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Economic Intelligence Report

TIN IN THE SINO-SOVIET BLOC

CIA/RR ER 61-23

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CENTRAL INTELLIGENCE AGENCY

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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 trade data were tabulated and evaluated. The methodology employed in deriving the estimates contained in this report is included in the text.

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50X1

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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. By 1960, production of tin by the Bloc had nearly quadrupled, reaching a total of more than 51,000 tons, or almost one-fourth of the world total. Production plans for 1965 indicate another substantial increase to about 85,000 tons*** (more than one-half as much as the Free World produced in 1960). 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, Bloc technology 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 42 percent to about 63 percent. By 1965, China is expected to account for about 67 percent of such production. The second largest producer of tin in the Bloc, the USSR, in 1960 produced about 35 percent of the Bloc's total output of tin. East Germany and North Vietnam, the only other producers of tin in the Bloc, accounted for only about 2 percent of the Bloc's total output in 1960.

Consumption of tin in the Sino-Soviet Bloc has not increased as rapidly as has production, but it has more than doubled during 1950-60. This rate of growth is not expected to change materially, and annual consumption of tin in the Bloc by 1965 should be about 55,000 tons. The USSR is by far the largest consumer of tin in the Bloc, taking much more than one-half of the Bloc's annual available supply of tin. Consumption of about 24,000 tons of tin in the USSR in 1960, however, contrasts strongly with the 83,000 tons of tin consumed in the US. The contrast is even greater if consumption levels in the two countries are compared on a per capita basis. In the USSR in 1959, consumption of tin per capita was about 0.11 kilogram and in the US

* The estimates and conclusions in this report represent the best judgment of this Office as of 15 April 1961.

** Tonnages are given in metric tons throughout this report.

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

0.44 kilogram. The great difference between the level of consumption of tin in the USSR and the US reflects the emphasis that the USSR places on production of capital goods, whereas the US emphasizes production of consumer goods. 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 1959 the USSR produced only 7.4 percent as much tinplate as the US. Until the Soviet economy becomes more oriented to production of consumer goods, consumption of tin is likely to continue lagging far behind that of the US. The same generalization can be made about consumption of tin in the entire Bloc.

Communist China is the only country in the Sino-Soviet Bloc that produces a surplus of tin, and Communist China also is the only producer of tin whose costs of production are believed to compare favorably with those of the major producers in the Free World. Information on costs of producing tin in the USSR and East Germany clearly indicates that their costs are much higher than those of the Free World. As long as production of tin in the Bloc is in excess of consumption needs, continuation of these high-cost operations is somewhat enigmatic. Were either the USSR or East Germany to discontinue production from all but their lowest cost operations, however, their dependence on the tin industry of China would increase greatly. Thus far, neither the USSR nor East Germany has been willing to increase its dependence on China by restricting production of tin to only the most efficient producers. On the contrary, plans of the USSR, in particular, indicate a trend in the opposite direction. The USSR not only intends to increase production of tin but also is making efforts to reduce production costs.

From the end of World War II until 1955, the Sino-Soviet Bloc was a net importer of tin from the Free World. In 1955, however, the Bloc became a net exporter of tin to the Free World, a position that has been maintained. This shift has come about fundamentally by the rapid increase in production of tin in Communist China.

Because the tin trade of the Sino-Soviet Bloc had consisted entirely of imports, the exports that initially were very small in 1955 became a great concern to producers of tin in the Free World when they suddenly reached sizable proportions in 1958. Annual production of tin in the West as early as 1950 exceeded consumption, and efforts were being made through the International Tin Council (ITC) to control the surplus in order to maintain a stable market price. By 1958, however, the Bloc's exports of tin were so large that the market stabilization scheme collapsed. As a result, the price of tin in the world market dropped precipitously. After much adverse publicity, the USSR agreed to cooperate with the ITC by limiting exports of tin

to the West to 13,500 tons in 1959. In general, the USSR subsequently has limited annual exports of tin to the Free World to about the same amount. Other countries in the Bloc, however, mainly China, also have exported tin to the Free World. To date, such exports have been relatively small, and the ITC has been able to accommodate the additional tonnage without great difficulty.

It appears from the plans of the Sino-Soviet Bloc for increasing production of tin and from the trend in domestic consumption that the Bloc may achieve an annual surplus of about 30,000 tons by 1965. The possibility exists of an increasingly serious problem for the ITC and its member producing countries, and the ITC may have to renegotiate with the Bloc to accommodate the export of the surplus quantity to Western markets. In such an event the role of Communist China in the negotiations probably will be a major one, in contrast to the situation that existed in 1958 when the USSR was the only Bloc country involved. In addition, the USSR may augment its existing stockpile for use in the event of either an East-West conflict or a decrease in the shipments of tin from China.

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, because of the necessity of depending on these remote sources for this strategic raw material, all the major industrial countries of the world have been engaged in intensive 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, production has exceeded demand. Since the early 1930's, there have been continual international efforts 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 average annual surplus of about 30,000 tons of tin 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 drastically curtailing production in those less developed countries where tin is the major industry.

Exports of tin from the Sino-Soviet Bloc during the last half of the 1950's upset the regulated stability of the tin market in the Free World.

II. Resources

Of an estimated total world reserve of 7.6 million tons of tin contained in ore, the Sino-Soviet Bloc has about 33 percent, or 2.5 million tons. 1/* The estimated distribution of tin reserves within the Bloc is as follows:

Country	Thousand Tons
USSR	500
Communist China	1,900
East Germany	65
North Vietnam	Negl.
Poland	Negl.
Total	2,465

50X1

A. USSR

1. Quantity of Reserves

Although the USSR is known to have numerous deposits of tin, current information on the magnitude of the reserves is incomplete. In 1944, Soviet officials claimed that reserves of tin ore 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.* Although placer ore has a much lower tin content than lode ore, less than 0.3 percent compared with a normal range of 1 to 8 percent, 4/ 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/ but 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 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/:

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

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 parts of the USSR, the relative importance of the two largest areas of tin reserves, the Yakutskaya ASSR 11/ and Chitinskaya Oblast, 12/ has not been 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, they are believed to be very large. Estimates of tin reserves in 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 probably 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 as high as 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. In 1953 the total tin reserves in East Germany were estimated at 35 million tons of ore, of which about 25 million tons (equivalent to about 65,000 tons of contained metal) were classified as known and probable reserves, the remainder being "possible" reserves of very low metal content. 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 apparently has sufficient reserves to support a small tin industry. 24/ In terms of the Bloc as a whole, however, these reserves are relatively insignificant.

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 more than 51,000 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. 25/ Within the Bloc, Communist China accounted for about

* Table 1 follows on p. 9.

Table 1

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

Thousand Metric Tons

Country	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
USSR	8.1	8.8	9.6	10.5	11.5	12.6	13.8	15.0	16.0	17.0	18.0
Communist China	6.0	7.3	13.8	15.0	16.0	18.0	19.2	25.8	31.0	32.0	32.0
East Germany	0.2	0.2	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.7	0.7
North Vietnam	0	0	0	0	0	0	0	0.1	0.2	0.4	0.4
Total	14.3	16.3	23.8	26.0	28.1	31.2	33.7	41.7	48.0	50.1	51.1

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 Sino-Soviet 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 the period 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 in production 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 26/:

* Following p. 10.
** Table 2 follows on p. 11.

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

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

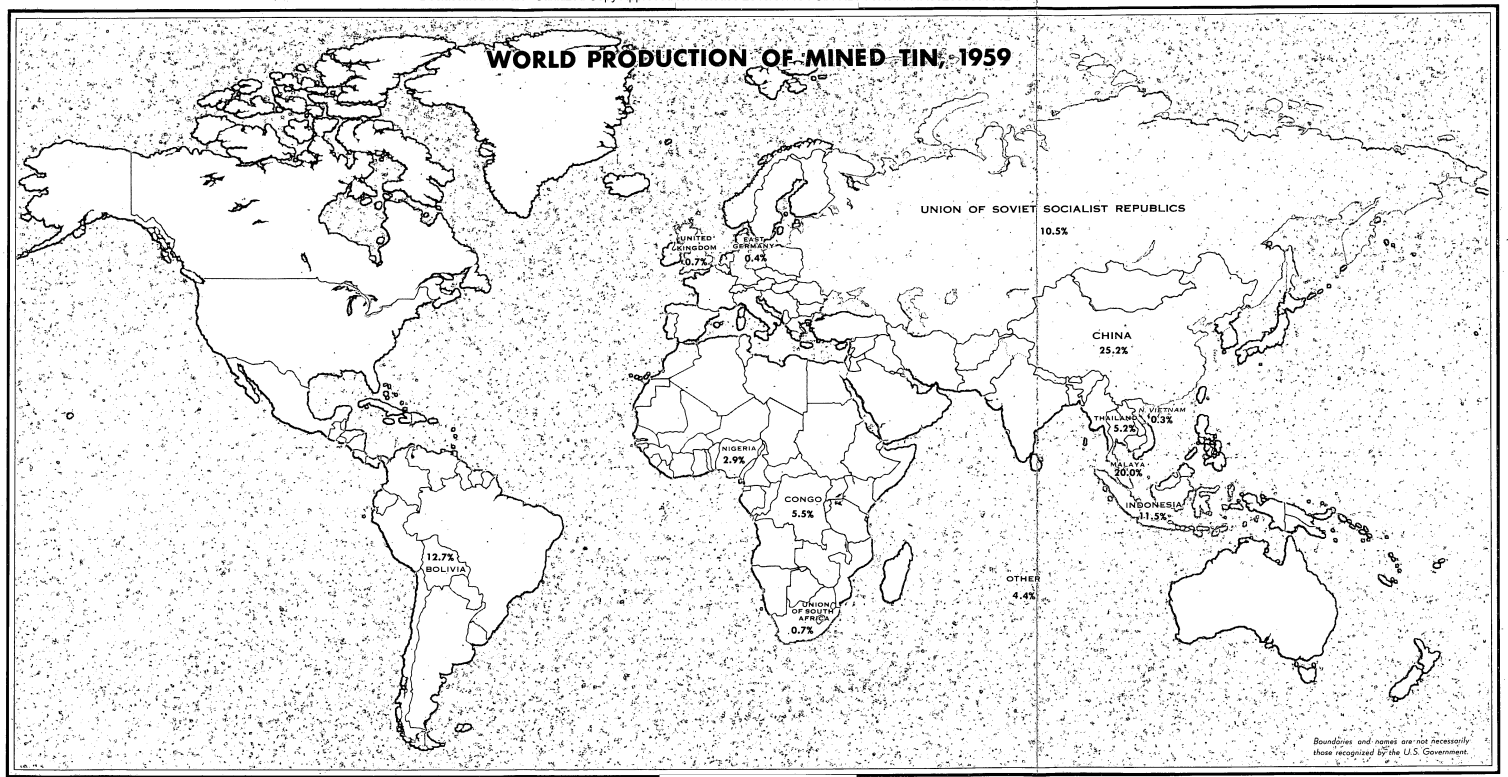
Of the tin mined in the USSR, 70 to 75 percent is from lode deposits. 27/ In the Free World, however, about 70 percent of the tin ore is mined from placer deposits. 28/ Placer deposits are exploited by dredging or open-cut methods, whereas lode deposits generally are worked by underground methods. In the USSR, however, there has been a decided shift away from underground operations, and quarry methods are now being applied to the exploitation of an increasing number of lode deposits. Open-cut working of tin mines in the USSR has increased from 12 percent of the total tin mined in 1944 29/ to about 50 percent in 1956. 30/ Where this conversion has taken place, the cost of the ore reportedly has been reduced 40 percent. 31/

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. 32/ These impurities must be removed to produce a tin metal of high quality.

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

* Following p. 10.

Figure 1 50X1



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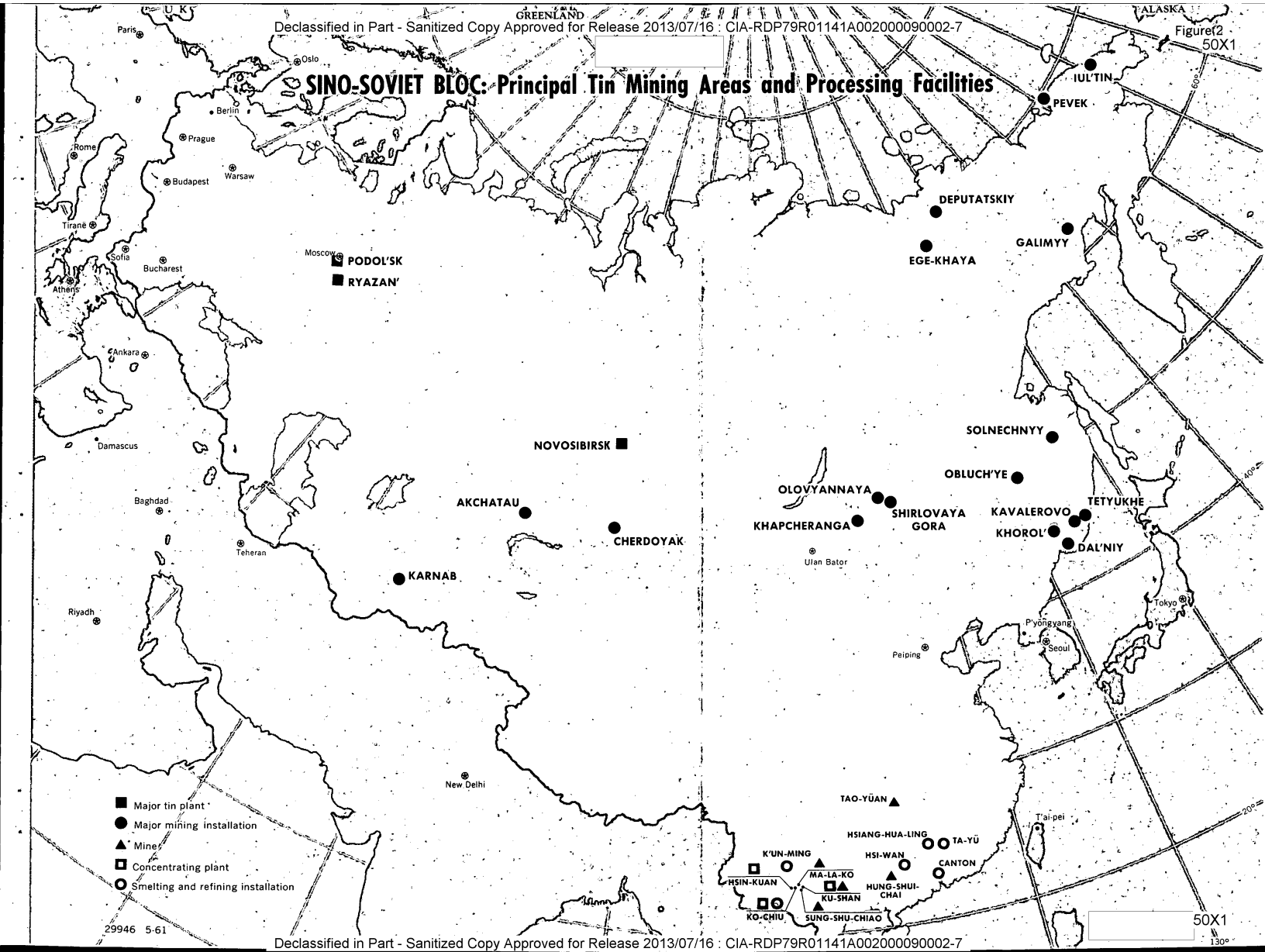
50X1

Figure 2

50X1

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



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50X1

Table 2

Estimated Production of Primary Tin in the USSR
Selected Years, 1940-65

Year	Thousand Metric Tons
1940 a/	2.0
1943 b/	3.4
1945 c/	4.4
1946 d/	5.3
1947 e/	6.2
1948 f/	6.8
1949 f/	7.4
1950 f/	8.1
1951 f/	8.8
1952 f/	9.6
1953 f/	10.5
1954 f/	11.5
1955 f/	12.6
1956 f/	13.8
1957 g/	15.0
1958 h/	16.0
1959 h/	17.0
1960 i/	18.0
1965 j/	22.4

a. On the assumption that a minimum of 200 tons of 40 percent concentrate were smelted in 1934, 33/ production of tin metal would have been 80 tons. This volume of production was assumed for 1934. Because tin smelting in 1938 was 10 times that in 1934, 34/ or 800 tons, a level of 500 tons was interpolated for 1937. Production in 1940 was reported to be 400 percent of that in 1937. 35/

b. Production in 1943 was reported to be 168 percent of that in 1940. 36/

c. Production in 1945 was reported to be 222 percent of that in 1940. 37/

d. Production in 1946 was reported to be 119.1 percent of that in 1945. 38/

Table 2

Estimated Production of Primary Tin in the USSR
Selected Years, 1940-65
(Continued)

e. Production for 9 months of 1947 was reported to be 117.7 percent of that in the corresponding period of 1946. 39/ This percentage was assumed to have applied for the entire year.
f. Interpolated between 1947 and 1957.
g. In 1957, about 5,000 tons of tin were used in production of tinplate for the manufacture of tin cans. 40/ It also was indicated that in 1957 about one-third of the tin produced went into preparation of tinplate for the canning industry. 41/
h. Interpolated between 1957 and 1960.
i. In 1960, production of tinplate for the canning industry was to require about 6,000 tons of tin. 42/ It was assumed that the same relationship to production existed as that 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. 43/

1950. 44/ The following recovery rates that are obtained in Soviet concentrating plants compare favorably with those in the Free World 45/:

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. 46/ Concentrate with a high tin content is produced by a two-phase method of concentrating,

which also provides for 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.

2. Metallurgical Reduction

In contrast to the mining and concentrating operations, which are dispersed widely throughout the Far Eastern USSR, nearly all of the metallurgical reduction and refining of tin is carried out in three tin plants: the Central Tin Plant at Novosibirsk (55°02' N - 82°55' E) 47/ and the tin plants at Podol'sk (55°26' N - 37°33' E) and at Ryazan (54°38' N - 39°44' E). 48/ The Central Tin Plant at Novosibirsk is the largest and most important of the three. As all of these major tin plants have been either built or rebuilt since World War II, the technology employed in them is quite up-to-date. Small quantities of tin also are produced at other nonferrous installations, such as the Moscow Copper Smelting and Electrolytic Plant imeni Molotova, the Chimkent and the Tetyukhe lead plants, and the Ukrainian Zinc Plant (Ukrtsink) in Konstantinovka. 49/

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, 50/ 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. 51/ Other advantages from using an electric arc furnace are that flue gases are eliminated, that continuous operation is possible, and that temperatures can be regulated precisely. 52/ The quality of the concentrate determines the rate of recovery achieved in smelting, as shown by the following data 53/:

Tin Content of Concentrate (Percent)	Rate of Recovery of Tin in Smelting (Percent)
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. 54/

As can be seen from the above tabulation, 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, and these were discarded as waste products. Now, through improved technology, 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. 55/ 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. 56/ The USSR claims that producing tin metal from these wastes is more economical than processing low-grade tin ores. 57/

Virtually all the tin produced in the USSR is refined by the pyrometallurgical (fire-refining) method, 58/ whereas in the Free World the electrolytic method also is in use. Although the electrolytic method produces a higher grade of tin, the thermal method apparently is more satisfactory for the USSR. The entire cycle of refining is carried out in a steel kettle 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 59/:

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 at 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 is being considered. 60/

3. Production of Secondary Tin

In the early 1930's, more than 2,000 tons of secondary tin were produced annually in the USSR, 61/ and current production is about 5,000 tons. 62/ 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. 63/ Scrap also is treated at some of the ferrous metallurgical installations where tin plate is produced and fabricated.

Because both runaround scrap* and old scrap are utilized equally for producing secondary tin, 64/ only one-half of the estimated current output, or 2,500 tons, is considered an addition to new supply. Old scrap is supplied at the present time mainly in the form of Babbitt metal. Runaround scrap consists of the slag formed in production of tinplate and of the shavings and cuttings from fabricating installations. Hydrometallurgical methods and resmelting in reverberatory furnaces both are used in production of secondary tin. 65/ 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. 66/ Most 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, Communist China produced about 20 million tons of tin ore. Some of the ore had a tin content as high as 2 percent, 67/ but the average tin content probably was about 0.25 percent. 68/ The estimate of ore mined is based on production of about 32,000 tons of primary tin in 1960** from ore averaging 0.25 percent tin content and on a rate of recovery of about 60 percent. 69/

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 is mined in China. At the time of the Communist rise to power in 1949, most of the ore was obtained from primitive "native" mines, 70/ of which there were several hundred. Under the Communist administration the mines have been enlarged and modernized. By 1959 the two major underground mines had been completely reequipped with

* Prompt industrial scrap as opposed to scrap obtained from farms, homes, and junk yards.
** See Table 3, p. 17, below.

Soviet-designed machinery, and modern ventilation and underground haulage systems had been installed. 71/ A third major modern underground mine began operation in 1957. 72/ 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. 73/ Insofar as is known, the technique in common usage at these mines is hydraulic mining. In contrast to the pre-Communist period, when nearly all the output in this area was derived from underground mining, as of 1957 as much as 60 percent of the ore was obtained from open-worked placer mines. 74/

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. 75/

2. Output of Concentrate

In 1960, about 80,000 tons of tin concentrate averaging 60 percent tin content were produced, principally in Yunnan Province. 76/ Only gravity concentrating methods are in use in China, and recently several Humphrey spirals* have been installed in the concentrating plants. The rate of recovery 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. 77/

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. The rate of recovery had been raised from 80 percent in 1950 to about 98 percent in 1959, 78/ and the crude tin produced had a metal content of 96 to 97 percent. 79/

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. 80/ Estimated production of refined primary tin in 1950-60 and in 1965 is shown in Table 3.**

* An up-to-date type of concentrating machine.

** Table 3 follows on p. 17.

Table 3

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

Year	Thousand Metric Tons
1950	6.0 a/
1951	7.3 b/
1952	13.8 c/
1953	15.0 d/
1954	16.0 e/
1955	18.0 e/
1956	19.2 f/
1957	25.8 g/
1958	31.0 h/
1959	32.0 i/
1960	32.0 i/
1965	57.0 j/

a. Production was equal to 38 percent of the peak output of 15,865 tons. 81/
b. Production was equal to 46 percent of the peak output. 82/
c. Production was equal to 91.7 percent of that in 1953. 83/
d. 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. 84/ The total estimate is based on the assumption that the rate of increase in the Ko-chiu area was representative of the whole country.
e. Interpolated between 1953 and 1956.
f. It was assumed that consumption equals production plus imports minus exports. In 1956, consumption is estimated to have been 2,000 tons, and exports were at least 17,200 tons. There were no imports.
g. Production was equal to 187 percent of that in 1952. 85/
h. Production of tin concentrates (metal content) was 21.8 times that in 1949. 86/ It was assumed that the increase also would apply to production of metal.
i. Exports in 1959 and 1960 appear to have been roughly of the same magnitude as in 1958. On the assumption that consumption equals production plus

Table 3

Estimated Production of Primary Tin in Communist China
1950-60 and Plan for 1965
(Continued)

imports minus exports and that there was a small increase in consumption, there also would have been a small increase in production.

j. Provision was made in the Second Five Year Plan (1957-62) for creating new capacity for producing 30,000 tons of metal. 87/ It was assumed that full use is to be made of the available capacity.

The potential of the Chinese tin industry is vast. Because of a planned doubling of plant capacity, it is estimated that production of primary tin may be as much as 57,000 tons in 1965. 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. Power supplies in the area have been increased greatly by the erection of a thermal-electric powerplant at Kai-yuan. 88/ In addition, a new canal has provided a dependable supply of water, thus alleviating what had been a major problem in the mining and concentrating phases of the tin industry. Also the completion of the rebuilding of the K'un-ming - Haiphong Railroad in 1957 connects the 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. Production of primary tin in 1957-60 was as follows 89/:

Year	Tons
1957	104
1958	220
1959	355
1960 (Plan)	430

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, and the quality of the explored reserves also is low. 90/ Although consideration was given in 1957 to closing the mines, operations have continued.

Three shaft mines now are operating in East Germany -- Altenberg accounts for about 65 percent of the ore mined; Ehrenfriedersdorf, somewhat more than 20 percent; and Rodewisch, the remainder of nearly 15 percent. 91/ To increase production, a new shaft is being built at Altenberg. 92/ 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. 93/

The ore is treated by both gravity concentration and flotation 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. 94/

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 99.6 percent, which is significantly lower than the world standard of 99.8 percent purity for first-grade commercial metal. Because the Freiberg refinery has been unable to produce a tin equal in purity to imported metal, users prefer imported metal. 95/ Production of crude and refined tin in East Germany in 1950-60 is estimated as follows 96/:

	Tons	
Year	Crude Tin	Electrolytically Refined Tin
1950	165	79
1951	220	137
1952	384	147
1953	476	140
1954	602	189
1955	620	220
1956	696	280
1957	814	N.A.
1958	757	N.A.
1959	737	420
1960 (Plan)	729	420

Production of crude tin in 1965 may reach 1,000 tons. 97/ 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. In 1951 the ore was analyzed as containing 0.01 percent tin, which was too low for exploitation. 98/ Although the mine at Gierczyn near Swieradow-Zdroj (50°54' N - 15°20' E) was reported in 1957 to be scheduled for reopening, this project is believed to have been abandoned. 99/

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 1954, 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 5 percent of the total supply.*

In 1955 the Sino-Soviet Bloc became a net exporter of tin metal, and exports of tin reached a high of about 27,700 tons by 1958. These exports by year and by country of origin are shown in Table 4.** The total value of these exports also is included.

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. 100/ In 1956 the tin producers and consumers in the Free World united under the title of the International Tin Council (ITC)*** to maintain a stable market

* See Table 10, p. 29, below.
** Table 4 follows on p. 21.
*** The operating agency of the International Tin Agreement.

Table 4

Estimated Net Exports of Tin from the Sino-Soviet Bloc to the Free World a/
1955-60

	1955	1956	1957	1958	1959	1960 b/
	Thousand Metric Tons					
USSR	Negl.	1.0	15.4	20.3	14.3	8.2
Communist China	0.7	0.7	2.0	4.1	3.8	4.2
Poland	0	0.4	0.1	3.3	0.7	0.2
Czechoslovakia	0	0.5	Negl.	Negl.	0.1	0
Hungary	0	0	0	Negl.	0.1	0
North Vietnam	0	0	0	0	0	0.1
Total	0.7	2.6	17.5	27.7	19.0	12.7
	Million Current US $					
Estimated total value of exports c/	1.5	6.0	37.6	57.0	42.6	27.9

a. 101/. Imports of tin by the Bloc were virtually nonexistent during this period.
b. Trade data for 1960 are incomplete.
c. Based on the average price on the London Metal Exchange for each year.

price for tin by preventing a surplus or shortage of tin in the world market. 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 Bloc's exports of tin were so large that the ITC had to reduce drastically the export quotas of the producing countries, which resulted in severe cutbacks in production. In southeast Asia and Bolivia, many mines were idled; unemployment increased rapidly; and general economic distress ensued. After much adverse publicity had accrued to the USSR, through which Bloc exports of tin were channeled, 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. 102/ Late in 1959 the USSR again agreed to limit exports of tin to 13,500 tons during 1960. 103/

[redacted] the USSR has performed according to its agreement with the ITC. Its exports in 1959 were only slightly more than 13,500 tons, and those in 1960 probably were less. The agreement, however, is not binding on other countries of the Sino-Soviet Bloc. This fact is of particular importance because Communist China is the largest producer of tin in the Bloc, and it is China's output that has enabled the Bloc to become an exporter of tin. There is nothing in the tin agreement between the ITC and the USSR to prevent China from exporting tin directly to the Free World, which it has been doing but, so far, only in small quantities. If China were to increase significantly its exports directly to the Free World, Bloc tin again could raise havoc in the world tin market in spite of the tin agreement. 50X1

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. In 1959, China supplied one-third of Poland's total imports of tin and about two-thirds of East Germany's. The pattern of intra-Bloc trade in tin in 1959 is shown in Table 5.* Although official information on intra-Bloc trade in 1960 is not yet available, the pattern probably is similar to that shown in Table 5.

V. 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 37,000 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 Bloc countries for the period 1950-60 are given in Table 6.**

Although the USSR is the second largest consumer of tin in the world, exceeded only by the US, 104/ where consumption was about 83,000 tons in 1960, 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,

* Table 5 follows on p. 23.
** Table 6 follows on p. 24.

Table 5

Trade in Tin Within the Sino-Soviet Bloc a/
1959

Thousand Metric Tons b/

Exporters	Importers							Total Intra-Bloc Exports
	USSR	Poland	East Germany	Hungary	Bulgaria	Rumania	Czechoslovakia	
USSR		2.2	0.1	0.4	0.1	0.3	1.4	4.5
Communist China	20.8	1.1	1.1	N.A.	0	0.2	0.1	23.3
Poland	0		0.4	N.A.	N.A.	N.A.	N.A.	0.4
North Vietnam	Negl.	Negl.	0.1	0.1	Negl.	Negl.	0	0.3
Total intra-Bloc imports	20.8	3.3	1.7	0.5	0.2	0.5	1.5	28.5

a. 105/
b. Rounded to the nearest hundred tons. Because of rounding, components may not add to the totals shown.

Table 6

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

Thousand Metric Tons

Country	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
USSR a/	9.3	9.3	11.1	12.6	14.9	16.6	17.4	18.6	21.9	23.0	24.0
Poland b/	2.0	2.0	1.9	1.8	1.7	1.7	1.7	2.5	2.5	2.5	2.5
Czechoslovakia c/	1.3	1.5	1.6	1.7	1.7	1.7	1.7	1.8	1.8	1.5	1.5
East Germany d/	1.0	1.5	1.5	0.5	1.3	1.5	1.2	1.4	1.9	2.2	2.2
Communist China e/	0.5	0.7	0.9	1.0	1.0	1.0	2.0	2.0	3.0	4.0	5.0
Hungary f/	0.6	0.8	0.3	0.5	0.9	0.9	0.9	1.2	0.8	1.1	1.0
Rumania b/	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.5	0.5	0.5	0.5
Bulgaria g/	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Total	15.0	16.2	17.6	18.4	21.8	23.7	25.2	28.1	32.6	35.0	36.9

a. From Table 9, p. 27, below.

50X1

[redacted]

e. Through 1950, Communist China consumed 500 tons of tin annually. 111/ Data for 1951-60 are projected on the basis of the increase in industrial development.

f. 112/

[redacted]

50X1

as can be seen in Table 7. This low rate reflects stringent economies in the application of tin and, in general, the emphasis on producing capital goods rather than consumer goods. The principal use of tin in the Sino-Soviet 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, only about one-third of the primary tin produced is consumed in the manufacture of tinplate. 114/ At present, the USSR is the only country in the Bloc with a significant production of tinplate. During the next 5 years, however, production of tinplate is expected to increase significantly both in the USSR and in the Satellites.

Table 7

Estimated Consumption of Primary Tin in Selected Countries
1959

Country	Kilograms Per Capita a/	Country	Kilograms Per Capita a/
US	0.44	East Germany	0.13
UK	0.40	USSR	0.11
West Germany	0.32	Czechoslovakia	0.11
Netherlands	0.27	Italy	0.08
France	0.24	Poland	0.09
Canada	0.22	Communist China	0.01
Japan	0.13		

a. Estimated by dividing the midyear population of each country 115/ into the level of consumption. 116/

Considering the general industrial expansion and the 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 24,000 tons in 1960, as shown in Table 6.*

* P. 24, above.

The largest consumer of tin in the USSR is the tinplating industry. In 1959, however, production of tinplate in the USSR was about 300,000 tons compared with production of about 4 million tons in the US. 117/

Although the quantities consumed differ considerably, the over-all 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.

Table 8

Estimated Consumption of Tin by Major Consuming Sector in the USSR and the US 1937 and 1955

Percent

	USSR		US	
Sector	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. 118/
b. 119/
c. 120/
d. Including all alloys except bronze.

There are several factors affecting 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. 121/ About one-half of this secondary metal in the USSR is produced from runaround scrap and the other half from old scrap. 122/ 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. Technological improvements, such as lacquering and converting to electrolytic methods of tinplating, also are reducing somewhat the requirements for tin in the USSR 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, as shown in Table 9.

Table 9

Estimated Consumption of Tin in the USSR
1950-59 and 1965

Thousand Metric Tons

	Tin Plate [a]		Consumption		
Year	Production	Content of Primary Tin	Primary Tin [b]	Secondary Tin [c]	Total
1950	80 to 100	1.8 to 2.2	7.3 [d]	2.0	9.3
1951	100	2.2	7.3	2.0	9.3
1952	124	2.7	9.1	2.0	11.1
1953	144	3.2	10.6	2.0	12.6
1954	176	3.9	12.9	2.0	14.9
1955	192	4.2	14.1	2.5	16.6
1956	203	4.5	14.9	2.5	17.4
1957	219	4.8	16.1	2.5	18.6
1958	265	5.8	19.4	2.5	21.9
1959	304	6.1	20.5	2.5	23.0
1965	403 to 435	6.9 to 7.2	24.0 [d]	3.0	27.0

a. Twenty-two kilograms of primary tin are required per ton of tinplate produced by the hot-dip method. 123/ 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 to 64 percent). 124/ 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. 125/

b. Tin required in the manufacture of tinplate is estimated to represent 30 percent of the total primary tin consumed. 126/

c. 127/

d. Derived by using the upper limit of the range.

B. European Satellites

The European Satellites currently consume about 8,000 tons of tin annually. The principal use for tin is in the form of industrial alloys such as bronzes, Babbitt metal, and solders. Although it is steadily increasing, production of tinplate still is small. The total requirements for tin in the European Satellites probably will not exceed 15,000 tons in 1965.*

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 did not exceed 5,000 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 may increase to about 10,000 tons annually by 1965. The requirements of tin metal for North Korea and North Vietnam are negligible.

VI. Relationship of Supply and Demand

Estimates of the annual changes in the level of tin stocks and of the total stocks available in the Sino-Soviet Bloc can be derived from the individual factors which comprise supply and demand and which have been presented elsewhere in this report. These data, presented in Table 10,** indicate that stocks of tin in the Bloc grew steadily from 1950 through 1956, increasing by an average of about 10,000 tons per year. A peak of about 76,000 tons was reached in 1956-57, a quantity equal to about three 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 10,000 tons were withdrawn from stocks, and in 1959 another withdrawal probably was necessary. Nevertheless, at the beginning of 1960 the Sino-Soviet Bloc appeared to possess a stockpile of about 63,000 tons of tin, which may have been increased during the year to about 67,000 tons -- about 2 years' requirements. In comparison, the US stockpile contained more than 350,000 tons of tin as of 31 March 1960. 128/ This quantity is equal to 4 or 5 years' requirements in the US. Other Western countries also maintain strategic reserves of tin metal.

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

* See Table 6, p. 24, above.
** Table 10 follows on p. 29.

Table 10

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

Thousand Metric Tons

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960 a/
New supply											
Primary production b/	14.3	16.3	23.8	26.0	28.1	31.2	33.7	41.7	48.0	50.1	51.1
Secondary production c/	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 d/	4.4	6.7	2.3	2.7	1.6	0.1	1.0	0	0	0	0
Total	20.7	25.0	28.1	30.7	31.7	33.8	37.2	44.2	50.5	52.6	53.6
Demand											
Net exports to the Free World e/	0	0	0	0	0	0.7	2.6	17.5	27.7	19.0	12.7
Domestic consumption f/	15.0	16.2	17.6	18.4	21.8	23.7	25.2	28.1	32.6	35.0	36.9
Total	15.0	16.2	17.6	18.4	21.8	24.4	27.8	45.6	60.3	54.0	49.6
Derived change in stocks g/	+5.7	+8.8	+10.5	+12.3	+9.9	+9.4	+9.4	-1.4	-9.8	-1.4	+4.0
Estimated total stocks (end of year) h/	15.7	24.5	35.0	47.3	57.2	66.6	76.0	74.6	64.8	63.4	67.4

a. Preliminary estimate because of incomplete trade data.
b. From Table 1, p. 9, above.
c. See III, A, 3, p. 15, above.
d. 129/
e. From Table 4, p. 21, above.
f. From Table 6, p. 24, above.
g. Difference between total new supply and total demand.
h. Stocks at the end of 1949 are estimated to have been 10,000 tons. Totals for 1950-60 are cumulated stock changes.

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 provides some insurance against the stoppage of shipments 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.

By 1965 the annual production of tin in the Sino-Soviet Bloc will be about 85,000 tons if the planned levels of production are achieved. The estimated maximum requirements for tin in that year are about 55,000 tons. By 1965, therefore, there may be some 30,000 tons of tin metal available annually either for export to the West or for addition to the Bloc stockpile of tin, compared with a similar surplus of about 17,000 tons annually in the late 1950's. This quantity, if exported to the West, again could cause considerable hardship to the underdeveloped countries of the West that produce tin.

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 relationship of the costs of production of selected nonferrous metals in the USSR 130/:

Metal	Index
Tin	100.0
Lead	7.7
Copper	5.6
Aluminum	5.0

That is, for what it costs the USSR to produce 1 ton of tin, it can produce 13 tons of lead, 18 tons of copper, or 20 tons of aluminum.* Not only is the cost of producing tin in the USSR high relative to

* 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 cost for other nonferrous metals, but also it is high relative to 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.* The ruble/dollar price ratios for a few selected commodities, as shown in Table 11,** indicate the wide gap between the ratios for tin and other intermediate producer goods.

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

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. 131/ 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

* 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) not included in Soviet accounting costs were assumed to be the same 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 B.

** Table 11 follows on p. 32.

Table 11

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
Bricks	4 to 1 c/
Machine tools	2 to 1 d/
Tool steel	2 to 1
Intermediate producer goods (average)	10 to 1

a. [redacted] Soviet prices are based on 1 July 1955 rubles (old rubles -- pre-1961 rate of exchange); and US prices are based on comparable dollar values. 50X1

b. A wide disparity exists in the USSR between the cost of producing tin and the internal price of tin. 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 B.

c. 133/

d. 134/

Magadanskaya Oblast and a reduction of more than 50 percent in the cost of mining for the Dal'olovo Combine in Primorskiy Kray. 135/

Additional reductions in cost have been achieved in concentrating, largely by improvements that permit the recovery of valuable byproducts, thus reducing the cost of producing tin. 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. 136/

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. It is believed to be very unlikely, however, that the magnitude of such reductions will be sufficient to bring the cost of producing tin down to a level comparable to that of the average for intermediate producer goods. The problems associated with the quality and location of ores appear too great for the USSR to overcome completely.

One of the factors in the cost of producing tin 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. 137/ By 1965 this investment requirement is planned to be reduced to about 250,000 rubles. 138/

B. Communist China

50X1

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. 139/

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, which may permit a more efficient utilization of at least some factors of production. On the basis of these considerations, it is believed that in relation to producing other nonferrous products the cost of producing tin in Communist China probably is low.

Two other facts suggest that costs in the tin industry of Communist China are not excessive. 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, other information suggests that 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. 140/ 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 major tin mining and processing facilities in the USSR and in Communist China -- the principal tin-producing areas in the Sino-Soviet Bloc -- are shown in Table 12* and Table 13,** respectively. The general locations of the principal tin mining and processing facilities in the Bloc are shown in Figure 2.***

* Table 12 follows on p. 37.
** Table 13 follows on p. 41.
*** Following p. 10, above.

Table 12

Major Tin Mining and Processing Facilities in the USSR

Location	Installations
	I. Tin Plants
RSFSR	
Region VII a/*	
Moskovskaya Oblast, Podol'sk	Podol'sk Tin Plant
Ryazanskaya Oblast, Ryazan'	Ryazan' Tin Plant
Region IX	
Novosibirskaya Oblast, Novosibirsk	Novosibirsk Tin Plant

50X1

50X1

* Footnote for Table 12 follows on p. 40.

Table 12

Major Tin Mining and Processing Facilities in the USSR
(Continued)

Location	Installations
	II. Major Mining Installations
RSFSR	
Region XI	
Chitinskaya Oblast	
Khapcheranga	Khapcheranginskiy Tin Combine
Olovyannaya	Ononskoye Mining Administration
Sherlovaya Gora	Sherlovogorskiy Mining and Concentrating Combine
Yakutskaya ASSR	
Deputatskiy	Deputatskoye Mining Administration
Ege-Khaya	Ege-Khaya Ore Mining Combine

50X1

50X1

Table 12

Major Tin Mining and Processing Facilities in the USSR
(Continued)

Location	Installations
	II. Major Mining Installations (Continued)
RSFSR	
Region XII	
Magadanskaya Oblast	
Pevek	Chaun-Chukotskiy Ore Mining Combine
Iul'tin	Iul'tinskiy Ore Mining Combine
Galimyy	Omsukchanskiy Tin Mining Combine
Khabarovskiy Kray	
Obluch'ye	Khingan Tin Combine
Near Komsomol'sk	Solnechnoye Tin Enterprise
Primorskiy Kray	
Dal'niy	Dal'olovo Tin Combine
Kavalerovo	Khrustal'nyy Mining and Concentrating Combine

50X1

50X1

Table 12

Major Tin Mining and Processing Facilities in the USSR
(Continued)

Location	Installations	[redacted] 50X1
	II. Major Mining Installations (Continued)	
RSFSR		
Region XII		
Primorskiy Kray (Continued)		50X1
Tetyukhe	Sikhote-Alinskiy Polymetallic Combine	[redacted]
Khorol'	Yaroslavskiy Tin Combine	

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

Table 13

Major Tin Mining and Processing Facilities in Communist China

50X1

Location	Installations
	I. Smelting and Refining Installations
Yunnan Province	Central Tin Plant at Ko-chiu
	K'un-ming Smelting Plant
Kiangsi Province	Ta-yu Tin Refinery
Kwangsi Chuang Autonomous Region	Hsi-wan Concentrating and Refining Plant
Kwangtung Province	Canton Refinery
Unknown	Hsiang-hua-ling Tin Mine and Refinery
	II. Concentrating Plants
Yunnan Province	Ku-shan
	Ta-t'an
	Huang-mao-shan
	Hsin-kuan
	Ko-chiu
	III. Mines
Yunnan Province	Ma-la-ko
	Lao-chang
	Sung-shu-chiao

Table 13

Major Tin Mining and Processing Facilities in Communist China
(Continued)

50X1

Location	Installations
	III. Mines (Continued)
Yunnan Province (Continued)	P'an-po
	Ku-shan
	Huang-mao-shan
	Niu-shan
Kwangsi Chuang Autonomous Region	P'ing-kuei Mining Bureau
Hunan Province	Tao-yuan Tin-tungsten Mine
Kwangsi Chuang Autonomous Region	Hung-shui-chai Tin-tungsten Mine

APPENDIX B

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 industry 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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