products: Value of U.S. imports for consumption, by principal sources, 1989-93

(In millions of dollars)

Source	1989	1990	1991	1992	1993
Canada	896	430	1,158	1,242	1,594
Uruguay	8	11	52	58	75
South Africa	(1)	(1)	0	(1)	63
Chile	94	87	113	84	56
Switzerland	228	273	224	52	40
Bolivia	26	79	64	40	27
Peru	5	57	95	37	25
Ecuador	2	5	1	10	24
Dominican Republic	70	70	61	21	24
Mexico	102	4	5	9	12
All other	67	65	163	346	74
Total	1,498	1,081	1,936	1,899	2,014

[1] Less than $500,000.

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

refined gold and gold products during 1989-93, with 79 percent of total imports in 1993. Other suppliers included Uruguay, South Africa, and Chile, representing a cumulative 10 percent of 1993 U.S. imports.

U.S. imports of gold coins[52] totalled $206.2 million in 1993. South Africa, the United Kingdom, Mexico, and Canada were principal suppliers in 1993, with 59 percent of gold coin imports. These coins included the Canadian Maple Leaf, the South African Kruggerand, and the Mexican peso bullion coins.

U.S. Trade Measures

The rates of duty for column 1 countries and special rates of duty appear in table 4 (see app. C for explanations of tariff and trade agreement terms). Gold ores and concentrates,[53] gold powders, bullion and dore, monetary gold, and gold waste and scrap enter free of duty; other gold forms, including semimanufactured gold, enter free of duty from Israel, eligible GSP, Andean, and CBERA countries as well as Mexico and Canada under the terms of the North American Free Trade Agreement. There are no known U.S. nontariff measures affecting imports of gold and gold products.

Foreign Markets

Foreign Market Profile

Because of the international nature of the gold market and gold's significance as a financial instrument, the traditional concept of a foreign consuming market with competition between low cost suppliers does not always apply.[54] While the world's major fabrication centers for gold jewelry—Italy, India, Japan, Taiwan, and Turkey—are promising export markets for U.S. producers of semifinished and fabricated gold, other countries and territories, such as Switzerland, the United Kingdom, and Hong Kong, are the locations of principal financial centers. These centers, which have been major U.S. export markets during the period, trade physical gold as well as paper gold (e.g., futures and options contracts), establish gold prices, and hold gold stocks for the reserve accounts of foreign countries.

Canada has also been a principal U.S. export market because of the link between Canadian companies and their U.S. mining subsidiaries and because of the gold refining services performed in the United States for Canadian interests.

China has recently emerged as the world's leading gold market for consumer purposes, with purchases in excess of an estimated 320 metric tons (10.3 million ounces) in 1993, much of it in the form of pure gold jewelry. Chinese gold production — at 127 metric tons in 1993 — is significantly lower than the 1993 consumption level of 420 metric tons.[55] Inflation, larger incomes, and currency devaluation have contributed to the growth in gold purchases by Chinese consumers. Such purchases are viewed as likely to continue unless the government takes measures to control inflation. In addition to consumer demand, the Chinese Government is believed to have purchased most of the gold sold (about 12.9 million ounces) by the Dutch central bank in late 1992.[56]

[52] Statistics on imports of monetary gold (HTS 7108.20.00), that is, coins for legal tender, are not collected.

[53] A tariff of 1.7 cents per kilogram applies to the lead content of gold ores and concentrates.

[54] See explanation in the U.S. consumption section.

[55] "Chinese Gold Demand Falls But Remains High," *Metal Bulletin*, July 28, 1994, p. 19.

[56] "China Now the Big Spender on Gold," *New York Times*, May 21, 1993, p. D1.

Table 4
Refined gold and gold products: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1994; U.S. exports, 1993; and U.S. imports, 1993

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1994		U.S. exports, 1993	U.S. imports, 1993
		General	Special[1]		
				Million dollars	
2616.90.00[2]	Precious metal ores and concentrates other than silver ..	1.7¢/kg on lead content	Free (CA, E, IL, J, MX)	3	12
7108.11.00	Gold powder, nonmonetary	Free		2	11
7108.12.10	Gold bullion and dore, nonmonetary	Free		8,296	1,630
7108.12.50	Nonmonetary gold, other than bullion and dore	8.2%	Free (CA, E, IL, J, MX)	51	53
7108.13.10	Gold leaf	3.1%	Free (A, CA, E, IL, J, MX)	2	4
7108.13.50	Semimanufactured forms of nonmonetary gold, other than gold leaf	8.2%	Free (CA, E, IL, J, MX)	48	242
7109.00.00	Base metals or silver, clad with gold, not further worked than semimanufactured	20%	Free (A, CA, E, IL, J, MX)	17	9
7112.10.00	Waste and scrap of gold	Free		617	65

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); North American Free Trade Agreement - goods from Canada (CA); Caribbean Basin Economic Recovery Act (E); Andean Trade Preference Act (J); United States-Israel Free-Trade Area (IL); and North American Free Trade Agreement - goods from Mexico (MX).

[2] Includes gold and precious metal ores and concentrates other than silver; trade data for this item are not included in aggregate import and export tables.

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

U.S. Exports

As a result of an estimated 520 metric tons of gold bullion released to the market from foreign stocks held by the New York Federal Reserve Bank,[57] U.S. exports of nonmonetary gold bullion spurred a nearly 4-fold overall export increase during the period to $9.0 billion in 1993 (table 5). The quantity of U.S. exports is believed to have increased at least commensurately, although data for 1993 are unavailable.[58]

Principal U.S. export markets, accounting for nearly 75 percent of U.S. exports in 1993, were the major world financial centers located in the United Kingdom and Switzerland. These two countries accounted for 83 percent of the gold bullion export flow in 1993. Canada was the third largest U.S. market in 1993, with 9 percent of U.S. exports. Canada was the principal market for gold waste and scrap exports, accounting for 56 percent ($343.6 million) of these exports in 1993. Most waste and scrap is refined into bullion bars.

U.S. exports of gold ores and concentrates were negligible. U.S. gold coin exports, such as the American Eagle, totalled $65.5 million in 1993, the lowest level for the period. Switzerland, Japan, and Mexico accounted for 68 percent of these exports in 1993.

Foreign Trade Measures

U.S. exports of gold began to enter Canada and Mexico duty free as of January 1, 1994 under the terms of the North American Free Trade Agreement (NAFTA). U.S. exports to Japan enter free of duty except for the category of base metals or silver clad with gold, which has a rate of duty of 4.8 percent. EU tariffs on gold imports from the United States range from free to 5.3 percent.

The Government of India lifted its ban on the importation of gold in February 1992 by permitting returning and non-resident Indians to bring in a maximum of 5 kilograms of gold every six months with a payment of 220 rupees per 10 grams,[59] thereby reducing gold smuggling and lowering the price of gold on Indian markets.

U.S. Trade Balance

The United States maintained a trade surplus in refined gold and gold products throughout 1989-93, amounting to $7.0 billion in 1993. Although the United States had a trade deficit with Canada for most years of the period, which reached $774 million in 1993, a trade surplus existed for many other major trading partners, such as the United Kingdom and Switzerland.

SILVER[60]

Silver is a critical metal used in many industrial applications. The metal and its compounds are valued for high conductivity, corrosion resistance, clarity enhancement in photographic uses, strength, malleability, and shine. Despite growth in industrial and fabrication demand and reported supply tightness, increases in silver holdings[61] contributed to sustained low prices during the 1989-93 period. Although silver is also purchased as an investment tool, the metal has lost much of its luster as a financial instrument with the rather precipitous decline to about $5 an ounce from its highest average price of $20.65 per ounce in 1980.[62]

[57] *Mineral Commodity Summaries 1994*, p. 73.

[58] According to the Bureau of Mines, gold exports (excluding net bullion flow, official monetary gold, and gold fabricated products) totalled 369 metric tons in 1992.

[59] *Gold 1992*, p. 49.

[60] Information for this section was derived principally from *World Silver Survey 1994* and *World Mine Production of Silver in 1993*, The Silver Institute, 1994, and *Mineral Commodity Summaries 1994* and *Silver Annual Report 1992*, U.S. Department of the Interior, Bureau of Mines, except as noted.

[61] Includes U.S. government stocks, U.S. dealer inventories, and commodity exchange registered stocks.

[62] The average monthly silver price peaked in January 1980 at $38.28.

Table 5
Refined gold and gold products: Value of U.S. exports of domestic merchandise, by principal markets, 1989-93

(In millions of dollars)

Market	1989	1990	1991	1992	1993
United Kingdom	401	688	607	998	3,902
Switzerland	535	646	761	547	2,838
Canada	365	523	425	489	820
Taiwan	3	3	44	475	376
Hong Kong	490	382	712	518	298
France	231	336	328	354	293
Germany	46	97	61	105	188
Mexico	95	91	80	179	115
Japan	78	16	75	139	58
Malaysia	9	11	14	39	24
All other	155	191	188	216	122
Total	2,408	2,984	3,295	4,059	9,034

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

Over one-half of all silver ores are commonly found in association with copper, lead, and zinc deposits, and are produced as a byproduct at minimal extra cost.[63] Less than 20 percent of domestic silver mine output is produced from silver ores. Base metal ores are usually processed by the flotation method, whereas gold and silver ores are generally treated by cyanidation. Base metal concentrates are smelted, from which the silver is recovered (figure 4). Refined silver is manufactured into bars, grains,[64] sheet, strip, foil, powder, and wire, rod, and tubing products.

Silver is also recovered by the secondary refining industry from remelted coins, jewelry, photographic film, and electronic silver scrap. Secondary silver production, however, has become less economically viable with the decline in the price of silver.

Because the U.S. silver mining and milling industry[65] is generally encompassed within base metal or other precious metal operations, the level of silver production more often reflects economic conditions of associated metal industries rather than economic fundamentals related to silver alone.[66] Despite the U.S. industry's position as the world's second largest silver producer, the United States is a net importer of silver, in part because of the dependence of silver output on the production levels of other metals. This situation has been exacerbated by the relatively low silver price, which has contributed to the closure of several silver producers during the period.

[63] Base metal deposits account for about two-thirds of world silver reserves, whereas the remaining one-third of reserves are located in deposits for which gold or silver are the principal ores.

[64] Grains are produced by pouring molten silver into water, yielding granular silver particles.

[65] Standard Industrial Classifications 1044, Silver Ores; and 3339 (pt.), Primary Smelting and Refining of Nonferrous Metals, Not Elsewhere Classified.

U.S. Industry Profile

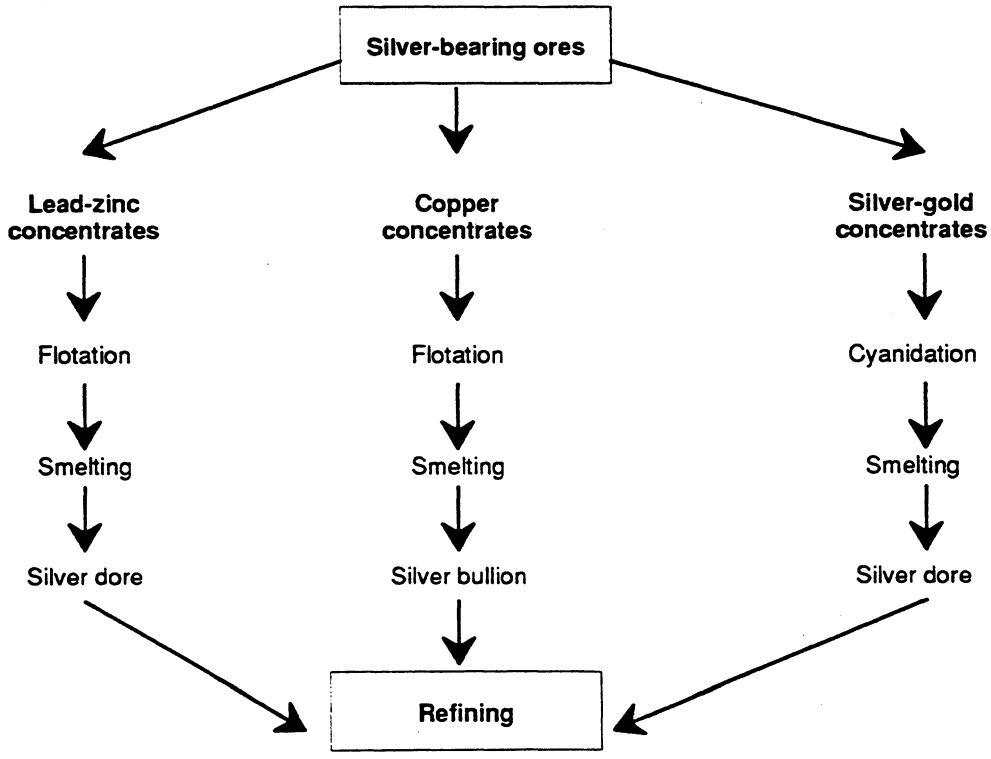
Industry Structure

The United States is the world's second largest silver producing country, and has the world's largest silver reserve base[67] (figure 5). Nearly 75 percent of domestic production in 1993 originated in the Western States of Nevada, Idaho, Arizona, and Montana. There are approximately 120 mines currently in production in about 17 States, a 25-percent decline from 160 mines in 1989. Most of these mines produce silver as a

[66] About 67 percent of 1993 silver mine production was a byproduct or coproduct of other metal output.

[67] Includes silver that is recoverable from base metal ores.

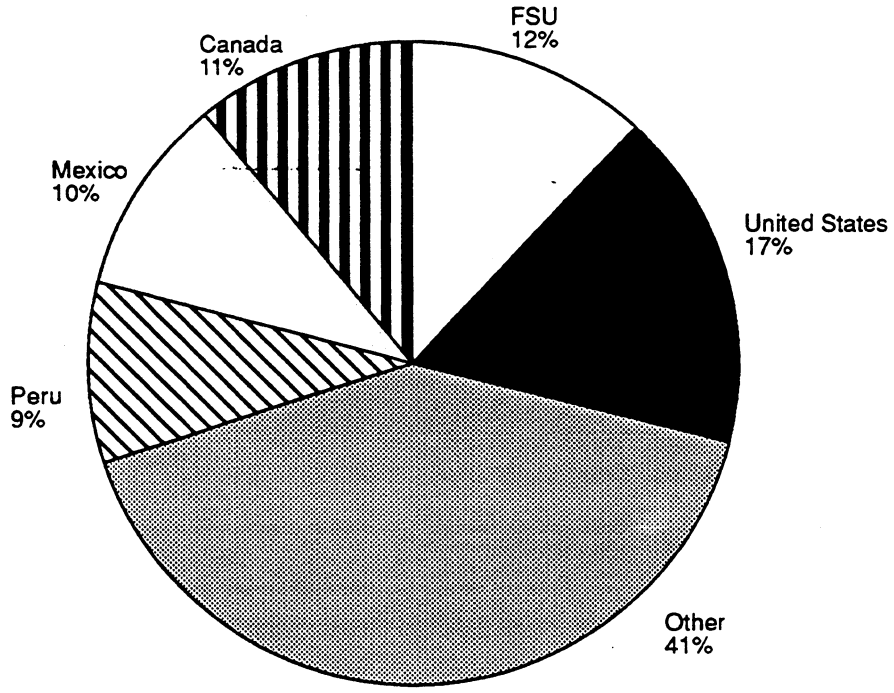
Figure 4
Silver recovery processes



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

Figure 5
Silver reserve base

(In thousand metric tons)



Source: *Mineral Commodity Summaries 1994*, Bureau of Mines, U.S. Department of Interior.

byproduct of other base and precious metal production. Eighteen of these mines[68] accounted for 79 percent of U.S. silver mine output in 1992. Of the ten leading U.S. silver-producing mines in 1992, only two produced silver as the primary ore (table 6). Four of these mines[69] were among the world's ten leading silver-producing mines in 1992. Sixty percent of U.S. silver mine production was obtained from copper and gold lode mines in 1992.

Mining companies are generally vertically integrated in milling and refining operations but not into fabricating operations. These firms are also horizontally integrated in that they mine and refine other base and precious metals. There are approximately 22 refiners of commercial-grade silver, most of which use primary metal rather than scrap because of low silver prices; currently less than 10 percent of U.S. silver refining is believed to be secondary (old scrap) production. Approximately 10 firms manufacture semifabricated silver products, such as plate and sheet. These firms are located primarily in the Northeast near principal end-users.

[68] Those mines producing in excess of 30 tons of silver annually.

[69] McCoy/Cove, Greens Creek, Rochester, and Bingham Canyon.

U.S. companies mining silver as a primary metal are generally more sensitive to the economic and financial consequences of low silver prices than are mining operations extracting other ores as well. Several leading primary and secondary producers closed or restructured during 1993 because of low silver prices. For example:

- Sunshine Mining Co., the largest domestic primary silver producer, operated at about 50 percent of capacity during 1992, and production declined by another 200,000 ounces in 1993 as the result of a rockburst.[70] Sunshine has been losing money at silver prices around $4.00 an ounce since its production costs exceed $5.00 an ounce.[71] Sunshine continues to operate, however, as current cash outlays are reportedly significantly less than would be required to operate at full capacity or to shut the mine and cover costs such as company debt, employee

[70] "Sunshine Mining Has a Net Loss of $42.2 Million for 1993, vs. $14.3 Million in 1992," *Mining Journal*, Apr. 1, 1994, p. 243.

[71] Sunshine announced a net loss of $42.2 million for 1993, which includes an extraordinary charge to retire remaining 8-percent bonds. "Sunshine Mining: Has Announced a Net Loss of $42.2 Million for 1993, vs. $14.3 Million in 1992."

Table 6
Silver mine production: Ten leading U.S. silver-producing mines and location, operator, and source of silver, 1992

Mine and location	Operator	Source of silver
McCoy/Cove (Nevada)	Echo Bay Mining Co.	Gold ore
Greens Creek (Alaska)[1]	Greens Creek Mining Co.	Zinc ore
Rochester (Nevada)	Coeur Rochester Inc.	Silver ore
Bingham Canyon (Utah)	Kennecott-Utah Copper Co.	Copper ore
Troy (Montana)[2]	ASARCO Incorporated	Copper ore
Red Dog (Alaska)	Cominco Alaska Inc.	Zinc ore
Sunshine (Idaho)	Sunshine Mining Co.	Silver ore
Lucky Friday (Idaho)	Hecla Mining Co.	Lead/zinc ore
DeLamar (Idaho)	NERCO DeLamar Co.	Gold ore
Paradise Peak (Nevada)	FMC Gold Co.	Gold ore

[1] Greens Creek, a lead/silver/zinc/gold mine, closed in early 1993 because of low metal prices. "Kennecott Closing Greens Creek Mine Because of Prices," *American Metal Market*, Feb. 18, 1993, p. 2.
[2] The Troy silver/copper mine closed in April 1993 because of low metal prices and declining output. "Troy Mine to Close," *Mining Journal*, Feb. 26, 1993, p. 147.

Source: *Silver Annual Report 1992*, U.S. Department of the Interior, Bureau of Mines, Dec. 1993, p. 13.

pensions, and environmental requirements (e.g., land reclamation).[72] The firm spent more than $1 million in 1992 on exploration for higher grade ores that can be profitably mined at current silver prices.

- The Greens Creek mine (Alaska), the largest U.S. silver mine[73] which also produced lead, zinc, and gold, closed in early 1993 because of low metals prices and higher costs associated with its location on Admiralty Island. Kennecott Corp, which owns 54 percent of the mine operated by Greens Creek Mining Co.,[74] plans to maintain operating permits and continue development in anticipation of higher metal prices.[75]

- The Troy copper/silver mine (Montana), owned and operated by ASARCO, closed in April 1993 in response to low metal prices and declining output. Although the mine was scheduled to be phased out when ASARCO's Rock Creek mine opened, the company decided to hold Troy's silver reserves and to resume operations when prices improve.[76]

Of the 25 leading U.S. silver-producing mines in 1990, five were Canadian-owned and one was German-owned. The interrelationship of silver mine production with that of other ores makes a more precise assessment of industry globalization difficult. Silver was produced as a byproduct at all six of these foreign-owned mines. Many U.S. mining companies operating abroad are also mining silver as a byproduct of other metals production, and specific information on silver operations is unavailable. However, major U.S. producers of silver have a significant number of foreign investments in Canada, and to a lesser extent in New Zealand, Australia, and South America.

Employment

The processing, refining, and fabricating of silver is relatively capital intensive and requires considerable plant and equipment expenditures and a skilled, higher wage labor force.[77] Employment in the silver mining and milling industry totalled an estimated 1,500 workers in 1993 compared to about 2,800 employees in 1989. The decline in employment during the period resulted in part from lower silver prices which reduced the operating rates at some silver mines and caused many closures. Those mines producing primarily silver were most affected by the silver price decline.

Production costs

The cost of producing an ounce of silver from all sources ranges between $1.00 to $8.00, depending upon ore grade, mine depth, location, and amount of byproduct metals. Primary silver mines are usually higher cost because of the absence of coproduct metal production. When processing silver ores, such environmental factors as water treatment, air quality

[72] "This Month in Mining," *Engineering and Mining Journal*, Feb. 1993, p. 22.
[73] 1992 silver output approached 7 million ounces (about 215 tons).
[74] Other partners include Hecla Mining Co. (28 percent), CXS Corp. (12 percent), and Exalas Resources of Canada (6 percent).
[75] "Kennecott Closing Greens Creek Mine Because of Prices," *American Metal Market*, Feb. 18, 1993, p. 2.
[76] "Money-Losing ASARCO Drop Polish Offer; To Shutter Troy," *American Metal Market*, Feb. 15, 1993, p. 1 and "Mine to Close," *Mining Journal*, Feb. 26, 1993, p. 147.
[77] The weekly wage for silver ore mining employees averaged $758 in 1992, compared to an overall U.S. weekly average of $498 for private industry and government employees. *Employment and Wages Annual Averages 1992*, U.S. Department of Labor, Bureau of Labor Statistics, Oct. 1993, pp. 6-7.

control, and tailings disposal must be addressed, as well as worker health issues such as worker exposure to airborne particulate silver.[78]

Pricing

Although silver is also a metal traded on a number of international financial markets, its price is more responsive to changes in industrial demand than are prices for other precious metals such as gold and platinum. The silver price is therefore generally more stable than that of gold or platinum. Although fabrication demand for silver increased during 1989-93 and exceeded global silver supply during 1990-93, large silver inventories held by commercial and private sources in part have reportedly filled this gap and suppressed potential price increases. Silver prices declined by nearly 22 percent during the period to an average of $4.30 an ounce in 1993 (figure 6).

Consumer Characteristics and Factors Affecting Demand

The quantity of silver and silver products demanded is principally driven by three factors: end-use demand, especially by the photographic industry (figure 7); consumer spending habits for jewelry and silverware; and price in the financial markets. Although alternative materials compete with silver in certain applications, the metal's current low price is a deterrent to widespread substitution for silver.

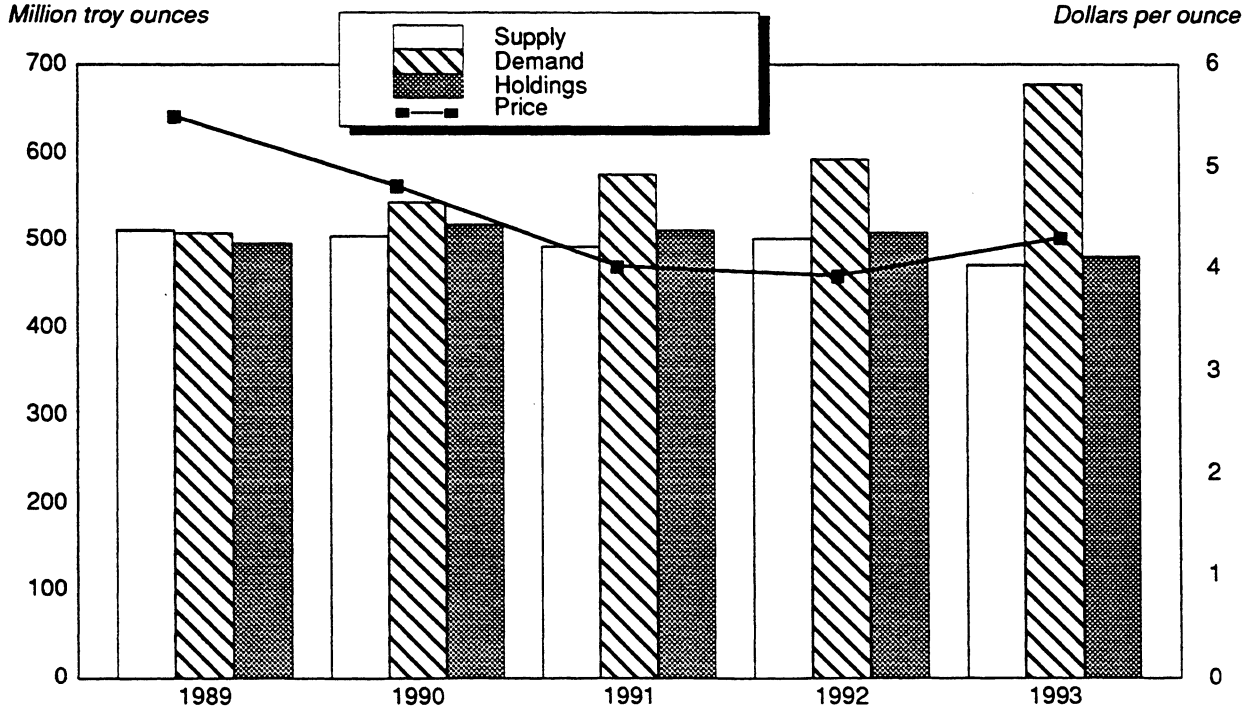
Photography is the principal application for silver, in the form of silver salts; photography applications[79] in the manufacture of film, photographic paper, x-ray film, photocopying paper, and other light sensitive media accounted for 50 percent of U.S. silver fabrication demand in 1993 (figure 8). When treated with photographic developers, silver salts produce a negative image of the original object, with image clarity and intensity determined by the level of light to which the silver was exposed. Although the thickness of silver coatings for photographic paper has decreased due to improvements in silver utilization, a growing photography market will likely boost silver consumption over the next 5 years by an estimated 11 percent.[80]

[78] The Occupational Safety and Health Administration limits the concentration of either silver metal or soluble silver compounds to less then 0.01 milligram per cubic meter of ambient air in workplaces.

[79] Includes amateur and professional products; x-rays; graphic arts; motion pictures; microreproduction; and miscellaneous applications. "Silver-Based Photography: Today and Tomorrow," a paper by Peter Krause, reprinted in *World Silver Survey 1992*.

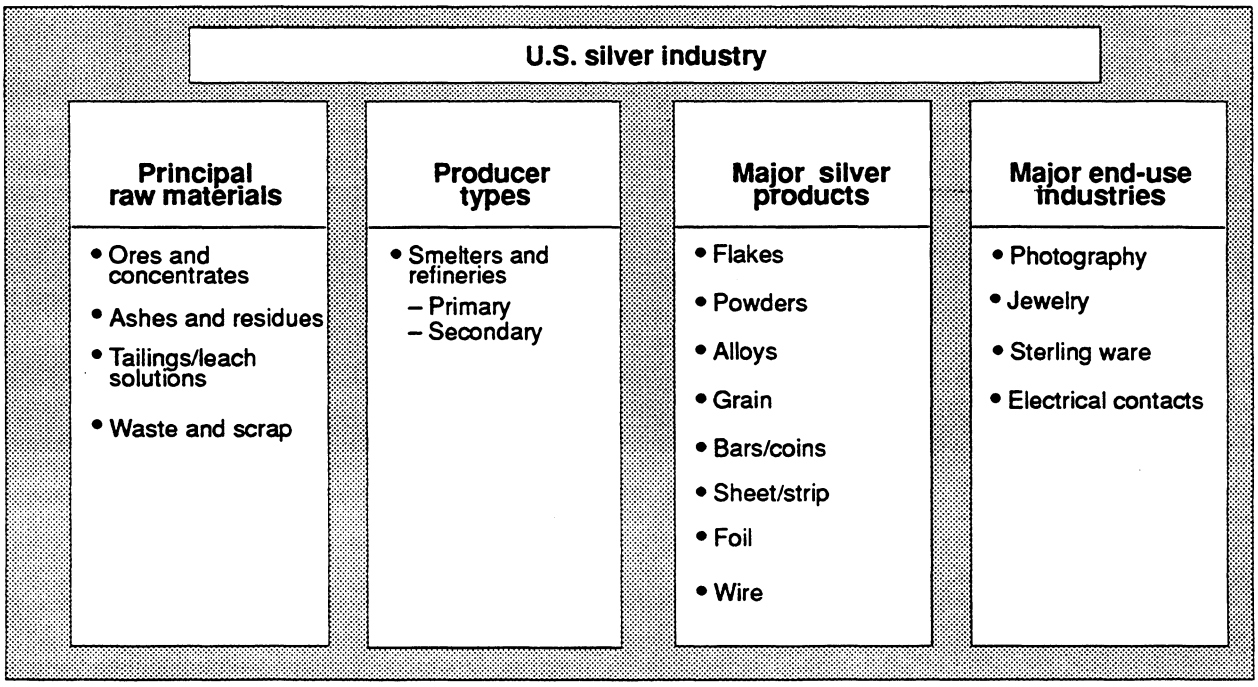
[80] "Silver-Based Photography: Today and Tomorrow."

Figure 6
Global silver supply and demand, 1989-93



Source: *World Silver Survey 1994*, The Silver Institute.

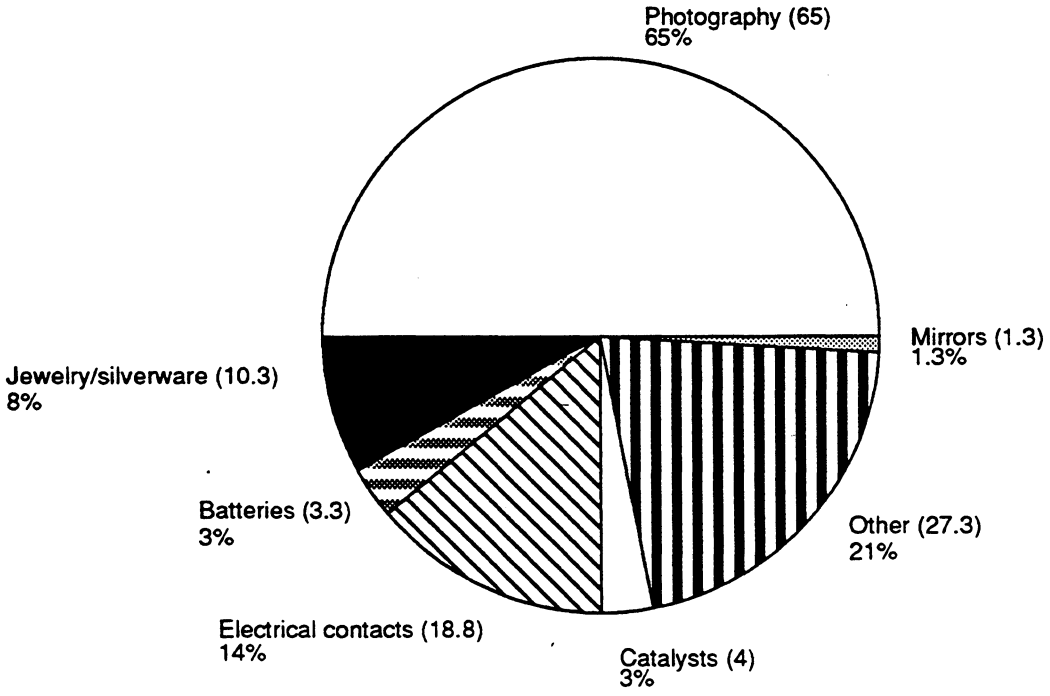
Figure 7
U.S. silver industry: Principal raw materials, producer types, major products, and major end-use industries



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

Figure 8
U.S. silver industrial demand, 1993

(In million troy ounces)



Source: *Mineral Commodity Summaries 1994*, Bureau of Mines, U.S. Department of Interior.

Alternatives to silver in some photographic applications include silverless black and white film and xerography. In addition, recent announcements by Xerox and Polaroid of the development of non-silver halide-based films have increased speculation about future silver demand by the photography sector. Xerox has developed a selenium/polymer film for the graphic arts sector that reportedly provides photographic resolution equal to, or better than, the silver halide coating.[81] The new film, called VerdeFilm, is undergoing test trials and will be marketed by Xerox with firms in the graphic arts industry.[82] Polaroid's Helios laser imaging is a dry process used in medical applications, such as X-rays and MRI scans. Testing is expected to continue through mid-1995 before a decision on commercial availability is considered.[83]

Although electrical and battery applications for silver were adversely affected by the 1990-92 economic slowdown,[84] such use increased by 3 percent from the 1992 level to 22.1 million ounces in 1993 as industrial demand improved. Electrical and battery applications accounted for 17 percent of U.S. silver consumption in 1993. Because of its high electrical and thermal conductivity, silver is used as an electrical contact material for switching devices and is often alloyed with other metals to improve strength or wear in other electronic applications. However, gold and PGMs may substitute for silver in electrical applications when improved resistance to oxidation is important. Batteries are another important end-use of silver, although cost considerations generally limit the use of silver to defense and space applications where reduced weight and size are important. Possible alternatives for silver in battery applications include lithium-based cells.

As secondary U.S. applications for silver, consumer demand for jewelry and silverware[85] is related to the health of the economy as a whole, the level of discretionary consumer spending in particular, and the relative price of silver. Demand for these articles also depends on consumer preference; alternative items such as gold jewelry and stainless steel flatware are highly competitive in terms of quality and appearance.

Foreign Industry Profile

The location of economically mineable deposits generally determines the major silver producing countries. Those countries, other than the United States, that produced in excess of 20 million troy ounces of silver in 1993 were Mexico, Peru, the former Soviet Union, Canada, Australia, Poland, and Chile (table 7). Of these countries, Mexico, Australia, Peru, and Canada are projected to increase silver mine production from present levels, as world production is projected to increase by 7 percent during 1993-97 to 466.6 million troy ounces.[86] For many of these countries, silver is produced as a byproduct or as a co-metal of base and other precious metals mining. Increased attention to environmental issues, silver's low price, improved investment climates, and/or changes in base and precious metal mining industries are contributing factors to the overall health and competitiveness of a nation's silver mining industry.

Mexico

Mexico is the world's single largest silver producing country,[87] accounting for about 15 percent of world production, and serves as a major exporter to the world market.[88] An 18-percent increase in mine production is projected by 1997, and because of its large ore reserves, Mexico should continue to be a major source of silver for many years. However, low prices have caused the closure of numerous small mines and independent operators, and have forced larger mines to streamline and improve production efficiencies. As a result, Mexican silver production declined by 10 percent during 1989-91. The closure of the Real de Angeles mine in 1993 resulted in a 6-percent drop from the 1992 production level to 61 million troy ounces in 1993.[89]

Some of the smaller silver mines have experienced cash flow problems[90] and higher operating costs because of the more modest scale of their operations and reduced accessibility to equipment and capital. These smaller firms have traditionally been in the forefront of exploration which has then been brought

[81] "Silver Market Dips with Xerox Film Development," *Metal Bulletin*, Nov. 4, 1993, p. 8.

[82] "Xerox Silver-Free Film Causes Stir," *Photographic Trade News*, Jan. 1994, p. 8.

[83] "Silver Bounces Back from Polaroid Selloff," *Platt's Metals Week*, Dec. 6, 1993, p. 4.

[84] Silver fabrication demand in this sector declined by 17 percent during 1990-92 to 21.4 million troy ounces.

[85] Sterling silver is commonly used to produce these articles.

[86] Global and individual country output projections represent an aggregate of individual companies' reported plans for silver mine production during 1994-97, as reported in *World Mine Production of Silver in 1993*.

[87] About 60 percent of Mexican silver mine production is byproduct or coproduct output; the remaining 40 percent is primary silver production.

[88] The United States has traditionally been Mexico's principal export market, accounting for over 65 percent of Mexican exports; Japan and the United Kingdom are secondary markets.

[89] Real de Angeles, a large open pit mine and Mexico's second largest silver producer, is a joint operation of Empresas Frisco S.A. (51 percent) and Placer Dome of Canada (49 percent). Most of its silver was contained in lead concentrates that were smelted and refined by Met-Mex Penoles. The mine closed in April 1993 because of low ore grades and recovery rates, but resumed production and was operating at full capacity in January 1994.

[90] *World Silver Survey 1992*, p. 16.

Table 7
Silver mine production: World reserves and mine production, by selected countries, 1989, 1993, and projected 1997

Country	Production 1989	Production 1993	Projected 1997[1]	Reserve base[2]
		Million troy ounces		*(Metric tons)*
Former Soviet Union[3]	64.7	65.2	65.2	50,000
Mexico	70.0	61.0	71.9	40,000
United States	60.8	56.0	50.1	72,000
Peru	56.8	47.0	48.1	37,000
Australia	37.3	39.1	46.6	(4)
Chile	17.7	32.9	32.2	(4)
Canada	41.3	27.9	41.0	47,000
Poland	34.0	25.7	25.7	(4)
All other	86.3	82.3	85.8	(4)
World total	468.9	437.1	466.6	420,000

[1] Projections based on numerous companies' mining plans for 1993-97; events such as strikes, closures, and floods not factored into projections.
[2] The reserve base includes demonstrated resources that are currently economic and marginally economic, as well as some reserves that are subeconomic.
[3] Estimated.
[4] Not available.

Source: Production figures for 1989 from *World Silver Survey 1994*, 1994, and for 1993 and projected 1997 from *World Mine Production of Silver in 1993*, May 1994, The Silver Institute, and reserve base figures from *Mineral Commodity Summaries 1994*, Jan. 1994, U.S. Department of the Interior, Bureau of Mines.

into production by larger mining firms.[91] The larger mines, which account for 85 percent of Mexican silver production, have greater access to domestic and foreign financing because of their established reputations, and are reportedly increasing their use of satellite technology to identify and locate possible silver deposits.[92]

The Mexican silver mining industry, like that of the United States, is vertically integrated into refining and smelting operations, and is also diversified into other base and precious metals because of the polymetallic nature of Mexican ore deposits. Silver output is concentrated in three states[93] which accounted for 62 percent of production in 1991.[94] The industry is generally owned by Mexican private interests, although several U.S. and Canadian firms are known to be equity partners in some silver-producing mines that are operating units of large Mexican mining groups. Because the Mexican government emerged as a principal buyer[95] of silver with the issuance of two bimetallic (silver/nickel) coins in 1993,[96] coinage accounted for over one-half of Mexican silver fabrication demand in that year. Secondary end-use markets in Mexico included photography and jewelry.

Mexico also has a significant secondary industry that recovers silver from materials such as jewelry and decorative items for re-use by other craftsmen. Secondary production is generally unreported, although believed to be a significant source of silver for the Mexican fabrication market.[97]

Peru

Peru's mine production is expected to increase by 2 percent by 1997 to 48.1 million troy ounces as its economic recovery and improved investment prospects draw foreign attention. The Peruvian government is pursuing privatization of certain state-owned entities, including Centromin, Peru's largest mining company,[98] in an effort to generate needed capital. In addition, the government is promoting investment opportunities for minerals exploration and development.[99]

Peruvian silver mine production remained relatively steady during 1989-91, but dropped by 17 percent during 1992-93 in response to economic and

[91] "Silver slump brings havoc to Mexican miners," *Metal Bulletin Monthly*, Feb. 1993, pp. 35-39.
[92] "Mexican silver close to melt-down," *Financial Times*, May 6, 1993.
[93] Zacatecas, Chihuahua, and Durango.
[94] Data provided from Semip, the Ministry of Mines, in "Silver slump brings havoc to Mexican miners," p. 37.
[95] Penoles has been awarded the contract to supply the silver for these coins.
[96] "Silver slump brings havoc to Mexican miners," p. 37.
[97] *World Silver Survey 1992*, The Silver Institute, p. 31.
[98] Centromin produced 17.3 million troy ounces of silver in 1993, about 37 percent of Peru's silver output. "Peru to Assume Environmental Debt of Centromin Mining Complex," Knight-Ridder, NewsEdge, Aug. 15, 1994.
[99] *Mineral Industries of Latin America and Canada, 1990 International Review*, Bureau of Mines, U.S. Department of the Interior, 1992, p. 291.

security problems. The Peruvian industry was buffeted not only by low prices, but also poor financial conditions, unfavorable exchange rates, inflation, terrorist activities, and labor disruptions. In response to declining prices, during the late 1980s the industry cut employment, deferred exploration projects, and concentrated mining on high grade materials, which reduces costs in the short term but may decrease the life of the mine and increase future operating costs.[100] In addition, many Peruvian mining companies reportedly lacked the equipment, technology, and cash to continue operations.

About 45 percent of Peruvian silver mines are considered marginal at current silver prices,[101] and an increasing share of silver output is byproduct/coproduct from lead and zinc mines.[102]

The Former Soviet Union

The political and economic turmoil in the republics of the former Soviet Union (FSU) has impacted local mining industries, with production projected to remain at an estimated 65.2 million troy ounces during 1994-97, relatively unchanged from the 1989 amount. The former Soviet Union has the world's second largest silver reserve base (50,000 metric tons), and, as a group, the countries of the FSU were believed to be the world's largest silver producer in 1993.

About 90 percent of the FSU's silver production is byproduct metal, particularly from nickel, cobalt, and copper deposits. Kazakhstan is believed to be the principal producing region with estimated production of 32.2 million troy ounces in 1993, although labor disruptions contributed to production declines there in 1990 and 1991. Russia, another important FSU source with estimated production of 27.3 million troy ounces, produces silver principally as a byproduct.

Canada

With improved metal fundamentals and greater byproduct output because of increased base and precious metal mining, the Canadian silver mining industry is projected to increase silver production by 47 percent during 1993-97, at which time Canada is likely to account for 8.8 percent of world silver production, compared to 6.4 percent in 1993. Canadian silver output declined by 32 percent during 1989-93 to 27.9 million troy ounces because of a drop in lead and zinc production, from which silver is produced as a byproduct.

[100] *Mineral Industries of Latin America and Canada, 1990 International Review*, p. 277.

[101] *World Silver Survey 1992*, p. 17.

[102] This share rose from 73 percent in 1989 to 85 percent in 1993.

Canada's reserve base is located primarily in Ontario, Quebec, and British Columbia. Like other major producing countries, much of Canada's silver mine production is byproduct metal,[103] which generally reflects the economic conditions for these metals rather than silver. Three major Canadian silver producers, all of which are located in British Columbia, are shown in the following tabulation:[104]

Company	Annual capacity
	Metric tons
Similco Mines Ltd.	[1]8,250
Equity Silver Mines Ltd.	[2]2,970
International Corona Corp	[3]1,320

[1] Capacity for silver/gold/copper concentrates.
[2] Capacity for silver/gold/copper concentrates; Equity closed during fourth quarter 1992 when the mine reached the end of its planned life.
[3] Mill feed.

Australia

Australia is projected to increase silver production during 1993-97 by 19 percent to 46.6 million troy ounces. This growth reflects increased base and other precious metal production because nearly all of Australia's silver output is byproduct. Two of the world's ten largest silver-producing mines are located in Australia. Mount Isa, owned by MIM Holdings, is the world's largest silver-producing mine, with output of 17.8 million ounces (555 tons) of silver as a byproduct of copper mining. The Broken Hill mine, a zinc/silver deposit, increased output 14 percent during 1991-92 to 5.4 million ounces (169 tons).[105]

Australian silver production rose by 8 percent during 1989-92 principally because of increased byproduct production from gold mining. The tax exemption on the gold industry, which was lifted in 1991, resulted in a production rush in 1990.

Poland

Polish silver mine production deteriorated with the economic rationalization and environmental-related closures of the Polish copper industry, which mines silver as a byproduct. Silver mine production fell by an estimated 24 percent during 1989-93 to 25.7 million troy ounces, and is projected to remain at this level through 1997. The major elements of the restructuring of the Polish copper industry are believed to be completed, which should stabilize silver production.

Because internal industrial demand has also declined as Polish industries have experienced cutbacks and closures, silver export levels have

[103] At least 80 percent of Canadian silver production is a byproduct or coproduct of other metal production.

[104] *Mineral Industries of Latin America and Canada, 1992 International Review*, p. 142.

[105] "Silver Survey," *Mining Journal*, May 28, 1993.

remained comparable to those that occurred during high silver/copper production periods.[106]

Chile

Although the regulatory environment and economic conditions have improved, Chilean silver output is projected to remain relatively unchanged at around 32 million troy ounces through 1997, in part because of higher production costs at base metal and other precious metal mines from which silver is produced as a byproduct. Silver output was relatively stable during 1989-91 until the La Coipa mine[107] came into full production in 1992, at which time silver production rose by 52 percent to 33.1 million troy ounces. Production fell slightly in 1993 to 32.9 million troy ounces.[108]

About 22 percent of Chile's silver output results as byproduct from Codelco's copper operations. Other major silver producers include San Cristobal, Niugini, and El Indio.[109]

U.S. Market

Consumption

The United States is the world's single largest market for silver. U.S. fabrication demand for silver remained relatively steady during the period, ranging between 127 and 134 million troy ounces; demand was 130 million troy ounces in 1993. U.S. imports accounted for a significant share of the value of U.S. consumption during the period because U.S. silver fabrication demand[110] exceeds U.S. production levels.

Another source of silver for consumption are stocks held by industry and the commodity exchanges, and the U.S. Government. The level of U.S. Government stocks[111] declined during the period as the U.S. Mint issued coins under new programs (e.g., Eagle silver bullion coins) with silver from the National Defense Stockpile (NDS).[112] Less than 2,000 metric tons of silver are currently held in the NDS, and the stockpile is expected to be totally depleted by 1998.[113] In addition, the U.S. Treasury Department sold a share of its excess silver inventories at auction, with remaining stocks[114] amounting to an estimated 700 metric tons by yearend 1993. Inventories held by industry and commodity exchanges also declined from the 1992 level by an estimated 11 percent to about 9,000 metric tons in 1993 in response to greater fabrication demand.

Production

Because of uncertain investment and mining conditions as well as depressed silver prices, domestic silver production is projected to decline by 11 percent through 1997 to 50.1 million troy ounces. Silver mine production is often tied directly to output levels of other base metals, and its supply is often unresponsive to changes in its price. U.S. mine production declined by 8 percent during 1989-93 to 56 million troy ounces.

U.S. production of refined silver and silver products generally declined during the period as low metal prices continued to pressure industry financial conditions, contributing to mine closures. Secondary (old scrap) recovery is estimated to have fallen by nearly 72 percent during 1989-93 to an estimated 200 metric tons, accounting for 10 percent of refinery production.

Imports

The United States has traditionally been a net importer of refined silver and silver products. U.S. imports of silver rose by 36 percent during 1989-93 to 4,500 metric tons, whereas the value declined by 38 percent to $437 million (table 8) in conjunction with the declining silver price during the period. About 68 percent of the imports are silver bullion, used for investment purposes or for commercial applications. Silver dore, which is usually refined into semifabricated products such as bars, rods, and sheets, is the second largest import category, accounting for 18 percent of U.S. imports.

Major import sources for refined silver are Canada and Mexico, with Chile and Peru secondary sources. Canada accounted for 33 percent and Mexico accounted for 30 percent of total imports in 1993. Canada and Mexico were the leading suppliers of silver bullion.

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[106] *World Silver Survey 1992*, The Silver Institute, 1992, pp. 20-21.

[107] La Coipa emerged as the world's second largest silver-producing mine in 1992, with silver produced as a byproduct of its gold operations. La Coipa's output tripled from the 1991 level to 15.9 million ounces (496 tons) in 1992, representing 48 percent of Chile's silver production. A new 16,500-ton-per-day processing plant began operation in July 1991, replacing an older 1,100-ton facility that closed in April 1991. Two Canadian companies, Placer Dome and TVX Gold, are 50-50 partners in La Coipa. "Silver Survey" and *Mineral Industries of Latin America and Canada*, p. 152.

[108] Ibid.

[109] *Mineral Industries of Latin America and Canada*, pp. 152 and 174.

[110] Fabrication demand represents industrial demand and excludes investment transactions.

[111] Stocks held by the Department of the Treasury, the National Defense Stockpile, and the Department of Defense.

[112] Silver bullion bars for the National Defense Stockpile must be 999 fine, free of foreign materials, and in bars weighing about 31 kilograms. The Mint must obtain silver for its coins from the NDS.

[113] "Defense Dept.'s silver surplus drops," *E&MJ Mining Activity Digest*, Mar. 3, 1993, p. 5.

[114] Balance reflects U.S. Mint stocks.

Table 8
Refined silver and silver products: Value of U.S. imports for consumption, by principal sources, 1989-93

(In millions of dollars)

Source	1989	1990	1991	1992	1993
Canada	242	204	124	127	145
Mexico	341	202	154	172	131
Chile	5	9	38	62	75
Peru	15	41	65	75	54
Estonia	(1)	(1)	(1)	(1)	8
Malaysia	2	2	6	3	5
Dominican Republic	5	3	4	16	4
United Kingdom	1	2	6	33	4
Germany	2	5	5	3	3
Japan	1	(2)	1	2	2
All other	94	67	122	11	6
Total	707	536	525	503	437

[1] Not available; data are included in "All other" category.
[2] Less than $500,000.

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

U.S. imports of silver ores and concentrates, like other precious metals, were minor during the period. U.S. imports of coins other than those of gold or platinum (most of which are believed to be of silver) amounted to $20.0 million in 1993. Principal U.S. import sources were Canada and the United Kingdom, accounting for a combined 66 percent of coin imports.

U.S. Trade Measures

The rates of duty for column 1 countries and special rates of duty appear in table 9. The majority of U.S. imports enter duty free under column 1; imports of silver other than bullion and dore as well as semifabricated silver products from eligible countries also enter duty free under all special provisions. There are no known U.S. nontariff measures affecting imports of silver and silver products.

Foreign Markets

Foreign Market Profile

U.S. growth prospects in export markets will likely reflect fabrication and investment demand in leading silver consuming countries. Greatest growth will likely occur in the Middle East countries (particularly the United Arab Emirates) and India, where silver is a valued financial instrument, and in certain Southeast Asian countries that are major jewelry fabricators and transit points for unofficial silver flows to India.[115]

However, the U.S. industry may find its share of the global market stagnating as U.S. production is projected to level off and other producing countries are expected to increase output.

U.S. Exports

Significant export growth to the United Arab Emirates, an emerging silver investment market, and Singapore, from which silver moves to India, accounted for most of the gain in U.S. silver exports during the period. U.S. exports rose by an estimated 33 percent during the period to 1,700 metric tons ($344.1 million) in 1993; because of lower silver prices, the value of these exports rose at a slower pace during the period (table 10).

Canada was the leading U.S. export market in 1993, with 26 percent of total exports and 40 percent of all U.S. exports of silver-bearing waste and scrap, which is refined into bullion or other silver products. Canada is a secondary investment market for silver, but emerged in 1990 as a major recycler of silver-bearing waste and scrap for the secondary market.

The second largest U.S. export market in 1993 was the United Kingdom, with 19 percent of total exports; about 65 percent of these exports were silver waste and scrap. The United Kingdom is also a leading export market for silver for investment purposes because London is a key world investment center. Other export markets include Singapore, Japan, United Arab Emirates, Germany, and Belgium.

[115] The Government of India lifted certain restrictions on the importation of silver in February 1992 by permitting returning and non-resident Indians to bring in 5 kilograms of silver, thereby reducing silver smuggling and lowering the price of silver on Indian markets. Indian silver prices remain at a premium to world prices, however, averaging about $1.00 higher than world prices at the end of 1993. About 500 metric tons of silver is estimated to have been smuggled into India in 1993,

[115]—*Continued*
accounting for about 15 percent of Indian silver imports. *Mineral Industry Surveys Gold and Silver Monthly*, U.S. Department of the Interior, Bureau of Mines, Apr. 12, 1993, *World Silver Survey 1994*, and ".....the weather factor," *Mining Journal*, May 20, 1994, p. 374.

Table 9
Refined silver and silver products: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1994; U.S. exports, 1993; and U.S. imports, 1993

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1994		U.S. exports, 1993	U.S. imports, 1993
		General	Special[1]		
				Million dollars	
2616.10.00[2]	Silver ores and concentrates	1.7¢/kg on lead content	Free (CA, E, IL, J, MX)	1	8
7106.10.00	Silver powder	Free		51	2
7106.91.10	Silver bullion and dore	Free		116	375
7106.91.50	Unwrought silver, other than bullion and dore	6%	Free (A, CA, E, IL, J, MX)	10	3
7106.92.00	Semimanufactured silver	6%	Free (A, CA, E, IL, J, MX)	21	12
7107.00.00	Base metals clad with silver, not further worked than semimanufactured	6.5%	Free (A, CA, E, IL, J, MX)	3	([3])
7112.90.00	Precious metal waste and scrap, other than gold and platinum	Free		142	46

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); North American Free Trade Agreement - goods from Canada (CA); Caribbean Basin Economic Recovery Act (E); United States-Israel Free Trade Area (IL); Andean Trade Preference Act (J); and North American Free Trade Agreement - goods from Mexico (MX).

[2] Trade data for this item are not included in aggregate import and export tables.

[3] Less than $500,000.

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

Table 10
Refined silver and silver products: Value of U.S. exports of domestic merchandise, by principal markets, 1989-93

(In millions of dollars)

Market	1989	1990	1991	1992	1993
Canada	47	76	60	76	89
United Kingdom	57	38	122	61	65
Singapore	1	6	7	23	39
Japan	58	107	47	28	20
United Arab Emirates	0	(1)	14	29	17
Germany	15	17	9	12	16
Belgium	19	18	22	26	15
France	31	25	20	21	14
Switzerland	17	1	1	6	13
Hong Kong	2	3	4	4	11
All other	27	30	58	33	44
Total	274	321	363	319	344

[1] Less than $500,000.

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

Silver waste and scrap and silver bullion represented 41 percent and 29 percent, respectively, of total exports by value in 1993. U.S. exports of silver ores and concentrates were negligible. U.S. exports of coins except those of gold were believed to be primarily silver coinage. These exports totalled $6.6 million in 1993, with the Bahamas and Venezuela the leading export markets with a total of 40 percent of U.S. exports.

Foreign Trade Measures

U.S. silver exports to Canada enter duty free as of January 1, 1994 under terms of the North American Free Trade Agreement. Under NAFTA, U.S. exports to Mexico enter duty free, except for silver powder which is subject to 5-year staged duty elimination from the 15-percent duty. Exports to Japan enter at rates of duty ranging between 2 percent and 5.8 percent. U.S. exports of refined silver and its products to the EU are subject to rates of duty ranging from free to 4.6 percent.

U.S. Trade Balance

The United States maintained a trade deficit in silver and related products throughout the period, totalling $93.3 million in 1993. The United States had a deficit in silver trade with Canada and Mexico during 1989-93, whereas a trade surplus was maintained with the United Kingdom and Japan for the entire period.

PLATINUM GROUP METALS[116]

Platinum group metals[117] (PGMs) are critical, and rather scarce, metals of significance to the automotive, petroleum, chemical, and electronic industries. These metals are valued primarily for their catalytic qualities[118] and have some common chemical and physical characteristics, such as chemical inertness. They are generally associated in the same ore deposits. Despite some similarities, production of these metals is driven by differences in the price of individual PGMs, their unique physical properties, and end-use applications.

There are few economically viable primary PGM deposits located throughout the world; two countries—South Africa and the former Soviet Union—account for 98 percent of known reserves. Although the United States has only one working mine for platinum and palladium, there is a sizeable domestic secondary refining industry that recycles scrap materials, such as catalytic converter shells. Consequently, the United States relies on imports of refined PGM metals for domestic consumption, and is a net exporter of PGM waste and scrap yielded from manufactured goods.

PGM mining is similar to that of other precious metals in terms of the underlying factors determining exploration and development.[119] The assaying of these metals is more difficult and expensive than other precious metals, however, because of the relative infrequence of PGMs and the co-existence of individual PGMs in a deposit, each with its own demand and price considerations. Because of the

[116] Information for this section was derived principally from *Platinum 1994*, Johnson Matthey, May 1994, and *Mineral Commodity Summaries 1994*, *Availability of Platinum and Platinum-Group Metals*, and *Platinum-Group Metals Annual Report 1992*, U.S. Department of the Interior, Bureau of Mines, except as noted.

[117] Platinum, palladium, rhodium, ruthenium, iridium, and osmium.

[118] A catalyst modifies, particularly increases, the rate of a chemical reaction without being consumed in the process. A catalyst is generally used in a smaller proportion than the substances being altered.

[119] See introduction of this report.

geologic association of these metals in a deposit, world PGM supply can be altered when production is emphasized for any one PGM metal since associated ores will be produced as co-metals. Platinum, however, is generally the most commonly produced of these metals.

PGM ores are processed in four steps: mining, concentrating, smelting, and refining (figure 9). Significant amounts of metal are also recovered from PGM recycling and recovery. Recovery from processed autocatalysts may be either *hydrometallurgical* or *pyrometallurgical*. Both methods face environmental problems of lead release and disposal, and hazardous waste and reagent control and removal. In addition, these recovery methods must achieve cost-effective recovery rates.

U.S. Industry Profile

Industry Structure

The sole U.S. mine[120] producing platinum group metals[121] — the Stillwater operation[122] — has recently received approval to expand its operations at an estimated cost of $50 million.[123] The mine, which began production in March 1987, currently processes at full capacity about 1,000 metric tons per day of ore, which will double once expansion is completed. Stillwater produced an estimated 1,800 kilograms of platinum and 6,500 kilograms of palladium in 1993 (a total value of an estimated $39 million). Palladium production accounted for an estimated 78 percent of 1993 production, with platinum representing the remainder. Stillwater can produce about 7 percent of domestic platinum requirements. Mine employment was an estimated 400 workers in 1993.

The mine's flotation mill recovers PGM ores, with the resulting concentrates filtered and dried. These concentrates are then processed at the Columbus, Montana smelter, which opened in 1990. The resulting *matte* is currently exported to Belgium for refining and separation of individual PGMs; however, expansion plans also include the construction of a refinery at the smelter site.[124]

[120] Because the U.S. mining industry is comprised of only one mine, many industry statistics usually provided in this section are unavailable for confidentiality reasons.

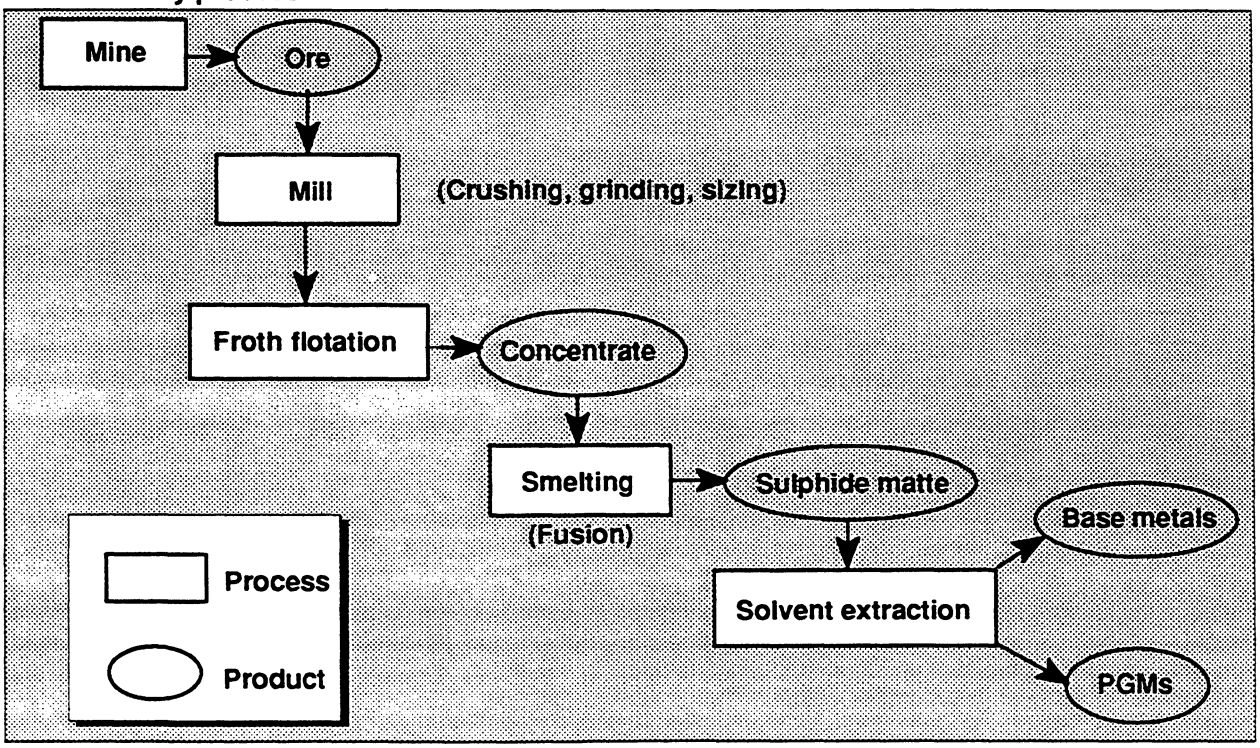
[121] Standard Industrial Classifications (SIC) 1099 (pt.), Metal Ores, Not Elsewhere Classified; and 3339 (pt.), Primary Smelting and Refining of Nonferrous Metals, Not Elsewhere Classified.

[122] The Stillwater Mining Company, which operates the mine located near Billings, Montana, is jointly owned by the Chevron Corp. (50 percent) and Manville Corp. (50 percent). Chevron and Manville are currently shifting ownership and management of the mine to Stillwater Mining Co. while maintaining a 50-percent equity interest. A public stock offering could occur in the future. "Stillwater being spun off after owners fail to find a buyer," *Metals Week*, Feb. 15, 1993, p. 7.

[123] "Nye Platinum Mine Expansion Planned," *American Metal Market*, June 10, 1994.

[124] Ibid.

Figure 9
PGM recovery process



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

In addition, a very small quantity of platinum and palladium is recovered as a byproduct of two copper refineries located in Texas and Utah. The total estimated PGM reserve base for the United States is 780,000 kilograms, approximately 1 percent of the global reserve base. There is no U.S. mine production of the four other platinum group metals.

About 20 secondary PGM refiners[125] are located principally on the East and West Coasts. The PGM semifabricating industry[126] is also small, with only seven known firms producing such products as sheet, foil, and tubing.

Production costs

Because the Stillwater deposit is a narrow vertical reef,[127] with seams four to twenty feet thick and a length of twenty miles, mining is labor-intensive, with a cut-and-fill method employed.[128] The average ore grade for Stillwater is estimated at 22.3 grams per metric ton, a high grade ore, with an estimated 35 million troy ounces of reserves. Because of its high ore grade, Stillwater's mine operating cost of an estimated $75 per ounce of recovered metal is believed to be considerably lower than other large PGM producing mines.

As with most metal mining, federal, state, and local environmental regulations contribute to higher capital and startup costs. In the case of Stillwater, over $10 million was spent on environmental analysis (e.g., Environmental Impact Study), bonds, and tax prepayments to obtain the licensing and permits required for mine production. The mining site also required extensive monitoring and environmental mitigation measures because of its location in a sensitive wildlife habitat only 35 miles from Yellowstone National Park. These measures included a tailing dam, from which 60 percent of the tailings are used as backfill at the mine site; water quality and monitoring programs; land reclamation projects; and instack continuous monitoring and control systems to check sulfur dioxide emissions.[129]

Prices for most PGMs, including platinum and palladium, have declined during the period as supply[130] exceeded Western World fabrication demand[131] (figure 10), squeezing profit levels for many mines.[132] Movement in PGM stocks account for the difference between supply and demand.

Secondary production/recycling

Because of the high value of many of these metals, PGM recovery from recycled materials can be a financially attractive industry. Secondary PGM production, primarily extracted from recycled autocatalysts, totalled an estimated 56,100 kilograms in 1993, an increase of 12 percent from the 1989 level. The U.S. secondary industry is comprised of scrap refiners and other firms that collect and separate scrap PGM materials. These firms generally extract the PGMs from the scrap materials (e.g., autocatalysts, electronics) and concentrate the secondary PGM metals to raise their average grade. These upgraded materials are then sold to refiners that extract the different PGMs. Most PGM recyclers specialize in processing a particular type of scrap because PGM scrap, like other recycled materials, must be refined with similar grades and types of scrap to ensure product consistency.

These refiners can be "toll" or "nontoll" operations, with the designation reflecting ownership of the PGM scrap. Toll refiners charge a fee for processing scrap owned by their customer, whereas nontoll operators own the scrap they refine and sell. An estimated 91 percent of secondary PGM recovery was done on a toll basis in 1993, which is representative of the period. Several U.S. refiners, such as Handy & Harman, are also fabricators of PGM products.[133]

The principal factors impacting the U.S. secondary industry production are the availability of scrap material, particularly autocatalysts, and sufficiently high PGM prices that cover the cost of metal recovery and ensure adequate return. The automotive catalyst segment of the PGM recycling industry holds the greatest potential for growth because U.S. automobile production has risen and the number of scrapped cars would be expected to increase over the next five years. Platinum is the major PGM component of

[125] SIC 3341 (pt.), Secondary Smelting and Refining of Nonferrous Metals.

[126] SICs 3356 (pt.), Rolling, Drawing, and Extruding of Nonferrous Metals, Except Copper and Aluminum; and 3497 (pt.), Metal Foil and Leaf.

[127] Ore-bearing horizons.

[128] The phased mining process by which excavation proceeds horizontally, working upward until the ore runs out. At that point more ore is blasted and removed with the previously excavated site filled in with waste material. This becomes the floor area for miners who then repeat the drilling, blasting, ore removal, and filling process. *A dictionary of mining, mineral, and related terms* and "Stillwater: Past, Present, and the Outlook," a paper presented to the Capital Metals & Materials Forum by Richard K. Doran, Marketing Manager for Chevron Resources Co., May 25, 1989.

[129] "Stillwater Mine—Persistence and Excellence Prevail in Regulatory Arena," *AMC Journal*, Jan. 1992, p. 11.

[130] Estimated sales by mines of primary platinum group metals.

[131] The quantity of primary platinum group metals purchased by consumers.

[132] Prices for platinum and palladium bullion are established daily in London by eight companies that are members of the London-Zurich Good Delivery Agreement. This group sets the standards for platinum and palladium trading in Europe. Futures contracts are traded on several international exchanges, including the New York Mercantile Exchange (NYMEX).

[133] Including but not limited to powders, sheet and foil, tube, and wire.

Figure 10
Western world platinum supply/demand, 1989-93

Source: *Platinum 1994*, Johnson Matthey.

autocatalysts,[134] and is the principal PGM recovered by the secondary industry.

Consumer Characteristics and Factors Affecting Demand

Demand for these metals is driven principally by the financial health of the automotive, electrical, and jewelry industries (figure 11), environmental statutes regulating emission levels, speculation/investment, and, ultimately, the price of the metal. The price often determines the intensity with which consuming industries and households seek substitute materials or reductions in metal usage.

Platinum group metals are characterized by their light weight, strong resistance to oxidation and acidic attack, and high melting point.[135] Platinum is the most important and abundant metal of the PGM group, and is the chief precious metal component of automotive catalysts. The U.S. automotive industry is a principal purchaser of platinum, palladium, and rhodium, which are used in the manufacture of catalytic converters.[136] Dental, chemical, and electrical applications also serve as significant markets for these metals as well as the other PGMs (figure 12).

Jewelry manufacturing accounts for nearly 70 percent of platinum fabrication demand in Japan, where nearly 85 percent of world platinum jewelry demand is concentrated. Japanese consumers have increased jewelry purchases as platinum metal prices fell, bringing platinum jewelry prices more in line with those of gold jewelry. Consumer preference for platinum settings for precious gems has also generated demand in Japan, as well as younger consumers' preference for platinum jewelry.

Palladium is the second most abundant PGM, with electrical applications[137] accounting for about 50

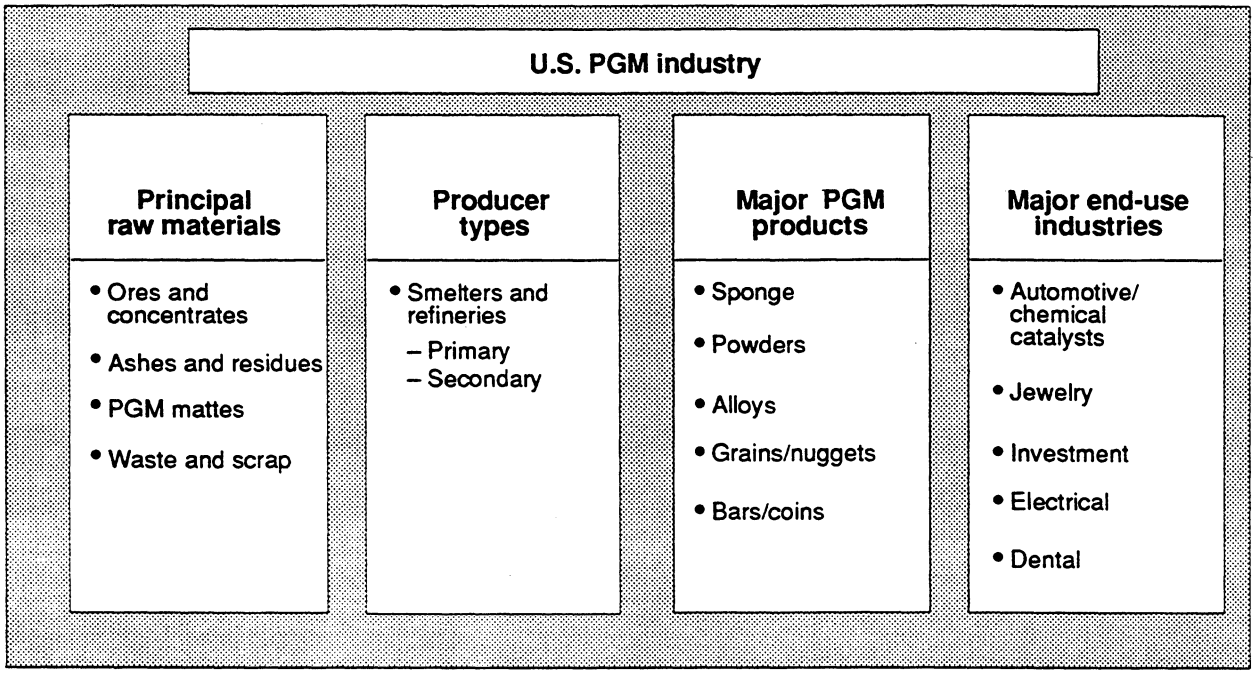
[134] The mix of PGMs in autocatalysts varies. Since 1981 the three-way catalyst is believed to contain about 0.0836 ounces of platinum, 0.0107 ounces of palladium, and 0.0057 ounces of rhodium.

[135] *A dictionary of mining, mineral, and related terms*, p. 835.

[136] The automotive industry accounted for an estimated 66 percent of total U.S. platinum sales, 10 percent of palladium sales, and 75 percent of rhodium sales in 1992.

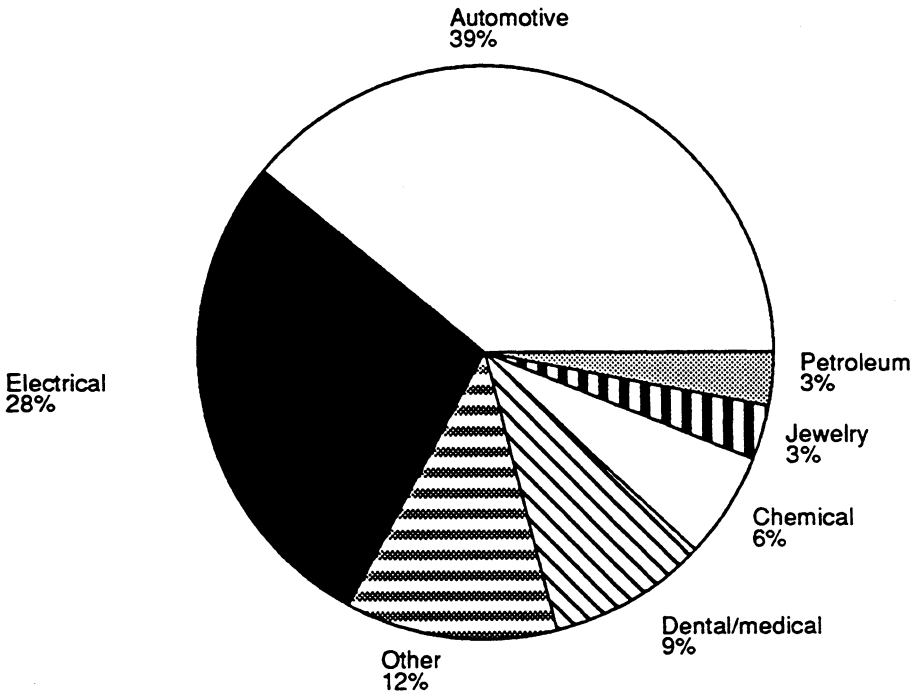
[137] For example, palladium is used in the form of a paste in the manufacture of multi-layer ceramic capacitors; palladium salts are applied as plating for parts of semiconductors.

Figure 11
U.S. platinum group metals industry: Principal raw materials, producer types, major products, and major end-use industries



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

Figure 12
Share of PGM sales to U.S. industry sectors, 1992



Source: *Mineral Commodity Summaries 1994*, Bureau of Mines, U.S. Department of Interior.

percent each of 1993 world demand and U.S. palladium sales. Autocatalyst demand accounted for nearly 99 percent of global consumption of rhodium. Ruthenium is principally consumed by the electrical and chemical industries, representing 68 and 30 percent of 1993 global demand, respectively. The chemical industry's share of iridium consumption was 62 percent. The dental industry accounts for nearly all consumption of osmium.

In the United States speculative trading and investment are not as significant for PGMs as for gold, but a number of financial centers (e.g., New York, Tokyo, Switzerland) are warehouses for investment bars and trading sites for physical metal and futures contracts. Such activities are most prevalent for platinum, particularly in Japan where investors are likely to hold precious metals as a long-term asset. The Japanese market accounted for roughly 75 percent of total Western investment demand[138] of 305,000 ounces in 1993, whereas the North American market represented 13 percent of such demand.

Because of the relatively high price of platinum[139] and the magnitude of its use relative to palladium and rhodium in catalytic converters, several companies have been exploring the development of converters requiring less intensive platinum use. Despite announcements of innovative converter designs by several companies,[140] wide-scale commercial application of these converters has yet to materialize. These announcements, however, create market uncertainty and stimulate immediate swings in the market prices of platinum, palladium, and rhodium. New autocatalyst designs could lower production costs by using less expensive palladium, and provide greater flexibility for autocatalyst manufacturers. However, the greater amount of palladium required for use in new autocatalyst designs nearly offsets the cost reductions achieved with cuts in platinum usage.

Fuel cells[141] are a potential application for platinum that could boost future domestic demand. Currently only one U.S. firm, International Fuel Cells, has developed and commercialized these products. A small number of fuel cells are currently being used by gas and electricity producers to generate power and heating. Fuel cells may have broader applications (e.g., as a vehicle power source) as these units undergo continued testing and development. Johnson Matthey PLC, the marketing arm of the world's largest platinum producer, anticipates that full-scale commercialization of these fuel cells could raise platinum demand by more than 100,000 ounces by the year 2000,[142] compared to the 1992 level of less than 10,000 ounces.

Foreign Industry Profile

Because of the geologic concentration of PGM deposits, only South Africa and the former Soviet Union are major producers of these metals. These countries account for about 98 percent of the world's PGM reserve base. Unlike the United States, secondary PGM industries are not well established in most countries, with the exception of Japan,[143] principally because of the absence of significant quantities of autocatalysts for PGM recovery. With the adoption of stricter automotive emission laws and increased autocatalyst use in Europe, there may be sufficient recoverable PGMs from autocatalysts to support a European secondary PGM industry within 5 to 10 years.

South Africa

The South African PGM mining industry is the world's largest and most technologically sophisticated, with an estimated 51 percent (4.5 million ounces or 140,000 kilograms) of 1993 world mine production. Since 1987, the South African PGM industry has completed expansions of 960,000 ounces compared to initial expansion plans of nearly 1.6 million ounces. Further significant capacity additions are unlikely because of lower PGM prices and weaker company financial positions. South African PGM production is expected to increase, although not significantly, during 1994-95 as committed expansions come to full production.

Platinum is the predominant PGM mined in South Africa. Approximately 95 percent of refined PGM production is exported, primarily to Europe, North America, and Japan[144] where PGM processing and fabricating occurs. There are currently six major groups mining PGMs in South Africa. Many of these mines also have refineries and smelters that process the mined ores.

The largest of the worked deposits is Rustenburg, part of Johannesburg Consolidated Investments. The deposit is located on the Merensky and Upper Group 2

[138] Platinum coins and bars.

[139] An average 1993 price of about $370 per ounce for platinum, $120 for palladium, and $1,200 for rhodium.

[140] Allied-Signal was the most recent firm to announce the introduction of a new catalyst system that uses only palladium. The converter system has been sold to one automobile manufacturer, and is being tested by several others. "Allied Signal's Catalyst Uses Only Palladium," *Wall Street Journal*, Mar. 3, 1993.

[141] Phosphoric acid fuel cells, which contain platinum catalysts, are the most widely commercialized type of units.

[142] *Platinum 1992*, Johnson Matthey PLC, May 1992, pp. 28-29.

[143] Although the Japanese PGM recovery industry is well developed, its PGM recovery is minor relative to U.S. recovery levels, totalling roughly 40,000 ounces in 1989 compared to the U.S. recovery in excess of 1.6 million ounces in the same year.

[144] *South Africa's Mineral Industry 1991/1992*, Minerals Bureau, Department of Mineral and Energy Affairs, p. 20.

(UG2) reef; platinum accounts for 54 to 61 percent of total PGMs in the Merensky reef, and 39 to 54 percent of the UG2 reef. Estimated capacity of this deposit over its lifetime exceeds 14.5 million metric tons of ore.[145] A PGM refinery was installed in 1990; prior to its opening, PGMs were refined in Great Britain. Johnson Matthey PLC markets the PGMs produced from this mine.

The mines and related facilities are owned or operated by establishments that belong to one of five holding company groups[146] that control most South African mineral rights. These groups associate through the Chamber of Mines of South Africa, which promotes and protects its members' mining interests though an advisory and service capacity.[147] The extensive linkages between these holding companies permit rapid exchange of new technology and shared procurement of capital. As a result of this oligopoly, foreign mining interests do not consider the mining investment climate in South Africa to be favorable.

South African PGM mines are underground operations that require high capital[148] and operating costs[149] and sophisticated mining techniques, many of which have been adapted from South African gold mining companies experienced in this type of mining. Smelting and refining treatments are selected to most effectively maximize ore recovery. South African PGM deposits are characterized by a high level of associated metals, such as gold, nickel, copper, and chromium, which can contribute to the earnings of a particular deposit and somewhat insulate the industry from volatile PGM prices. Since platinum and palladium are the easiest PGMs to extract, their recovery rate is about 98 percent. Extraction of the other four PGMs is more difficult, and lowers total PGM recovery rate to roughly 75 percent. However, the higher prices received for some of these PGM metals, such as rhodium, usually offset the lower recovery rates.

The South African industry is increasing mechanization at PGM mines to reduce costs, especially labor, and improve productivity through adoption of such equipment as mobile articulated dump trucks and drill rigs. Underground mining of PGMs has traditionally been labor intensive, but labor issues and wage increases at a time of declining prices have generally prompted mining companies to reduce the size of the labor force. Greater mechanization requires a more skilled workforce, with labor cuts most affecting the large pool of lower skilled laborers (about 88 percent of mining industry employees).

Other factors affecting the competitiveness of the South African PGM mining industry include the foreign exchange rate of the rand, inflation, and taxes. The depreciation of the rand versus the U.S. dollar generally improves industry profitability because the earnings from international PGM sales accrue to these companies in U.S. dollars. However, this devaluation may also mask the effects of inflation, which has risen annually at a level exceeding 15 percent. In addition, the effective tax rate for mining companies of 57.5 percent of taxable income reflects a 50-percent income tax plus a 15-percent surcharge. Additional royalty fees are also assessed, although the levels vary depending on agreements between mining companies and indigenous populations.

The Former Soviet Union

As the world's second largest source of PGMs, the former Soviet Union plays a pivotal role in international PGM markets. Estimated 1993 mine production was 110,000 kilograms (3.5 million ounces, or 40 percent of world production).[150] Most was a byproduct of the Norilsk Nickel Combine (NNC) nickel-copper mines, which are reported to be the world's largest sources of palladium and second largest sources of platinum and rhodium. The Norilsk smelter and refinery, located in the Russian Federation

[145] The in situ grade of PGMs and gold in the Merensky reef ranges between 6 and 8 grams per metric ton; the UG2 reef grade ranges between 5.9 to 7.7 grams per metric ton.

[146] Johannesburg Consolidated Investment Trust Ltd. (JCI), General Mining Corporation of South Africa (Gencor), Barlow Rand, Gold Fields of South Africa (GFSA), and Lonrho.

[147] *South Africa's Mineral Industry 1990*, Minerals Bureau, Department of Mineral and Energy Affairs.

[148] For example, initial equipment and plant capital investment for mine development in South Africa is estimated to range between $53 million and $118 million, depending on mine depth. The construction of milling operations would cost an additional $40 million to $72 million. In some locations, infrastructure improvements (e.g., roads, housing) would be necessary, at a cost of $16 million to $23 million. To encourage investment and reduce the cost burden for mining companies, the South African government grants a capital redemption for platinum mining investments in the year incurred, and provides depreciation allowances for nonmining assets to encourage vertical integration.

[149] Although specific operational costs for South African PGM mines are unavailable, the U.S. Bureau of Mines has estimated average mine operating costs (includes mill, smelting, and refining) of $202 per troy ounce, whereas similar estimated costs for mines under development or proposed average $250 per troy ounce. The higher costs for developing mines is attributable to their smaller size and greater depths. Total operating costs (includes mine, mill, smelting, and refining) average $281 per ounce for producing mines versus $351 per ounce for developing or proposed (nonproducing) mines. In addition to size differences, nonproducing operations will be treating ores with high chromite content and shipping the concentrates to existing mills and smelters, incurring transportation and tolling charges.

[150] Because PGM production statistics are not released by the former Soviet Union, Russian sales of these metals are most often used as a proxy for production.

(Russia), accounts for more than 95 percent of Russian production of refined PGMs. The remaining 5 percent is recovered from byproduct operations on the Kola Peninsula.

A variety of interrelated factors resulting from the dissolution of the former Soviet Union have affected the region's platinum production and export sales, with an associated effect on global prices. The breakup of the Soviet Union eliminated the state monopoly on platinum production and export, which resulted in some disruption of long-term relationships for suppliers and purchasers accustomed to working with known state authorities. In Russia, Almaz, the state PGM trader and marketer, was relieved of sole responsibility for these metals in 1990 and shared access to export markets with Vneshekonombank (Soviet Bank for Foreign Economic Affairs).[151] Sales by these two entities contributed to high levels of Russian platinum sales in the global market (1.1 million troy ounces in 1991).[152] The Soviet Bank is believed to have sold platinum to service the FSU's foreign debt, exhausting its platinum supply in early 1992. The high 1991 sales led the Russian government to reestablish Almaz as Russia's only PGM trader in early 1992.

Although PGM sales are expected to continue as an important source of hard currency, the likely level of exports is unclear. Current Russian PGM export levels may be possible to maintain because of declining industrial demand, which contributed to a reported 30-percent decline in nickel production during 1991-92,[153] thus increasing the availability of metal for export. However, the drop in nickel production also resulted in an associated decrease in byproduct PGM production. PGM production is believed to have declined further in 1993 as capital needed to maintain plant and equipment is scarce and ore grades have declined.

NNC is currently the subject of a limited privatization plan that will turn NNC into a joint stock company. The Russian Federation will hold at least 51 percent of the voting shares. The news of declining PGM production and supply uncertainties associated with political and economic instability have resulted in price spikes for platinum and palladium.[154]

[151] "Almaz relieved to be back in control," *Metal Bulletin Monthly*, Aug. 1992, p. 26.

[152] Russian platinum sales in 1988 totaled 440,000 ounces; in 1992 such sales had dropped from the 1991 peak to 750,000 ounces, and dropped further in 1993 to 680,000 ounces.

[153] *Platinum 1993*, Johnson Matthey, May 1993, p. 6.

[154] For example, in 1993 the Russian government was uncertain what quantity of PGMs would be available for sale, raising concerns by major Japanese consumers who have maintained annual contracts with Russian PGM suppliers. Although these contracts were eventually finalized and supplies fulfilled, questions concerning reliability of Russian supply contributed to price increases in mid-1993.

U.S. Market

Consumption

Apparent U.S. consumption[155] of PGMs peaked in 1990 at 117,000 kilograms as higher rhodium prices spurred the U.S. automotive industry to increase rhodium purchases for inventory. The rhodium price nearly tripled from the average 1989 level of $1,300 per ounce to a 1990 average of $3,565 in response to processing difficulties at a South African refinery and the lack of spot sales of rhodium from the former Soviet Union. By 1993 U.S. consumption of these metals declined to 112,300 kilograms, although this consumption level reflects an overall growth of 11 percent from the 1989 level.

In addition, the U.S. secondary industry refined greater levels of PGM scrap during 1990-91 as PGM prices, especially that of rhodium, spurred metal recovery. Because of U.S. import dependence on PGM metals, imports maintained a high share (87 to 90 percent) of U.S. refined PGM consumption during the period. The majority of precious metals are refined before shipment; therefore, U.S. consumption of PGM ores and concentrates reflect primarily U.S. metal production.

The U.S. Government has established National Defense Stockpile goals for five of six PGM metals (excluding osmium). However, only platinum, palladium, and iridium are in inventory, with no purchases or disposals in 1993. Industry[156] PGM stocks exhibited a 26-percent decline during the period, to an estimated 24,000 kilograms in 1993. This decline occurred, in part, because of a significant fall-off in rhodium inventory purchases by the U.S. automotive industry. In addition, activity on NYMEX was adversely affected by the global economic downturn and declining investor speculation in platinum.

Production

With the planned doubling of capacity at the Stillwater mine, U.S. PGM production will increase substantially. U.S. mine production rose significantly during 1989-90 as the Stillwater Complex maximized platinum and palladium production, reaching an estimated 8,300 kilograms in 1993, as shown in the following tabulations:

[154]—*Continued*

[155] Includes refiner, importer, and dealer stocks, as well as PGMs held in depositories of the New York Mercantile Exchange.

[156] Includes adjustments for Government and industry stock changes.

Platinum

Year	Quantity	Value
	Kilograms	*1,000 dollars*
1989	1,430	23,306
1990	1,810	27,176
1991	1,730	20,635
1992	1,840	21,060
1993[1]	1,800	21,412

[1] Estimated by the U.S. Bureau of Mines.

Palladium

Year	Quantity	Value
	Kilograms	*1,000 dollars*
1989	4,850	22,454
1990	5,930	21,735
1991	6,050	16,923
1992	6,470	18,097
1993[1]	6,500	25,078

[1] Estimated by the U.S. Bureau of Mines

The U.S. secondary industry will remain the principal source of domestic refined PGM production because of the absence of significant primary refining capacity. The level and composition of PGM recovery will continue to reflect industrial demand, autocatalyst recovery rates, innovations in catalytic converter design, strengthened automotive emission regulations, and metal prices. Total secondary production rose overall by an estimated 12 percent during 1989-93, as shown in the following tabulation:

Year	Quantity
	Kilograms
1989	50,186
1990	71,428
1991	72,349
1992	61,614
1993	56,100

The spike in secondary recovery during 1990-91 corresponds with higher rhodium prices when metal recovery would have been financially attractive.

Imports

U.S. imports of PGM ores and concentrates are negligible. Platinum represents the bulk of U.S. PGM imports, accounting for more than one-half of the value of U.S. imports in 1993. Over 85 percent of platinum imports are in the form of sponge, which can be converted into other forms such as bars and paste.

The volatility of rhodium prices during the period is reflected in U.S. import value data. Although sustained high rhodium prices contributed to the metal's significant import share during 1990-92, its 50-percent price drop in 1993 resulted in the large gain in import share by platinum metal and its various forms, with 52 percent of U.S. imports in 1993. Conversely, the share of total U.S. PGM imports accounted for by rhodium declined from 42 percent in 1992 to about 20 percent in 1993. Total U.S. PGM imports rose by an estimated 26 percent during the period to about 143,000 kilograms ($1.3 billion) primarily in response to greater palladium demand by the automotive industry for use in autocatalysts (table 11). U.S. importers of these metals are generally manufacturers, such as those producing catalytic converters and jewelry, or metal refiners that have limited domestic sources of supply.

Because of its predominant world position in production of these and other PGMs, South Africa was the leading U.S. supplying country with 49 percent of U.S. imports in 1993. Russia was the second leading supplier of PGMs in 1993, accounting for 16 percent of total U.S. imports. Most U.S. imports from Russia were platinum sponge and unwrought and

Table 11
Platinum group metals, refined: Value of U.S. imports for consumption, by principal sources, 1989-93

(In millions of dollars)

Source	1989	1990	1991	1992	1993
South Africa	756	1,022	1,042	809	630
Russia	(1)	(1)	(1)	120	205
United Kingdom	218	270	241	189	153
Belgium	61	54	75	80	89
Switzerland	63	17	14	7	64
Germany	41	100	115	86	41
Japan	10	26	14	20	19
Colombia	(2)	5	1	25	19
Canada	36	16	20	16	17
Mexico	(2)	1	2	4	12
All other	197	395	219	101	48
Total	1,382	1,905	1,743	1,456	1,298

[1] Not available; data are included in "All other" category.
[2] Less than $500,000.

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

semimanufactured palladium. The United Kingdom was the third largest import source (12 percent), principally supplying platinum sponge and unwrought palladium from secondary PGM refiners.

U.S. imports of platinum coins amounted to $12.5 million in 1993. Australia and Canada, leading world platinum coin minters, accounted for 60 percent and 22 percent, respectively, of these imports.

U.S. Trade Measures

The rates of duty for column 1 countries and special rates of duty appear in table 12. The majority of U.S. imports enter duty free under column 1; imports of base metals clad with platinum enter duty free for countries eligible for all special provisions. There are no known U.S. nontariff measures affecting imports of platinum group metals.

Foreign Markets

Foreign Market Profile

The adoption of more stringent air quality standards and vehicle emission limitations in the European Union[157] will likely provide increased market opportunities for refined platinum and palladium suppliers, including those in the United States. These standards will virtually mandate the use of autocatalysts to achieve legal emission levels.[158] However, increased PGM demand will be determined, in part, by the region's economic health and European automobile production.

Currently the major foreign markets for U.S. PGM exports include Japan, Switzerland, the United Kingdom, and Belgium. Japan is a major financial center for PGM investment and trading, and also has strong automotive and jewelry markets that utilize platinum group metals. In addition, Japan has two of the world's three companies that are developing fuel cell technology for commercial applications. Switzerland emerged as a major market for U.S. exports in 1993, primarily platinum, in large part because of the manufacture of a commemorative Swatch watch, each containing 1 ounce of platinum.

Belgium is the refining location for Stillwater's PGM production, and a major world recycler of PGM waste and scrap. The United Kingdom serves as one of the world's principal financial and warehouse centers, as well as a PGM recovery site.

U.S. Exports

Because of the growth in U.S. PGM production that was exported to Belgium for further refining and the increase in platinum exports to Switzerland in 1993, U.S. exports of PGMs during 1989-93 more than doubled to an estimated 86,000 kilograms valued at about $442 million (table 13). The bulk of U.S. exports during the period were unwrought platinum and platinum waste and scrap, each of which accounted for 23 percent of 1993 exports. U.S. exports of PGM ores and concentrates are believed to total less than $1 million in 1993.

Japan was the principal export market during most of the period, accounting for 30 percent of 1993 U.S. exports. Switzerland and the United Kingdom were the second and third largest U.S. markets, with 15 percent each.

Foreign Trade Measures

U.S. exports of PGMs to Canada and Mexico enter duty free as of January 1, 1994 under terms of the North American Free Trade Agreement. U.S. exports of PGMs to Japan are subject to rates of duty ranging from free to 4 percent. EU duties on PGM imports from the United States range from duty free to 3.2 percent.

U.S. Trade Balance

The United States consistently maintained a trade deficit in refined platinum group metals during the period, which declined to its lowest level in 1993 at $856 million. South Africa, the United Kingdom, Russia, and Belgium maintained trade surpluses with the United States throughout the period. The United States had a trade surplus of $111.6 million with Japan and $10.0 million with Canada in 1993. Because of limited domestic PGM reserves, the United States is likely to maintain a trade deficit in platinum group metals for the foreseeable future.

[157] EU emissions standards became effective for new car models on July 1, 1992, and for all new cars on December 31, 1992.

[158] Diesel cars currently meet emission level standards without catalytic converters in the EU, but the adoption of stricter standards in 1996 will necessitate all cars to be fitted with catalytic converters.

Table 12
Platinum group metals, refined: Harmonized Tariff Schedule subheading; description; U.S. col. 1 rate of duty as of Jan. 1, 1994; U.S. exports, 1993; and U.S. imports, 1993

HTS subheading	Description	Col. 1 rate of duty as of Jan. 1, 1994		U.S. exports, 1993	U.S. imports, 1993
		General	Special[1]		
				Million dollars	
7110.11.00	Platinum, unwrought or in powder form	Free		103	656
7110.19.00	Platinum, semimanufactured	Free		80	16
7110.21.00	Palladium, unwrought or in powder form	Free		63	232
7110.29.00	Palladium, semimanufactured	Free		51	81
7110.31.00	Rhodium, unwrought or in powder form	Free		33	197
7110.39.00	Rhodium, semimanufactured	Free		6	68
7110.41.00	Iridium, osmium, and ruthenium, unwrought or in powder form	Free		3	7
7110.49.00	Iridium, osmium, and ruthenium, semimanufactured	Free		1	(2)
7111.00.00	Base metals, silver or gold, clad with platinum, not further worked than semimanufactured	20%	Free(A, CA, E, IL, J, MX)	1	(2)
7112.20.00	Waste and scrap of platinum	Free		100	41

[1] Programs under which special tariff treatment may be provided, and the corresponding symbols for such programs as they are indicated in the "Special" subcolumn, are as follows: Generalized System of Preferences (A); Automotive Products Trade Act (B); Agreement on Trade in Civil Aircraft (C); North American Free Trade Agreement - goods from Canada (CA); Caribbean Basin Economic Recovery Act (E); United States-Israel Free-Trade Area (IL); Andean Trade Preference Act (J); and North American Free Trade Agreement - goods from Mexico (MX).

[2] Less than $500,000.

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

Table 13
Platinum group metals, refined: Value of U.S. exports of domestic merchandise, by principal markets, 1989-93

(In millions of dollars)

Market	1989	1990	1991	1992	1993
Japan	101	85	139	83	131
Switzerland	14	6	22	24	68
United Kingdom	103	90	56	58	67
Belgium	20	52	86	73	61
Canada	48	30	36	51	27
Netherlands	10	7	8	9	19
Germany	42	54	33	19	14
Korea	8	20	23	8	11
Italy	13	42	22	12	9
France	4	1	5	11	8
All other	41	29	28	35	27
Total	404	416	458	382	442

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

APPENDIX A
GLOSSARY OF CERTAIN METAL AND MINING TERMS

Terms[1]

Amalgamation	The process by which gold is extracted from ores by alloying with mercury; the cyanide leaching process has generally superseded amalgamation.
Bullion	Uncoined precious metal in the shape of bars, ingots, or other comparable forms.
Catalyst	A substance that modifies (especially increases) the rate of a chemical reaction without being consumed in the process. In the case of catalytic converters, the PGM three-way catalyst converts carbon monoxide to carbon dioxide, hydrocarbons to water and carbon dioxide, and nitrogen oxides to nitrogen gas and carbon monoxide.
Concentration	Separation and accumulation of desired minerals from other minerals in the ore.
Cupellation	The process by which gold and silver are freed from base metals which can be oxidized. The metal mixture is roasted in a blast of air that separates the base metal oxides from the pure metal.
Cyanide leaching	The process by which gold is extracted from crushed ores, concentrates, or tailings by means of a cyanide of potassium or sodium used in dilute solution. The gold is dissolved and is then precipitated with zinc dust (the Merrill-Crowe process) or collected from cyanided pulp (the carbon-in-pulp process), for example. This process occurs in tanks or on leaching pads.
Dore	Bullion that remains in the cupelling furnace after the lead has been oxidized and removed.
Flotation	Generally refers to froth flotation, by which a froth created in water by numerous reagents floats certain minerals, such as gold, and causes other minerals to sink.
Futures market	The sale or purchase of contracts for future metal delivery.
Garimpeiros	The term used for independent gold miners in Brazil.
Gravity concentration	The process by which materials, such as gold, are separated by exploiting the differences in their densities.
Hedging	The act of locking in a commodity price that will be paid or received for future deliveries, thus reducing risk and limiting potential financial losses and/or gains.
Hydrometallurgical process	The dissolution of the PGMs or substrate material with subsequent precipitation of the platinum group metals.
Karat	Measures gold purity and is expressed in 24ths.
Lode	A tabular deposit of valuable mineral consisting of quartz and other rock in place; often used synonomously with vein and reef.
Matte	A metallic sulfide mixture produced from the roasted product when smelting sulfide ores of copper, lead, and nickel.
Placer	A mass of gravel, sand, or similar material resulting from the crumbling and erosion of solid rocks and containing particles or nuggets of gold, platinum, tin, or other valuable minerals, that have been derived from rocks or veins.

[1]Definitions from *A Dictionary of Mining, Mineral, and Related Terms*, U.S. Department of the Interior, Bureau of Mines, 1968.

Pyrometallurgical process	The smelting of the catalytic material using plasma fusion or base metal smelters.
Refining	The purification of crude metallic products.
Rockburst	The rupture or other failure of rock in a mine that is not likely to occur until depths of 1,500 to 3,000 feet are reached. Rockbursts can lead to the collapse of pillars, roofs, walls, and other mine structures.
Settling ponds	A pond for recovering the solids from the surplus water discharged during beneficiation.
Sizing	The process by which particles are separated into groups of the same or similar particle size.
Smelting	A process in which metals are subjected to fusion and thereby separated from impurities associated with the ore.
Sterling silver	Silver that is 925 fine, with the remaining 75 parts being copper.
Tailings	Washed ore or refuse that is considered inferior in quality or value to be treated further.
Toll refining	The operation in which refiners contract with ore or scrap suppliers to produce a specified metal for a fee. The metal is then turned over to the supplier for processing or sale.

APPENDIX B
MINING LAW REVISIONS

Environmental/reclamation issues

Precious metal industries are concerned that additional permitting and reclamation compliance costs[1] will adversely affect their production costs and long-term viability. Nearly every mining State currently has its own reclamation laws stipulating the procedures and standards companies must meet to be in compliance.[2]

Although not specifically cited in the proposed reclamation measures for soil and water clean up, the precious metals industries (particularly gold) are subject to legislation requiring bond payments for surface mines and mines using cyanide and other leaching agents on public lands.[3] These bonds must equal 100 percent of the Bureau of Land Management's estimated reclamation costs as required by Federal or State laws.

Federal royalty/taxes and patenting

Under the 1872 Mining Law, the Bureau of Land Management can award miners a "patent" (or claim) for Federal land for $2.50 or $5.00 per acre (depending on type of mineral deposit) if valuable minerals or metals are proven to exist and if certain work requirements are met. No royalties are currently assessed on companies that mine on public lands. However, Congress is considering levying a royalty on the value of the minerals mined from public lands.[4] This royalty would apply only to new patents, not those previously awarded. A royalty would represent an additional cost to the precious metals industry, raising company operating costs with implications for future exploration and development decisions.

At the Federal level, U.S. mining companies are subject to the corporate income tax rate of 34 percent plus applicable State income taxes.[5] In addition, royalties and mining-specific taxes are often imposed on precious metals operations at the State level. Royalties are generally paid on production from public lands. States with significant mining industries impose taxes that are often linked to a company's net income level, such as Nevada's Net Proceeds of Mines Tax.[6] Because of declining corporate incomes, taxes collected by the States have generally fallen. Mine expansions and new mine openings usually generate increased property tax payments for the States.

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[1] U.S. gold mining companies spent more than $14 million in 1991 on reclamation activities. *The U.S. Gold Industry 1992*, p. 24.

[2] Ibid.

[3] These bonds are reportedly required in only 20 percent of land reclamation cases. *Congressional Record - Senate*, Jan. 28, 1993, S899.

[4] An 8-percent gross proceeds royalty on hard-rock minerals was cited in proposed Congressional legislation (H.R. 322 and S. 257) during the 103rd Congress, but this and other proposed significant reforms to the 1872 Mining Law were not enacted.

[5] "Mining Law Reform Gets Top Billing at Denver Meeting," *Engineering and Mining Journal*, May 1993, p. 16AA.

[6] *The U.S. Gold Industry 1992*, p. 13.

APPENDIX C
EXPLANATION OF 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 incorporate the internationally adopted Harmonized Commodity Description and Coding System through the 6-digit level of product description and have U.S. product subdivisions at the 8-digit level. Chapters 98 and 99 contain special U.S. classifications and temporary rate provisions, respectively.

Duty rates in the ***general*** subcolumn of HTS column 1 are most-favored-nation (MFN) rates, many of which have been eliminated or are being reduced as concessions resulting from the Uruguay Round of Multilateral Trade Negotiations. Column 1-general duty rates apply to all countries except those enumerated in HTS general note 3(b) (Afghanistan, Azerbaijan, Cuba, Kampuchea, Laos, North Korea, and Vietnam), which are subject to the rates set forth in ***column 2***. Albania, Armenia, Belarus, Bosnia, Bulgaria, the People's Republic of China, Croatia, the Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Mongolia, Poland, Romania, Russia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan are accorded MFN treatment. Specified goods from designated MFN-eligible 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 or in the general notes. If eligibility for special tariff rates is not claimed or established, goods are dutiable at column 1-general rates. The HTS does not enumerate those countries as to which a total or partial embargo has been declared.

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 for 10 years and extended three times thereafter, applies to merchandise imported on or after January 1, 1976 and before the close of July 30, 1995. Indicated by the symbol "A" or "A*" in the special subcolumn, 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. Indicated by the symbol "E" or "E*" in the special subcolumn, 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.

Free rates of duty in the special subcolumn 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.

Preferential nonreciprocal duty-free or reduced-duty treatment in the special subcolumn 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 as 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 or free rates of duty in the special subcolumn 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, implemented effective January 1, 1994 by Presidential Proclamation 6641 of December 15, 1993.

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), ***articles imported from freely associated states*** (general note 10), ***pharmaceutical products*** (general note 13), and ***intermediate chemicals for dyes*** (general note 14).

The ***General Agreement on Tariffs and Trade 1994*** (GATT 1994), annexed to the Agreement Establishing the World Trade Organization, replaces an earlier agreement (the GATT 1947 [61 Stat. (pt. 5) A58; 8 UST (pt. 2) 1786]) as the primary multilateral system of disciplines and

principles governing international trade. Signatories' obligations under both the 1994 and 1947 agreements focus upon 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, dispute settlement, and other measures. The results of the Uruguay Round of 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 importing and exporting countries to negotiate bilateral agreements limiting textile and apparel shipments, or for importing countries to take unilateral action in the absence or violation of an agreement. These agreements establish quantitative limits on textiles and apparel of cotton, other vegetable fibers, wool, man-made fibers or silk blends in an effort to prevent or limit 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.