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Transfer of Technology from the United States to the USSR: Problems and Prospects

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Transfer of Technology from the United States to the USSR: Problems and Prospects

Soviet leaders recognize that rapid economic growth can be achieved once again only by accelerating technological progress. Because the Soviet applied R&D sector has been relatively inefficient in developing and applying new technology, the USSR has turned increasingly to imported technology as a means of accelerating technological progress and economic growth.

The major channel for acquiring technology from abroad is the purchase of machinery and equipment. Other channels have included the acquisition of technical data, contacts with Western firms and scientists, and formal arrangements for joint research and exchange of scientific and technical information. None of these channels has lived up to Soviet expectations. Western equipment frequently is not as productive in a Soviet setting as it is on native ground. Attempts to exploit foreign technical data or copy foreign machinery have had mixed success. In some military fields, the results of reverse engineering have been good; in civilian sectors, the outcome has been less happy.

The onset of detente has dismantled some of the traditional obstacles to Soviet acquisition of US technology. Medium-term and long-term credits were extended by the United States after May 1972, resulting in a large increase in Soviet imports of US equipment and technology. The relaxation of US export controls since detente contributed to the rise in imports, although controls continue to limit access to very specialized and sophisticated foreign technology. Nevertheless, bureaucratic problems unique to the USSR still present problems to US businessmen.

Despite the improvement in the opportunities for acquiring foreign technology, the USSR continues to have trouble in assimilating it. The Soviet labor force is unfamiliar with complex foreign machinery, spare parts for foreign equipment are often in short supply, and Soviet maintenance programs frequently are inadequate. These problems have caused the USSR to turn increasingly to the purchase of turnkey factories, relying on foreign firms to design the plant, supervise construction, and install the equipment.

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Because machinery imports – and especially turnkey plants – are expensive, the Soviet leadership is trying to hold down the cost of acquiring foreign technology through this channel. The most prominent innovation in Soviet policy is the push for cooperative economic ventures that provide for the export to the USSR of equipment and technology on long-term credits. The credits are repaid by deliveries of goods produced by the venture. As an alternative means of acquiring technology, the USSR is also strongly pressing for increased cooperative research with the United States in scientific and technological areas. More than a dozen agreements with US firms have been concluded. Most promise to give the USSR tangible technological gains, while the US companies hope to enhance their sales prospects in the USSR. The USSR also expects to benefit from research in Eastern Europe as well as from Western technology sold to these countries. In its drive to spur productivity growth in the civilian economy, however, there is little evidence that the USSR plans to release high-quality resources from military R&D.

The overall prospects are dim that technology transfer from the United States to the USSR will have a substantial influence on Soviet economic development. The growing expense of debt service will limit machinery imports to perhaps $4 billion to $5 billion per year. Although transfers of technology in the form of imported machinery and the acquisition of technical data from the West will continue, they will be insufficient and too slowly assimilated to have a substantial impact on Soviet economic and technical development. Ultimately, the USSR must depend on its own applied R&D sector to close the technological gap with the West and to boost economic growth. In certain areas, however, the acquisition of key Western technology could make some Soviet products – such as commercial aircraft and pharmaceuticals – competitive in Western markets.

DISCUSSION

Introduction

1. Moscow's interest in Western, and especially US, technology has flourished in the past five years or so. In pursuing trade deals, cooperation agreements, and bilateral technological contacts, the USSR has been more aggressive than at any time since the 1920s. This activity has raised questions about the extent of the resulting technology transfer and its impact on Soviet economic capabilities and performance. This report first sketches the background of the Soviet preoccupation with Western technology, with particular focus on US-Soviet ties. It then discusses the channels through which technology flows from West to East and the degree of success that the USSR has had in assimilating technology from abroad. Recent Soviet efforts to increase the volume and improve the effectiveness of technological transfer are described, and general judgments are made as to the effect of current Soviet policies with respect to acquiring Western technology on the development of the economy.

2. Inasmuch as the technology offensive is still gathering steam, the conclusions of this report should be considered preliminary. In many areas – and particularly in the analysis of the technology transfer implied by the increasing number of direct contacts between Soviet organizations and US firms – a good deal of spade work remains to be done. Much more work also is needed on the transfer of particular types of technology and its impact on individual industries. In addition, the world energy bind and changing US attitudes toward the granting of long-term credits to the USSR are likely to have a substantial impact on Soviet programs to attract Western technology.

Background of the Soviet Interest in US Technology

3. Since 1960, Soviet economic growth has slowed appreciably despite large continuing increases in the labor force and investment. For a number of reasons, the average annual rate of increase in the productivity of labor and capital inputs fell off abruptly in the 1960s, and productivity actually declined in 1971-72, as shown in the following tabulation:

	Percent		
	1951-60	1961-70	1971-72
GNP	6½	5½	3
Output per unit of labor and capital	3	1½	-1

Looking into the future, Soviet leaders recognized that the rate of economic growth would not trend upward again unless productivity could be accelerated. Because of lower birth rates, the labor force would eventually increase at a slower rate while the growth of plant and equipment is becoming harder to sustain in the face of competing demands for consumer goods.

4. In part, the disappointing performance of productivity since 1960 has been caused by a failure to introduce improvements in technology at the rate that was possible during the period of reconstruction after World War II. The lower rate of Soviet technological advance, moreover, has preserved the substantial technological gap that separates Western from Soviet practice in almost every economic sector.

5. This disparity in technology is of great concern to the leadership, particularly since the resources devoted to promoting technological progress are enormous. The USSR has more engineers employed in RDT&E* than the United States and almost as many scientists. Expenditures on R&D are now almost four times the 1960 level, whereas the number of scientific workers with advanced degrees increased from 109,000 in 1960 to 298,000 in 1972. A major problem is that the R&D sector has been characterized by great unevenness. Basic research, particularly theoretical work, is considered strong, while applied R&D has been weak except in priority military sectors (including military applications of the space program), which attract the best scientific and material assets. In large part, the weakness of applied R&D in the civilian economy stems from its incompatibility with rigidly centralized direction and management. In addition, the indifferent quality of many Soviet engineers and applied scientists has hampered the civilian R&D effort. The training of Soviet engineers and applied scientists is rather narrow, and many of the engineers are best described as technicians by Western standards.

6. In the 1960s the Soviet leaders first concentrated on domestic reform as the solution for sagging economic performance. The 1965 reform of economic administration and numerous decrees designed to reform applied R&D were intended to spur productivity growth. Reform has not produced the desired results, however, and the USSR has turned increasingly to imported technology as a means of accelerating technical progress and economic growth. The recent US-Soviet detente has encouraged this trend. A relaxation of US export controls and the offer of US credits have redirected Soviet acquisitions of equipment and technology toward the United States, although West Germany and Japan are still the largest non-Communist suppliers of machinery and equipment to the USSR.

* Research, development, testing, and evaluation – the span of the innovation process from basic research to introduction into series production. This entire process is referred to as R&D in this report.

7. The revival of Soviet interest in US products and technology is partly political, but is also in line with the traditional policy of acquiring the most advanced technology available. US companies are the preferred sources of automotive equipment, oilfield equipment, both computer hardware and software, and civilian aircraft technology. The Soviets are also seeking equipment and know-how from the United States in numerous other specialized areas such as cryogenics, air traffic control, and advanced metallurgical processing. If contracts cannot be reached with US companies, the Soviets recognize that other countries often can provide technology that is as good or almost as good. The USSR has had success, for example, in buying computer hardware and some kinds of automotive equipment and machine tools from Western Europe and Japan. In other areas, such as oilfield equipment for Arctic exploration, the United States is the only technology source in the eyes of the Soviets.

Soviet Acquisition of Foreign Technology

Overview

8. The USSR has acquired foreign technology mainly by purchasing machinery and equipment. Imports of machinery and equipment from the developed West have climbed especially rapidly since Brezhnev came to power. In 1972 they reached a record $1.4 billion, about $800 million higher than the level in the mid-1960s. Other channels of transfer have included the acquisition of technical data (by purchase or theft), attendance at international meetings, visits to Western firms, and formal agreements for collaborative research and the exchange of scientific and technical information.

9. In part, the USSR has been forced to buy machinery abroad simply because investment priorities were changing too rapidly for the capabilities of domestic industry. In the early 1960s, for example, Khrushchev's chemical campaign required a sudden surge in imports of chemical plant and equipment from the West. These gave way in the middle and late 1960s to imports of automotive manufacturing equipment for the giant FIAT plant and for the modernization of existing motor vehicle plants. In the past few years there have been massive imports of machinery and equipment (including large-diameter pipe) for transmitting natural gas. Last year's purchases were concentrated in the automotive, chemical, and wood processing industries. Currently, a large part of the imported machinery will be used to satisfy the requirements of the Kama truck complex.

10. Soviet engineers have had mixed success in exploiting foreign technical data or in practicing reverse engineering on examples of Western machinery. In the military area, their performance has been sometimes startling – as in the quick duplication and production of Western air defense

missiles. In other areas, Soviet applied R&D has been so slow in working with Western blueprints or models that the products are obsolete by the time they enter series production. The Soviet effort to copy US space suit technology, for example, resulted in a product 7-8 years behind the current US level of sophistication. Copies of US biological materials (vaccines and antibiotics) are not up to US standards of efficacy and purity. In what has been a classic example of reverse engineering, the Soviet attempt to make the RYAD family of computers compatible with IBM machines is far behind schedule.

11. To bypass some of these problems of exploiting foreign technology, the USSR has recently placed greater emphasis on buying turnkey plants and arranging cooperative ventures with Western firms. Although expensive, turnkey plants avoid many of the problems that plague Soviet applied R&D. Soviet-style cooperative ventures permit the USSR to acquire technology on credit and to repay the Western partner with the products (raw materials or manufactured goods) of the venture. These arrangements ensure Western participation in the development and provide for repayment in full by the end of a stated term. Hence, the projects are designed to be self-liquidating.

Obstacles to Acquisition of Foreign Technology

12. Some of the barriers that have impeded the flow of US equipment and technology to the USSR in the past have diminished with the onset of detente. Other obstacles remain. The current status of the various barriers to technology transfer is discussed below.

- Prior to the extension of medium-term and long-term credits to the USSR by the developed West, hard currency shortages were the major constraint on acquisition of Western machinery and equipment. With the increased availability of medium-term and long-term credit, this constraint has been eased somewhat. Between 1968 and 1971, the USSR drew $2.5 billion in medium-term and long-term credit from Western Europe and Japan. Credit from the United States was extended only after the May 1972 summit, and in 1972-73 US credits are expected to account for about half of the $2.5 billion total for the two years.

- US attitudes toward trading with the USSR have long obstructed transfers of US technology to the USSR. Many US firms have opposed trading with the USSR, and US public opinion has influenced other firms to refuse to deal with the USSR. Since the mid-1960s these attitudes have shifted a great deal in favor of increased contacts with the Soviet Union.

- Bureaucratic problems unique to the conduct of trade with the Soviet Union present special problems for US businessmen. Long, expensive pilgrimages to Moscow without assurance of seeing the right people are often followed by long, difficult, and expensive negotiations with the Soviets that do not bear fruit. The US businessman is frustrated by the great difficulty in contacting the ultimate user of his product; he must work with foreign trade organizations instead, adding to the usual delays encountered in conducting business in the USSR.

- Western firms frequently are reluctant to part with their technology, preferring the sale of their finished products to a transfer that might generate future competition for the firms in world markets.

- Export controls continue to limit Soviet access to very specialized and sophisticated foreign technology. The range of controls has been reduced substantially in recent years, however, as East-West tensions have eased and as Western exporters have pressed for expanded sales to Communist countries. The United States is now supplying the Kama River truck complex with manufacturing equipment and technology that was embargoed two years ago. Computers, integrated circuits, telecommunications, avionics, and other sophisticated electronics technology continue to be controlled, although controls have been relaxed even in these fields. Third-generation computers of rather sophisticated design can now be exported where they could not be a year ago. Nevertheless, the controls on other high-technology items such as advanced disc units and disc pack technology still hinder Soviet computer development.

Problems in Assimilating Foreign Technology

13. Foreign technology has been of less help to the Soviet Union than expected in a great many instances, particularly when machinery is bought piecemeal. Frequently, the purchased machinery fails to mesh well with existing Soviet equipment, with other foreign equipment, or with Soviet inputs within a production process. In part, this interface problem is a natural one. The Soviet applied R&D sector, however, takes an inordinate length of time to solve problems of compatibility in the civilian economy. In the case of the Kama truck factory, where most of the equipment is being supplied by numerous foreign firms, Western engineers estimate that several years will be required to interface all of the equipment

into an integrated operation. By the time trucks roll off the assembly line, they will be obsolete by Western standards.

14. The USSR's difficulties stem partly from a tendency to import equipment that is too advanced for rapid assimilation, given existing levels of domestic technological development. This overreaching is especially evident in the computer field but extends into other sectors such as production of color television sets. In 1968 the USSR purchased from a US firm a complete package of very advanced automated machinery and technology for the fabrication of shadow masks for color television tubes, capable of supporting an output of one million color television sets annually. By the end of 1971, despite a year's training in the United States for four Soviet technicians, the equipment still was not operational, and, in fact, had suffered severe damage through improper operating procedures and poor maintenance. Thus the Soviets were forced to procure, at a cost greater than the original purchase price, additional technical assistance and parts to restore the line to its original condition. This line, now operating at only a fraction of its rated capacity, is a major bottleneck in Soviet production of color television sets which, in 1972, reached a level of only 200,000 a year.

15. As a result of Soviet reticence to supply foreign companies with information on how the imported machinery is to be used, purchased Western machinery is sometimes less productive than it otherwise would be. The Kama plant is an example; the buildings at the truck plant are standing, and foreign equipment will have to fit into space allotments that have already been designated. Yet foreign suppliers have been hindered in obtaining useful drawings of the factory and in obtaining permission to visit the site. Where security is considered critical, the USSR would rather forgo a purchase than release details necessary to make an interface possible. For this reason, purchases of aircraft navigation equipment, radar equipment, and the like have been deferred in the past.

16. Assimilation of foreign technology also depends on the quality of the labor force. Soviet workers must first master the unfamiliar and complex foreign machinery, so many foreign-built plants do not reach rated capacity until after lengthy delays. For example, the huge FIAT-equipped passenger car facility in Tol'yatti became fully operational about 2 years behind schedule. A major factor retarding assimilation of the technology was the quality of the Soviet labor force. Soviet workers frequently shut down an entire line to make minor adjustments to a single piece of machinery. Despite intensive training in Italy, technicians commonly reassembled machines improperly after repairs, and workers were casual in their approach to the maintenance of precision machinery. Supervisory personnel at the working level, reluctant to make even minor decisions,

bucked upstairs virtually all problem-solving decisions. In addition, the installation of the FIAT plant was also hampered by language barriers and frequent conflicts between Soviet workers and foreign supervisors.

17. To keep foreign plants and equipment operating, the USSR needs a steady supply of spare parts and solid maintenance programs. Shortcomings in these areas have often put foreign equipment out of commission. Foreign-made spare parts seem to be purchased only for high-priority industries such as the chemical industry. Industries with lower priority apparently get no foreign exchange to buy spare parts. Because of the shortage of foreign spare parts, low-priority industries may favor less modern domestic machinery or East European machinery even if hard currency is available for the purchase of original equipment from the West.

18. Because of its problems in digesting imported technology piecemeal, the USSR, as indicated earlier, has turned increasingly to the purchase of turnkey factories. Foreign firms design the factory, supervise construction, and are responsible for the selection and installation of equipment; Soviet workers assume control once the plant is operating. The USSR has purchased numerous chemical plants on a turnkey basis, but the most famous turnkey plant in the USSR is the FIAT plant discussed above.

19. Turnkey plants have not proved to be the final answer to the USSR's difficulties with foreign technology, because they are too expensive to buy on a massive scale and because they do not resolve all of the interface problems. As in the case of the FIAT plant, the Western plants often require labor skills in construction and operation that exceed the skills available on site in the Soviet Union. In addition, as the Soviets found in taking over Western-built chemical plants, the processes sometimes demand raw and semi-finished materials of a quality that the domestic economy is not prepared to supply.

20. It should be noted, too, that the Soviets' relative lack of experience in managing large complexes of very modern technology may cause problems. Soviet managers have been trained to concentrate on meeting narrowly defined production goals in an organizational environment that does not promote the coordination of many complex parts. Western corporate management has invested heavily in specifically training middle-level managers in problems of complex organization before advancing them to higher levels. The Soviets have displayed much interest in importing these Western management techniques.

New Directions in Soviet Policy Toward Technology Transfer

21. Moscow, in promoting the acquisition of foreign technology, has had to contend with the USSR's hard currency problem. The increased

availability of long-term credits on favorable terms and a resumption of gold sales in 1972 enabled the USSR to postpone the consequences of its inability to sell enough to the West. Nevertheless, Soviet indebtedness to the West has increased sharply; by the end of 1973 it will amount to $3.5 billion, and 27% of the USSR's hard currency exports will be needed just for debt service. The leadership is trying to hold down the cost of acquiring technology from abroad by exercising a number of the options available to it. The cooperative ventures discussed earlier and bilateral agreements to cooperate in research are the most prominent innovations in Soviet policy. The USSR is also attempting to involve Eastern Europe more directly in Soviet technology interests. Thus far, however, there is no indication that the USSR will transfer high-quality resources presently allocated to military R&D to work on assimilation of technology in civilian industry.

Search for Economic Cooperation

22. Economic cooperation agreements promise a partial solution to the USSR's growing balance-of-payments problem. Cooperative ventures provide for the export to the USSR of equipment and technology on long-term credits. The credits are to be repaid by deliveries of goods produced by the venture, easing the Soviet hard currency problem. Indeed, these projects often involve Soviet deliveries in excess of repayments and thus create new markets for Soviet exports. The gas-for-pipe deals with West Germany, France, Italy, and Austria are prime examples of this kind of arrangement. More recently, Occidental Petroleum and El Paso Natural Gas signed a letter of intent with the USSR to help develop the Yakutsk natural gas fields in Eastern Siberia and to supply transmission equipment and facilities in exchange for a share of the gas over a given period of years.

Bilateral Scientific and Technological Cooperation

23. The trade and joint venture aspects of the transfer of technology between the United States and the USSR basically favor the USSR and are of a conventional commercial nature. Since the US-USSR summit meeting of May 1972, the Soviet Union has also strongly supported increased cooperative research with the United States in scientific and technological areas. The Soviets portray such cooperation as a means of achieving a genuine exchange of technology and enhancing the returns to the vast resources devoted to R&D in the two countries.

24. Under the US-USSR Agreement on Cooperation in the Fields of Science and Technology signed on 24 May 1972, the Soviets have participated actively in planning joint research programs with US scientists in a variety of fields, including medicine and biology, space, pollution,

chemical catalysis, energy research, microbiological synthesis, and scientific and technical information processing. They have also markedly increased the number of direct contacts with US industrial firms, which are permitted under Article 4 of the Agreement, and in more than a dozen instances have signed agreements or protocols with specific organizations.

25. In contrast with earlier cooperative agreements in science and technology, which emphasized basic scientific research, the more recent Soviet interests are directed more toward areas of technology where additional work could lead fairly quickly to improved products and stepped up productivity for the USSR. For example, joint US-USSR research on catalytic reactor modeling and joint work on the design and operation of thermal and hydroelectric power stations are likely to benefit the USSR within a shorter period than the more scholarly work in pure mathematics or theoretical physics carried out under prior agreements. With some exceptions, the Soviets have had a longstanding interest in these newer areas, but their progress has been slow. Interestingly, in most of the areas – including magnetohydrodynamics (MHD), scientific and technological information processing, and metrology and standardization – at least one proposed project involves the use of computers, which is in consonance with other indications of intense Soviet interest in Western computer technology and applications.

26. Judging by the vigor of these efforts, it is clear that they have been strongly endorsed by the top leadership of the USSR. The Soviet scientists identified to pursue the collaborative research are among the USSR's best, and they seem to have received somewhat more freedom than in the past to plan and carry out viable cooperative programs.

27. Despite the Soviet desire for successful scientific and technological cooperation with the United States, the agreements have encountered delays. In some cases, the Soviets are not yet ready to receive, fund, and otherwise take care of the US researchers who would be working in the USSR. Hard currency problems continually reappear with respect to Soviets traveling abroad, and communications between US scientists and their Soviet counterparts, particularly by letter, are very slow. Vestiges of the USSR's long history of secrecy and bureaucracy in science and technology are still visible, but some loosening appears to be taking place.

28. To date, the USSR's recent overtures to US industry under Article 4 of the Agreement have been decidedly one-sided, in that US companies in the end have given information to Soviet agencies not in return for other information but rather in the hope of getting a foothold in Soviet markets. With very few exceptions, the Soviets have refrained from revealing any technology of their own for possible licensing or trade with the US firms. However, there is some feeling on the part of the US firms that

there probably is not much Soviet technology that would interest them. So far in these contacts, the Soviets have exhibited a preference for high technology and for dealing with large firms – conglomerates and multi-nationals. It appears that the USSR's principal objective is to explore and exploit at minimum cost modern US technology under the guise of cooperation, just as they have done with the French under the Soviet-French cooperation agreement.

Sharing the Burden with Eastern Europe

29. Eastern Europe's laboratories and industry have been an important source of technology for the USSR in the past. Through CEMA, the Soviets are trying to arrange a more systematic allocation of research responsibilities. The RYAD computer program is a notable example. In the late 1960s, Bulgaria, Czechoslovakia, East Germany, Hungary, and Poland reluctantly agreed to cooperate with the USSR in the joint development and production of RYAD computers. These countries already had their own computer projects as well as licenses to produce Western-style computers that were not compatible with RYAD. Eastern Europe was first given responsibility for developing software and peripheral equipment. Later, its role was expanded to include central processing units as well. In the nuclear field, the USSR and Eastern Europe have cooperated for a number of years in the production and distribution of radioisotopes for medical research and industry. The program was expanded in 1970 to include reactor engineering.

30. Meanwhile, the USSR expects to benefit from growing East European acquisition of Western technology, especially in the field of electronics. There are enough reported cases of such transfers to suggest that the Soviet Union normally gets the benefit of East European purchases of Western equipment, sometimes including the equipment itself. A good deal of state-of-the-art as well as obsolescent technology has been transferred within the CEMA area in connection with the large and rapidly growing trade in machinery, the sale of licenses, and the recent spurt in joint Soviet-East European investment projects.

Release of Military R&D Resources

31. Although the resources presently preempted by Soviet military and space R&D programs would be of great use in the development of civilian technology or in assimilating Western technology, there is very little evidence that the USSR is moving in this direction. In fact, the current pace of development of Soviet military weapons systems is such that, barring abrupt cancellations of major programs, all major military R&D resources – including those concerned with ballistic missiles, major surface ships, manned bomber aircraft, space systems, and nuclear and conventional

warfare weapons – should be employed almost exclusively in military work at least through 1975. After that time, the effects of international SALT negotiations may lead to some realignment in the allocation of R&D resources between military and civilian uses.

Outlook

32. The Soviet campaign to acquire foreign technology has been and will be successful in a limited sense. The growing imports of machinery and equipment together with more cooperative ventures and bilateral agreements will transfer a substantial amount of Western technology to the USSR – whether in the form of informal (and sometimes inadvertent) disclosure of know-how, exchanges of technical data, or finished products. Nevertheless, these transfers are unlikely to close the technological gap with the West or to speed Soviet economic growth appreciably. On balance, the Soviet leadership probably will be disappointed in what is accomplished through importing machinery from the West, and the prospects for rapidly and effectively exploiting the other channels of technology transfer appear not much better.

- The direct effect of machinery imports will not be large, because their volume will be small relative to total domestic investment in the USSR. In 1972, total imports of machinery and equipment from the developed West were $1.4 billion. In view of the cost of debt service and the Soviet Union's hard currency constraint, it is reasonable to assume that machinery imports will not exceed $4 billion to $5 billion per year by 1982. If imports grow evenly to $4 billion to $5 billion over the next 10 years and are all directed into industry, the growth of industrial investment will increase by less than one half percent per year.

- Although the imported technology should be more productive than the technology available domestically, it clearly cannot have a large impact unless it can be duplicated and adapted on a wide scale. There is no indication that the Soviet record with respect to assimilating foreign technology will improve markedly in the short or medium term.

33. The cooperative ventures now being considered have an importance beyond the quantity of technology transferred, however. Without Western (and particularly US) help, the Soviet Union could not develop its raw material resources as quickly as it hopes to. In part, the USSR simply lacks critical elements of the technology needed to exploit

its raw materials. The United States can supply, for example, the drilling and production technology necessary for rapid exploitation of oil and gas deposits in the permafrost regions of Siberia or off Soviet shores. Although the USSR will sell part of this oil and gas to finance its machinery imports, there is some evidence that the projects designated for joint Soviet-Western development will be needed to avert a Soviet energy shortage by the 1980s.

34. While technology transferred from the West is not likely to improve the USSR's overall economic performance much, this technology could be instrumental in making some Soviet products competitive in important Western markets.

- With a well-developed technology in U-235 enrichment, and low electric power costs in Siberia, some of the Soviet enrichment plants probably have a competitive advantage over Western plants. If the USSR develops or obtains additional gaseous diffusion technology, the Soviet advantage would tend to increase. In general, Soviet nuclear power reactor technology is on a par with that in the West, although Soviet designs suffer from a difference in safety philosophy. The Soviets will either have to adopt Western safety practices or convince the West of the validity of their approach before they will be able to sell any reactor plants in the West.

- Soviet commercial aircraft have been improving steadily in terms of world standards. At least two remaining technical hurdles must be overcome, however, before Soviet civilian aircraft can be considered truly competitive in the world market: they must have (1) internationally approved navigation systems and (2) performance in terms of engine life, maintenance, and economy comparable with Western aircraft. The USSR is well on its way to acquiring navigation systems by purchase of Western equipment and technology. Improving engine performance may take longer because the Soviet metallurgical industry generally has not been able to control quality adequately in the production of high-temperature materials. However, acquisition of this technology from the West may be prohibited because of its direct military application.

- The Soviet manufacture of certain common biological products and pharmaceuticals – aspirin, penicillin, streptomycin, and the like – could be improved, with minimal technical help, to the level that would allow international competition with similar Western items. This same observation applies to many packaged foods and drinks.

35. The bilateral scientific-technical agreements, if carried out on a sufficiently broad basis, could help the USSR where it needs help most – by providing a spark to the civilian R&D sector. Some joint projects – principally those involved in basic research – will result in a fairly equitable distribution of benefits between the United States and the USSR. Most other projects will benefit the USSR more than its partners. In all cases, the quality of Soviet R&D work should be enhanced by the close contacts required by the agreements. Still, delays in communication and both government and private reluctance to divulge information will be a continuing problem and in a few instances may well lead to the termination of projects.

36. In sum, the prospects are dim that technology transferred from the United States to the USSR will have a substantial influence on Soviet economic development because – for all of the reasons discussed above – the transfers will probably be too meager and too slow. The domestic R&D establishment itself must generate most of the productivity gains necessary to speed up economic growth and to narrow the technological gap separating the USSR from Western countries.