TIN IN THE SINO-SOVIET BLOC

December 1961

CENTRAL INTELLIGENCE AGENCY

Declassified in Part - Sanitized Copy Approved for Release 2013/05/08 : CIA-RDP79R01141A002200090001-6

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CIA/RR ER 61-52

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Office of Research and Reports

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FOREWORD

The purpose of this report is to assess the supply of and demand for tin in the Sino-Soviet Bloc and to estimate the potential significance of Soviet supplies of tin to the Free World. The following steps have been taken in order to assess these problems: estimates of production of tin have been developed, taking into account the producing potential within the Sino-Soviet Bloc; the probable demand for tin in the countries of the Bloc was estimated; and data on trade were tabulated and evaluated. The text includes the methodology employed in deriving the estimates.

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TIN IN THE SINO-SOVIET BLOC

Summary

During the 1950's the Sino-Soviet Bloc became a major producer of tin. In 1950 the Bloc produced about 14,000 tons* of tin, which was about 8 percent of the world total, and production by 1960 had nearly quadrupled, reaching a total of about 52,000 tons, or almost one-fourth of the world total. Plans for 1965 indicate another substantial increase to about 80,000 to 85,000 tons,** and as far as can be determined at this time, the Bloc should have no serious difficulty in achieving this goal. Tin reserves in the Bloc are sufficiently large to support an annual production of this magnitude for many years, and although the ores generally are of low grade, the technology of the Bloc is adequate to handle successfully whatever processing problems may be encountered.

Predominant among the tin-producing countries in the Sino-Soviet Bloc is Communist China. From 1950 to 1960, China's share of the tin produced by the Bloc increased from about 44 percent to about 63 percent, and by 1965 this share is expected to increase to about 67 percent. The second largest producer of tin in the Bloc, the USSR, in 1960 produced about 35 percent of the total output of the Bloc, whereas East Germany and North Vietnam, the only other producers, accounted for only about 2 percent.

Consumption of tin in the Sino-Soviet Bloc, although not growing as rapidly as production, has increased nearly 150 percent during 1950-60, from 15,000 tons to about 38,000 tons. This rate of growth is not expected to change materially, and by 1965 the annual consumption of tin should be about 55,000 tons. The USSR is by far the largest consumer, taking about two-thirds of the annual available supply. Consumption of about 23,000 to 24,000 tons of tin in the USSR in 1960, however, contrasts sharply with the consumption of 82,000 tons in the US. The contrast is even greater if levels of consumption in the two countries are compared on a per capita basis. In the USSR in 1960, consumption of tin per capita was about 0.11 kilogram, and in the US 0.46 kilogram. One of the principal uses of tin in both countries is in tinplate, the bulk of which is fabricated into tin cans for preserving food. In 1960 the USSR produced only 6.4 percent as much tinplate as the US.

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* Tonnages are given in metric tons throughout this report.

** Including about 4,000 tons of secondary metal.

Communist China, the only country in the Sino-Soviet Bloc that produces a surplus of tin, also is the only producer whose costs of production are believed to compare favorably with those of the major producers in the Free World. Information clearly indicates that costs of producing tin in the USSR and East Germany are high, but as long as production in the Bloc exceeds consumption, the continuation of these high-cost operations is somewhat perplexing. Were either the USSR or East Germany to discontinue production at their less efficient plants, however, their dependence on the tin industry of China would increase greatly, and thus far neither the USSR nor East Germany has been willing to take these steps. On the contrary, the plans of the USSR in particular indicate a trend in the opposite direction -- not only to increase production of tin but also to reduce costs of production.

The pattern of Bloc trade in tin has altered considerably in recent years. From the end of World War II through 1955, the Sino-Soviet Bloc was a net importer of tin from the Free World, but in 1956 the Bloc became a net exporter and has maintained that position -- fundamentally because of the rapid increase in production of tin in Communist China.

When the quantity of tin exported by the Bloc to the Free World suddenly reached sizable proportions in 1958, producers of tin in the Free World became greatly concerned. At that time, annual production of tin in the Free World exceeded consumption, and efforts were being made through the International Tin Council (ITC) to control the surplus of production in order to maintain a stable market price. By 1958, however, the additional supplies of tin from the Bloc were too large to be accommodated by the ITC, and the plan for stabilizing the market collapsed. As a result, the price of tin in the world market dropped precipitously. The USSR subsequently agreed to cooperate with the ITC by limiting exports of tin to the West to 13,500 tons in 1959 and since that time has limited annual exports of tin to the Free World to the same quantity or less. Other countries in the Bloc, mainly China, also have exported tin to the Free World, but such exports were relatively small through 1960.

Early in 1961 the world tin situation again changed drastically. Free World consumption exceeded available supplies, and, for the immediate future at least, a continuing shortage of supplies of tin in the West is likely. In the Bloc, however, in spite of a rising trend in consumption, planned increases in production are such that an annual surplus of about 25,000 to 30,000 tons may be available for export by 1965. In the event that exports of tin by the Bloc to the Free World then increase to this level, Communist China most probably will be the principal exporter to the Free World.

I. Introduction

In spite of the widespread occurrence of tin minerals, commercial deposits of tin are found in relatively few areas of the world, principally in the less developed countries of Asia, Africa, and South America and in China and the USSR. Over the years, in part because of the necessity of depending on such remote sources for this strategic raw material, all the major industrial countries of the world have been engaged in programs to minimize their requirements for tin. Although some successes have been achieved through technological advances and the development of substitutes, certain tin alloys have continued to be essential for many industrial applications.

World production and consumption of tin have fluctuated widely for many years, and, in general, until 1959-60, production exceeded demand. Since the early 1930's, continued international efforts have been made to correct the imbalance between the demand for the metal and the level of production. With the fulfillment of the US program for stockpiling tin, which absorbed much of the Free World's annual surplus during 1950-55, the International Tin Agreement of 1956 attempted to maintain a stable market price for tin principally by establishing export quotas for the tin-producing countries. These export quotas had the effect of curtailing production in the major tin-producing countries which not only are underdeveloped economically but which also are dependent on exports of tin as a major source of foreign exchange.

The significance of exports of tin from the Sino-Soviet Bloc to the Free World has varied over the years in accordance with the world supply situation. Exports during the last half of the 1950's contributed to upsetting the regulated stability of the tin market in the Free World. Since late 1960, however, the supply of tin in the Free World has been deficient, and the industrial West could absorb additional supplies of tin from the Bloc.

II. Resources

Of an estimated total world reserve of 7.6 million tons of tin contained in ore, the Sino-Soviet Bloc has about one-third, or 2.5 million tons. 1/* The estimated distribution of these reserves within the Bloc

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is as follows*:

Country	Thousand Tons
USSR	500
Communist China	1,900
East Germany	N.A.
North Vietnam	75
Poland	Negl.
Minimum Total	2,475

A. USSR

1. Quantity of Reserves

Although the USSR is known to have numerous deposits of tin, information on the magnitude of the reserves is incomplete. In 1944, Soviet officials claimed that reserves of tin ore in the USSR were exceeded only by those of Southeast Asia (presumably including southern China) and Bolivia. 2/ This statement implied a Soviet reserve of between 300,000 and 500,000 tons of contained metal. Since that time the USSR has continued to explore for tin ores. These efforts have been successful to some extent, for increases in tin reserves have been reported as recently as 1959. 3/ On the basis of this information the tin reserves of the USSR as of 1960 are estimated to be about 500,000 tons.

2. Quality of Ore

Pure cassiterite (tin dioxide), the mineral from which nearly all the world's tin is produced, theoretically contains 78.6 percent tin, and the ore containing this mineral occurs in two types of deposits -- placer and lode.** Placer ore has a much lower tin content than lode ore, less than 0.3 percent compared with a range of 1 to 8 percent, 4/ but it generally contains fewer impurities and is therefore easier to concentrate. In the Free World, at least one-half of the tin reserves are in placer deposits, 5/ whereas only 9 percent of the tin reserves of the USSR are in such deposits. 6/

Another source of tin is stannite, also known as tin pyrite. At present, stannite ore is not being exploited commercially, but a

* The methodology for estimating reserves of tin in the Bloc follows in the paragraphs below.

** Placer ore can be mined by some type of dredging or open-pit method, but lode ore usually is mined by more expensive underground methods.

technological process for the recovery of tin from stannite ore reportedly is being developed in the USSR. 7/ The theoretical tin content in pure stannite is 27.5 percent, but the high content of sulfur and copper impedes efficient recovery of the tin. 8/ Outside the USSR the only occurrences of stannite ore that appear to be of commercial interest are in Bolivia. 9/

3. Location of Deposits

Virtually all the tin reserves in the USSR are located in East Siberia and the Soviet Far East. As of 1 January 1938 the prospected tin reserves of the USSR in terms of metal content were distributed geographically as follows 10/:

Area	Percent
RSFSR	81.1
Chitinskaya Oblast	29.2
Yakutskaya ASSR	37.2
Primorskiy Kray	14.7
Kazakh SSR	10.8
Kirgiz SSR	7.0
Tadzhik SSR	1.1
Total reserves	100.0

Although geological prospecting since World War II has resulted in the discovery of tin deposits in other regions of the USSR, the relative importance of the two largest areas of tin reserves, Yakutskaya ASSR 11/ and Chitinskaya Oblast, 12/ has not changed. Significant additional reserves have been discovered in Magadanskaya Oblast and in the Khabarovskiy and Primorskiy Krays in the Soviet Far East.

B. Communist China

1. Quantity of Reserves

Although definite information on the extent of the resources of tin in Communist China is not available, reserves are believed to be very large. Estimates for pre-Communist China range from 650,000 tons 13/ to 1.9 million tons of tin contained in ore, 14/ and during the past 10 years additional discoveries have been claimed. In 1958 the Vice Minister of Geology stated that China had the largest resources of tin in the world. 15/ For comparison, Malaya, which heretofore has been considered

to have the largest resources, is estimated to possess tin reserves of about 1.5 million tons of metal contained in ore. 16/ In view of the official nature of the claim made for the largest reserves in the world, the current tin reserves in China may approach in magnitude the upper limit of the range of estimates made in the pre-Communist era.

2. Quality of Ore

Tin ore occurs in Communist China in both lode and placer deposits, but probably most of the reserves are contained in lode deposits. Some of the lode ores have a tin content of at least 2 percent, 17/ and most of them contain such impurities as iron, copper, zinc, lead, antimony, bismuth, and arsenic. The removal of these metals, necessary to produce commercial grades of tin, is reported to be very difficult. 18/ Furthermore, the grains of cassiterite in these ores are unusually small, a factor that inhibits a high recovery of the tin content. 19/

3. Location of Deposits

Of the total tin reserves in Communist China, probably about 80 percent is located in Yunnan Province in the Ko-chiu area (23°23' N - 103°09' E). 20/ The remainder of the tin resources of China consists of scattered deposits in south and southwestern China, particularly in the Kwangsi Chuang Autonomous Region and in Kiangsi, Hunan, and Kwangtung Provinces. 21/ Recent geological prospecting programs have resulted in reports of the discovery of additional deposits of tin ore in far western and northwestern China. As yet, however, very little is known of the size, quality, and economic potential of these occurrences.

C. East Germany

East Germany is the only European Satellite with any appreciable tin reserves, but the quantity of the reserves is not known with any certainty. 22/ All the reserves are in lode deposits located in the Erzgebirge (Saxony Ore Mountains) near the Czechoslovak border of East Germany. Ores now being mined there are complex and have a metal content ranging between 0.30 and 0.35 percent tin. 23/

D. North Vietnam

North Vietnam also has sufficient reserves to support a small but growing tin industry. 24/ These reserves reportedly consist of 50 million tons of ore with a tin content of 0.15 percent, or about 75,000 tons of tin. 25/

E. Poland

Deposits of low-grade tin ore are located in western Poland. In 1951 the ore was reported to contain 0.01 percent tin, not sufficient to justify exploitation. 26/

III. Production

During 1950-60 the annual production of primary tin in the Sino-Soviet Bloc increased from an estimated total of about 14,000 tons to about 52,000 tons, as shown in Table 1,* or from about 8 percent of the world's total production in 1950 to about 25 percent in 1960. 27/ Within the Bloc, Communist China accounted for about 63 percent of the tin produced in 1960, the USSR produced about 35 percent, and East Germany and North Vietnam each accounted for about 1 percent. The relative importance of the countries of the Bloc in relation to the other tin-producing countries of the world is shown on the map, Figure 1.**

A. USSR

In 1960 the USSR accounted for about 8 percent of the world production of primary tin. The estimated production of primary tin in the USSR for 1940-65 is shown in Table 2.***

No specific goal has been announced for production of tin under the Seven Year Plan (1959-65), but production of tin in 1965 probably will be about 22,000 to 23,000 tons. Most of the increase is expected to be obtained through the improved utilization of existing capacity.

1. Mining and Concentrating

The major tin ore mining and concentrating enterprises of the USSR are located in East Siberia and the Far East. The regional distribution of production of tin ore in the USSR, in percent of the total Soviet production, is as follows 28/†:

Area	Percent
East Siberia	
Yakutskaya ASSR	25 to 30
Chitinskaya Oblast	15
Far East	
Magadanskaya Oblast	15
Khabarovskiy Kray	15
Primorskiy Kray	15
Remainder (including Kazakh, Kirgiz, Tadzhik, and Uzbek SSR's)	10 to 15
Total	100

* Table 1 follows on p. 8.
** Following p. 8.
*** Table 2 follows on p. 9.
† Text continued on p. 10.

Table 1

Estimated Production of Primary Tin in the Sino-Soviet Bloc
1950-60

Thousand Metric Tons a/

Country	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
USSR	7.7	8.5	9.3	10.3	11.3	12.4	13.6	15.0	16.0	17.0	18.0
Communist China	6.0	7.3	14.0	15.0	16.0	18.0	19.0	26.0	32.0	33.0	33.0
East Germany	Negl.	0.3	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
North Vietnam	Negl.	Negl.	Negl.	Negl.	Negl.	Negl.	Negl.	0.1	0.2	0.4	0.5
Total	13.7	16.1	23.9	25.8	27.9	31.0	33.2	41.7	48.8	51.0	52.1

a. In general, zeros appearing after the decimal point are not significant but are used merely for consistency in presentation.

Figure 1

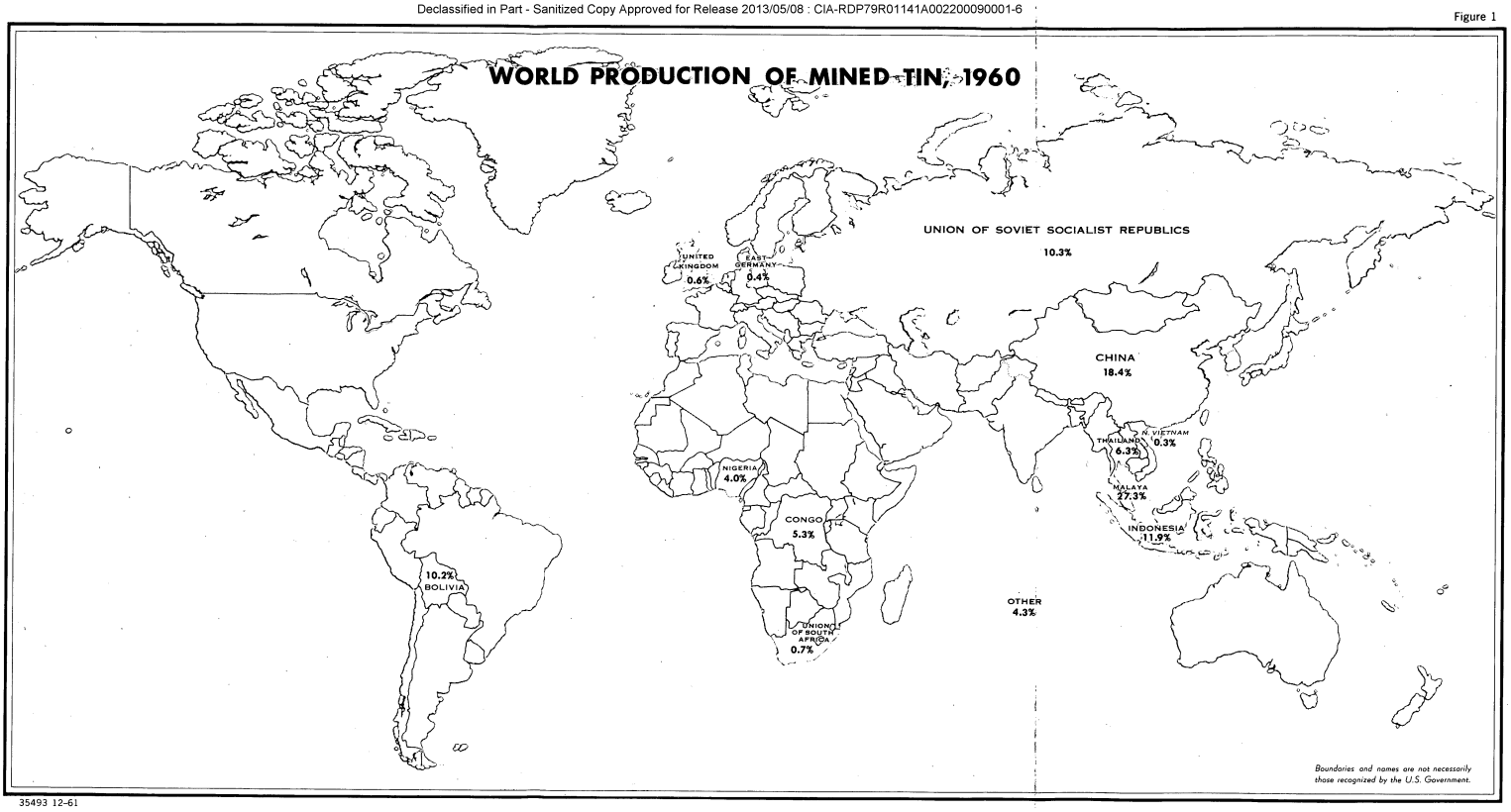

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Table 2

Estimated Production of Primary Tin in the USSR
Selected Years, 1940-60 and 1965

Year	Thousand Metric Tons a/	Year	Thousand Metric Tons a/
1940	2.0 b/	1952	9.3 f/
		1953	10.3 f/
1943	3.4 c/	1954	11.3 f/
		1955	12.4 f/
1945	4.4 d/	1956	13.6 f/
1946	5.3 e/	1957	15.0 g/
1947	5.8 f/	1958	16.0 h/
1948	6.4 f/	1959	17.0 h/
1949	7.0 f/	1960	18.0 i/
1950	7.7 f/		
1951	8.5 f/	1965	22.0 to 23.0 j/

a. In general, zeros appearing after the decimal point are not significant but are used merely for consistency in presentation.
b. Production in 1940 was reported to be 400 percent of that in 1937. 29/ Production of 500 metric tons in 1937 was interpolated between 1934 and 1938. Production of tin in 1934 was about 80 metric tons, 30/ and production in 1938 reportedly was 10 times that in 1934, or 800 metric tons. 31/
c. Production in 1943 was reported to be 168 percent of that in 1940. 32/
d. Production in 1945 was reported to be 222 percent of that in 1940. 33/
e. Production in 1946 was reported to be 119.1 percent of that in 1945. 34/
f. Interpolated between 1946 and 1957.
g. In 1957, about 5,000 metric tons of tin were used in production of tinplate for the manufacture of tin cans. 35/ It also was indicated that in 1957 about one-third of the tin produced went into preparation of tinplate for the canning industry. 36/
h. Interpolated between 1957 and 1960.
i. In 1960, production of tinplate for the canning industry was to require about 6,000 metric tons of tin. 37/ It was assumed that the same relationship to production existed as in 1957.
j. Specific production goals for tin under the Seven Year Plan have not been announced, but the increase planned for 1965 reportedly is about 40 percent more than the level for 1958. 38/

Locations of the principal tin mining areas and processing facilities in the Sino-Soviet Bloc are shown on the map, Figure 2.*

Of the tin mined in the USSR, 70 to 75 percent is from lode deposits, 39/ whereas in the Free World about 70 percent of the tin ore is mined from placer deposits. 40/ Placer deposits can be exploited by dredging or open-pit methods, whereas lode deposits generally are worked by underground methods. In the USSR, however, a decided shift away from underground operations has taken place, and quarry methods are now being applied to the exploitation of an increasing number of lode deposits. Open-pit working of tin mines in the USSR had increased to about 50 percent in 1956. 41/

Lode ore, in addition to being more difficult to mine, also is generally more difficult to process because of its more complex nature. In the USSR, more than 95 percent of the tin ore mined is a complex, polymetallic sulfide ore containing a variety of impurities in the form of metallic sulfides and oxides that must be removed to produce a tin metal of high quality. 42/

The principal methods employed for treating tin ores in the USSR are gravitational and magnetic separation and flotation. The flotation method has been used industrially in the USSR since 1950. 43/ The recovery rates reported for Soviet concentrating plants compare favorably with those in the Free World 44/:

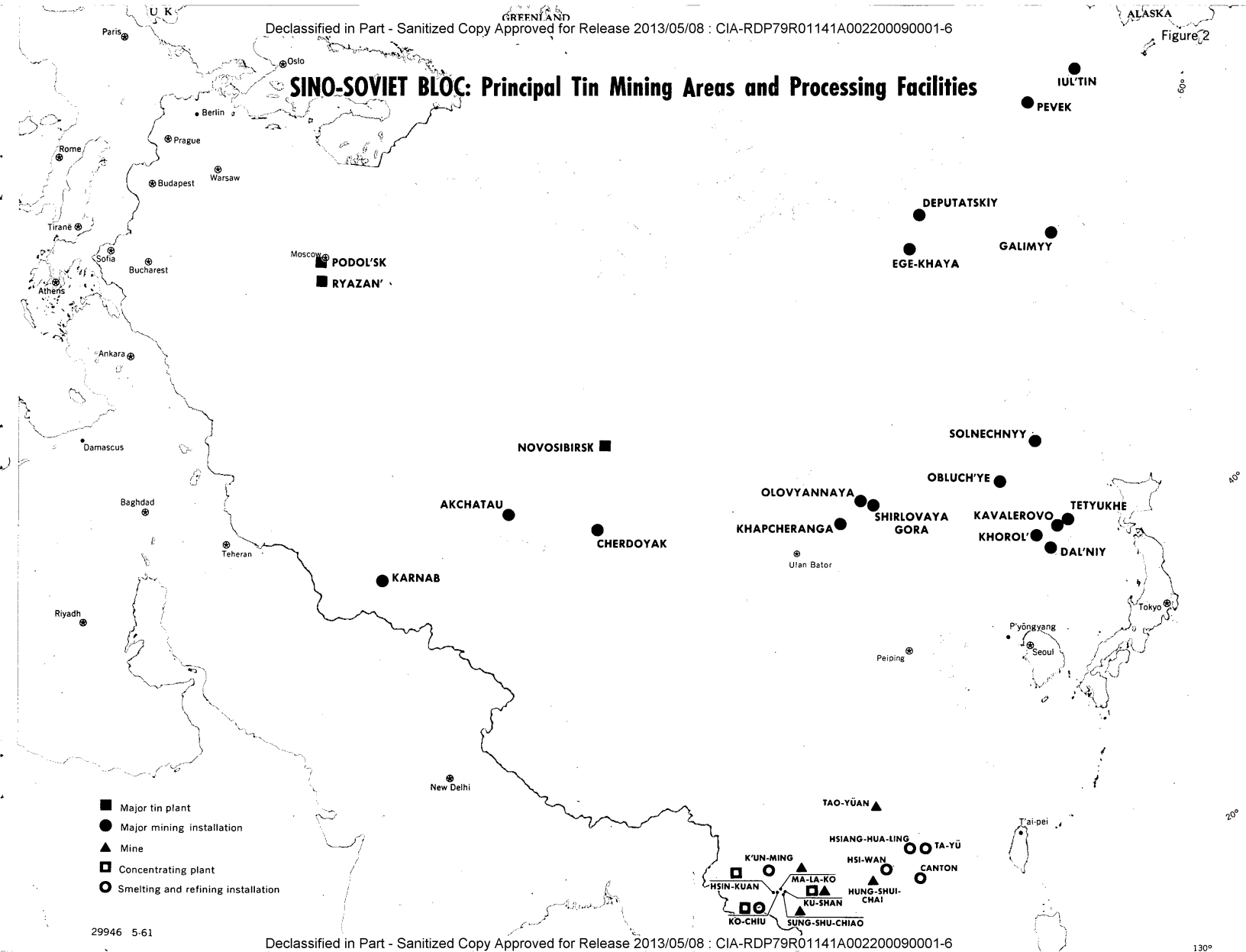
Percent of Total Concentrating Plants	Rate of Recovery of Tin from Ore (Percent)
20	70 to 90
60	60 to 70
20	Less than 60

The average tin content of the concentrate produced in the USSR ranges between 60 and 70 percent. 45/ Concentrate with a high tin content is produced by a two-phase method of concentrating, which also results in the recovery of other elements that are present in the complex ores. After initial concentrating near the mining area, the product is shipped to finishing plants, where a 70-percent tin concentrate is produced and where such metals as lead, zinc, mercury, tungsten, and lithium are recovered.

* Following p. 10.

Figure 2

SINO-SOVIET BLOC: Principal Tin Mining Areas and Processing Facilities



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2. Metallurgical Reduction

In contrast to the mining and concentrating operations, which are dispersed widely throughout the USSR, nearly all of the metallurgical reduction and refining of tin is carried out in three tin plants: the Central Tin Plant in Novosibirsk (55°02' N - 82°55' E) 46/ and the tin plants in Podol'sk (55°26' N - 37°33' E) and in Ryazan' (54°38' N - 39°44' E). 47/ The Central Tin Plant in Novosibirsk is the largest and most important of the three. All of these major tin plants have been either built or rebuilt since World War II, and the technology employed in them is comparable to that used in the Free World. Small quantities of tin also are produced at other nonferrous installations, such as the Moscow Copper Smelting and Electrolytic Plant imeni Molotov, the Chimkent and the Tetyukhe lead plants, and the Ukrainian Zinc Plant (Ukrtsink) in Konstantinovka. 48/

Depending on its tin content, concentrate is smelted in either a reverberatory or an electric arc furnace. Concentrate with a low tin content is reduced in a reverberatory furnace to a crude tin of 97 percent purity, 49/ and that with a high tin content is smelted in an electric arc furnace. The crude tin produced in the electric arc smelter may have a tin content as high as 99 percent and can be used for some purposes without further refining. 50/ Other advantages from using an electric arc furnace are that flue gases are eliminated, continuous operation is possible, and temperatures can be regulated precisely. 51/ The quality of the concentrate determines the rate of recovery achieved in smelting, as shown by the following data 52/:

Percent

Tin Content of Concentrate	Rate of Recovery of Tin in Smelting
65 to 73	85 to 91
50 to 65	74 to 84
20 to 50	50 to 72

For comparison, as much as 98 percent recovery in smelting has been reported in Malaya. 53/

Sizable quantities of tin are not recovered in the smelting process. Until recently the practice in the USSR was to allow from 9 to 50 percent of the tin actually contained in the concentrate to pass into slags and dusts, which were discarded as waste products. Now, through improved technology, which has been adopted in all three Soviet plants, tin is recovered from these wastes. For example, first-run slags are

treated in regular shaft furnaces or water-jacketed furnaces, and a crude tin of 93 to 95 percent purity is produced. 54/ Second-run slags and dusts also are being processed successfully in electric furnaces or slag-fuming installations at several of the nonferrous plants. By 1965, about 12 such installations are scheduled to be in operation, and nearly 1,000 tons of tin are to be produced annually from the slags obtained at lead plants alone. 55/ The USSR claims that producing tin metal from these wastes is more economical than processing low-grade tin ores. 56/

Virtually all the tin smelted in the USSR is refined by the pyrometallurgical (fire-refining) method. 57/ Although the electrolytic method, which sometimes is used in the Free World, would produce a higher grade of tin, the thermal method apparently is more economical and is adequate for most requirements. The entire cycle of refining is carried out in steel kettles heated by coal, mazut, or electricity, and the refinery slags also are reprocessed. The refined metal produced is classified according to official state standards. The minimum tin content required for each grade is as follows 58/:

Mark	Minimum Tin Content (Percent)
01	99.90
02	99.56
03	98.35
04	96.25

In addition to the standard grades of refined tin, tin of ultrahigh purity is produced by vacuum filtration, vacuum distillation, and zone refining. An industrial-scale shop for zone refining of tin at the Central Tin Plant in Novosibirsk began operating in 1957. Tin metal with a purity of 99.9998 percent is produced at this installation with a recovery rate of 80 to 85 percent. Output of this shop is approximately 145 kilograms per month, and the construction of a second such installation was being considered in 1960. 59/

3. Production of Secondary Tin

In the early 1930's, more than 2,000 tons of secondary tin were produced annually in the USSR, 60/ and current production is about 5,000 to 6,000 tons. 61/ Facilities for the recovery of secondary metal have been installed at the Moscow Copper Smelting and Electrolytic Plant imeni Molotov, at the Krasnyy Vyborzhets Plant in Leningrad, and at plants in Verkhneyvinsk and Podol'sk. 62/ Scrap also is treated at some of the ferrous metallurgical installations where tinplate is produced and fabricated.

In the USSR, secondary tin is produced in about equal quantities (2,500 to 3,000 tons) from both old and runaround or "prompt industrial" scrap. The runaround scrap, which consists of the slag formed in production of tinplate and of the shavings and cuttings from fabricating installations, is not considered to be an addition to new supply, as it is in constant cycle. At the present time, old scrap is supplied mainly in the form of Babbitt metal. Hydrometallurgical methods and resmelting in reverberatory furnaces both are used in production of secondary tin. 63/ Refined metal with a tin content of 99.9 percent can be produced in the reprocessing of runaround scrap and with a tin content of 98.5 percent in the reprocessing of old scrap. 64/ Much of the secondary tin, however, is used in alloyed form and consequently does not require refining.

B. Communist China

1. Output from Mines

In 1960, on the basis of the estimated level of output of metal, Communist China probably produced about 20 million tons of tin ore. The tin content of some of the ore in China was estimated in 1948 to be as high as 2 percent, 65/ but the average tin content probably was about 0.25 percent. 66/ The estimate of ore mined is based on production of about 33,000 tons of primary tin in 1960 (see Table 3*) from ore averaging 0.25 percent tin content and on a rate of recovery of about 60 percent. 67/

Most of the important tin mines are located in the Ko-chiu area of Yunnan Province in southwestern China, where perhaps 80 percent of all tin ore in China is mined. At the time of the Communist rise to power in 1949, most of the ore was obtained from several hundred primitive "native" mines, 68/ which have been enlarged and modernized under the Communist administration. By 1959 the two major underground mines had been completely reequipped with Soviet-designed machinery, and modern ventilation and underground haulage systems had been installed. 69/ A third major modern underground mine began operation in 1957. 70/ In addition to the development of the underground facilities, a number of larger placer mines have been developed in the Ko-chiu area under Soviet technical direction, 71/ and, as far as is known, the technique of hydraulic mining is used. In contrast to the pre-Communist period, when nearly all output in this area was derived from underground mining, by 1957 as much as 60 percent of the ore was obtained from open-pit placer mines. 72/

In the other tin mining areas of south and southwestern China, much of the ore is obtained from small, scattered placer deposits, most of which are exploited by hydraulic mining. In addition, some tin is produced as a byproduct in the processing of tungsten-tin ores in Hunan and Kiangsi Provinces. 73/

* Table 3 follows on p. 14.

Table 3

Estimated Production of Primary Tin in Communist China
1950-60 and 1965

Year	Thousand Metric Tons a/
1950	6.0 b/
1951	7.3 c/
1952	14.0 d/
1953	15.0 e/
1954	16.0 f/
1955	18.0 f/
1956	19.0 g/
1957	26.0 h/
1958	32.0 i/
1959	33.0 j/
1960	33.0 j/
1965	57.0 k/

a. In general, zeros appearing after the decimal point are not significant but are used merely for consistency in presentation.
b. Production was equal to 38 percent of the peak output of 15,865 metric tons before World War II. 74/
c. Production was equal to 46 percent of the peak prewar output. 75/
d. Production was equal to 91.7 percent of that in 1953. 76/
e. Production in the Ko-chiu area, which accounts for more than 80 percent of the total, was equal to 250 percent of that in 1950. 77/ The total estimate is based on the assumption that the rate of increase in the Ko-chiu area was representative of the whole country.
f. Interpolated between 1953 and 1956.
g. An estimate of production for 1956 of 19,000 metric tons was based on the assumption that production was equal to consumption plus exports minus imports.
h. Production was equal to 187 percent of that in 1952. 78/
i. Production of tin concentrates (metal content) was 21.8 times the output of between 1,400 and 1,500 metric tons in 1949. 79/ It was assumed that the increase also would apply to production of metal.
j. Exports in 1959 and 1960 appear to have been roughly of the same magnitude as in 1958. On the assumption that production equals consumption plus exports minus imports and that consumption increased slightly, production also would have increased slightly.
k. Provision was made in the Second Five Year Plan (1958-62) for creating new capacity for producing 30,000 metric tons of metal. 80/ It is assumed that full use is to be made of the available capacity and that some additional increase will have occurred by 1965.

2. Output of Concentrate

In 1960, on the basis of the estimated output of metal, probably about 80,000 tons of tin concentrate averaging 60 percent tin content were produced, principally in Yunnan Province. 81/ Only gravity concentrating methods are in use in China, and recently several Humphrey spirals (up-to-date concentrating machines) have been installed in the concentrating plants. The rate of recovery, it is claimed, has increased from 54 percent in 1952 to a current rate of 64 percent as a result of such improvements in this sector of the industry. 82/

3. Smelting and Refining

The metallurgical reduction of tin also is centered in the Ko-chiu area of Yunnan Province. Smelting is carried out in new reverberatory furnaces, which were installed with Soviet aid, and in 1959 the crude tin produced had a metal content of 96 to 97 percent. 83/

Both pyrometallurgical and electrolytic refining methods are used at the Ko-chiu Tin Plant. The rate of recovery is 98 to 99 percent, and the metal produced now has a tin content of 99.6 to 99.8 percent, whereas in 1950 the best grade was 99.0 percent. 84/ The estimated production of refined primary tin in 1950-60 and in 1965 is shown in Table 3.

The entire Ko-chiu complex has undergone extensive development under the Communist regime. Over the last decade, with Soviet aid, new construction and technology have transformed the Chinese tin industry from a handicraft state into a relatively modern operation. Supplies of electric power in the area have been increased greatly by the erection of a thermal electric power plant at Kai-yuan. 85/ In addition, a new canal has provided a dependable supply of water, thus alleviating what had been a major problem in the tin industry. Also the K'un-ming - Haiphong Railroad, rebuilt in 1957, now connects the tin-producing area directly to an excellent overseas shipping point on the coast of North Vietnam.

C. North Vietnam

The relatively minor output of tin in North Vietnam is not a major factor in the total supply of the Sino-Soviet Bloc. Tin is produced from both lode and placer deposits. The announced production of primary tin in 1957-60 was as follows 86/:

Year	Tons	Year	Tons
1957	104	1959	355
1958	220	1960	473

By 1965, production should exceed 500 tons.

D. European Satellites

1. East Germany

Production of tin in East Germany is based on the exploitation of extremely poor ores in an area that has been mined for the past 800 or 900 years. The tin content of the ore being worked declined from about 0.4 percent to about 0.2 percent during 1948-58. 87/ Although consideration was given in 1957 to closing the mines, operations have continued.

Three shaft mines were operating in East Germany in 1958 -- Altenberg, accounting for about 65 percent of the ore mined; Ehrenfriedersdorf, somewhat more than 20 percent; and Rodewisch, the remainder of nearly 15 percent. 88/ A new shaft was under construction at Altenberg at that time. 89/ By 1965 the new facilities and techniques are expected to make possible an increase in the level of production at Altenberg of 250 percent above that in 1958. 90/

The ore is treated by both gravity concentration and floatation at Altenberg with a resultant concentrate containing about 40 percent tin. The rate of recovery does not exceed 40 to 45 percent. The ores treated at Ehrenfriedersdorf undergo a more complex processing, including flotation. 91/

Smelting and refining are carried out at the VEB Zinnhuette, Freiberg. The crude tin produced at the smelter has a purity of 99 percent and contains traces of bismuth and copper. Much of the output of the smelter is consumed in this crude form, and some is refined electrolytically to a purity of 99.9 percent. 92/ Production of primary tin metal in East Germany in 1950-60 is estimated as follows 93/:

Year	Tons	Year	Tons
1950	Negl.	1956	610
1951	321	1957	610
1952	572	1958	610
1953	488	1959	610
1954	610	1960	610
1955	615		

Production of primary tin metal in 1965 may reach 1,000 tons. 94/ In addition, East Germany is believed to produce minor quantities of secondary tin and tin alloys.

2. Poland

Although deposits of low-grade tin ores have been discovered and an old German tin mine exists in the western territories of Poland, no primary tin is believed to have been produced under the Communist regime. The mine at Gierczyn near Swieradow-Zdroj (50°54' N - 15°20' E) was reported in 1957 to be scheduled for reopening, but this project is believed to have been abandoned. 95/

IV. Trade

A. East-West

Between the end of World War II and 1955 the Sino-Soviet Bloc was a net importer of tin metal from the Free World. From 1950 to 1955, Bloc imports ranged from an estimated maximum of about 6,700 tons in 1951 to a minimum of about 1,600 tons in 1954. During this period, Bloc imports decreased both in terms of actual tonnage and in terms of their relative importance to the total Bloc supply of tin. In 1951, for example, imports from the Free World represented nearly 27 percent of the total Bloc supply of tin, but in 1955, the last year in which the Bloc was a net importer of tin from the Free World, the share of imports had decreased to about 6 percent of the total supply.*

In 1956 the Sino-Soviet Bloc became a net exporter of tin metal, and exports of tin reached a high of more than 27,000 tons by 1958. These exports by year and by country of origin are shown in Table 4.**

Because the Bloc's trade in tin before 1955 had consisted entirely of imports, exports by the Bloc in recent years greatly surprised the producers of the Free World. Supplies of tin in the Free World since 1950 had been considerably larger than world consumption, with an annual surplus of 20,000 to 50,000 tons. 96/ In 1956, all of the tin producers and several consumers in the Free World formed the International Tin Council (ITC), the operating agency for the International Tin Agreement, to maintain a stable market price for tin. To do so, the ITC attempted to bring the supply of tin into closer balance with demand by restricting exports from the producing countries. By 1958, however, the addition of the Bloc's exports of tin to the Free World supply was too much for the ITC to accommodate. After much adverse publicity had accrued to the USSR and prolonged negotiations had taken place between the USSR and the ITC, the USSR agreed to limit its exports to the Free World to 13,500 tons in 1959. 97/ Late in 1959 the USSR again agreed to limit exports of tin to 13,500 tons during 1960. 98/

* See Table 9, p. 25, below.
** Table 4 follows on p. 18.

The export of tin by the Sino-Soviet Bloc is now a recognized factor in the Western market. Apparently the USSR has performed according to its arrangements with the ITC. Exports in 1959 were only slightly more than 13,500 tons, and those in 1960 probably were less. Nothing in the agreement between the ITC and the USSR prevents China from exporting tin directly to the Free World. In spite of a pressing need for foreign exchange, China has made thus far only small, though increasing, shipments (see Table 4), even though it is China's output that has enabled the Bloc to become an exporter of tin.

Table 4

Estimated Net Exports of Tin from the Sino-Soviet Bloc to the Free World a/
1956-60

Thousand Metric Tons

Country	1956	1957	1958	1959	1960 b/
USSR	1.0	15.5	19.8	13.8	8.2
Communist China	0.4	1.9	4.1	3.7	4.6
Poland	0.2	0.6	3.3	0.6	0.2
Czechoslovakia	0.5	-0.2 c/	0	0.1	Negl.
Hungary	0.4	Negl.	-Negl. c/	0.5	-0.1 c/
North Vietnam	0	0	0	0	0.2
Total d/	2.6	17.9	27.2	18.7	13.2

a. 99/
b. Preliminary estimate because of incomplete data on trade.
c. Indicating net import.
d. Because of rounding, components may not add to the totals shown and may differ from data presented on Table 9, p. 25, below.

Although sales of tin by the Bloc in the late 1950's increased the problems caused by the oversupply in the West, the situation has been reversed in the 1960's. Since 1960, consumption of tin by the Free World actually has exceeded the level of production, and in 1961 some shortage of supplies was apparent. As a result, current exports of tin by the Bloc are being accommodated without difficulty and actually may be a welcome addition to the supply of the Free World for some time to come.

B. Intra-Bloc

Communist China and the USSR are the main suppliers of tin metal to the other countries of the Sino-Soviet Bloc. China is the leading

exporter of tin within the Bloc, shipping primarily to the USSR. The USSR, in turn, supplies the European Satellites. Recently, however, significant quantities of tin from China and North Vietnam have been shipped directly to the European Satellites. The pattern of intra-Bloc trade in tin in 1960 is shown in Table 5.*

V. Domestic Consumption

During 1950-60 the total consumption of tin in the Sino-Soviet Bloc is estimated to have risen from about 15,000 tons to about 38,000 tons. During this period the USSR was by far the largest consumer, accounting for about two-thirds of the total consumed by the Bloc. The remainder was consumed mainly by Communist China, Poland, East Germany, and Czechoslovakia. Estimates of the quantity of tin consumed in each of the countries of the Bloc during 1950-60 are given in Table 6.**

Although the USSR is the third largest consumer of tin in the world, exceeded only by the US, where consumption was about 82,000 tons in 1960, and by West Germany, 100/ the level of consumption of tin per capita in the USSR and in the other countries of the Sino-Soviet Bloc, when compared with the countries of the industrial West, is quite low (see Table 7***). The principal use of tin in the Bloc is in production of industrial alloys, whereas in the Free World greater quantities of tin are used in production of tinplate. In the USSR, the only country in the Bloc with a significant production of tinplate, only about one-third of the primary tin produced, about 5,000 to 6,000 tons, is consumed in this form, whereas about 60 percent of the primary tin consumed in the US, about 30,000 to 35,000 tons, goes into tinplate. 101/

Considering the general industrial expansion and a planned increase in production of tinplate, the maximum requirements for consumption of tin in the Sino-Soviet Bloc in 1965 are estimated at about 55,000 tons. The USSR will continue to be the major consumer, but the rate of increase in consumption of tin in Communist China may be more spectacular, reflecting a more rapid pace of industrialization.

A. USSR

Consumption of tin in the USSR, the leading consumer of tin in the Sino-Soviet Bloc, is estimated to have increased from about 9,000 tons in 1950 to about 23,000 to 24,000 tons in 1960, as shown in Table 6. The largest consumer of tin in the USSR is the tinplating industry. In†

* Table 5 follows on p. 20.
** Table 6 follows on p. 21.
*** Table 7 follows on p. 22.
† Text continued on p. 22.

Table 5

Trade in Tin Within the Sino-Soviet Bloc a/
1960

Metric Tons

Exporters	Importers								
	USSR	Poland	East Germany	Hungary	Bulgaria	Rumania	Czechoslovakia	North Korea	Total b/
USSR		1,100	N.A.	320	150	260	1,200	0	3,030
Communist China	17,700	150	N.A.	N.A.	0	Negl.	Negl.	0	N.A.
Poland	0		N.A.	0	0	0	0	0	N.A.
North Vietnam	45	40	Negl.	Negl.	Negl.	Negl.	0	Negl.	85
Total	17,800 b/	1,290	N.A.	885 b/	150	260	1,200	Negl.	N.A.

a. 102/
b. Totals may not equal the sum of components. In some cases, total imports were reported without any indication of the country of origin.

Table 6

Estimated Domestic Consumption of Tin in the Sino-Soviet Bloc
1950-60

Thousand Metric Tons a/

Country	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
USSR b/	9.3	9.3	11.1	12.6	14.9	16.6	17.4	18.6	21.9	23.0	24.0 c/
Poland d/	2.0	2.0	1.9	1.8	1.7	1.7	1.7	1.8	1.8	1.8	1.8
Czechoslovakia d/	1.3	1.5	1.6	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8
East Germany d/	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Communist China d/	0.6	0.9	1.5	1.9	2.4	3.6	3.6	4.8	5.4	5.4	7.2
Hungary e/	0.6	0.8	0.3	0.5	0.9	-0.1 f/	0.3	1.2	0.8	0.7	1.0
Rumania b/	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	15.1	16.3	18.1	20.2	23.3	25.2	26.4	29.9	33.4	34.4	37.5

a. In general, zeros appearing after the decimal point are not significant but are used merely for consistency in presentation.
b. See the methodology, Tables 13 and 14, Appendix B, pp. 36 and 37, below.
c. The upper limit of the range of 23,000 to 24,000 metric tons.
d. 103/
e. Apparent consumption based on reported net trade. 104/
f. Hungary had a net export of about 100 metric tons, constituting a negative consumption, as indicated.

1960, however, production of tinplate in the USSR was only about 312,000 tons compared with production of about 4.9 million tons in the US. 105/

Table 7

Estimated Domestic Consumption of Tin in Selected Countries
1960

Country	Kilograms Per Capita a/	Total Consumption b/ (Thousand Metric Tons)
West Germany	0.51	28.2
US	0.46	81.9
UK	0.45	23.2
Netherlands	0.28	3.1
France	0.25	11.4
Canada	0.23	4.2
Japan	0.17	15.5
Czechoslovakia	0.13	1.8
USSR	0.11	24.0 c/
Italy	0.09	4.8
East Germany	0.09	1.5
Poland	0.06	1.8
Communist China	0.01	7.2

a. Estimated by dividing the population of each country 106/ into the level of consumption.
b. 107/
c. The upper limit of the range of 23,000 to 24,000 metric tons.

Although the quantities consumed differ considerably, the overall pattern for consumption of tin in the USSR now more closely resembles that in the US, whereas the patterns that prevailed before World War II were quite different. The pattern of consumption of tin in the USSR and the US in 1937 and 1955 is presented in Table 8.*

Several factors affect the total consumption of tin. In the USSR in 1959, only about 20 percent of the total consumption of tin was based on secondary tin, whereas in the US secondary tin accounted for about 42 percent of the total. 108/ About one-half of this secondary metal in the the USSR is produced from runaround scrap and the other half from old

* Table 8 follows on p. 23.

scrap. 109/ Drives for increasing the recovery of tin from scrap are being promoted in the USSR, and substitutes for tin also are receiving considerable attention, along with efforts to reduce the tin content of Babbitt metal, solders, and other alloys. By means of technological improvements, such as lacquering and converting to electrolytic methods of tinplating, the requirements for tin in the USSR are being reduced relative to the increasing industrial output. Although these programs are expected to continue with increasing success, the total requirements for consumption of tin in the USSR will continue to rise, probably reaching a level of about 30,000 tons in 1965.*

Table 8

Estimated Percentage Distribution of Domestic Consumption of Tin in the USSR and the US, by Major Consuming Sector 1937 and 1955

Percent

Sector	USSR		US	
	1937 a/	1955 b/	1937 a/	1955 c/
Tinplate	12.4	30 to 42	54.5	37.2
Bronze casting	34.7	25 to 30	5.2	21.2
Babbitt metal	32.8	More than 33 d/	6.2	4.8
Tinning	5.5		3.4	2.9
Polygraphic metal	1.0		1.5	1.6
Solder and other uses	13.6		29.2	32.3
Total	100.0	100	100.0	100.0

a. 110/
b. 111/
c. 112/
d. Including all alloys except bronze.

B. European Satellites

The European Satellites annually consume about 6,000 tons of tin.** The principal use for tin is in the form of industrial alloys such as bronzes, Babbitt metal, and solders. Although steadily increasing, production of tinplate still is small, and the total requirements for tin in the European Satellites probably will not exceed 15,000 tons in 1965.

* See the methodology, Tables 13 and 14, Appendix B, pp. 36 and 37, below.
** See Table 6, p. 21, above.

C. Communist China, North Korea, and North Vietnam

Although consumption of tin in Communist China probably has increased steadily along with the rising industrial production of that country, the domestic demand for tin in 1960 probably was only about 7,200 tons.* The present demand consists largely of requirements for such alloys as bronze, Babbitt metal, and type metal, for China as yet does not produce tinplate. If the initiation of a tinplating industry goes according to plan, however, the requirements for tin may increase to about 10,000 tons annually by 1965. The requirements for tin metal in North Korea and North Vietnam are negligible.

VI. Stockpile

During 1950-60 the estimated new supply of tin in the Sino-Soviet Bloc exceeded the quantity estimated to be required for domestic consumption and export to the extent that the Bloc may have been able to accumulate and maintain substantial stocks. These stocks are estimated to have increased steadily from 1950 through 1956 by an average of nearly 9,000 tons per year. During 1956 the stockpile reached a peak of more than 68,000 tons, a quantity equal to more than two times the rate of the estimated annual consumption in 1956. In 1958, however, because of unusually large exports of tin to the West, probably about 9,000 tons were withdrawn from stocks. Inasmuch as the estimate of stocks must be based on estimated production and consumption and assumed withdrawals, the actual quantity of stocks is unknown. Nevertheless, at the beginning of 1961 the Sino-Soviet Bloc appeared to possess a stockpile of about 60,000 tons of tin, about 18 months' requirements. In comparison, however, the US stockpile is estimated to contain more than 300,000 tons of tin, 113/ a quantity equal to about 4 years' requirements in the US. For the estimated annual stocks in the Bloc, 1950 through 1960, see Table 9.**

During 1960-65 the annual new supply of tin in the Sino-Soviet Bloc in all likelihood will exceed domestic requirements to a greater degree than during 1950-60. By 1965 the annual production of tin in the Sino-Soviet Bloc will be 80,000 to 85,000 tons, including about 4,000 tons of secondary metal if the planned levels of production are achieved. The estimated maximum domestic requirements in that year are about 55,000 tons. By 1965, therefore, about 25,000 to 30,000 tons of tin metal may be available annually either for export to the West or for addition to the Bloc stockpile, compared with an average surplus of about 14,500 tons annually in the last half of the 1950's.

* See Table 6, p. 21, above.
** Table 9 follows on p. 25.

Table 9

Estimated Balance of Supply and Demand for Tin in the Sino-Soviet Bloc
1950-60

Thousand Metric Tons a/

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960 b/
New Supply											
Primary production c/	13.7	16.1	23.9	25.8	27.9	31.0	33.2	41.7	48.8	51.0	52.1
Secondary production d/	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5
Imports from the Free World e/	4.4	6.7	2.3	2.7	1.6	2.0	0.9	0.2	0.1	0.2	0.1
Total	20.1	24.8	28.2	30.5	31.5	35.5	36.6	44.4	51.4	53.7	54.7
Demand											
Exports to the Free World e/	0	0	0	0	0	1.0	3.4	18.1	27.2	18.8	13.2
Domestic consumption f/	15.1	16.3	18.1	20.2	23.3	25.2	26.4	29.9	33.4	34.4	37.5
Total	15.1	16.3	18.1	20.2	23.3	26.2	29.8	48.0	60.6	53.2	50.7
Derived change in stock g/	+5.0	+8.5	+10.1	+10.3	+8.2	+9.3	+6.8	-3.6	-9.2	+0.5	+4.0
Estimated total stock h/ (end of the year)	15.0	23.5	33.6	43.9	52.1	61.4	68.2	64.6	55.4	55.9	59.9

a. In general, zeros appearing after the decimal point are not significant but are used merely for consistency in presentation.
b. Preliminary estimate because of incomplete data on trade.
c. From Table 1, p. 8, above.
d. The lower limit of the range of old scrap secondary tin for the USSR. See III, A, 3, p. 12, above.
e. 114/
f. From Table 6, p. 21, above.
g. Difference between the total new supply and the total demand.
h. Stocks at the end of 1949 are estimated to have been 10,000 metric tons. The totals for 1950-60 are cumulated stock changes. The figures for the total stocks probably are correct to the nearest ten thousand metric tons.

Most of the tin stocks in the Sino-Soviet Bloc probably are held in the USSR. Data on exports of tin from Communist China to the USSR during 1951-54 are not available, but such shipments probably occurred in quantity, enabling the accumulation of substantial stocks within the USSR. The quantity of tin held in reserve by the USSR may be some insurance against any stoppage of Soviet imports of tin from China as well as a strategic stockpile available in the event of any East-West conflict. China and the European Satellites also may hold some reserve stocks of tin metal.

VII. Internal Costs and Prices

A. USSR

The cost of production (sebestoimost') of tin in the USSR appears to be high relative to the cost of producing other intermediate producer goods. Of the nonferrous metals for which information about cost or price is available, tin has one of the highest costs of production, as indicated by the following reported relationship of the costs of production in 1959 of selected nonferrous metals in the USSR 115/:

Metal	Index
Tin	100.0
Lead	7.7
Copper	5.6
Aluminum	5.0

That is, for the cost of producing 1 ton of tin, the USSR can produce 13 tons of lead, 18 tons of copper, or 20 tons of aluminum.* The cost of producing tin in the USSR is high not only relative to the cost for other nonferrous metals but also relative to the cost of many other commodities. One way of expressing these relationships between various commodities is by ruble/dollar ratios. Such ratios have been derived for the prices of a number of commodities.** In the ruble/dollar

* Insofar as prices in the Free World indicate relative costs, tin is a metal of higher cost than the other three. Prices in the Free World in 1959 indicated that 1 ton of tin was approximately equal in price to 3 tons of copper, 4 tons of aluminum, or 8 tons of lead.

** The following assumptions were made in comparing Soviet data on internal prices. First, the difference between average cost and marginal cost was assumed to be the same (expressed as a percentage of marginal cost) for all commodities cited. Second, the factor costs (principally depreciation and interest), which are not included in Soviet accounting costs, were assumed to be the same [footnote continued on p. 27]

price ratios for a few selected commodities, as shown in Table 10, a wide gap exists between the ratios for tin and other intermediate producer goods.

Table 10

Ruble/Dollar Price Ratios for Selected Commodities in the USSR a/

Commodity	Ruble/Dollar Price Ratio
Tin	48 to 1 b/
Lead	22 to 1
Aluminum	9 to 1
Copper	8 to 1
Cement	7 to 1
Sulfuric acid	7 to 1
Crude oil	5 to 1 c/
Bricks	4 to 1
Tool steel	2 to 1
Intermediate producer goods (average)	10 to 1

[redacted] Soviet prices are as of 1 July 1955 (see the footnote on p. 28, below), and US prices are based on comparable dollar values. STAT

b. A wide disparity exists in the USSR between the cost of producing tin and the internal price of tin, whereas prices of other commodities tend to approximate actual costs. If Soviet cost had been used instead of price, the ruble/dollar ratio would have been about 36 to 1. The gap between the ratios for tin and the other commodities, however, would continue to be large. For a further discussion of ruble/dollar ratios, see Appendix C, p. 37, below.

c. 11 7/

The high cost of production for the tin industry of the USSR can be attributed primarily to three factors. First, the available ore generally is of rather poor quality and is extremely complex. Second, many

proportion of accounting costs for each commodity cited. Although capital charges as a proportion of real costs probably are different for the various commodities, the difference is believed to be too small to affect seriously the analysis or to alter the sequence in the list of ruble/dollar ratios. For a further discussion of ruble/dollar ratios, see Appendix C, p. 39, below.

of the deposits occur in areas where the winters are long and extremely cold, and such conditions hinder all phases of mining operations. Third, much of the ore and concentrate must be transported long distances over difficult terrain for processing.

Although the cost of producing tin in the USSR in 1960 continued to be very high, the Soviet press claims that over the past 10 years significant reductions in the cost of production have been achieved. Many of these reductions in cost are attributable directly to improvements and changes in the mining and concentrating of tin ores. Normally these phases of production account for a major part of the total costs of producing tin, primarily because very large quantities of materials must be processed.

In mining, much of the reduction in cost has been obtained by shifting from underground to open-pit mining operations. For example, ore mined in 1959 by underground methods at two mines in Primorskiy Kray cost more than 125 rubles* per ton, whereas ore mined by open-pit methods at the Khingan Combine in Khabarovskiy Kray cost less than 25 rubles per ton. 118/ Specific examples of economies claimed to have been achieved by a shift to open-pit mining methods include a reduction of about 50 percent in the cost of mining in Magadanskaya Oblast and a reduction of more than 50 percent in the cost of mining for the Dal'olovo Combine in Primorskiy Kray. 119/

Additional reductions in cost have been achieved in concentrating, largely by improvements that permit the recovery of valuable byproducts. At the Sherlovaya Gora Tin Combine in Chitinskaya Oblast, for example, about 24 percent of the cost of beneficiating tin ores now is being charged to the recovery of valuable byproducts. 120/

Some savings also are being obtained in smelting, primarily through the introduction of electric furnaces. The use of such furnaces permits the USSR to achieve a higher rate of recovery of the metal contained in the concentrate and thus reduces the amount of concentrate required per ton of metal produced.

Further reductions in the cost of producing tin undoubtedly will be achieved over the next 5 years. That the magnitude of such reductions will be sufficient to lower the cost of producing tin to a level comparable to that of the average for intermediate producer goods is very unlikely. The problems associated with the quality and location of ores appear too great for the USSR to overcome completely.

* Unless otherwise indicated, ruble values in this report are given in old rubles (ruble values in use before the Soviet currency reform of 1961) and may be converted to US dollars at the rate of exchange of 4 rubles to US $1. For ruble/dollar price ratios covering certain specific commodities, see Table 10, p. 27, above.

One of the cost factors that the USSR plans to reduce is the investment requirement for new capacity in all phases of production. As of 1960 the total investment required to add new capacity to produce 1 ton of tin (from ore to metal) was about 330,000 rubles. 121/ By 1965 the plan is to reduce this investment requirement to about 250,000 rubles. 122/

B. Communist China

The available data that relate directly to the cost of producing tin in Communist China are fragmentary and subject to an unusually wide range from plant to plant. Any average or marginal cost figures derived from such data probably would contain distortions so large as to make the figures meaningless.

Price ratios also are of little value for evaluating comparative costs of production of tin and other similar products in Communist China. In general, the Chinese include in their internal prices of industrial raw materials a very large margin of profit, which may be a means of capital accumulation or possibly of restricting consumption of the product. For example, the price that a smelter pays for a ton of copper contained in concentrate includes a profit to the concentrator of more than 100 percent. 123/

Some qualitative statements, however, can be made concerning the probable relative cost of producing tin and other nonferrous metals in Communist China. In contrast to the aluminum, lead, and zinc industries, the ores mined by the tin industry are of relatively high quality. The facilities of the tin industry not only are new but also use a higher proportion of capital to labor than is generally true of the Chinese nonferrous industry. Furthermore, these facilities, in the main, are concentrated within one small area of about 600 square kilometers -- a situation that may permit a more efficient utilization of at least some factors of production. On the basis of these considerations, the cost of producing tin in Communist China probably is low in relation to the cost of producing other nonferrous products.

Two other facts suggest that costs in the tin industry of Communist China are competitive with those of leading producers in the Free World. First, pre-Communist China, operating under capitalistic terms of reference, produced and sold significant quantities of tin in international markets. Second, the major, if not the sole, purpose of the rapid expansion of the tin industry under the Communist regime has been for the sale of the product in the export market. That a product of high cost would have been selected for this purpose is believed to be unlikely.

C. East Germany

Although East Germany has not published quantitative information about the cost of producing tin in that country, the cost probably is high. The available ores are extremely low in tin content and are very complex. An average of only about 50 percent of the small tin content in the ore is recovered in the concentrating process. 124/ Furthermore, all deposits must be worked by underground mining operations, which are much more costly than are open-pit operations.

APPENDIX A

PRINCIPAL TIN ENTERPRISES IN THE SINO-SOVIET BLOC

The principal tin mining areas and processing facilities in the USSR and in Communist China -- the major tin-producing countries in the Sino-Soviet Bloc -- are shown in Table 11* and Table 12,** respectively, and the general locations of these facilities in the Bloc are shown on the map, Figure 2.***

* Table 11 follows on p. 32.
** Table 12 follows on p. 34.
*** Following p. 10, above.

Table 11

Principal Tin Mining Areas and Processing Facilities in the USSR

Location	Installations	Coordinates
	I. Tin Plants	
RSFSR		
Region VII a/		
Moskovskaya Oblast, Podol'sk	Podol'sk Tin Plant	55°26' N - 37°33' E
Ryazanskaya Oblast, Ryazan'	Ryazan' Tin Plant	54°38' N - 39°44' E
Region IX		
Novosibirskaya Oblast, Novosibirsk	Novosibirsk Tin Plant	55°02' N - 82°55' E
	II. Major Mining Installations	
Region XI		
Chitinskaya Oblast		
Khapcheranga	Khapcheranginskiy Tin Combine	49°42' N - 112°24' E
Olovyannaya	Ononskoye Mining Administration	50°56' N - 115°35' E
Sherlovaya Gora	Sherlovogorskiy Mining and Concentrating Combine	50°34' N - 116°15' E
Yakutskaya ASSR		
Deputatskiy	Deputatskoye Mining Administration	69°18' N - 139°54' E
Ege-Khaya	Ege-Khaya Ore Mining Combine	67°31' N - 134°40' E

Table 11

(Continued)

Location	Installations	Coordinates
	II. Major Mining Installations (Continued)	
RSFSR		
Region XII		
Magadanskaya Oblast		
Pevek	Chaun-Chukotskiy Ore Mining Combine	69°42' N - 170°17' E
Iul'tin	Iul'tinskiy Ore Mining Combine	67°50' N - 178°48' E
Galimyy	Omsukchanskiy Tin Mining Combine	62°20' N - 155°59' E
Khabarovskiy Kray		
Obluch'ye	Khingan Tin Combine	49°00' N - 131°05' E
Near Komsomol'sk	Solnechnoye Tin Enterprise	N.A.
Primorskiy Kray		
Dal'niy	Dal'olovo Tin Combine	43°00' N - 132°57' E
Kavalerovo	Khrustal'nyy Mining and Concentrating Combine	44°16' N - 135°05' E
Tetyukhe	Sikhote-Alinskiy Polymetallic Combine	44°25' N - 135°55' E
Khorol'	Yaroslovskiy Tin Combine	44°25' N - 132°04' E

a. The term region refers to economic regions defined and numbered on map 29184 (7-60), USSR: Economic Administrative Regions, 1 July 1960.

Table 12

Principal Tin Mining Areas and Processing Facilities in Communist China

Location	Installations	Coordinates
	I. Smelting and Refining Installations	
Yunnan Province	Central Tin Plant at Ko-chiu	23°23' N - 103°09' E
	K'un-ming Smelting Plant	25°04' N - 102°41' E
Kiangsi Province	Ta-yu Tin Refinery	25°24' N - 114°22' E
Kwangsi Chuang Autonomous Region	Hsi-wan Concentrating and Refining Plant	24°29' N - 111°39' E
Kwangtung Province	Canton Refinery	23°07' N - 113°15' E
Unknown	Hsiang-hua-ling Tin Mine and Refinery	Unknown
	II. Concentrating Plants	
Yunnan Province	Ku-shan	23°25' N - 103°15' E
	Ta-t'an	N.A.
	Huang-mao-shan	N.A.
	Hsin-kuan	N.A.
	Ko-chiu	23°23' N - 103°09' E
	III. Mines	
Yunnan Province	Ma-la-ko	23°30' N - 103°10' E
	Lao-chang	N.A.
	Sung-shu-chiao	23°22' N - 103°14' E
	P'an-po	N.A.
	Ku-shan	23°25' N - 103°15' E
	Huang-mao-shan	N.A.
	Niu-shan	N.A.
Kwangsi Chuang Autonomous Region	P'ing-kuei Mining Bureau	N.A.
Hunan Province	Tao-yuan Tin-tungsten Mine	28°54' N - 111°29' E
Kwangsi Chuang Autonomous Region	Hung-shui-chai Tin-tungsten Mine	23°24' N - 110°06' E

APPENDIX B

METHODOLOGY

Table 13

Estimated Production of Tinplate in the USSR a/
1950-60 and 1965

Thousand Metric Tons

Year	Production b/	Consumption of Primary Tin
1950	80 to 100	1.8 to 2.2
1951	100	2.2
1952	124	2.7
1953	144	3.2
1954	176	3.9
1955	192	4.2
1956	203	4.5
1957	219	4.8
1958	265	5.8
1959	304	6.2
1960	312	6.3
1965	403 to 435	6.9 to 7.2

a. Twenty-two kilograms of primary tin are required per ton of tinplate produced by the hot-dip method. 125/ The estimate for 1965 is based on the maximum possible increase in production of tinplate consistent with the planned increase in the total output of rolled metal by the ferrous metallurgical industry (52 percent to 64 percent). 126/ It was assumed that through 1958 all the tinplate was produced by the hot-dip process and that all the increase by 1965 will be produced by the electrolytic method, which requires 8 kilograms of tin per ton of tinplate. 127/

b. 128/

Table 14

Estimated Consumption of Tin in the USSR
1950-60 and 1965

Thousand Metric Tons a/

Year	Primary Tin b/	Secondary Tin c/	Total
1950	7.3 d/	2.0	9.3
1951	7.3	2.0	9.3
1952	9.1	2.0	11.1
1953	10.6	2.0	12.6
1954	12.9	2.0	14.9
1955	14.1	2.5	16.6
1956	14.9	2.5	17.4
1957	16.1	2.5	18.6
1958	19.4	2.5	21.9
1959	20.5	2.5	23.0
1960	21.0	3.0	24.0
1965	24.0 e/	3.0	27.0

a. In general, zeros appearing after the decimal point are not significant but are used merely for consistency in presentation.
b. Tin required in the manufacture of tinplate (see Table 13) is estimated to represent 30 percent (the lower limit of a range of 30 percent to 42 percent reported in 1955) of the total primary tin consumed. 129/
c. 130/. Because half of the secondary tin produced is based on runaround scrap, this constant quantity is withheld from tabulations of both production and consumption.
d. The upper limit of the range of 6,000 to 7,300 metric tons.
e. The upper limit of the range of 23,000 to 24,000 metric tons.

APPENDIX C

RUBLE/DOLLAR PRICE RATIOS

The concept of cost of production used in the USSR and that used in the Free World are not the same for all items of costs. The significance of the ratios developed in this report, however, is not that of direct relationships of the costs of producing the same commodity in the two areas. Rather, it is the more complex idea of comparing the costs of two separate products in the USSR in relation to the comparative costs of producing the same two products in the Free World.

A more serious distortion results from the use of prices in attempting to equate costs of production. In general, the price of industrial raw materials in the USSR at present appears to be derived by dividing the total output of the product into the sum of the cost expended in the production effort. Thus the Soviet price tends to equate to the average cost of production. In the Free World, on the other hand, the price tends to equate to the cost of production of the highest cost producer in the industry (that is, the cost at the margin). When ruble/dollar price ratios are used to make comparisons of relative costs of production, the assumption is implicit that the difference between the cost of the product at the margin in one economy (US) and the average cost of the same product in another economy (USSR) is approximately equal to the proportional difference between the cost at the margin of other products in the one economy (US) and the average cost of the same products in the other economy (USSR).

Although prices in the Free World for many commodities may be administered prices, the proposition is made that the costs of production at the margin will tend to approximate the price. This proposition is based on the following two observations. First, the standard practice in the nonferrous mining industries of the Free World is to adjust the ore mix to the price -- that is, as the price rises, the average metal content of the ore mined is lowered. The purpose of this trend is to extend the period of exploitation of the deposits (thus maximizing profits over the long run). The result of such action, however, is that mining costs tend to rise as the price rises. Second, for many mining industries, such as the tin industries of Malaya, Thailand, and Nigeria, which have large placer deposits that are suitable for exploitation by relatively simple operations, entry into the industry by small operators is relatively easy.

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