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TRENDS IN THE PRODUCTION OF ELECTRONICS IN THE USSR

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Trends in Production Of Electronics In The USSR

Discussion

Current Plans and Programs

1. In the recently published "Draft Directives" for the Ninth Five Year Plan, programs in the electronics industry of several years standing have been reaffirmed. The computer industry is planned to grow, as formerly, at a rapid rate. The output of "computational equipment"* will increase by 140% during 1971-75, or at an average annual rate of about 19%. Within this category, the output of computers will increase at a somewhat faster rate, about 21% (160% increase), and equipment for the "mechanization and automation of engineering and administrative work" will be pushed. The production of electronic instruments for use in scientific research, electronic medical devices (based on integrated circuits), and electronic equipment for use with industrial process control systems and other forms of automation will be emphasized. It is also planned that production of radio equipment for navigation and air traffic control will increase. Finally, in a laconic, almost casual reference, the "directives" reveal one new program "to organize the series production of a new family of electronic computers based on integrated circuits."**

2. A somewhat unusual feature of the current plan is the total absence of guidelines for the electronics industry as a whole or even of a

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* *"Sredstva vychislitel'noy tekhniki." This category includes computers, computer peripherals, electronic calculators, and other business-type machines (orgtekhnika).*

** *Osvoit seriynoye proizvodstvo novogo kompleksa elektronnykh mashin na base integral'nykh skhem.*

generalized reference to its projected rapid growth. Output goals are not given for either the Ministry of the Radio Industry or the Ministry of the Electronics Industry. Moreover, and most surprisingly, the current plan contains no explicit goals for the consumer sector -- that is, for the output of consumer radios and television sets.

3. These omissions may be significant and could indicate that programs for the production of military electronics are being expanded, perhaps at the expense of output in the consumer electronics sector. In that case, Soviet planners would be understandably reluctant to release details on industry and consumer electronic goods that might reveal such a shift in emphasis.

4. The failure to announce Plan goals for radios and TVs is especially curious in the light of the regime's current efforts to curry favor with the Soviet consumer. Possibly, the growth in output of radios and TVs is being deliberately slowed down pending improvements in the product quality. It is instructive to note that stocks of unsold electronics consumer items in the retail and wholesale trade network have mushroomed in recent years. In 1969, inventory was valued at more than one billion rubles, or about 43% of the value of retail sales of these goods (*radiotovary*). In 1965 the inventory was valued at 21% of sales. It is also possible that the rate of increase in the output of radios and TVs is being constrained to accommodate the increased production of other types of consumer goods in electronics plants. According to the "draft directives," the production of consumer and household goods is being increased in all branches of industry and "in heavy machine building, instrument making, shipbuilding and electronic industries, by 2.2 - 2.5 times."

5. Finally, it is possible that Soviet planners are themselves uncertain about feasible programs and goals. From all accounts, the Soviet electronics industry is entering a major transitional phase -- that is, the Soviets are making a big push to modernize the electronic component base, to shift over from time-honored production of electronic equipment based on electron tubes to the manufacture of equipment based on semiconductor technology, and specifically, silicon

devices such as integrated circuits. Because this transition involves fundamental and far-reaching changes in manufacturing methods, Soviet planners may be uncertain about the quantity and mix of product that can be achieved in the short run. Uncertainty about the extent to which Free World equipment or technology will become available could be an additional complicating factor.

6. Parallel with efforts to reshape the computer and semiconductor industries from indigenous resources, the Soviets are pressing forward with efforts to procure Western manufacturing technology in these and a variety of related fields. It is abundantly clear that the Soviets are acutely aware of the significant and growing technology gap in electronics between the USSR and advanced Western nations and are seriously concerned about it. The gap is extensive and covers virtually all product categories. To close the gap, the USSR in recent months has offered to buy complete turnkey facilities from the West, many encompassing advanced technology and advanced technological products for which approval for export would be most unlikely. For example, the Soviets want to purchase turnkey facilities for the production of computers, integrated circuits, magnetic tape, core memories, tape memories, disc drives, small video recording equipment, and professional broadcasting video tape recorders. Types of advanced products sought are: high-capacity multiplexing equipment, electronic switching equipment, avionics equipment, advanced oscilloscopes, and other types of scientific and industrial instrumentation.

7. From the foregoing, it is suggested that the electronics industry currently has three major objectives: (a) to put integrated circuits into large-scale production; (b) to begin the production of third-generation computers; and (c) to maximize its purchases of advanced electronic equipment abroad to reduce the "technology gap."

Sectoral Trends

Semiconductor Industry

8. Limited quantities of integrated circuits (ICs) apparently are being manufactured at the

Radio Parts Plant in Voronezh, in plants of the Svetlana Production Association* in Leningrad, and in unidentified facilities in the Moscow suburbs of Kryukovo and Zelenograd. All available evidence indicates that the output of usable monolithic ICs in these facilities is so low by Western standards that the effort should be described as experimental or pilot line production.

9. A major Soviet effort to build an advanced semiconductor industry based on planar, planar/epitaxial, and metal oxide (MOS) technologies has been evident since the mid-1960s. This task has proved to be unusually intractable. It is estimated that the gross output (including rejects) of semiconductors in the USSR in 1970 was about 1.1 billion units -- compared to 850 million in 1969 -- including mainly transistors, diodes, and rectifier diodes (see Table 1). No breakdown of these devices, in quantitative terms, is possible. However, the following general comments are believed to be applicable: an overwhelming proportion of the output is germanium-based; diodes make up the lion's share of the devices; and probably less than 10% of total semiconductor output is accounted for by silicon devices manufactured by planar epitaxial production techniques. It may be noted in this connection that many pieces of Soviet electronic end-products have been technically examined in the United States in recent years. None have contained silicon transistors.

10. It is this relatively primitive state of development of silicon transistor technology that accounts, in very large measure, for the relatively

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* *The Svetlana Production Association comprises five factories and five experimental design bureaus. It is one of 14 such associations currently functioning in the electronics (component) branch. In the Svetlana Association, subordinate enterprises have no juridically independent status. All enterprises are administered by the head enterprise. The Association has all the rights of a "Main Administration" and is directly subordinate to a Deputy Minister of the Electronics Industry. The Svetlana Association (and all other associations) are still an experimental form of industrial management.*

large and growing gap in advanced solid-state technology between the USSR and the United States; indeed, between the USSR and the West generally. The manufacture of monolithic integrated circuits presupposes a well-developed silicon transistor manufacturing industry based on planar/epitaxial methods. Superficially, the tardiness of the Soviet electronics industry in mastering silicon technology is explained by its overlong concentration on the development and production of devices based on germanium. But this explanation reduces to a tautology. The true reasons are more complex and are deep-rooted in the psychology and organization of an economic system that discourages creative, innovative activity and adapts to change slowly. A few of the more obvious factors that have perpetuated obsolescence in the electronics component sector are: a cumbersome planning system, lack of incentives for factory workers and built-in resistance to change at the factory management level, faulty coordination between plants and between plants and research and development institutes; and disharmony between component designers and end-equipment designers.

11. Moreover, in more concrete terms, a number of crucial inadequacies are observable in the production equipment available to the Soviets. That is, Soviet progress in advanced solid-state manufacturing technology is impaired by the unavailability of high-quality precision equipment and materials of the following types: final test equipment, silicon diffusion furnaces, photo resists, photolithographic equipment and precision masks, chemical etchers for lead frames and printed circuits boards,* bonders (ultrasonic), and scribing and dicing equipment. In addition, there are indications that the USSR does not make good quality plastic encapsulation packages. All of the above factors contribute to a general inability of the industry to maintain consistent quality in the manufacture of silicon semiconductor devices over long production runs.

12. As a general appraisal, Soviet state-of-the-art lags at least five years behind that of

* *The USSR has imported some advanced chemical etching machines from the West during the past year.*

the United States in the area of monolithic ICs. In the area of hybrid integrated circuits -- that is, the use of thin and thick film passive components with discrete semiconductor elements -- the gap is probably somewhat less. The USSR lags least in the manufacture of thin and thick film resistors and capacitors.

13. The USSR is acutely aware of its technological backwardness (relative to the United States) in advanced semiconductor technology. This backwardness has denied the USSR many of the fruits of modern technology such as advanced high-speed computers, modern microminiaturized avionics equipment, and sophisticated instrumentation across-the-board. The USSR has been partly successful in filling the gap by importing computers, oscilloscopes, and other instruments from the West in recent years. Such purchases are at best stop-gap measures and do not offer a viable long-term solution to the expanding needs of the Soviet economy.

14. The USSR is committed to the development of a modern component manufacturing industry. To accelerate the development of this industry, the USSR has embarked on an intensive effort to acquire the necessary technology and production machinery in the West. It is attempting to buy individual items of machinery as well as whole plants in a turnkey operation. It is probable that the degree to which the Soviets will be able to build a modern semiconductor industry during the current five-year plan will hinge on their success in acquiring Western manufacturing technology.

Military

15. The most interesting development in military electronics appears to be taking place in radar production, particularly in the production of ground-based aircraft control and early-warning types (EW/GCI). Although no plant data are available, important inferences about production and state-of-the-art can be drawn from an analysis of radar order of battle. First, emphasis has shifted from purely quantitative growth in output

to a qualitative up-grading of existing systems and the development and production of new types, incorporating newer and higher technology. Second, newer Soviet radars are being equipped with longer life tubes and better components to enhance operational reliability. Third, there has been a shift in design philosophy away from excess concern with the maintainability of radar systems under field conditions. The evidence for these inferences follows.

16. After more than a decade of steady growth in the deployment of EW/GCI radars and radar sites, deployment levels have stabilized at a total of about 3,400-3,600 radars at 950-1,050 sites. These numbers have not changed significantly in more than two years. In sharp contrast to previous practices, the Soviets in very recent years, have retired older model radars from the inventory as new ones have been introduced. For example, TOKEN has entirely disappeared from the inventory of EW/GCI systems, and KNIFEREST is rapidly disappearing. It is believed that as older radars are phased out, modernized versions are brought in, probably incorporating electronic countermeasures (ECM) devices, and improved signal processing circuitry. In addition, the newest radars being produced, such as PART TIME, BACK NET, SIDE NET, THIN SKIN, and LONG TRACK, represent a quantum leap in technology over most of the existing radar types

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17. A major factor contributing to the unreliability of Soviet radars has been the relatively short life of radar tubes, and probably of other components as well. In the past the problem of reliability has been manageable because an excess number of radars has been stationed at EW/GCI sites. Hence, field personnel have been able to prolong the operational life of radar tubes by using the radars alternately for only short periods of time on a regular basis. At the same time, multiple radars provided operational advantages such as frequency diversity, redundant

coverage, and increased survivability. It is obvious that, as radar systems become ever more complex, this practice becomes an extremely cost-intensive alternative. The Soviets now seem determined to overcome the reliability problem more rationally -- that is, by upgrading the electronic components. Newer radars exhibit characteristics that require stable and reliable components, suggesting that this problem is gradually being resolved.

18. Historically, Soviet radars have been difficult to maintain, and "downtime" for maintenance has been significant. Maintenance is an especially difficult problem in the USSR because radars are generally deployed without protective radomes under harsh environmental conditions. Hence, designers have always emphasized simplicity in order to field radars that were easy to operate, test, and maintain. It is apparent from the fact that designs are becoming increasingly complex that operational capability is now being stressed over maintainability. Probably with improved components available, maintainability is not now the problem it once was.

19. The trend toward increased emphasis on improved technology is observable in other areas of military electronics as well. For example, the Soviets are attempting to improve command and control communications by introducing high-speed data transmission systems. [

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20. Despite the efforts that are being made to advance the technology of radar systems, it should be emphasized that even the very latest EW/GCI radars do not measure up to the systems capability or technology of modern US (and other Free World) radars of corresponding types.

Computers

21. Computers are manufactured in the USSR by both the electronics industry and the instrument building industry. The division of production

responsibilities is not clear. The electronics industry is believed to have primary responsibility, with the role of the instrument building industry restricted, perhaps, to the manufacture of computers for use in industrial process control systems. In any event, Soviet computers, no matter by whom manufactured, have not kept pace with the World state-of-the-art and are a source of serious concern to Soviet policymakers.

21. The development of a modern computer industry was first stated to be a high priority goal of the Soviet Communist Party at the November 1962 Plenum of the Central Committee. It is clear from the deliberations of that Plenum that Soviet planners were thinking in terms of computers primarily for industrial use, and only secondarily for the broader purposes of economic planning. This policy was reaffirmed at the December 1969 Plenum of the Central Committee, according to Academician V.M. Glushkov. He also stated that the Soviet objective is an inventory of 38,000 computers by 1980, mostly for use in industry.*

22. How realistic is that goal? During the past decade, the USSR is estimated to have produced less than 6,000 digital computers. Output in the current decade (1971-80) would have to increase more than fivefold to reach the announced total. In the current 5-year period, the planned rate of growth in output of computers averages to about 21% per annum, compared to rates of 25%-30% during the previous 5-year period. Hence, it would appear that either Glushkov has announced a wish and not a goal, or the Soviets are planning to pour enormous resources into the computer industry during the second half of the 1970s.

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* *There is some evidence of resistance to the use of computers at the plant level. Existing computers in industry are said to be only "half used," and enthusiastic clients for computers are few in number. Enterprise managers apparently shrink from using computers. Potential long-term benefits are sacrificed to more tangible short-term sales and profit goals.*

23. By the end of 1970, it is estimated that the USSR had 6,000-7,000 digital computers in use, or available for use. This is less than 10% of the number installed in the United States. At least half of the Soviet machines are small-capacity machines (roughly equivalent, in capacity, to the IBM-360-20, or below). The US has about 2,500 large (capacity equal to or greater than the IBM 360-50) computers in use, compared with about 30 in the USSR.

24. A comparison based on numbers, however, is misleading in many respects. The majority of US computers are third-generation machines (based on integrated circuits) equipped with a multiplicity of input/output devices that permit relatively full use of the central processor's capabilities. None of the Soviet computers in use are third-generation machines; they are first-generation (tubes), and second-generation (transistors) machines equipped with wholly inadequate peripherals and relatively primitive software. Given similar operating characteristics (that is, "bus-rate," or "processing data rate") a Soviet computer has significantly less capability to perform useful work, compared to its US counterpart, because of the inadequacies of software and peripheral equipment.

25. The major shortcoming of the Soviet computer industry is in production technology, rather than design. Without fundamental improvements in production technology, the USSR will continue to manufacture obsolescent machines with poor reliability. The USSR would like to resolve its computer production problems with Free World assistance and can be expected to press negotiations with large Western suppliers toward that end. At the same time, the Soviets will probably seek temporary relief by accelerating imports of computers from the West,

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26. The role of the CEMA countries in Soviet plans is unclear. It is believed that the Soviets

are pressing some of the East European countries to cooperate in the production of computers. For example, the Soviets would like Poland to provide the USSR with small central processors; Hungary with assorted magnetic storage devices; and Czechoslovakia with some, as yet undefined, computer circuitry.

27. In a sense, technological backwardness in computers is both the cause and result of backwardness in other areas of electronics, and is symptomatic of the inferiority (relative to the West) of Soviet electronics equipment generally. Failure to manufacture modern, high-speed, high-capacity computers affects the Soviet image abroad. More importantly, it frustrates Soviet programs at home, particularly in the area of industrial management. Hence, the Soviets are now investing heavily in a third-generation RYAD computer. Production of a few machines was to have begun by now, but only one or two prototypes are believed to exist. It is doubtful that any significant production will take place before the mid-1970s.

28. The RYAD is a direct copy of the IBM-360 series. The Soviets had planned to solve their software problems and avoid a costly and time-consuming software development program by using pirated IBM software. It appears, however, that IBM software is not compatible with the RYAD machine and that the cost of adapting IBM software may be as great as developing an entirely Soviet software system.

Consumer Electronics

29. The USSR for several years has produced a large quantity of consumer radio and television sets. It now produces a large volume of audio tape recorders as well -- more than one million annually. Levels of output of consumer electronic items in the United States and the USSR for 1970 are compared in the tabulation below.

	Million Units		
	US	USSR	USSR as a Percent of US
Television sets	11.6 a/	6.7	58
Black and white	5.1	6.6	129
Color	6.5	0.1	2
Radio and phonographs	17.7	7.8	44
Tape recorders	1.7	1.1 b/	65

a. Includes US factory sales of domestically produced sets and sets produced by US manufacturers abroad for sale in the United States.
b. Estimated.

30. Soviet consumer electronic products are of relatively poor quality and incorporate outdated technology. For example, most of the television receivers in production in 1970 contain large numbers of tubes and semiconductor diodes, but relatively few transistors. A few all-transistor models have been advertised but, as yet, they are in an experimental or very limited production stage. The Soviets have targeted 1975 as the year in which all production model television receivers are to be fully transistorized. To overcome buyer resistance, a number of models recently have been taken out of production and replaced with improved versions containing more semiconductors. For some models, the manufacturer's warranty has been extended from 12 to 18 months.

31. Color television in the USSR is still in its infancy. Color broadcasting has been carried out for more than three years on a very limited schedule, but color receivers are in very short supply and are very expensive. Prices recently were cut from 900-1,200 rubles to 600-900 rubles. No appreciable effect on demand has been noted. Four models of color TV receivers are currently being produced.

32. The Soviets have had a difficult time getting color receivers into production. The major

bottleneck stems from difficulties in the manufacture of the color picture tube. The joint Soviet-French development program for the production of maskless tubes is far behind schedule. Moreover, the Soviets, who also have a large program for producing mask-type tubes, have had to import some technology from the United States, especially for the manufacture of masks.

33. In radio production, the trend is toward increased transistorization and miniaturization, more tasteful design, and a somewhat broader application of a UHF reception capability to portable types. According to the manager of the Riga VEF Radio Plant, all portable receivers manufactured by that plant (one of the largest producers in the USSR) are now transistorized. Console models, however, are still based largely on tubes.

34. The first transistorized radio was produced in the USSR about eight years ago. In 1965, about one-third of all the radios produced were transistorized, and in 1968 about 54%. During the past two years, several new transistorized models have appeared. During the current Plan period, most radios will probably be transistorized.

35. Audio tape recorders are manufactured for the consumer market in 13 different models. Most are of the two-track, monaural type. According to the Soviet press, none of these recorders in 1969 met the highest "state standards" (GOST) for quality.*

36. Curiously, while the USSR manufactures audio recorders in relatively large volume, it does not have a broad-based magnetic recording technology. Some studio-type video recorders are produced but on a very limited, hand-built basis despite an intensive development program of over 10 years duration and obvious and growing requirements. Machines that have been produced are direct

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* *According to state standards, there are five classes of tape recorders: highest and Classes I, II, III, and IV. None of the recorders produced in 1969 was classified as "highest" or even Class I.*

copies of AMPEX and RCA equipments. Moreover, the reliability of Soviet-made video recorders is poor. Head-life of the KADR model VTR that has been "in production" in recent years is still only 100 hours. According to East European users, Soviet recorders are of poor quality. Unlike most Western countries, a range of magnetic recording products usable for a wide variety of scientific, commercial, and military applications does not exist in the USSR.

37. Some recognition of Soviet problems in magnetic recording technology has appeared in the Soviet press. In October 1970, *Pravda* reported: "there is a shortage of recording equipment and recording tapes ... . Broadcasting studios must be equipped as soon as possible. They must be furnished with modern tape recorders. Questions connected with the repair of sound-recording apparatus must also be resolved." In November 1969, similar sentiments were expressed at the first nationwide scientific-technical conference on the theory and technology of magnetic recording, held in Kiev. The conference revealed that "at the present time, the demand for magnetic tape recording equipment significantly exceeds production," and that "owing to the absence of production capacity, a large number of newly developed magnetic tape recording devices are frequently not introduced into series production." The conference stressed the need for: (a) theoretical and experimental work to improve the quality of recording technology for sound, video, digital, and precision applications; (b) the development of methods and apparatus for testing and measuring bandwidth; and (c) the development of miniaturized components for use in recording equipment.

38. Because of the extensive military, military/industrial, and scientific applications of magnetic recorders, it is likely that the strong development effort that is known to exist will be sustained during the current Plan period. In addition, the USSR will probably increase its purchases of recorders in the West to the extent permitted by the international embargo.

Growth

39. As a quasi-military industry, the Soviet electronics industry is a high-priority claimant on economic and technical resources. This privileged status has enabled the electronics industry to register impressive growth throughout the post-World War II period. Between 1950 and 1958, output grew more than eight times with average annual rates of 35%-40% in the early 1950s tapering off to about 20% in 1958. During the Seven Year Plan, output was originally planned to triple, implying a further slowing of the growth rate to about 17% (compounded) per year -- a result fully consistent with the secular trend of any growing industry as its base grows larger and the industry matures. That plan, however, appears to have been scrapped in late 1962 in favor of a far more ambitious target for 1965 designed to raise output in that year to a level four times that of 1958. No data on fulfillment of the Seven Year Plan for the electronics industry has ever been published, however, and it is still possible to argue, on the basis of conflicting evidence, that the industry followed a course during 1959-65 generally in accord with the original Plan goals. It can even be argued from published indexes that output in 1965 may have fallen short of the original Plan, although this would imply an inconsistency with the historic pattern of growth and with the privileged priority status of the industry that would be difficult to sustain on purely logical grounds.

40. There are good reasons for believing that the original goals of the Seven Year Plan were, in fact, revised. First, it is believed that shifts in the military demand for electronics in the early 1960s resulting from the intensification of offensive SS-9 and SS-11 systems, the defensive SA-5, and ABM-1 missile deployment systems could have accelerated the production of electronics hardware and generated increased expenditures on electronics R&D. Second, an important change seems to have taken place in the general organization of science and industry early in the period that could have influenced the goals of the Seven Year Plan. Research and development facilities appear to have been transferred from the USSR

Academy of Sciences to the electronics industry sometime after 1961.* The number of facilities that were transferred to the electronics industry is not known. An editorial in the January 1963 issue of *Radio* stressed the significance of this new policy for the electronics industry, but no data that would permit an evaluation of the impact have been released. It appears, however, that the electronics industry, after 1961, was responsible for the administration and financing of scientific research and experimental design as well as planning work not contemplated at the outset of the Seven-Year Plan. The expenditures involved could easily have engendered an upward bias in the gross value of output of electronics for 1965 as well as for the whole post-1961 period.

41. Finally, an upward revision in the Seven-Year Plan goals may have been prompted, in part, by a better-than-anticipated performance of the industry during 1961-62. It is known, for example, that the output of Soviet industry generally, and of the machine building sector in particular (the electronics industry is a branch of the machine building sector), made impressive above-plan gains in output during this period. The electronics industry, abetted by above-plan deliveries of material inputs, could have shared in these gains and stimulated industry planners, in the expectation of continued gains for the remainder of the Seven-Year Plan period, to project a threefold growth by 1965.

42. During the years of the Eighth Five-Year Plan (1966-70), output in the electronics industry is believed to have expanded at a rate of about

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* *A new state policy designed to tighten the relationship between R&D and production appears to have been initiated by the CPSU in 1961 and ratified at the November 1962 Plenum of the CPSU. That Plenum decreed the "transfer of leading scientific, planning, and design institutes, and design bureaus of plants with developmental and experimental bases, to the branch state committees."* Plenum Tsentral'nogo Komiteta Kommunistichesko Partii Sovetskogo Soyuzo, 19-23 Noyabrya, 1962 Goda: Stenograficheskiy Otchet; *Moscow, Gospolitizdat, 1963, p. 405.*

17% annually. One source implied that the "output of electronics" increased by about 19% a year during the first three years of the period (1966-68), suggesting that growth may have tapered off to a rate below 15% during the final two years of the plan. Within the industry, it appears that the output of components is growing significantly faster than end products. This would not be surprising since the inadequate supply of components has long been a production bottleneck and large resources are apparently being poured into research and development in this area to catch up with Western technological advances. According to A.I. Shokin, the Minister of the Electronics Industry, his industry, which produces electronic components, grew three times during 1966-70. It is not known how fast the Ministry of the Radio Industry has grown, but according to the Minister, V. Kalmykov, a doubling of output during 1966-70 was planned. A late 1968 press item reaffirmed this plan, suggesting that the industry was probably developing according to schedule and that the plan would be realized.

Gross Value of Output of Electronics, 1966-70

43. [redacted] in 1966, CIA presented a methodology for deriving the ruble value of output of electronics in the USSR. It was emphasized, at that time, that the methodology depended in a crucial way on two values: (a) the gross value of output (GVO) of the machine building and metalworking (MBMW) sector in 1965; and (b) the rate of growth in output of the electronics industry during 1959-65. Given true values for these variables, the GVO for electronics could be uniquely determined for 1965.

44. As indicated above, no plan fulfillment data for the electronics industry covering the years 1959-65 have ever been released. Nevertheless, there are some grounds for believing that it grew four times. In respect to MBMW, the most recent evidence available points to a GVO of 53.0 billion rubles in 1965.* These data yield a GVO for the

* *Derived from data given by one V.S. Lel'shuk in his article "Industrial Development of the USSR During the Seven Year* [footnote continued on p. 18]

electronics industry of 7.9 billion rubles in 1965. Other values for MBMW are also arguable -- that is, other values falling in the range 51-61 billion rubles can also be supported by statements of Soviet officials or are derivable from official data. Hence, other values for the GVO of electronics ranging from 7.4 to 10.4 billion rubles are also possible. Pending further clarification of the GVO, MBMW, and the growth rate of the electronics industry during the Seven-Year Plan, the figure of 7.9 billion rubles is the "best" estimate available for the gross output of electronics in 1965.

Net Value of Output of Electronics, 1966-70

45. For the analysis of the electronics industry, the gross value of output is useful only as a starting point. Of greater interest is the net value of output.* This paper presents a revised (tentative) estimate of the net value of output of the Soviet electronics industry. The revised figures are significantly lower than those presented at previous Conferences, a result that invites a word of explanation.

46. As of 1 January 1967, wholesale prices of goods in the electronics industry were substantially reduced across-the-board. Prices in the "radiotechnical" industry were reduced by 25% and in the "electronics" industry by 30%.** Further

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Plan (1959-65)", Moscow, Istoriya SSSR, *No. 5, September-October 1970, pp. 3-25. He gives the original goal for MBMW (49 billion rubles), the original planned index of growth (1958 = 100; 1965 = 218.9), and the actual index of growth (1958 = 100; 1965 = 237). The gross values of MBMW production given in this report are somewhat higher than the net values shown in other reports prepared by the Office of Economic Research.*

* *Net of double counting of components. Net figures are derived by subtracting the estimated value of output of the component sector from the gross value of output of electronics.*

** *These references are assumed to apply to the Ministry of the Radio Industry and the Ministry of the Electronics Industry, respectively.*

reductions were planned, but have not been confirmed, for 1970. It is believed that these price changes were needed to correct for a systematic upward bias in the valuation of electronics products. Over time, the bias has increasingly distorted the relationship of the 1955 wholesale selling prices to the actual costs of production. Hence, the output of the industry in gross value terms has been inflated. The methodology used for recomputing the value of output of electronics in the USSR involved adjusting 1955 prices to account for changes in the wholesale price by prorating the price reductions for components (electronics) and end-equipment (radiotechnical) over the 12-year span 1956-67.

47. The net value of output of electronics in the USSR in 1970 is estimated to fall in the range of 9.2 to 13.1 billion rubles (see Figure 1). Within this range, the best estimate of total output in 1970 is 9.9 billion rubles, an increase of nearly 90% over the level of 1965, estimated at 5.2 billion rubles. An overwhelming proportion of the goods produced -- about four-fifths annually -- goes directly to the government for military and industrial use. Only about one-fifth represents the production of end-items for the Soviet consumer. Ruble values for the years 1965-70 are shown in Table 2.

48. The relative sizes of the US and the Soviet electronics industries in 1965 and 1970, based on a dollar comparison, may be seen in Table 3 and Figure 2. In comparing these industries, two important factors should be borne in mind: (a) the size of the Soviet industry, in dollars, is highly sensitive to the ruble-dollar ratios used to convert Soviet rubles to dollars. In this paper, two ratios have been used: one to convert the ruble value of consumer electronics (US $1 = 0.9 ruble), and one to convert the ruble value of military/industrial output (US $1 = 0.7 ruble); and (b) capacity output in the USSR is being compared with actual output in the United States. Since 1967, actual output in the United States has been depressed below potential capacity levels by the general recession in economic activity.

49. Some interesting conclusions result from a comparison of the US and Soviet electronics

industries in US dollars. First, the Soviet electronics industry in 1970 is about two-thirds as large as the US electronics industry. The output of consumer electronics is about three-fifths that of the United States and the output of electronics for military and industrial end-use is only slightly more than two-thirds that of the United States. This last comparison should be qualified. In the United States in 1970, about 40% of the output for military/industrial end-use represents goods for industry and commerce. In the USSR, on the other hand, the corresponding percentage is believed to be very small, probably less than 10%. Thus it is more meaningful to compare the output of Soviet military/industrial products with the output of purely military products in the United States. This comparison is also shown in Table 3. It may be inferred from that comparison that the output of military electronics (including expenditures on military, space, and R&D in the USSR in 1970) is approximately as large as that of the United States. Looking forward, it is suggested that, in the course of the next few years, the output of military electronics in the USSR will catch, and surpass, in value terms, the output of military electronics in the United States. No linear projection of these sectors is practicable, because, both in the United States and the USSR, future levels of expenditures on military electronics will depend on the outcome of the SALT talks, and, in the United States, on decisions made with respect to the deployment of the US anti-ballistic missile system.

50. It is believed that these conclusions are valid despite the ambiguities in the data base and the sensitivity of the dollar values of Soviet output to the conversion factor used. This is so because: (a) a minimum figure has been used for the gross value of output of electronics in the USSR in 1965, the starting point of the analysis (virtually any other alternative value would yield higher ruble and dollar figures for the USSR for the entire time series); and (b) although the United States has made remarkable and impressive gains in productivity in recent years, especially in the manufacture of components, Soviet gains in efficiency since 1955, relative to those of the United

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Figure 1

USSR: Estimated Output of Electronics

(Billion rubles)

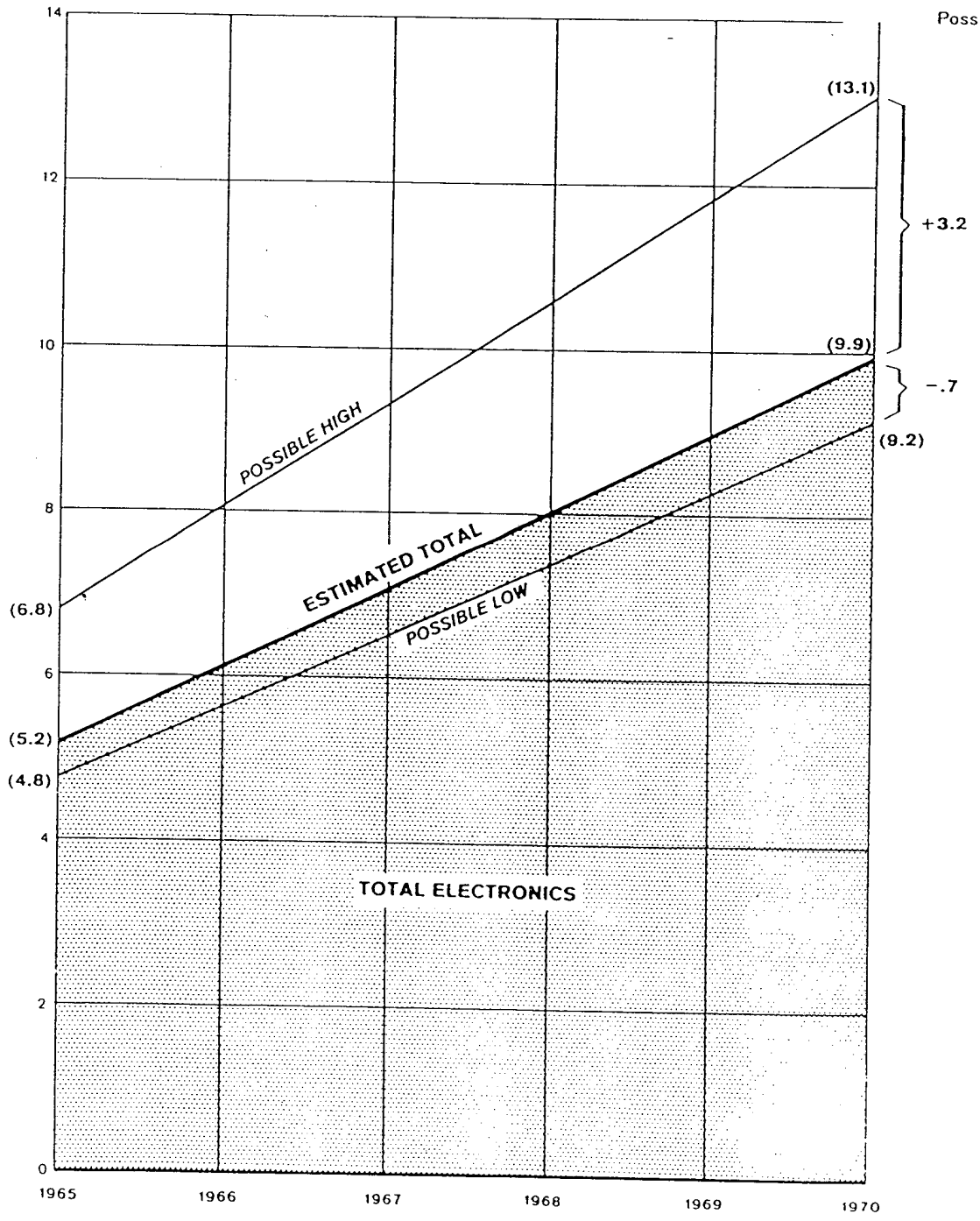

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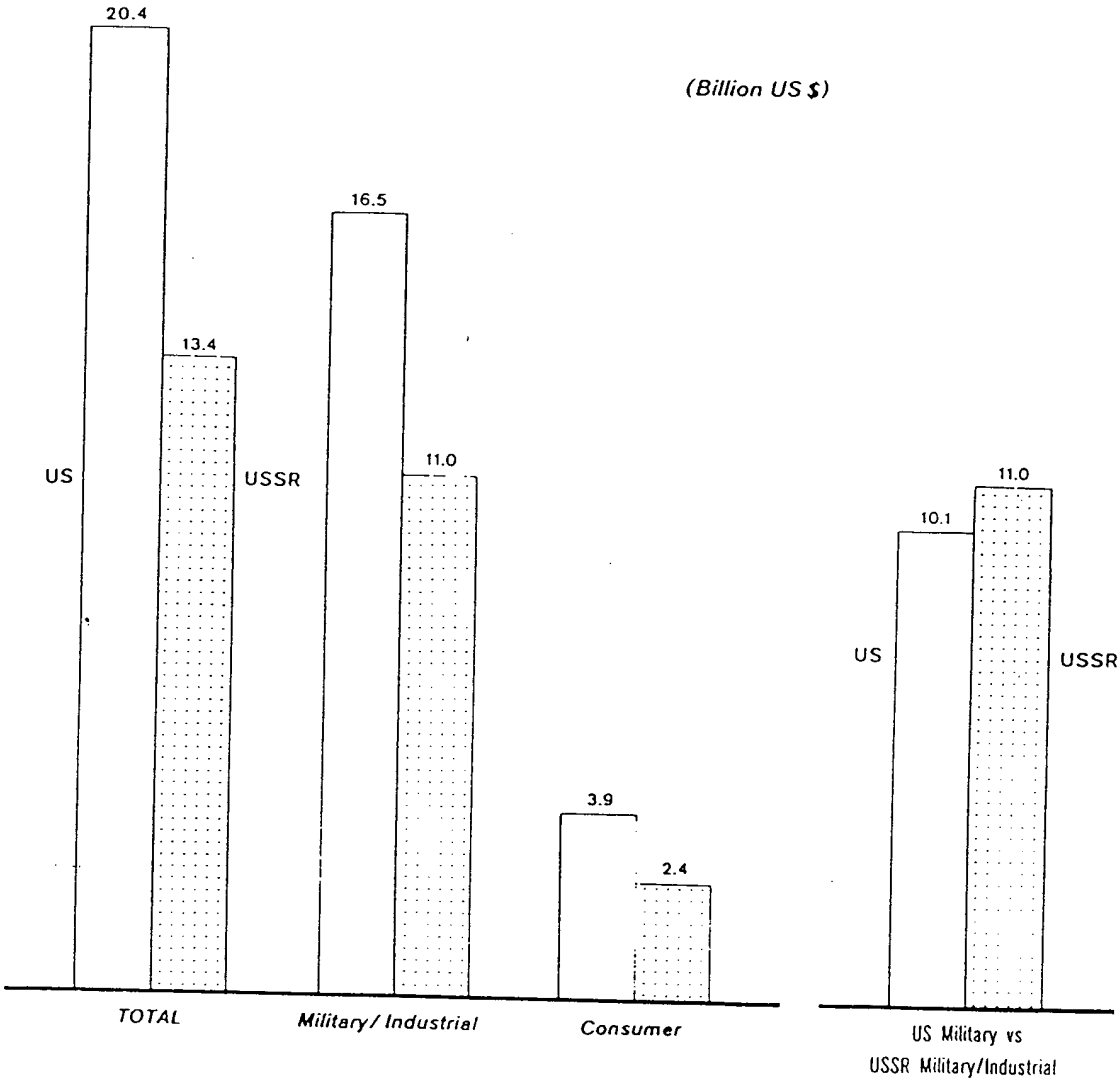
Figure 2

US and USSR: Comparison of Electronics Output, by Sector 1970



States, may have been even greater because of the gross inefficiency (resulting from inferior capital equipment and redundant labor) of the USSR in the 1955 base year. Hence, it can be argued that the conversion coefficient should be somewhat less than what has been postulated. A lesser coefficient would also yield higher dollar valuations of the Soviet output.

Table 1

US and USSR: Production of Semiconductors

	Million Units		
	US Factory Sales	USSR Estimated	USSR as a Percent of US
Semiconductors			
1960	313.3	55.0	18
1965	1,520.4	350.0	23
1969	3,120.5	850.0	27
Integrated circuits			
1960	--	--	--
1965	9.5 a/	--	--
1969	252.9 a/	Negl.	--

a. Understates production. Substantial quantities of ICs manufactured by US end-equipment manufacturers (e.g., IBM) for their own use are not reflected in these statistics.

Table 2

USSR: Estimated Value of Output of Electronics, by Major Sectors

	1965	1966	1967	1968	1969	1970
	Billion Rubles					
Consumer	1.0	1.2	1.3	1.6	1.9	2.1
Military/industrial	4.2	4.6	5.2	5.9	6.7	7.7
Total a/	*5.2*	*5.8*	*6.5*	*7.5*	*8.6*	*9.9*
Military/industrial as a percent of total b/	82	80	80	79	78	78
	Billion US $					
Consumer	1.1	1.3	1.5	1.8	2.1	2.4
Military/industrial	6.0	6.6	7.4	8.4	9.5	11.0
Total a/	*7.1*	*7.9*	*8.9*	*10.2*	*11.7*	*13.4*

a. Because of rounding, components may not add to the totals shown.
b. Percentages are based on unrounded data.

Table 3

US and USSR: Comparison of Output a/

Billion US $ in Constant 1955 Prices b/

	1965	1966	1967	1968	1969	1970
Total electronics						
US	16.5	18.0	19.0	19.6	20.0	20.4
USSR	7.1	7.9	8.9	10.2	11.7	13.4
USSR as a percent of US	43	44	47	52	59	66
Military/industrial						
US	12.9	14.1	15.3	15.8	16.2	16.5
USSR	6.0	6.6	7.4	8.4	9.5	11.0
USSR as a percent of US	47	47	48	53	59	67
Consumer						
US	3.6	3.9	3.7	3.8	3.8	3.9
USSR	1.1	1.3	1.5	1.8	2.1	2.4
USSR as a percent of US	31	33	41	47	55	62
US military	8.1	9.0	9.9	10.3	10.0	10.1
USSR military/ industrial	6.0	6.6	7.4	8.4	9.5	11.0
USSR as a percent of US	74	73	75	82	95	109

a. Because of rounding, components may not add to the totals shown.
b. Deflated.