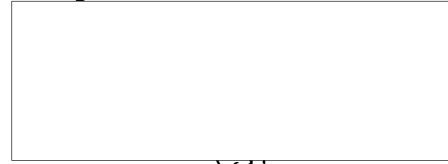


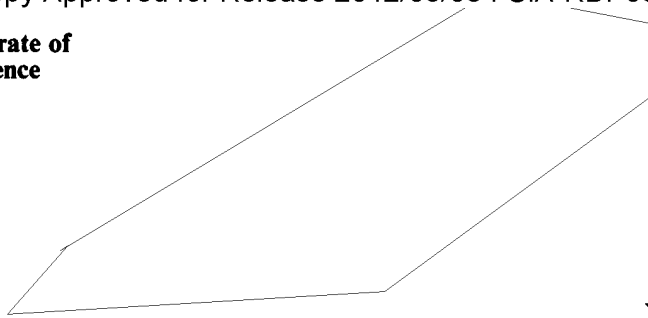


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USSR: Gold Production and Sales Potential



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USSR: Gold Production and Sales Potential




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A Research Paper

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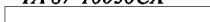
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USSR: Gold Production and Sales Potential



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Summary

Information available as of 1 February 1987 was used in this report.

We expect Soviet gold production—currently one-fifth of the world's annual output—to continue to grow slowly through the early 1990s, enabling Moscow to increase gold sales for hard currency without substantially reducing its gold reserve. Rising gold sales, however, probably will not offset the effect of continued low world oil prices on Moscow's hard currency earning capacity.



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Soviet gold production grew less than 2 percent annually during 1981-85, after decades of growth exceeding 3 percent per year. The main reason for the slowdown was the sharp decline in the gold content of mined ore in many key areas, particularly in the Northeast Region, which accounts for nearly 40 percent of Soviet production.



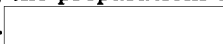
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We project that by 1990 annual production will reach roughly 330 to 360 metric tons, an increase of 2.5 to 12.8 percent over the 1985 level of roughly 320 tons, mainly as a result of gains in the utilization of existing capacity. We believe the Soviets can do little to boost production much above these levels, largely because most plants and mines will be operating close to capacity. Moscow has been making an effort to expand capacity for several years, but most construction is still at an early stage, and hard currency constraints may prevent purchases of the Western earthmoving equipment and spare parts needed to expand operations.



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We believe that slow output growth will continue during the early 1990s. The grade of mineable ore in the Northeast Region will probably deteriorate further, and the amount of new capacity under construction indicates the Soviets probably are not making the preparations necessary for a large surge in output in the next decade.



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Beginning in late 1985, Moscow dramatically increased gold sales as one of several steps to help offset the decline in hard currency earnings from energy sales. (Other steps included borrowing more on international markets, increasing exports, and cutting back on imports.) During 1986, Moscow was able to hold total hard currency revenues near the 1985 level by selling roughly 350 tons of gold for about \$4 billion. Sales in 1985 were about 190 tons. In comparison, oil sales earned \$7-8 billion in hard currency in 1986.

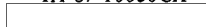


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Although we expect a high level of sales to continue during the remainder of the decade to help offset continued lower revenues from energy exports, the Soviets may be concerned about the state of their gold reserve. Its value has been hit by a "double whammy" in recent years. First, the falling content of gold in mined ore in key regions led to a decline in the rate of output growth and increased the cost of production. Second, despite a buildup of stocks in the early 1980s, the drop in the world gold price devalued the Soviet reserve by \$9 billion during 1981-85. Price increases last year helped recoup some of this "loss."



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Moscow's flexibility to sell gold during 1987-90 will be limited only by market capacity. Market experts indicate that annual sales will probably be limited to roughly 300 tons—although they could be as high as 450 tons in perhaps one or two years—if selling is done judiciously to avoid disrupting the market and causing a major, sustained price decline. At yearend 1986, the USSR had an estimated stockpiled reserve of 2,290 tons, and we project that 270 to 310 tons of surplus production (in excess of domestic use) could be sold annually during 1987-90 without drawing down this reserve. Assuming an average price of \$400 per ounce, Moscow could earn as much as \$4-6 billion annually from sales of 300 to 450 tons. Revenue from gold sales at these amounts, however, would cover only part of Moscow's expected hard currency shortfalls through 1990.



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Moscow could realize an annual earnings windfall of several billion dollars above our projections if South Africa's gold sales were substantially curtailed for an extended period—for example, in the highly unlikely event of intense nationwide strife bordering on civil war. In this scenario, prices would probably rise sharply, and the Soviet share of world sales could jump from roughly 15 percent in 1985 to 50 percent or more.



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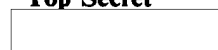
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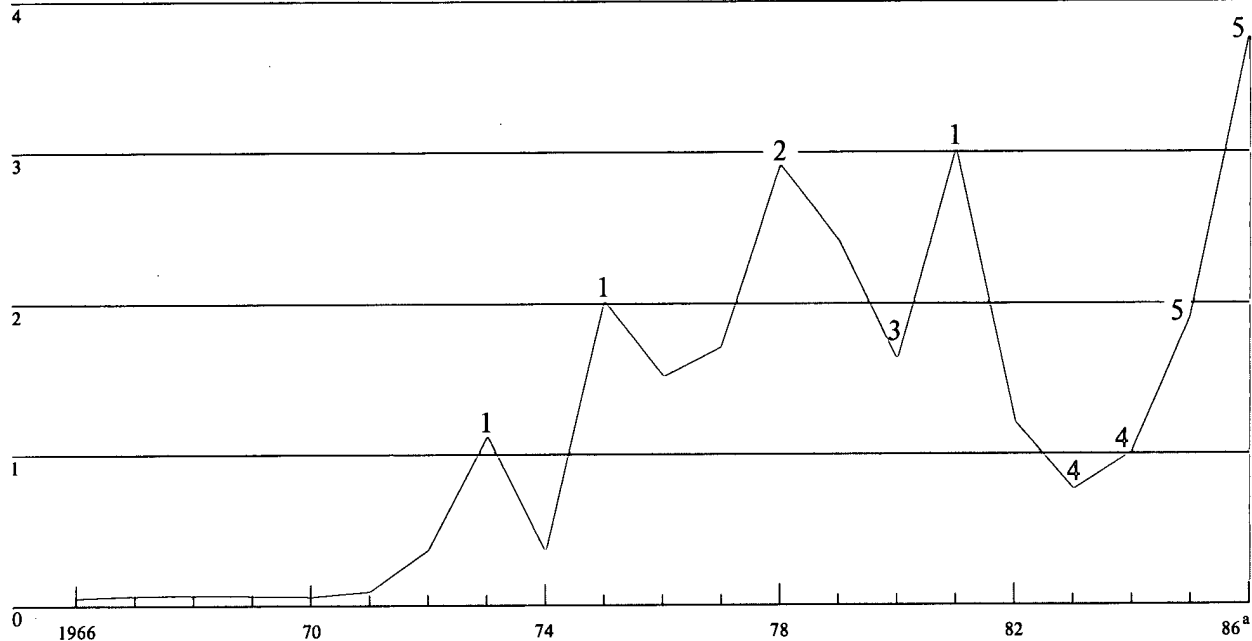
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Figure 1
USSR: Estimated Gold Sales, 1966-86

Legend

- 1 Large grain imports
- 2 Large rise in machinery and pipe imports
- 3 Jump in world oil price
- 4 Record oil earnings
- 5 Low oil earnings

Billion US dollars



^a Estimated earnings.

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USSR: Gold Production and Sales Potential

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Role of Gold Sales in Foreign Trade

Analysis of the trends in the Soviet hard currency balance of payments indicates that Moscow uses gold sales primarily as a financing mechanism rather than a trade commodity like oil. The Soviets generally sell more gold when they need a rapid infusion of cash, and less—even when prices are high—when they are in a good cash-flow position. During the mid-1970s, when Moscow needed to finance large purchases of grain and equipment, for example, gold sales were high (see figure 1). Hard currency crises in 1981 and 1982 forced considerable sales, even though a falling gold price cut into earnings. Gold sales were relatively small in 1983 and 1984 as record oil revenues from the West obviated the need for extra cash.

The sharp decline in hard currency export earnings beginning in 1985 has again sparked substantial gold sales. Oil production problems in 1985 cut annual Soviet oil revenues by nearly \$4 billion, which Moscow partially offset by selling approximately 190 tons of gold worth just under \$2 billion. Even though oil exports recovered somewhat in 1986, the steep drop in world oil prices resulted in another decline of \$3-4 billion in hard currency sales. Estimated oil revenues of \$7-8 billion last year were just half the peak earnings of \$15.6 billion recorded in 1983. Moscow again responded with higher gold sales, selling an estimated 250 tons in July and August 1986. We believe that total gold sales in 1986 may have reached 350 tons, earning \$4 billion.

Recent Production Trends

Because of the importance of gold sales as a source of financing, maintaini



Table 1
Major Gold Producers

Metric tons

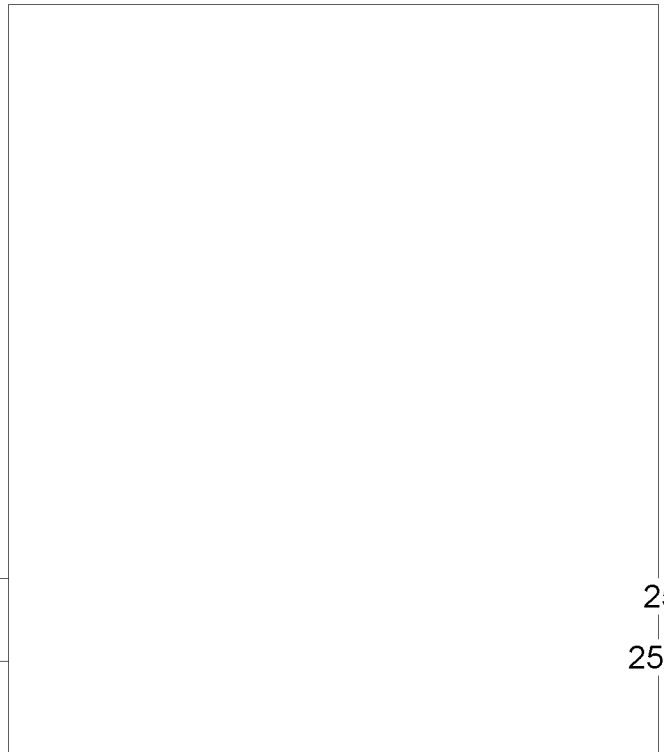
| | 1970 | 1975 | 1980 | 1985 |
|---------------|-------|------|------|------|
| South Africa | 1,000 | 714 | 674 | 619 |
| USSR | 211 | 251 | 294 | 321 |
| Canada | 75 | 51 | 51 | 86 |
| United States | 54 | 33 | 30 | 77 |
| Brazil | 5 | 5 | 40 | 62 |
| Australia | 19 | 16 | 17 | 57 |

Note: The USSR figures are estimated. The other figures are from *Handbook of Economic Statistics, 1986*, Central Intelligence Agency.

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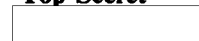
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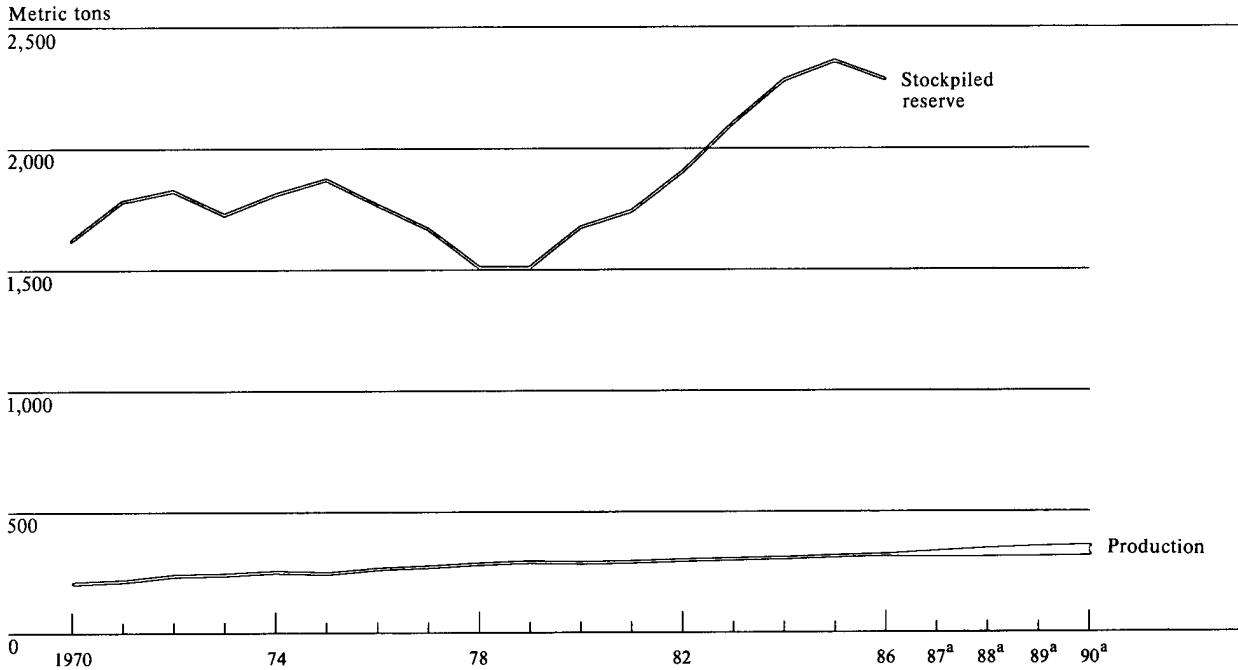


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Figure 2
USSR: Estimated Gold Supply, 1970-90



^a Projected.

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Declining Gold Content

The major cause of the slower growth in output in recent years was the sharp decline in the gold content of mined ores, particularly in the Northeast Region, the main source of the Soviet gold supply for the last 50 years (see figure 3 and inset on page 4).⁴ The region's annual output peaked at an estimated 133 tons in 1977, but then fell to about 120 tons in 1980 and leveled off. In 1970, the Soviet press reported that it was necessary to process 28 percent more ore per

⁴ For the purposes of this paper, the Northeast Region includes the Yakut ASSR and Magadan Oblast.

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Figure 3
Soviet Gold-Ore-Processing Plants

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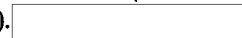
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unit of gold production than in 1965. By 1975, another 50-percent increase in ore processing was required.



Earlier, the Soviets offset the declining quality of ore by processing increasingly greater volumes, partly with the help of imported earthmoving equipment. After 1977, however, the Soviets were unable to compensate with increased processing because of limited equipment availability.

the mines are placers that are in a state of decline after having been worked for several years.⁵ However, the overall contribution from these two areas was small; in 1985, we estimate these regions together produced less than 15 tons (less than 5 percent of national output).



⁵ A placer deposit is an alluvial or glacial formation of sand or gravel that has been eroded from bedrock and has concentrated in low-lying areas such as stream valleys. In contrast, a lode deposit is a collection of gold ore veins. See appendix C for a discussion of gold-mining and -processing methods.

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Substantial declines in the content of ores mined throughout East Siberia and the Urals were also a factor in the slow growth of national output. Most of

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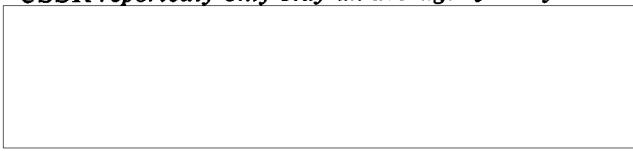
Shifting Output Away From the Northeast Region

The deteriorating ore base and high production costs have prompted a shift in output away from the Northeast Region to other areas of the country (see figure 4).

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In addition, production costs are high, mainly because of the limited mining season, difficulties associated with operating in the harsh environment, high labor costs, and periodic supply shortages that disrupt production. Operation of the region's placer mines, which account for at least 90 percent of output, is limited to only about six months each year, when flowing water is available for washing operations (see appendix C). The high level of stress exerted on earthmoving equipment when removing permafrost—the permanently frozen ground that lies beneath the top few centimeters—contributes to high failure rates. Relatively high wages must be paid to attract workers to the region. Nevertheless, labor shortages persist because of the harsh weather, inadequate housing, and low level of social and cultural amenities. Worker turnover is also very high; gold industry workers who migrate from other areas of the USSR reportedly only stay an average of two years.



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Low Utilization of Capacity

Muruntau and Zod-Ararat, two of the largest Soviet gold plants, have been operating below capacity since they began production in 1969 and 1976, respectively. Muruntau's output in 1985 was approximately 50 tons of refined gold, only two-thirds of its estimated capacity of about 75 tons. Zod-Ararat's output was

roughly 9 tons, or 50 percent of capacity. An analysis of Muruntau's operations [redacted] showed an inadequate capacity to load and unload railcars that deliver ore from the mine to the processing plant (see figure 5 on page 6). An analysis [redacted] of the Zod-Ararat plant indicates that there was probably an adequate capacity to deliver ore to the plant but that only two of four thickener tanks were in use [redacted]

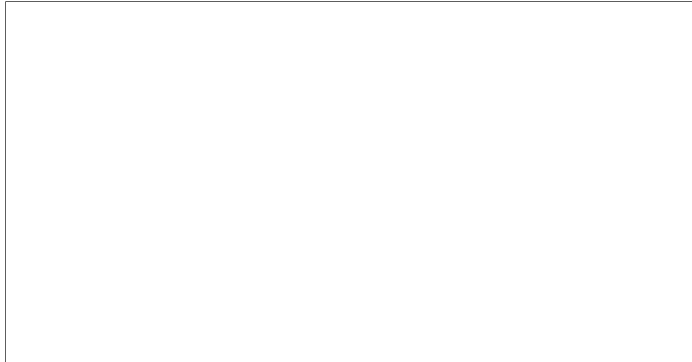
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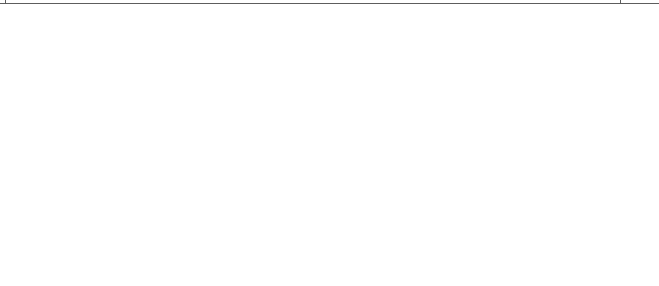


- Soviet technical literature has not reported on the advantages of the RIP process since the 1970s, when the Soviets claimed this technology would increase output and cut production costs by 20 percent compared with conventional gold extraction techniques—claims discounted by US engineers.
- Articles in the Soviet press during the 1960s and 1970s indicated that at least five gold-ore-processing plants would be converted to the RIP process, but analysis [redacted] of known gold plants indicates that only the Muruntau and Zod-Ararat plants use this process.

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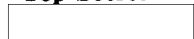
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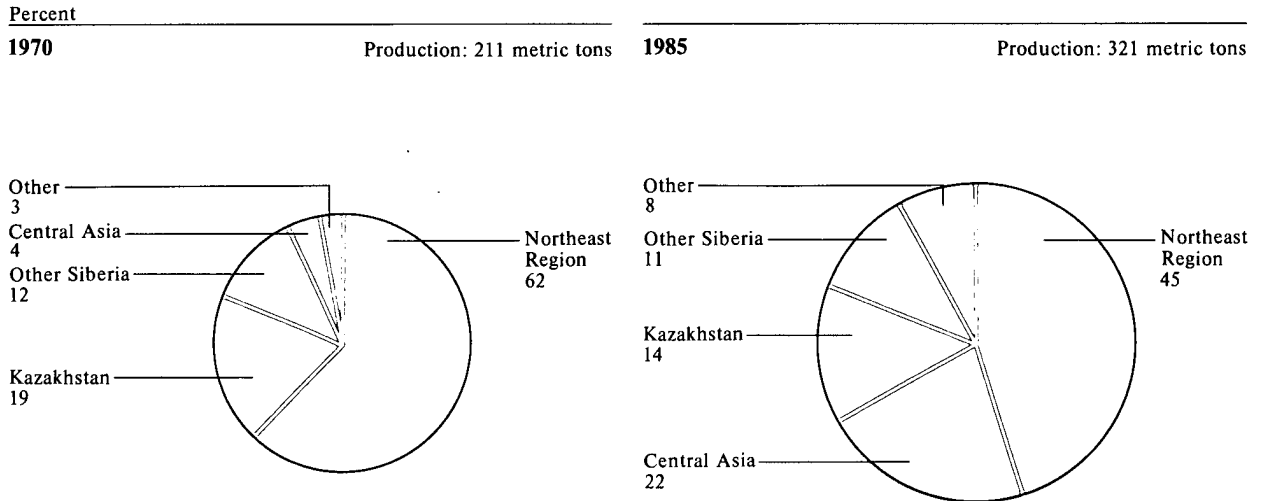
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Figure 4
USSR: Geographical Distribution of Gold Output, 1970 and 1985^a



^a Excluding gold produced as a byproduct from the production of other metals, 36 metric tons in 1970 and 56 metric tons in 1985.

[Redacted]

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Analysis [Redacted] of seven smaller ore-processing plants shows an inadequate number of dump trucks to deliver ore from nearby mines, a possible indication of gold production problems. We estimate the total annual capacity of these plants in 1985 was roughly 28 tons, but production could have been as low as 14 tons. [Redacted]

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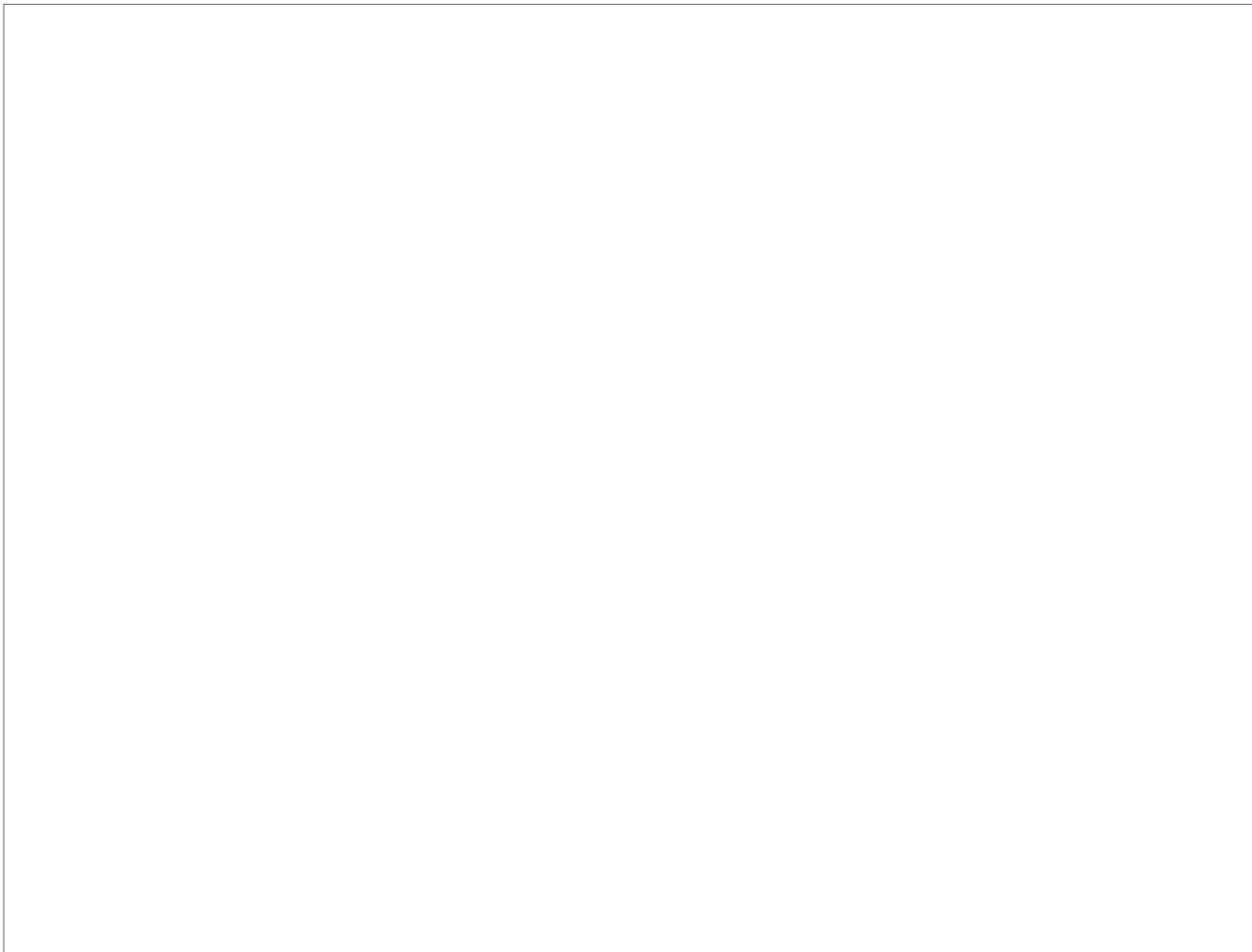
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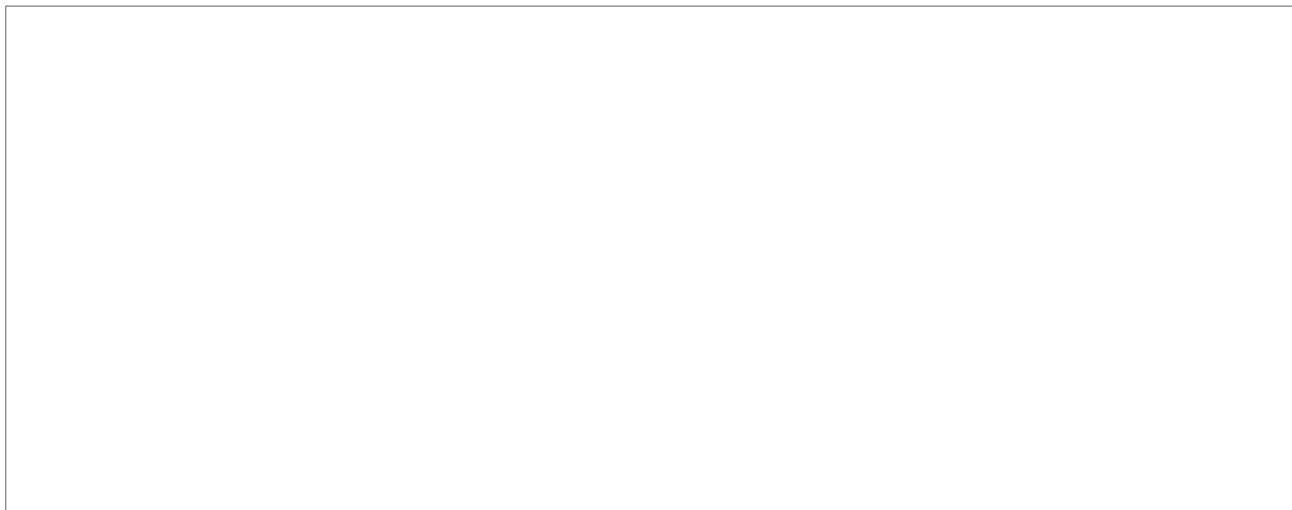


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Table 2
USSR: Estimated
Gold Production and Reserve

Metric tons
(except where noted)

| | Produc- tion | Net Sales | Domestic Consump- tion ^a | Yearend Reserve | Market Value of Reserve (billion US \$) |
|------|-----------------|--------------|---|--------------------|---|
| 1970 | 211 | 3 | 39 | 1,624 | 1.9 |
| 1971 | 220 | 19 | 39 | 1,786 | 2.4 |
| 1972 | 242 | 158 | 40 | 1,830 | 3.4 |
| 1973 | 246 | 304 | 41 | 1,731 | 5.4 |
| 1974 | 257 | 131 | 42 | 1,815 | 9.3 |
| 1975 | 251 | 147 | 43 | 1,876 | 9.7 |
| 1976 | 269 | 328 | 45 | 1,772 | 7.1 |
| 1977 | 278 | 332 | 46 | 1,672 | 8.0 |
| 1978 | 290 | 401 | 47 | 1,514 | 9.4 |
| 1979 | 298 | 250 | 48 | 1,514 | 14.8 |
| 1980 | 294 | 80 | 48 | 1,680 | 33.1 |
| 1981 | 298 | 183 | 49 | 1,746 | 25.8 |
| 1982 | 304 | 91 | 50 | 1,909 | 23.0 |
| 1983 | 309 | 55 | 51 | 2,112 | 28.8 |
| 1984 | 314 | 86 | 52 | 2,288 | 26.5 |
| 1985 | 321 | 190 | 52 | 2,367 | 24.1 |
| 1986 | 326 | 350 | 53 | 2,290 | 27.1 |

^a Mostly gold used in jewelry, electronics, and dentistry.

Rapid Buildup of the Stockpiled Reserve

Despite slow production growth, we estimate that Moscow's stockpiled gold reserve grew from 1,680 tons at the end of 1980 to 2,290 tons at the end of 1986 (see table 2 and figure 2). Even though the reserve increased, the potential market value actually declined by one-fourth during 1981-85 because of the nearly 50-percent fall in world gold prices. In 1980, the reserve had a value of about \$33 billion; in 1985, the larger stockpile was worth approximately \$24 billion. Price increases last year, however, helped recoup some of this "loss."

This decline in value, coupled with slow production growth, may have caused Moscow to place increasingly tight restrictions on domestic use, which has traditionally accounted for approximately one-sixth of annual production.

These restrictions followed other long-established measures to keep domestic consumption low. Industrial allocations of valuable materials are generally limited to high-priority uses for which there are no suitable substitutes. Since the 1960s, Moscow has attempted to reduce the amount of gold used in making jewelry.⁹ Soviet citizens are also prohibited from holding gold for savings or investment purposes. Gold used in electronics, jewelry, and dentistry probably accounts for the bulk of consumption.¹⁰

Slow Growth in Output Projected To Continue

Although Moscow is apparently making a concerted effort to expand capacity, most of the construction we have identified is at an early stage. Therefore, increases in production during 1986-90 will be mainly from gains in utilizing existing capacity. We project

¹⁰ Electronics may be the fastest growing domestic use in the USSR. Gold is used in advanced electronics applications where its relatively high electrical conductivity, temperature stability, corrosion resistance, and nonmagnetic properties compared with most other metals are important for increasing reliability. In the West, in 1985, the use of gold in jewelry accounted for approximately 60 percent of consumption. Dental and electronics applications accounted for about 15 percent; coinage, investment, and other industrial uses accounted for the remainder.

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Soviet gold output will grow at an average annual rate of 0.5 to 2.5 percent during the period, reaching 330 to 360 tons in 1990:

- Output from the Northeast Region will probably decline further, despite efforts to expand capacity, because of continued deterioration in the grade of mineable ore. Although stepped-up geological exploration over the past decade has located some new placer deposits that are now in various stages of development, their combined output will be too small to offset declines elsewhere in the region. In addition, we project no output from a new gold plant

growth for the other metals and a continuing absence of incentives to motivate plant managers to boost byproduct production.¹³

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Shortages of hard currency could exacerbate the slow growth we project through 1990 by preventing or delaying the purchase of Western earthmoving equipment and spare parts needed for expanded operations. Output could be particularly affected in areas where the gold content of mined ore is declining and the Soviets need to increase the volume of ore processed.

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- Annual production at the Murantau and Zodararat plants will probably continue to increase as gains are made in solving the likely technical problems at both plants.

We believe there is little the Soviets can do to boost production much above the levels that we project through 1990. We project most existing plants and placer mines will be operating close to capacity. Roughly 10 tons of additional annual output could be realized by bringing production of the seven small plants up to full capacity. New placer deposits would probably not yield much additional gold even if developed on a priority basis because this type of deposit is generally small and typically located in remote areas of the eastern USSR where lack of infrastructure delays startup by several years. In addition, earthmoving equipment required for stepped-up mining operations would probably have to be imported for hard currency.

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- We project about 3 tons of annual output during 1987-90 from a new plant at Plast in the Urals

We project no output, however, from the new plant under construction near Kazarman in the Kirghiz SSR, another under construction at Auezov (Bakyrchik) in Kazakhstan, and a new facility planned for the Tajik SSR because they will probably not be completed until the early 1990s.¹²

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- Outside the Northeast Region, a small increase will come from several small, scattered placer mines reportedly in various stages of development.

Moscow could realize a small boost in its salable supply by implementing additional limits on domestic use, but such consumption is already at or near minimum levels. The Soviets could try to increase gold output by using heap leaching, a recovery method recently implemented in the West that can be set

- Gold produced as a byproduct from other metals—mainly copper and to a lesser extent lead and zinc—will probably increase slowly and supply about one-sixth of annual production. We project slow output

¹³ Although the Soviets recognize that there is a large potential to increase the production of nonferrous metals as a byproduct and have called for an increase in such production in 1986-90, the open press reported little progress in 1986. The performance of nonferrous metals plants is gauged primarily by the fulfillment of production quotas for the primary metal; little credit is generally given for the small amount of gold produced.

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¹² The planned construction of the Tajik plant was announced in the Soviet press in late 1985.

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Table 3
USSR: Projected Gold Supply

Metric tons

| | Production | Domestic Consumption | Excess Production | Reserves Remaining If | |
|------|------------|----------------------|-------------------|---------------------------|---------------------------|
| | | | | Annual Sales are 300 Tons | Annual Sales are 450 Tons |
| 1987 | 324 to 338 | 52 to 56 | 268 to 286 | 2,258 to 2,276 | 2,108 to 2,126 |
| 1988 | 325 to 349 | 53 to 57 | 268 to 296 | 2,226 to 2,272 | 1,926 to 1,972 |
| 1989 | 326 to 357 | 52 to 58 | 268 to 305 | 2,194 to 2,277 | 1,744 to 1,827 |
| 1990 | 329 to 362 | 52 to 60 | 269 to 310 | 2,163 to 2,287 | 1,563 to 1,687 |

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up quickly, requires a much smaller capital investment, and is less expensive to operate than traditional gold recovery methods.¹⁴ But we have seen no evidence that this technology is being used in the USSR.

sales are spread over the year and among all the geographic markets. The Soviets may even be able to push sales to as much as 450 tons for one or perhaps two years without causing a price decline, but

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After 1990, we expect output to continue to grow slowly for several years. The grade of minable ore in the Northeast Region will probably deteriorate further, and the new capacity we have observed under construction indicates the Soviets probably are not making the preparations necessary for a large surge in output in the next decade.

the USSR would turn to the futures markets to sell quantities in excess of 300 tons ¹⁵ Sales at these levels could be met mostly from current production, requiring only a small to moderate reduction in the stockpiled reserve (see table 3). At the estimated 1986 sales level of 350 tons, for example, Moscow would have had to dip into its reserve for only about 75 tons.¹⁶

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Continued Sales Flexibility

Even with slow production growth well into the 1990s, Moscow's flexibility to sell gold will be limited only by market "capacity." Market capacity projections are somewhat speculative.

Sales averaging 300 tons would earn nearly \$4 billion annually, assuming a price of \$400 per troy ounce.¹⁷ Revenue from gold sales at these amounts, however,

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Moscow could sell as much as 300 tons of gold annually on the open or "physicals" market and through direct bilateral sales without much effect on the price—if

¹⁵ These projections are based on the assumption that world gold market conditions do not substantially change. A stronger gold market and a higher price could moderately increase the market limit on Soviet sales.

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¹⁶ Although today's market is substantially different, there is historical precedent for a large drawdown of the Soviet gold reserve. Moscow drew down its reserve to about 900 tons in 1965, the lowest level in the last 30 years.

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¹⁷ One metric ton is equal to 32,151 troy ounces.

¹⁴ Heap leaching can be used to recover gold from both placer and lode deposits and is often used to process low-grade ores. It involves distributing a weak cyanide solution over the top of an open mound or leveled heap of gold ore placed on an impermeable pad and collecting the gold-enriched solutions from the base of the heap. Depending on ore permeability, 67 to 95 percent of the gold can usually be extracted.

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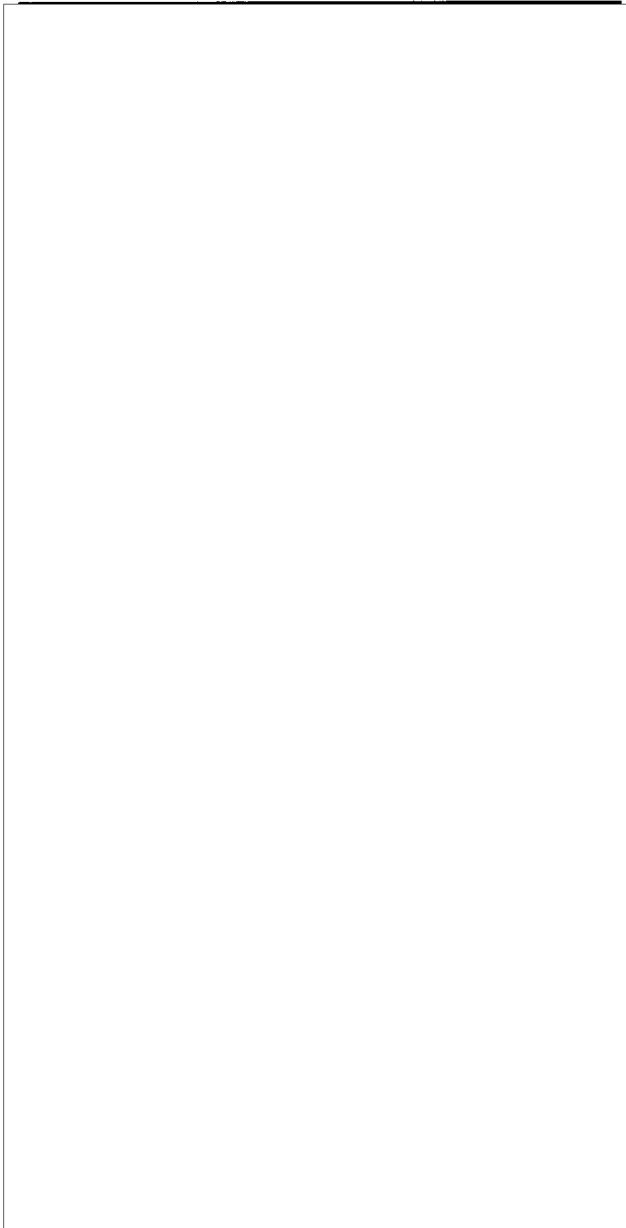
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would only partly ease Moscow's expected hard currency shortfalls.¹⁸ Even if oil prices continue to rise, the volume of hard currency oil exports is projected to decline as oil production tapers off toward the end of the decade. With prospects poor for much growth in nonenergy exports, Moscow's annual hard currency export earnings are likely to run some \$7-10 billion below the peak of \$32 billion in 1982-84.



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Moscow could realize an annual earnings windfall of several billion dollars if the supply of South African gold sold on world markets was substantially cut back or curtailed for an extended period. A prolonged halt in South African exports caused by intense nationwide strife bordering on civil war—an event we view as highly unlikely—could make the USSR the world's leading supplier. In such a scenario, prices would probably rise sharply and the Soviet share of world sales could jump from roughly 15 percent in 1985 to 50 percent or more.¹⁹



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¹⁹ The increase in the Soviet share of world sales would depend on how far Moscow would be willing to draw down its reserve to take advantage of a halt in South African sales, which were about 640 tons in 1986.



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Appendix C

Soviet Gold Mining and Processing

Roughly two-thirds of the gold produced in the Soviet Union, including gold produced as a byproduct from the production of other metals, is from placer mines, and one-third is from lode mines. Placers are alluvial or glacial deposits of sand or gravel that have been eroded from bedrock and have concentrated in low-lying areas such as stream valleys. Placer gold occurs in relatively coarse grains or flakes that may also contain small amounts of other metals, such as silver. The gold can usually be separated from the sand or gravel by various washing methods, followed by amalgamation. Washing uses flowing water as a medium to separate the heavier particles, primarily gold and heavy sands, from lighter sands. Amalgamation further concentrates the gold by using mercury, which adheres to the gold (forming an amalgam) but not to other heavy particles. The amalgam can then be subjected to intense heat (smelting) to separate the mercury, leaving the relatively pure gold. []

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The Soviet gold industry primarily uses four washing methods to recover gold from placer deposits: sluicing, washing plants, dredges, and panning. *Sluicing*, the most common method of washing gold, generally uses bulldozers and other earthmoving equipment to remove overburden and move the gold-bearing ore to a device called a buddle trough. A high-pressure water spray directed into the trough partially disintegrates the ore and separates heavier and coarser particles from lighter particles. The resulting slurry is then pumped to the top of a sluice, a long, sloping, rectangular trough with transverse bars or slats called riffles or a rough-textured mat on the bottom. As the slurry flows down the sluice, the heavy gold particles are caught in the grooves between the riffles or in the mat, and the lighter sand and gravel particles are washed away. []

Washing plants are frequently used where coarse gravels and fine clay-based soils are cemented into a hardened mass. The ore is usually prepared and moved to the plant as a slurry. A short primary sluice removes large gold particles, a revolving drum scrubber pulverizes and separates the coarse from the fine particles, and secondary sluices recover the remaining gold. *Dredges* are the most efficient method for recovering gold from large placer deposits. They are barges that contain an excavating system, equipment for separating and recovering valuable minerals, and a tailings disposal system. Dredges float in natural bodies of water or in ponds created when the deposit is excavated. *Panning* is usually used in small placers and areas where sufficient water to operate sluices or washing plants is not available. []

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A lode deposit is usually defined as a collection of gold ore veins. The ore is mined by traditional open-pit or underground methods and transported to a gold plant where it is crushed and ground in a mill with water to a fine pulp. The pulp is typically passed through a gravity concentrator where some of the heavy gold particles settle out. They are then collected and taken to a refinery where most of the remaining impurities are removed. The bulk of the remaining gold in the pulp is generally recovered by some form of cyanide leaching, followed by refining. []

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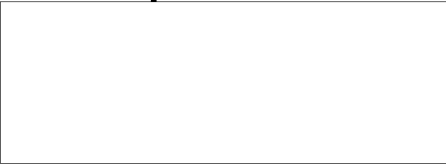
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