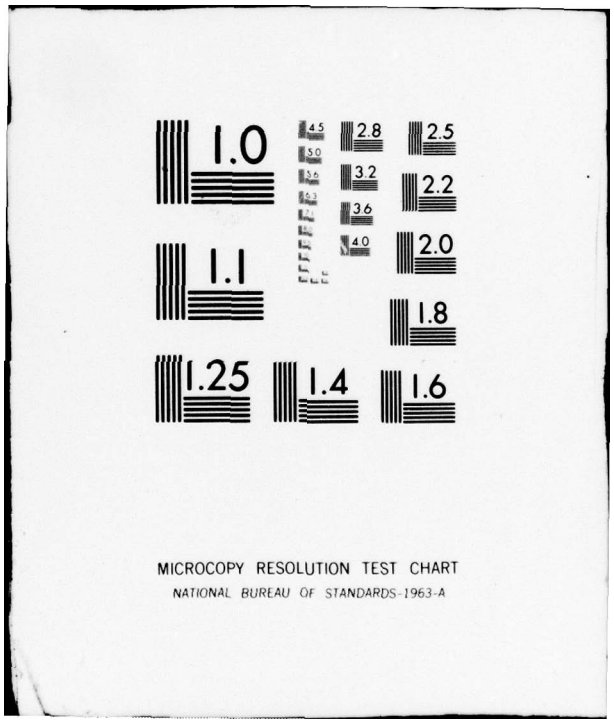
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TRANSFER OF U.S. TECHNOLOGY TO THE SOVIET UNION: IMPACT ON U.S. COMMERCIAL INTERESTS

By: HERBERT S. LEVINE
M. MARK EARLE, Jr.
CHARLES H. MOVIT
ANNE R. LIEBERMAN

Prepared for:

DEPARTMENT OF STATE

February 1976

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By: (10) HERBERT S. LEVINE
M. MARK EARLE, Jr.
CHARLES H. MOVIT
ANNE R. LIEBERMAN

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This study is one of a number done by academic and other research institutions for the Department of State as part of its external research program. These studies are designed to supplement the Department's own research capabilities and provide independent expert views to policy officers and analysts on key questions with important policy implications.

The idea for this study on Transfer of U.S. Technology to the Soviet Union was proposed jointly by Mr. Howard Wiedemann, the Special Assistant to the Director of the Bureau of Intelligence and Research (INR) and by that Bureau's Office of Economic Research and Analysis. The work statement for the project was developed in discussions with officers in several Department Bureaus. Overall monitoring of the project within the Department was under the direction of Warren H. Reynolds, Senior Program Officer in INR's Office of External Research, with the assistance of an interagency working group. The members of this group are listed on the following pages.

The External Research Program is planned and coordinated by the Department of State Research Council and managed by the Office of External Research. Comments on this study or queries about the program may be addressed to:

E. Raymond Platig, Director
Office of External Research
Bureau of Intelligence and
Research
Department of State
Washington, D. C. 20520

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LIST OF INTERAGENCY GROUP

DEPARTMENT OF STATE

Warren H. Reynolds, Chairman of the Working Group
Office of External Research
Bureau of Intelligence and Research

Margaret B. Dray
Office of Economic Research and Analysis
Bureau of Intelligence and Research

Martin J. Kohn
Office of Economic Research and Analysis
Bureau of Intelligence and Research

David B. Timmins
Formerly in Office of Economic Research and Analysis
Bureau of Intelligence and Research

Arthur C. Morrissey
Office of Strategic Affairs
Bureau of Intelligence and Research

Herbert Block, INR Consultant nominee
Bureau of Intelligence and Research

Joseph Mintzes, INR Consultant
Bureau of Intelligence and Research

Howard Wiedemann
Office of the Soviet Union and Eastern Europe
Bureau of Intelligence and Research

Leo S. Packer
Office of Technology Policy and Space Affairs
Bureau of Oceans and International Environmental and Scientific Affairs

Raymond J. Waldmann
Former Deputy Assistant Secretary for Transportation and Telecommunications
Bureau of Economic and Business Affairs

Robert B. Wright
Office of East-West Trade
Bureau of Economic and Business Affairs

Wreatham E. Gathright
Policy Planning Staff

James L. Colbert
Office of Soviet Union Affairs
Bureau of European Affairs

Milton Kovner
Office of Soviet Union Affairs
Formerly in the Bureau of European Affairs

OTHER AGENCIES

Tim Regan
Council on International Economic Policy

Richard Gray
Science and Technology Policy Office
National Science Foundation

Maureen R. Smith
Bureau of East-West Trade
Department of Commerce

John Shepard
Bureau of East-West Trade
Department of Commerce

William C. Holt
Executive Director for the Commerce Technical Advisory Board
Department of Commerce

George Lindamood
National Bureau of Standards
Department of Commerce

Robert C. Christensen
Office of Maritime Technology
Maritime Administration
Department of Commerce

Jan P. Herring
Central Intelligence Agency

Robert H. Fraser
Central Intelligence Agency

Norman C. Davis
Central Intelligence Agency

Gerry Sullivan
Defense Advanced Research Projects Agency

Henry A. Arnold
Office of Science and Technology
Agency for International Development

James R. Hoath
Office of Policy Development and Analysis
Agency for International Development

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ABSTRACT

This report contains an assessment of the impact on U.S. commercial interests of the transfer of advanced U.S. technology to the Soviet Union. Research in three areas provides the basis for the assessment. In the first, institutional factors and potential institutional change affecting the purpose and effectiveness of Soviet importation of technology and thus the ability of the USSR to compete in world markets are examined. Next, specific Soviet technology needs and requirements are identified as a means of determining current and prospective areas of the U.S.-USSR technology transfer. In the third area, the likelihood of market penetration by the Soviet Union in four specific product areas in the 1975-85 time period is discussed. Finally, the results of the three investigations are synthesized on an aggregate level and conclusions are drawn on the prospects for Soviet economic competition with the U.S. as a result of the acquisition of U.S. technology.

FOREWORD

Policy pertaining to the expansion of economic relations between the United States and the USSR has three major components: problems resulting from differences between a market-oriented economy (United States) and a nonmarket economy (USSR); national security concerns arising from ideological differences; and commercial aspects relating to the place of U.S.-USSR relations in the overall foreign economic strategy of the U.S. This study addresses only one aspect of these issues areas, the possibility that the Soviets may become more competitive in third country markets as a result of their acquisition of advanced U.S. technology.

The research was conducted under the leadership of Professor Herbert S. Levine, Professor of Economics at the University of Pennsylvania and Senior Research consultant to the SSC, and Mr. M. Mark Earle, Jr., Senior Economist and Assistant Director, with the assistance of Mr. Charles H. Movit and Ms. Anne R. Lieberman. During the conduct of the research, a series of input papers was generated. Among the contributors were Professor Edward A. Hewett of the University of Texas (Soviet policies on convertible currency receipts), Professor Melvyn B. Krauss of Stanford University (institutional aspects of expanded East-West economic relations), and Professor Francis W. Rushing of Georgia State University (Soviet technology needs and requirements). Major inputs to the product area case studies were provided by the industrial economists at SRI Menlo Park under the leadership of Mr. Daniel D. Shearer. Contributors to these studies were Mr. W. Frank Greenman, Mr. W. Dan Brockett, Mr. Malcolm C. Brown, and Mr. Thomas C. Gunn. Important material pertaining to the role of foreign trade in Soviet economic development was provided by Ms. Jenny Sternbach working as research assistant to Dr. Levine. The assistance of Mr. Neal O. Weigel and Mrs. Helen Lewis of the SSC also contributed to the success of the project. In addition, the SRI project team acknowledges the many contributions of the interagency working group, especially Warren H. Reynolds, the technical monitor.

Richard B. Foster, Director
Strategic Studies Center

Executive Summary

The objective of this study is twofold: (1) to identify and analyze the various factors which bear on the ability of the Soviet Union to compete with U.S. firms in world markets as a result of potential Soviet acquisition of advanced U.S. technology; and (2) to identify the areas in which this competition would most likely arise in the 1975–85 timeframe. The analysis was pursued along four lines of investigation:

- The need, ability, and commitment of the USSR to compete in world markets;
- Prospective areas of U.S.–USSR technology transfer;
- The likelihood of market penetration by the Soviet Union in four specific product areas; and finally,
- An overall assessment of the prospects for Soviet commercial competition with the United States in world markets, given Soviet acquisition of U.S. technology.

The findings in each of these topic areas are summarized below.

The first line of investigation proceeded from the assumption that the need, ability, and commitment of the USSR to compete in world markets will be largely determined by the past record and future prospects of Soviet economic growth, the future role of foreign trade in Soviet development strategy, Soviet ability to absorb foreign technology, and the impact of Soviet economic processes and foreign trade practices on trade competitiveness.

The analysis of the long-term prospects for the Soviet economy using the SRI-WEFA Soviet Econometric Model provided insights on economic pressures that will face Soviet decisionmakers in the 1975–85 period. The baseline model projection is based on a continuation of the past economic development strategy. It indicates a rising share of investment and a falling share of consumption in GNP, a shortage of able-bodied labor, and practically no growth in combined labor and capital productivity in the overall economy. This pattern of behavior would lead to serious difficulties in these areas by 1990--an extraordinarily low share of consumption in GNP of 39 percent with 52 percent of GNP accounted for by investment and a requirement for 108 percent of the able-bodied population as it is currently defined. While it is doubtful, therefore, that the Soviets could continue such a pattern of behavior to 1990, the implication is clear that the pressure to improve factor productivity will be strong.

The interaction of the pressure to improve economic performance and Soviet initiatives in foreign trade may be played out in either of two alternative scenarios which may be formulated depicting the future role of foreign trade in Soviet development strategy. The first scenario draws on the historical pattern of Russian and Soviet foreign trade--a pattern of periodic forays into the international economy, associated with an overall fitful pattern of economic development. The second scenario foresees a greater degree of interrelatedness based on the more general pattern found among developed industrial nations.

Under the second alternative, the USSR would not need to abandon its pursuit of nondependence on the capitalist economies. It would increase economic interrelatedness through intra-industrial specialization in such a manner as not to involve Western nations in the core of the Soviet economy; the USSR could operate at the margin to improve economic performance. Under either alternative, Soviet strategy vis-a-vis world markets will reflect the need to expand its hard currency exports. One possible element of expansion may involve increasing earnings from the present major hard currency export base--primary products--by increasing the level of fabrication of these exports. Another element might involve what has been designated in this study as the "dual external/internal option"--that is, expanding productive capacity for export in areas where there is high domestic demand. If this export program does not prove successful, the production capacity could then be used to satisfy domestic requirements. While this criterion is not particularly useful, when applied alone, to predict Soviet export strategy, it does argue against the reasoning that the USSR will not export in areas in which there is significant unsatisfied domestic demand. It must be recognized, however, that the Soviets view foreign trade as an instrument of national purpose, and Soviet foreign trade strategy, therefore, is not guided solely by considerations of economic benefit.

The ability of the Soviet Union to absorb foreign technology will impact strongly on Soviet trade competitiveness in areas requiring this technology. This ability is inhibited by a number of well known behavioral and institutional characteristics, including inappropriate incentive mechanisms, organizational difficulties in research and development efforts, bureaucratic resistance to change, lack of competition, and the closed nature of Soviet society which restricts the effectiveness of technology transfer through personnel. Other specific aspects of the Soviet industrial environment and foreign trade apparatus have also adversely affected trade competitiveness in the past, i.e., poor quality standards, insensitivity to users' needs, poorly developed after-sales support services, and highly bureaucratized foreign trade practices. Some new Soviet approaches to these problems, such as involving producing enterprises and ministries in foreign trade negotiations, may improve their ability to absorb and maintain technology and compete effectively in foreign markets.

The second research task included a survey of contracts and agreements between U.S. firms and Soviet organizations from 1970 through August 1974. This survey was designed as an indicator of commercial activity in various product areas and not a measure of technology licensing, which is only one form in which technology may be transferred. The results of the survey show that of the almost 200 contracts and agreements documented during the time period, the majority (135) came under the category of nonelectric machinery to be used in numerous sectors of industry. Within this major group, large numbers of agreements were signed for such industries as metalworking (36), construction, mining and materials handling (29), general industrial machinery (25), specialized industrial machinery other than metalworking (20) and office and accounting machines (13). The technologies involved in these agreements covered the automotive equipment, agricultural equipment, earthmoving equipment, oilfield equipment, foundry equipment, food-processing, textile and medical equipment areas. The second largest major group, transport equipment, accounted for only 18 agreements; fabricated metal products and electric machinery for 13 each; and measuring, analyzing and control instruments, photographic, medical and optical goods, watches and clocks-11 agreements.

A more limited survey of Soviet agreements with West European and Japanese firms compared the patterns with U.S.-USSR trade patterns. The two patterns were much the same except for the heavier concentration under chemical equipment and light industry--especially synthetic fibers, textile equipment and clothing--for West European and Japanese agreements with the USSR. This profile of potential activity, although neither a measure of trade flow nor a quantitative dollar measure of relative importance, served as an important input, along with a survey of Soviet and Western economic literature, to the analysis of Soviet technology needs and requirements.

The third task was the examination of the likelihood of Soviet market penetration in specific product areas. Since all areas of potential activity could not be covered due to practical constraints, the specific product areas to be studied were selected to provide insights into very different areas of product technology and wide variations in market characteristics. The specific areas selected for in-depth analysis of potential impact on U.S. market positions of the transfer of advanced technology to the USSR were: semiconductors, commercial aircraft, construction machinery and equipment, and synthetic fibers. The highlights of the net assessments of the impact in each area follow.

It was determined that, given the rapid technological change, high development costs, extreme fluctuations in sales, and rapidly declining prices characteristic of the world semiconductor market, it is improbable that the USSR will decide to compete in that market. It is even more improbable, should such a decision be made, that the Soviet Union could compete successfully in the world semiconductor market in light of the weakness of Soviet industry in technological innovation, responsiveness to users' needs, and manufacturing efficiency.

The probability of a Soviet commitment to penetrate the wide-body jet aircraft market is thought to be not very high. The stringent requirements of the commercial aircraft market, especially in the areas of maintenance, spare parts, and other after-sales support services, have been a particular deficiency in Soviet export efforts in aircraft and machinery. Competition with the United States in airline service cannot be ruled out, however, with improvements in passenger comfort.

Analysis of Soviet domestic needs for construction machinery and equipment indicates that a very large investment is required in that sector to meet internal demand. Since the USSR has begun to create a wide-spectrum production capability in construction machinery and equipment, it is likely that opportunities in foreign markets in this area will be tested. Should profitable trade fail to materialize, production facilities are readily put to domestic purposes. This strategy for market penetration, the "dual external/internal" option, should prove attractive to a risk-averting bureaucracy. Only marginal success in penetrating the world construction machinery and equipment market is likely, however, because poor after-sales service and reliability typical of Soviet equipment has outweighed price considerations for purchasers in the developed West in the past. Marketing efforts in LDCs may meet with somewhat greater success given lower prices and their cheaper labor rates and hard-currency constraints.

The USSR is also developing a synthetic fiber industry, and it is also likely that foreign markets for the commodity fibers will be tested. The commodity fiber field offers a large, readily served market

which requires new entrants only to meet minimum product specifications, assure a continuous supply, and undercut existing prices. While the USSR could offer competition in the commodity fibers, it is unlikely to compete successfully in specialty fibers which require major sales and technical service efforts and involve mastering highly specialized technologies.

The fourth and final task involved the integration of the results of the preceding investigations to provide conclusions for the general prospects for increased Soviet economic competition with the United States. The conclusions were twofold. First, economic pressures resulting from continued inability to solve a variety of performance problems will interact with a changing role of foreign trade in Soviet development strategy to induce the Soviets to seek to compete with the United States and other Western countries in more areas and more extensively during the next decade than has been the case in the past. The impact on Soviet trade competitiveness would depend both on the strength of the political commitment to penetrate world markets and on the response of Soviet decisionmakers to increased interrelatedness. Advanced technology from the West is needed for the development program, but it is not an unavoidable requirement.

Secondly, since it was not possible to predict specifically in which product areas the Soviet Union would seek to compete, it is important to understand the potential market penetration strategy and the factors which will guide the choice of product area. It will not be feasible for the Soviets to compete simultaneously over a broad range of high-technology product lines. If a high-level political commitment is made, the Soviets can become competitive in some high-technology areas, but a specific product line cannot be predicated. The dual external/internal option logic does suggest that an attempt to test foreign markets is likely in both construction machinery and equipment and basic commodity fibers. It is also likely that the Soviets will try to expand their current major hard-currency export base, i.e. primary products, and will try to increase the level of fabrication of primary product exports in order to reap the higher value added. The Soviets have demonstrated a willingness to consider altering institutions and mechanisms in order to meet the requirements of trade competitiveness, and some positive impact might be expected without overall reform of the economic system.

Major uncertainties in assessing the ability of the Soviet Union to meet the competitive requirements of the world market involve both economic and political conditions internal to and external to the USSR. External conditions which bear on an increased role for the USSR in the international economy include reasonable normalization over time of political relations between the Soviet Union and the industrialized West and economic stability in the West which would not lead Soviet leaders to seek to insulate their economy from extreme fluctuations. Internally, current policies favoring increased interrelatedness will depend for their continuation on the successors to the current leadership. Secondly, policy toward a wide range of economic activity--resource allocation, incentive mechanisms, the organization of foreign trade, appropriate hard currency strategies, and the establishment of long-term relationships with Western firms--will have to be properly orchestrated early in the period to impact on Soviet trade competitiveness in the 1975–85 timeframe.

I SUMMARY

The objective of this study is twofold:

1. To identify and analyze the various factors which bear on the ability of the Soviet Union to compete with U.S. firms in world markets as a result of Soviet acquisition of advanced U.S. technology in the broadest sense;[1] and

2. To identify the areas in which this impact would most likely occur in the time frame 1975-85.

The U.S. and USSR have agreed that, despite ideological differences, normalization of relations involves the appropriate expansion of economic ties between the two nations. On the U.S. side, this expansion must be guided, however, by policy which reflects consideration of a wide range of issue areas including systemic economic differences, national security concerns and commercial implications of increased trade and technology exchange. This study addresses only one aspect of these issues and is thus not a net assessment of all of the implications of expanding U.S./USSR economic relations. The focus of the study is the potential impact on U.S. commercial interests of the transfer of advanced technology to the Soviet Union within the time frame 1975-85.

The analysis was pursued along four lines of investigation:

1. An evaluation of the need, ability and commitment of the USSR to compete in world markets (Chapter III);

2. Identification of current and prospective areas of technology transfer from the United States to the USSR (Chapter IV);

---

[1] That is, a future-oriented consideration of technology acquired through a variety of processes--licensing, embodied in equipment, exchange of personnel, etc.

3. Examination of the likelihood of Soviet market penetration in four specific product areas (Chapter V); and

4. An assessment of the overall prospects for Soviet economic competition with the United States in third country markets, should the USSR acquire advanced U.S. technology (Chapter VI).

A. Economic Factors Affecting Soviet Trade Competitiveness

The economic factors which will impact on future Soviet trade competitiveness are fourfold: the recent record of and future prospects for economic growth, the future role of foreign trade in Soviet development strategy, the Soviet ability to absorb foreign technology, and Soviet economic processes and foreign trade practices.

An examination of the recent record of Soviet economic growth and a consideration of growth prospects, via a long-term projection of the SRI-WEFA Econometric Model of the Soviet Union, provide insight to the economic pressures that will face Soviet decisionmakers in the 1975-85 time frame. The pressures involve a falling share of consumption in GNP and a growing share of investment. Consumption is projected to grow at a rate (2.2 percent per year) substantially below that of GNP, while investment is seen to grow at a steady high rate (7.2 percent per year). If this pattern were to continue, it would lead to a remarkable drop of the share of consumption in GNP to an extraordinarily low 39 percent in 1990 (measured in constant 1970 rubles), while the investment share would reach 52 percent. Moreover, the ratio of employment to able-bodied population, as currently defined, is seen to exceed 100 percent by the 1980s and reach 108 percent by 1990; this means that more workers than would currently be expected to be available would need to be drawn into the labor pool. The model projects practically no growth in combined labor and capital productivity in the overall economy (0.2 percent per year). While it is doubtful that the Soviets could continue their current economic practices which would lead to these conditions in 1990, the implication is that there will be strong pressure to improve factor productivity.

An historical overview of the role of foreign trade in Russian and Soviet development strategy reveals a pattern of periodic forays into the international economy associated with an overall fitful pattern of economic development. This pattern serves as one possible basis for analyzing future Soviet trade behavior. A second future scenario is possible, however. It focuses on the general pattern of trade and development associated with the industrialization of Western economies rather than the solely Russian historical pattern and argues therefore that in the course of further industrialization, the USSR will be increasingly involved in international economic relations. By viewing increased international involvement as increasing interrelatedness rather than interdependence (which would imply increasing Soviet dependence on the West, at least in selected areas) the attractiveness of the second scenario is reinforced as a description of the future path for Soviet behavior.

Given today's level of Soviet economic development, expanded economic relations need not involve Western nations in the basic core of the Soviet economy. The USSR could, in effect, operate "at the margin" to improve economic performance. The type of international specialization which has been developing among industrialized nations in the past several decades has been marked by intraindustrial, rather than interindustrial division of labor. Thus, trade can expand without substantial changes in the internal structure of production. A precedent for growing international economic involvement can be found in Russian experience--the period 1905-13 when state-dominated development showed signs of giving way to the international involvement pattern of Western industrialized nations, terminated by World War I and the Revolution.

The future role of foreign trade in the Soviet economy will be influenced by two other considerations. Foreign trade is viewed as an instrument of Soviet national purpose and as such is not guided solely by considerations of economic benefit. Secondly, if economic relations with the West are to be maintained over the long run (or if the periodic procurement policy is of some significance), a strategy for increasing hard currency earnings must be developed. One possible element of this strategy may in-

volve increasing earnings from the present major export base (primary products) by increasing the level of fabrication of these exports. Another element might involve what has been designated in this study as the "dual external/ internal option" strategy. That is, expanding productive capacity for export in areas in which there is high domestic demand. If the export program does not prove successful, the production capacity could then be converted to domestic requirements. While this criterion is not particularly useful when applied alone, it does argue against the reasoning that the USSR will not export in areas where there is significant unsatisfied domestic demand.

The ability of the Soviets to absorb foreign technology will impact strongly on future Soviet trade competitiveness. This ability is inhibited by a number of well-known behavioral and institutional characteristics. Incentive mechanisms do not reward innovation sufficiently relative to the inherent risks--the mechanism is still basically oriented to the fulfillment of performance targets. Research and development is separated from production efforts and thus innovations are not effectively incorporated into the production process. The bureaucratic nature of the Soviet economy, moreover, provides for effective resistance to the creative destruction inherent in technological change. Due to the lack of competition in the Soviet economy and especially if technology is acquired only for domestic purposes, there is no pressure to maintain technological currency. Lastly, while it has become apparent in the West that effective technology transfer is a result of a people process, the Soviets have relied mainly on publications and product emulation to acquire foreign technology, while the people process is limited by the closed nature of Soviet society.

Other specific aspects of Soviet economic processes and foreign trade practices will also affect Soviet trade competitiveness. The Soviet industrial environment is marked by poor quality standards, insensitivity to users' needs, and poorly developed after-sales support services, all of which would act unfavorably in competition for world markets. The separation of the Western firm and its Soviet trading partner by bureaucratic

intervention of the foreign trade apparatus is not well-suited to the requirements of world markets, particularly in high technology areas. While bureaucratic foreign trade pricing does permit the USSR to undercut world prices, and compensate for deficiencies in foreign trade practices, operating across the entire economy with "loss leaders" would be untenable.

Some evidence does exist that indicates recent Soviet approaches to behavioral problems may improve both their ability to absorb and maintain technology and to compete effectively in foreign markets. The expanded involvement in joint venture operations brings Western knowhow to bear on both these aspects. Greater involvement of producing ministries and enterprises in foreign trade operations increases the vested interests of these organizations in export production and increases the contact between the actual trading partners. Devoting a segment of productive capacity exclusively to export production is also under consideration. This would involve the production process directly with the requirements of competing successfully on world markets.

B. Soviet Technology Requirements

A survey of contracts and agreements of U.S. firms with the Soviet Union was made for the period 1970 to September 1974. The survey was an input to the assessment of the areas in which Soviets might potentially compete with the United States in third country markets. Data sources were threefold: U.S. Government agencies, private research and consulting firms and Soviet and U.S. technical publications.

Data assembled were classified where possible to the 4-digit level of the Standard Industrial Classification (SIC) groups. Table I-1 summarizes the information at the 2-digit SIC level. The results of the survey show that of the almost two hundred contracts and agreements documented during the time period, the majority (135) came under the category of nonelectric machinery to be used in numerous sectors of the industry. Within this major group, large numbers of agreements were signed for such industries as metalworking machinery and equipment (36), construction, mining, and

Table I-1

SOVIET IMPORTS OF U.S. TECHNOLOGY

By SIC Groups

SIC Groups	Major Headings	Number of Companies Signing Contracts or Agreements
13	Oil and gas extraction	1
16	Construction other than building construction--general contractors	1
20	Food and kindred products	2
22	Textile mill products	1
26	Paper and allied products	1
28	Chemicals and allied products	2
33	Primary metal industries	5
34	Fabricated metal products except machinery and transportation equipment	13
35	Machinery except electrical	135
36	Electrical and electronic machinery, equipment, and supplies	13
37	Transportation equipment	18
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	11
39	Miscellaneous manufacturing industries	3
44	Water transportation	1
49	Electric, gas and sanitary services	1
50	Wholesale trade--durable goods	1
73	Business services	6
89	Miscellaneous services	2

NOTE: Data at a 4-digit level appear in Chapter IV. Those data are more illuminating in the machinery categories. The information cut-off date for this table was September 1974.

materials handling machinery and equipment (29), general industrial machinery and equipment (25), specialized industrial machinery except metalworking (20), and office and accounting machines (13). A further subdivision indicates that the technologies for which agreements were signed cover such diverse areas as automotive equipment (especially for the Kama River truck plant), agricultural equipment, earthmoving equipment, oilfield equipment, chemical equipment, food-processing equipment, textile equipment, foundry equipment, and medical equipment. The second largest major group, transportation equipment, contained only 18 contracts and agreements. In other categories 13 each were signed for fabricated metal products and electric machinery; 11 for the category containing measuring, analyzing and controlling instruments, photographic, medical and optical goods, watches and clocks, and less than 6 for the remaining classifications in which trade took place.

This study does not include the indirect transfer of technology from the United States to the USSR--that is, technology which is transferred from the United States to Eastern or Western Europe and from there to the Soviet Union. In selected areas, this indirect route could be the means by which the Soviet Union acquires U.S. technology used to compete with the United States in third country markets.

In addition to U.S.-Soviet trade, a more limited survey was made of Soviet trade with Western Europe and Japan in 1974. This survey was made in order to compare patterns of U.S.-USSR trade with those of Western Europe/Japan-USSR trade. In general, a pattern similar to that observed for U.S.-USSR trade emerges. There is heavy concentration in the metallurgy and metalworking, automotive, chemical, heavy machinery, and power industries, as was noted in U.S.-USSR trade flows. The major difference is the larger number of Soviet-West European/Japanese contracts and agreements under the headings of chemical equipment and light industry, especially synthetic fibers, textile equipment and clothing.

The data available for the survey of contracts and agreements signed by the Soviet Union and U.S. firms were limited to nontechnical reports in

a variety of published sources. The data on the agreements were not reported in any consistent manner; this affects the accuracy of the Standard Industrial Classification scheme employed. The survey must be viewed, then, as a profile of potential activity and not as a measure of trade flow or a quantitative dollar measure of relative importance.

C. Product Area Case Studies

From a general analysis of Soviet technological requirements, both as expressed in actual import activity and through a review of Soviet economic literature, thirteen product areas were identified as potentially having significant impacts on U.S. market positions. The thirteen technology areas are: agriculture (agribusiness and food processing machinery and equipment); alumina; automotive (both for heavy trucks and passenger autos); aviation; chemical production (synthetic fibers, fertilizers, and basic chemicals); computer; construction equipment; electronics; energy production (electric power generation and nuclear power plants); forest products; medical equipment; mining equipment; and oil and gas extraction, transport and refining.

After an in-process review with the interagency working group which monitors the study, four areas were selected for in-depth analysis. Within each general area a subsector was identified to receive particular emphasis. The four areas are:

General Area	Specific Subsector
Electronics	semiconductors
Aviation/Commercial Aircraft	wide-body jets
Construction Machinery and Equipment (CME)	earthmoving machinery and equipment (EME)
Chemicals/Man-made Fibers	synthetic fibers

The net assessments of the four product areas follow.

1. A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the world semiconductor market concluded that such a development is highly unlikely.

It is improbable, given competitive market conditions and Soviet goals in foreign trade, that the decision will be made to compete in the high technology semiconductor market. In view of the rapid change in technology and high development costs, the semiconductor industry does not hold out the promise of being a large net contributor to the Soviets' hard currency balance. This market, furthermore, is characterized by extreme fluctuations in sales and rapidly declining prices, and thus does not represent the stable pattern of trade which the Soviet Union normally seeks to establish.

It is even more improbable, should the Soviet Union decide to compete in the world semiconductor market, that the effort would be successful. Soviet industry's past performance in a number of aspects determined to be characteristics of competitive advantage in the semiconductor market has been consistently poor.

The unique managerial-technical skills which enable Western producers to meet these competitive requirements are not well-developed in the Soviet industrial environment. Incentives to Soviet managers for technological innovation and responsiveness to users' needs are outweighed by the need to fulfill planned targets for output. Much of the cost-reducing technical change in the U.S. semiconductor industry involves improvements in manufacturing efficiency and results primarily from the "learning" process. Manufacturing efficiency is a weak area in Soviet industry. Even in the Western industry, the transfer of advanced semiconductor technology is a difficult and complex problem. This transfer has often been accomplished in the past by hiring away key personnel from the originating firm.

International technology transfer, via sales of equipment and turnkey plants, and licensing, would not provide Soviet producers with the prerequisites for successful competition in the world high-technology semiconductor market. Technology acquisition in the lower spectrum of semiconductor technology could still seem attractive for domestic applications. Since joint ventures could provide some of the market-oriented know-how the Soviets lack, it is conceivable the Soviet Union could establish itself as a supplier of semiconductors well below the frontier of technology, especially to less developed countries. This might pressure other countries

(e.g., Japan) who are now active in this part of the market to concentrate development efforts in order to export higher technology semiconductor devices, and thus might indirectly increase the competitive pressure on the United States. Such a joint venture approach by the Soviets would be compatible with the export/import options component of their foreign trade strategy.

Clearly, high (and some non-frontier) technology semiconductors have defense applications and could provide potentially significant assistance in a variety of domestic economic sectors. These assessments, also bearing on formation of U.S. export policy, are not within the scope of this study.

2. A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the sale of wide-body jets concluded that such a development was unlikely unless a major commitment is made at the highest political level for an all-out effort in the interest of national prestige.

The probability of a political commitment to penetrate the wide-body jet market, given the stringent requirements of the commercial aircraft market, is unlikely. Yet, for national prestige purposes it may be sufficient to export only 50-75 planes; thus this possibility should not be totally discounted.

While there is a strong political rationale to compete with the United States, the dominant producer of commercial aircraft, a large commitment of resources would be required, even though the Soviet Union has the basic technology and the capability to produce most individual components of commercial aircraft that would be competitive with the U.S. products. The factors which would make Soviet aircraft competitive are not major considerations in meeting domestic needs--passenger comfort, reduced cost per seat-mile, after-sales service, etc. For air carriers in the industrialized West, these shortcomings in current aircraft packages have outweighed lower

skepticism about the Soviets' ability to correct these deficiencies would inhibit the willingness to purchase aircraft early in the development/ production process, as is the normal case in the West.

In the future, however, sales to less developed countries could be tied to Soviet credits extended under bilateral agreements, or even be part of special fuel subsidies or purchases. Although the LDC market potential to 1985 is large, two factors limit the Soviets' ability to exploit it. First, low prices have contributed to successful past sales programs to LDCs, but poor maintenance and after-sales service have caused dissatisfaction and even return of the aircraft. Secondly, the "haves" among the LDCs are already purchasing wide-body jets and are expected to continue to do so during the 1975-80 period. The Soviets could not absorb the requisite engine and passenger-related technologies in sufficient time to meet these market opportunities.

A second consideration of potential competition from the Soviet Union is airline service. Problems of passenger comfort, including air conditioning failure and faulty pressurization, now plague Aeroflot service, but these problems could be overcome. Aeroflot operates profitably on Moscow-Tokyo and Moscow-Western Europe routes, but altogether barely breaks even. Many routes are unprofitable due to low load factors; the routes are maintained more for national image than for profit. Most Aeroflot flights to foreign airports are on a revenue-sharing basis. If performance is improved it is likely that Aeroflot could prove to be much more competition for U.S. and other carriers than at present; there is no reason to conclude that this will not occur particularly if some price cutting is employed or tourist "package deals" developed and stressed.

As in semiconductors there are important defense considerations in the transfer of aircraft technology; these factors, however, were not within the scope of this study.

3. A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the world CME and EME markets concluded that the likelihood of such a development is only marginal.

Analysis of Soviet domestic needs for construction machinery and equipment indicates that very large investment in the CME sector is required in order to meet internal demand. It is, indeed, apparent that the Soviet Union is embarked upon creating a wide-spectrum CME production sector, independent from agricultural equipment production. This production capability, then, provides the opportunity to test foreign markets, without much risk, since the production facilities can be converted to domestic use, should profitable trade fail to materialize.

Given a decision to enter the world CME and EME market, only marginal success is likely, particularly in trade with the developed West. Most purchases of CME and EME in the developed West are by contractors who must meet tight time and cost constraints and as a result reliable, productive, often multi-use equipment and strong after-sales services, including spare parts service, are major considerations in choosing suppliers. As has been noted, Soviet CME and EME are weak in these areas relative to Western equipment. After-sales service has been a major weakness of the Soviet industrial environment. Price undercutting has not been an effective tool for market penetration in the case of the developed West, so that successfully meeting the stringent demands of this market in the industrialized West would require a major overhaul of Soviet manufacturing and servicing methods, and thus, the likelihood of success is deemed only marginal.

In the case of the CME and EME markets in LDCs, however, price may play a more important role, mitigating somewhat considerations of reliability and productivity. Lower prices for Soviet CME and EME, possibly reflecting simpler equipment, may prove attractive to LDCs, especially given their generally cheaper labor rates and also hard-currency constraints introduced by inflated oil bills. Soviet-produced construction machinery and equipment also represents an attractive product line to be marketed to LDCs through bilateral trade agreements.

The major uncertainty in the net assessment lies in the possibility that the Soviet Union may organize CME and EME production dedicated

to export. While special quality standards cover export production and special export sales support organizations already exist, firms producing for export would then have an important stake in meeting the demands of the world market, i.e., increasing the reliability and productivity of the equipment and providing after-sales service. Joint ventures could be utilized to facilitate after-sales service and parts distribution abroad.

4. A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the man-made fibers market concluded that it is not likely that the USSR will be an effective competitor in the high technology specialty fiber market, but it is probable that some competition will be offered in the commodity fiber market.

Soviet domestic demand for man-made fibers is high and, as yet, unsatisfied. The Soviet Union is engaged in developing a man-made fiber industry and a decision to test the foreign market, as in the case of construction machinery and equipment, is likely.

Given a decision to enter the world man-made fiber market, it is also likely that the Soviet Union could meet the requirements for success in the commodity fiber end of the market, i.e., establish some sales and technical service abroad, meet minimum product specifications, provide assurance of a continuous supply, and undercut existing prices.

In the area of specialty fibers, price-cutting is less of a factor, while a major sales and technical service effort is required with extensive producer-user feedback and technical cooperation. In addition, it is more difficult to master highly specialized technologies than the basic spinning processes for commodity fibers.

The commodity fiber field offers a large, readily-served market. While the basic spinning technology is readily available from fiber producers in Western Europe, Japan, and the United States, the expansion of fiberspinning capacity and alleviation of resin shortage problems necessary to make a significant impact on world commodity fiber markets would require

from five to ten years. This area has been given priority in the USSR for quite some time, yet its performance in mastering and developing new technology has been less than impressive. Solving the problems in the man-made fiber industry may prove rather important, given the increased emphasis on consumers goods and the significance of this industry in their expanded production, and may benefit from a highly concerted effort in the 10th Five-Year Plan (1976-80).

The major uncertainty in this assessment is the degree to which the Soviet Union will devote an expanded man-made fiber sector to the satisfaction of domestic demand and the needs of other CMEA nations. The commodity fiber market could prove an attractive source of hard currency earnings for high-priority imports.

D. Prospects for Soviet Economic Competition with the United States as a Result of Acquiring U.S. Technology

The discussion of the prospects for increased Soviet economic competition with the United States is organized into four issue areas: (1) the interaction between economic pressures and the changing role of foreign trade, (2) dominant characteristics of potential market penetration strategy, (3) new initiatives to solve competitive disadvantage problems, and (4) major uncertainties in assessing the ability to compete.

1. Interaction Between Economic Pressures and the Changing Role of Foreign Trade

The analysis of the interaction of the economic pressures resulting from continued inability to solve a variety of performance problems and the role of foreign trade in the Soviet development strategy, either as a traditional means to solve economic problems or as an instrument to alter their economic relations with the West, lead to the conclusion that the Soviets will seek to compete with the United States and other Western countries in more areas and more extensively during the next decade than has been the case in the past.

While nondependence on the West has been a guiding principle of Soviet development strategy, the degree of economic problems facing Soviet leaders leads to a need but not an unavoidable requirement to increase their imports from less developed and nonsocialist countries. An injection of advanced technology from the West, embodied in a traditional spurt of purchasing, could supply some capability for accelerated "intensive" development, i.e., solution to productivity problems or development of high priority sectors. Increasing interrelatedness, if properly pursued by the Soviets, probably does not involve significant increases in dependence on relations with the West.

Without increased interrelatedness with the West, however, the behavioral and institutional aspects of the Soviet economy which inhibit technological advance will be operative and the technology transfer would not become a self-sustaining factor for economic growth. Additional technology and equipment procurement forays would then be required with greater frequency.

The impact on competitiveness would depend both on the strength of the political commitment to penetrate world markets and on the response of decisionmakers to increased interrelatedness. It was evident in the assessment of the case studies that the strength of the commitment is a vital factor in successfully competing in world markets, given the level of effort required to overcome the disadvantages of the Soviet industrial environment. If, as a result of increased interrelatedness, a segment of Soviet production is devoted to export and managers thus develop a vested interest in providing a competitive product, the effect of such a commitment would be self-reinforcing.

2. Dominant Characteristics of Potential Market Penetration Strategy

The conclusion drawn from both general analysis and the case studies was that within the 1975-85 time frame it is unlikely that the USSR could offer serious competition across a broad range of product areas involving advanced design and production technology. This indication was supported in

considering the semiconductor and commercial aircraft areas and is borne out, as well, by the examination of the past record of Soviet production and the behavioral and institutional characteristics of the Soviet economy. This is particularly true in areas which not only involve high technology, but are dominated by rapid technological change. The absorption of advanced technology is a complex process and one in which, for the reasons outlined in this study, the Soviets have not enjoyed great success.

While the feasibility of simultaneously competing with the United States over a broad range of high-technology product lines can be ruled out, if high level political decisions are made, the Soviets can become competitive in some high technology areas. It is possible to measure the comparative problems and probabilities between product areas which would potentially be selected for export, but it is not possible, however, to predict a specific product line. It is important, therefore, to understand the dominant characteristics of the market penetration strategy.

A rational point of departure for Soviet decisionmakers in formulating an export strategy is the current export base of the USSR. An examination of the major sources of Soviet hard currency reveals a pattern of product areas in which the Soviets have had success. That pattern is heavily weighted toward primary products in which the problems encountered by Soviet manufactures in the world market are not a factor. Expansion of the existing major hard currency export base, i.e., primary products, could involve three non-mutually exclusive options: increase primary product export capacity, divert primary product exports from the socialist bloc to hard currency countries, and/or increase the degree of fabrication of primary exports one level in order to gain hard currency from the increased value added. The first option is likely to be pursued to some extent, but this entails a large commitment of resources, while domestic claims on investment resources and primary product output are expected to grow rapidly. The second option, to divert exports from the socialist bloc, is already being

pursued but is limited by the effect of such a diversion on the East European economies which would then face world prices (in convertible currency) for primary products. The last option does appear tenable and is likely to be pursued along with expansion of primary product output for export. This latter option appears particularly attractive in light of the dual external/internal option strategy described below, especially given that the export of semifabricates involved would not make demands on production characteristics that would be superfluous from a domestic use point of view.

The dual "external/internal" options strategy for the development of new export bases should prove attractive to Soviet decisionmakers. This strategy involves the expansion of productive capacity in areas where there is a significant unsatisfied domestic demand. A portion of this productive capacity would then be dedicated to export to determine the potential for penetration of the world market. Should the initial effort prove rewarding, the portion of capacity justified by the utility of hard currency earnings balanced against the opportunity cost of diverting the output from the domestic economy, would continue to be devoted to export. Should the export effort prove unrewarding in view of the domestic opportunity costs, the capacity could easily be converted for domestic use. Given the risk-averting tendencies of a bureaucracy, such a relatively safe strategic economic option has many desirable features. This reasoning really argues against the usual notion that the USSR will not export in an area where there is significant unsatisfied domestic demand.

In the case studies, the logic of the dual external/internal option led to the conclusion that both in construction machinery and equipment and the commodity group of synthetic fibers, the extent of domestic demand and potential hard currency earning would most likely recommend an attempt to test foreign markets in these areas.

3. New Initiatives to Solve Problems Related to Trade Competitiveness

Major disadvantages in Soviet competition for world markets are a result of the behavioral and institutional characteristics of the Soviet economy. While significant reforms of the Soviet economic system have been initiated in the past, they have not dealt successfully with major impediments to efficiency and responsiveness to the needs of the users of the production. The round of economic reforms initiated in 1965 had considerably less impact than first anticipated by Western observers of the Soviet economy. The implication of recent reforms creating industrial associations is still uncertain, but it is not anticipated that the characteristics adversely affecting Soviet trade competitiveness will be altered to any signficant extent.

Although overall reform of the economic system is not likely to be accomplished in favor of Soviet trade competitiveness, the Soviets have given strong indications that new initiatives are under consideration in specific areas related to foreign economic interaction. While the specific initiatives now under consideration may or may not have broad impact on Soviet success in penetrating foreign markets, the willingness to consider altering institutions and mechanisms to meet the requirements of trade competitiveness is significant. New external forms of interaction with foreign economies are also being developed. The expanded use of joint ventures with Western firms is actively being explored. Soviet leaders also have under consideration proposals from U.S. firms to establish joint venture operations on Soviet territory in which the Western partner would share management functions as well as profits.

4. Major Uncertainties in Assessing the Ability to Compete

The major uncertainties in assessing the ability of the Soviet Union to meet the competitive requirements of the world market involve both political developments and economic conditions in the West and high-level political decisionmaking and the timing of those decisions in the Soviet Union.

The likelihood that the Soviet Union would follow the path observed for most industrialized nations, that is, increasing interrelatedness with other developed countries, will depend on a reasonable normalization over time of political relations between the Soviet Union and the industrialized West.

Another external consideration is the economic stability of the West. If the relevant time frame is marked by rapid and extreme fluctuations in the Western economies, the increased role of the Soviet Union in international markets would be in doubt. Soviet leaders seek to insulate the Soviet economy from the wide fluctuations in the world economy. The leaders would be very reluctant to increase the role of foreign trade given conditions of extreme economic instability in the West.

The internal uncertainties concern political decisionmaking in the Soviet Union and the decisionmakers themselves. The current policy of detente with the West is strongly associated with General Secretary L. I. Brezhnev. Thus, the potential competition for world markets offered by the Soviet Union is tied to the question of leadership succession.

Apart from the normalization of foreign economic relations, Soviet trade competitiveness will depend as well on government policies at many levels relative to the role of foreign trade being properly orchestrated. These policies will concern a wide range of economic activity: resource allocation, incentive mechanisms, the organization of foreign trade, appropriate hard currency strategies and the establishment of long-term relationships with Western firms in order to achieve self-sustaining technological change as well as develop other management techniques involving quality control and product support services. These government policies, while they may not be in evidence to Western observers until the latter part of the 1975-85 time frame, must be instituted earlier in the period in order to tool up for a significant market penetration effort in the 1980s.

E. Findings and Conclusions

The research effort provided insights which may be summarized in three areas of concern: general implications for Soviet foreign trade patterns; specific implications for Soviet trade competitiveness; and preliminary policy implications.

General implications of the research for future Soviet patterns of foreign trade include:

- Expanded economic relations with the West need not involve true interdependence, which may be undesirable in the view of Soviet leaders, but rather interrelatedness, more attractive to the leadership and a means by which they could operate on the margin to improve Soviet economic performance.

- Trade between Western industrialized nations has involved, in the pre-World War I and post-World War II periods, increased intraindustrial specialization rather than the pattern described by classical Ricardian theory. The foreign trade of the USSR with the West, if it also followed this pattern, could expand significantly without a radical restructuring of the Soviet economy.

- Political and economic stability in the West is most important to the USSR, which needs to develop stable trading patterns for planning exports and imports and hard currency for its development strategy.

- The importance to the USSR of engaging in cooperative ventures with Western firms is significantly enhanced by the help this would provide in maintaining the currency of technology and penetrating world markets.

The research provided, as well, the following specific implications for Soviet trade competitiveness:

- The role of foreign trade in the Soviet development strategy is changing.

- Due to the interaction of domestic economic pressures and the changing role of foreign trade, the USSR will seek, to a greater extent than has previously been noted, to compete in world markets.

- The Soviets have a need, but not an unavoidable requirement, to import from the West.

- The USSR cannot compete simultaneously across a broad range of advanced technology product lines. Moreover, it cannot be predicted with any certainty which lines might be selected.

- It is important to understand, therefore, the logic of what may be the Soviet strategy for the penetration of world markets.

- The survey effort proved critical in defining the areas in which competition from the USSR might be expected in the future.

- While only a small number of case studies could be performed, problems applicable over a wide range of product lines were addressed, due to the representativeness of the specific studies.

- The potential competition that U.S. commercial interests might expect from the USSR in a particular product area may be negligible, but the national security impact of technology transfer in that same area may be serious--a prime example would be the semiconductor area.

While not a major focus of the study, several policy implications were suggested by the research findings:

- It is apparent from the analysis that price considerations will play an important role in the expansion of East-West trade, not only in regard to protection from dumping, but also as price relates to fair trade practices in the day-to-day conduct of international competition.

- There is a vital need for increased information flows, both government-to-government and internal to the U.S., between government and the private sector both as inputs to the formation of U.S. policy in the area of East-West trade and to enable U.S. firms to make normal business calculations necessary for decisionmaking.

- Although the pricing of technology is a complex issue even in a Western setting where there has been considerable experience with technology transfer in a competitive environment, it is evident that some emphasis must be placed by both the public and private sectors on augmenting the ability to price properly technology sold to the USSR, given the asymmetries inherent in the interface of the two different economic systems.

II INTRODUCTION

A. Objective

The objective of this study is twofold:

1. To identify and analyze the various factors which bear on the ability of the Soviet Union to compete with U.S. firms in world markets as a result of Soviet acquisition of advanced U.S. technology, and

2. To identify the areas in which this impact would most likely occur in the time frame 1975-85.

B. Nature of the Problem

The "Basic Principles of Relations Between the United States of America and the Union of Soviet Socialist Republics," signed 29 May 1972, states:

> The USA and the USSR regard commercial and economic ties as an important and necessary element in the strengthening of their bilateral relations and thus will actively promote the growth of such ties. They will facilitate cooperation between the relevant organizations and enterprises of the two countries and the conclusion of appropriate agreements and contracts, including long-term ones.[1]

Thus, the U.S. and USSR have agreed that, despite ideological differences, normalization of relations involves the appropriate expansion

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[1] "Basic Principles of Relations Between the United States of America and the Union of Soviet Socialist Republics," 29 May 1972, Weekly Compilation of Presidential Documents, p. 943, (5 June 1972).

of economic ties between the two nations. This expansion must be guided on the U.S. side, however, by policy which reflects a consideration of a wide range of issues areas, including systemic economic differences and national security concerns. The formulation and execution of such policy will ensure the development of U.S.-USSR economic relations on a mutually advantageous basis.

Systemic differences include the role that foreign economic relations play in the Soviet economy and Soviet state monopoly of foreign trade. While there have been some indications that the traditional foreign trade strategy is being reappraised, if the short term gap-filling nature of Soviet trade predominates, the potential for long-term U.S.-USSR economic relations would be somewhat limited. The mutually advantageous character of U.S.-USSR economic relations, moreover, is mitigated by asymmetries inherent in the interface of centrally-planned and market-oriented economies. Some of the issues in this set of concerns include:

- Will the disadvantages associated with individual U.S. firms having to deal with Soviet state trading monopolies necessitate new U.S. institutional initiatives to facilitate expanded relations?

- How are U.S. firms to obtain the sort of commercial information necessary to make intelligent business calculations in U.S.-USSR economic relations?

- Can the contractual terms required by central planners in order to meet annual, mid-term, and long-range development plans be reconciled with exigencies faced by U.S. firms in the world market?

- Is the role of foreign trade in the Soviet economy changing; i.e., are economic relations limited to periodic spurts of Soviet purchasing in response to lagging technology, poor harvests, or other economic bottlenecks?

National security concerns, as well, arise in the expansion of U.S.-USSR trade and technology exchange. The following are some of the issues relevant to the consequences of commercial relations with the USSR for U.S. national security:

- To what extent do expanded U.S.-USSR economic relations--trade, technology transfer, and investment--provide

strategic assistance to the Soviet infrastructure, i.e., contribute indirectly to a sustained military buildup?

- What is the likelihood of direct application of technology acquired from the U.S. to military capabilities?

- Is the spillover to the defense sector of technological capabilities acquired from the U.S. for civilian purposes likely to be a significant contribution to the Soviet military effort?

Apart from the national security concerns, and related to the problems inherent in the interface of fundamentally different economic systems, there are numerous issues which concern the role of U.S.-USSR economic relations in the overall foreign economic strategy of the U.S. In the formulation of the commercial and institutional framework for expanded U.S.-USSR economic relations, such issues as these must be addressed:

- In engaging in trade and technology exchange with the Soviet Union, is the United States helping to establish a Soviet potential to affect the U.S. position in the world market adversely?

- Could the Soviet Union achieve its economic aims in expanded economic relations with the West, to a significant degree, solely via trade and technology exchange with Western Europe and Japan?

- Will the expansion of economic relations with the USSR provide an opportunity to obtain new markets for U.S. goods in Eastern Europe?

- Can the USSR be regarded as a reliable source of supply for industrial raw materials and as a consistent customer for U.S. industry?

- To what extent do expanded U.S.-USSR economic relations depend on the extension of credit, particularly at other than commercial terms?

This study addresses only one aspect of these issues. It is not intended as a net assessment of the advisability of expanding U.S.-USSR economic relations, but, rather, as an input to such an overall assessment. The focus of the study is the potential impact on U.S. commercial

interests of the transfer of advanced technology to the Soviet Union, within the 1975-85 time frame.

C. Approach

Four tasks comprise the research approach:

1. Assess the purpose and effectiveness of the Soviet importation of foreign technology and thus the ability and commitment of the USSR to compete in world markets. (Chapter III.)

2. Identify current and prospective areas of technology transfer, U.S.-USSR. (Chapter IV.)

3. Examine via case studies the likelihood of world market penetration by the USSR in four specific areas in the 1975-85 time frame. (Chapter V.)

4. Synthesize overall conclusions on the prospects for Soviet economic competition with the U.S. using acquired U.S. technology. (Chapter VI.)

III ECONOMIC FACTORS AFFECTING SOVIET TRADE COMPETITIVENESS

A. Introduction

The issue of potential Soviet trade competitiveness must be viewed in the context of the institutional framework and behavioral characteristics of the Soviet economy which support and circumscribe Soviet foreign trade activity. It must also be viewed with regard to the attitude of Soviet leaders toward foreign economic relations, especially such relations with the advanced industrial nations of the West. It will be shown that the nature of economic relations with the West and in turn the role accorded foreign economic relations in the Soviet national economic strategy will profoundly affect Soviet efforts and ability to achieve competitive positions in world markets.

This chapter is devoted to a discussion of these matters. It begins with a consideration of the impact of recent and prospective Soviet economic performance on the attitude of Soviet leaders toward foreign economic relations. It then examines the broad historical background of Russian involvement in the international economy, particularly in regard to technology transfer, and it develops two alternative scenarios to analyze future Soviet policy toward the international economy. It concludes with a discussion of the effects of Soviet economic institutional and behavioral characteristics on the potential ability of the Soviet Union to be internationally competitive.

B. Economic Growth: Recent Record and Future Prospects

One of the basic factors affecting the attitude of Soviet leaders toward the expansion of economic relations with the West has been the postwar record of growth of Soviet production and productivity, and its future prospects.

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If the postwar period is divided into three subperiods--1950-58, 1959-67, and 1967-74--a relationship of great significance can be observed. First of all, the rate of growth of Soviet national product has been decreasing. This is true both in Western calculations on the Soviet economy and in official Soviet data. According to certain Western calculations, the rate of growth in the first subperiod was 6.4 percent per year; in the second, 5.3 percent; and in the third, roughly 4.5 percent.[1] Official Soviet data show higher rates, but also a downward trend: 10.9 percent, 7.2 percent, 6.8 percent.[2]

Secondly, while the rates of growth of output were declining, the rates of growth of labor and capital inputs into the economy have remained relatively stable over the entire 1950-74 period. Thus, what has been occurring is an erosion of the rate of growth of factor productivity. When a statistical comparison is made between the Western calculations of the rates of growth of output and the rates of growth of combined labor and capital inputs, it is seen that the rate of growth of total factor productivity in the Soviet Union has persistently decreased: from 1.7 percent per year in the period 1950-58, to 0.7 percent in 1958-67, to 0.2 percent in the period 1967-74.[3] Thus, during the most recent period, output has barely grown more rapidly than inputs.

In developed industrial economies, the growth of factor productivity is an important source of economic growth. Its decline in the Soviet economy

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[1] Data are derived from Stanley H. Cohn, "General Growth Performance of the Soviet Economy," in Joint Economic Committee, U.S. Congress, Economic Performance and the Military Burden in the Soviet Union, p. 17 (G.P.O., Washington, D.C., 1970); Abram Bergson, "Toward a New Growth Model," Problems of Communism, pp. 1-9 (March-April 1973); articles by John Hardt and Murray Feshbach in Joint Economic Committee, U.S. Congress, Soviet Economic Prospects for the Seventies, pp. ix, 520-521 (G.P.O., Washington, D.C., 1973); C.I.A., Handbook of Economic Statistics, 1975, Washington, D.C., 1975, p. 46.

[2] Narodnoye khozyaystvo SSSR v 1972 g, p. 531 (Narkhoz 1972) and p. 603 (Narkhoz 1973). The third period is 1967-73.

[3] Same sources as footnote # 1 above. Total factor productivity is calculated on the basis of a Cobb-Douglas production function with labor and capital exponents of .6 and .4.

has, therefore, become a matter of grave concern to Soviet leaders. It can be seen as an erosion of the effectiveness of the Soviet growth model, which--in somewhat oversimplified form--has called for Soviet authorities to concentrate on the maintenance of a steady growth in the supply of inputs into the economy with the expectation that this will lead to a more than proportional increase in output.

Furthermore, the decline in factor productivity casts its shadow ahead. This can be seen in data drawn from a long-term projection of the first generation SRI/WEFA (Wharton Econometric Forecasting Associates) Soviet Econometric Model (SOVMOD I). While this projection is not a "forecast", but is a tracing of the path the economy would follow if Soviet decisionmakers continued to behave in the future as they have in the past, it does shed light on future problem areas and possible future Soviet policies. (See Table III-1.)

The summary growth data for such aggregates as GNP and industrial output show rates of growth through the 70s similar to the previous period (GNP: 4.7; Industry: 5.4) with a slight falling off in the 1980s (GNP: 4.3; Industry: 4.3), while agriculture (under the assumption of average weather each year) and transport and communications show a slight increase in rates of growth from the 70s to the 80s (Agriculture: 1.8 to 2.8; Transport and Communications: 7.6 to 7.8). In regard to end-use of national product, consumption is seen to drop in the 80s compared with the 70s, and for the entire period to be at a rate (2.2) substantially below that of GNP, while investment, as a direct result of exogenous assumption, is projected to grow at a steady high rate (7.2 percent per year).

Several key long-term problem areas for the Soviet economy through the next 15 years emerge from the SOVMOD I projection. These include: (1) the role of consumption, (2) the share of investment in GNP, (3) employment and demographic issues and (4) factor productivity.

Table III-1

Projected Average Annual Rates of Growth in the Soviet Economy

1973 - 1990

(in %)

	1973-1980	1980-1990	1973-1990
I. Aggregate Output			
GNP	4.7	4.3	4.5
II. Sectors of Origin			
Industry	5.4	4.3	4.7
Agriculture	1.8	2.8	2.4
Transport & Communications	7.6	7.8	7.7
III. End-Use			
Consumption	3.2	1.5	2.2
Investment	7.3	7.2	7.2

Source: Long-Term Projections, SRI/WEFA Soviet Econometric Model (SOVMOD I).

1. Role and Nature of Consumption

In this long-term simulation of SOVMOD I, consumption is specified as a residual end-use of GNP. As a result of this specification, the relatively low projected rate of growth of consumption, especially in the 1980s, stands out starkly. In the 1970s, consumption is expected to grow at more than 3 percent per year. But its rate of growth is projected to decrease in the 1980s to 1.5 percent per year. This leads to a remarkable drop of the share of consumption in GNP from a rather low, but still respectable, 57 percent in 1973 to an extraordinarily low 39 percent in 1990 (all measured in constant 1970 rubles).

Given the increasing importance being accorded consumption in the Soviet Union, such a low share of consumption in GNP would be politically untenable. It is sometimes argued that in view of their long history of living under harsh centralized control, both before and after the Russian Revolution, the Soviet people are conditioned to sacrifice, particularly if the spectre of an external enemy is raised. Thus, it follows that the Russian leaders would be able to sustain politically a significant decrease in the rate of consumption in the future if they deem it necessary to do so. This analysis, however, supports the view that the "propensity to sacrifice" on the part of the Russian people may be diminishing. This is primarily because the relatively small, but growing, elite of party leaders, economic managers and skilled workers, after more than half a century of communism, must be rewarded by the system they lead and serve. Second, the demonstration effect, through modern communications media and travel (in and out), has brought to Soviet citizens, particularly those in urban areas, knowledge of superior consumption standards elsewhere in the world, not only in the West but also in most of the socialist countries of Eastern Europe. Deterioration of the relative growth and position of consumption in the 1980s would present the Soviet leaders with difficult policy decisions which they would not be able to avoid.

Several other problems related to consumption warrant attention. One is the growing ratio of household money income to consumer expenditures. By the end of the 1980s, the annual money income is projected to be more than 30 percent greater than the flow of consumer expenditures. This represents serious dangers in regard to the possible erosion of the incentive to work for further money income, and the destabilizing effects of an overhang of potentially "hot money" in household savings. The various possible approaches to the problem--increased prices and taxes, imports of consumer goods, reallocation of resources away from defense and investment to consumption--all present political problems of one sort or another to the Soviet leaders.

Another problem is related to the rather substantial production of consumer goods, mostly consumer durables, in defense industry factories. The design of these factories and the interests of their managers are directed toward their military output rather than their consumer output. This leads to low-efficiency, high-resource-cost consumer goods production in these otherwise, relatively speaking, efficient defense plants.

2. Share of Investment in GNP

In constructing the long-run simulation of the Soviet model, investment (sectoral and total) was derived through a set of behavioral equations in which exogenous planned financing plays a major, though not totally determining, role. As indicated above, total output (GNP) is expected to grow at a substantially lower rate than investment, which leads to a steady climb in the investment share of GNP. By 1990 the investment share reaches the astronomical level of 52 percent, surpassing the 39 percent consumption share (even the share of new fixed investment alone (42 percent) surpasses the share of consumption).

Clearly what is involved in the rising investment share is a fall in the capital productivity. This fall averages 3 percent per year, with capital productivity decreasing by more than 40 percent from 1973 to 1990.

The decrease in capital productivity is uneven across productive sectors: agriculture, 66 percent; construction, 50 percent; industry, 46 percent; goods, services, trade, 33 percent; and transport and communications, 25 percent.

The particular problem of productivity in agriculture is evident here. Soviet authorities throughout this period are seen to commit a substantial 20 to 21 percent of new fixed investment to agriculture. Investment in agriculture grows at 11 percent per year, and employment in agriculture falls very little--only 4 percent over the entire period (0.2 percent per year)—and yet projected agricultural output, even under our assumption of steady average weather, continues to grow sluggishly.

Our calculations show investment in the transport and communications sector growing at over 10 percent per year. Associated with its relatively low drop in capital productivity, the output of this sector is seen to grow 7.7 percent per year, substantially higher than the rate of growth of GNP, leading to a rise of its share of GNP from 10 percent in 1973 to 17 percent in 1990. Since in the Soviet economy, transport and communications perform primarily production services, however, their increasing share in GNP is a sign of decreasing productivity in the use by the rest of the economy of the services of transport and communications.

3. Employment and Demographic Issues

According to U.S. Bureau of Census estimates, the Soviet population will grow at a fairly steady rate through the 1973-90 period, but the growth of the able-bodied population (men: 16-59; women: 16-54) will drop precipitously in the 1980s. The long-term econometric model projection indicates an increase of employment consistently above the growth of total and able-bodied population. As a consequence, employment steadily increases relative to population. In fact, the model projection indicates that in 1990, the number of people that will be employed in the Soviet economy will exceed the able-bodied population as currently defined. Given the desire to maintain

high rates of growth of output, the pressure in the Soviet Union to augment its sources of labor will intensify. Possible sources of additional labor are the increased employment of pensioners, the employment of foreign labor, and/or the possible shift of manpower from military to civilian employment.

The focus of interest with respect to the labor shortage issue is usually the industrial and other nonagricultural sectors. In these terms, the agricultural sector is a potential source of additional labor. The model projection does not indicate any dramatic release of labor from the agricultural sector; indeed, there is hardly any drop at all shown in agricultural employment from 1973 to 1990. If such a drop were to be forced, without a significant improvement in agricultural technology, agricultural output would suffer. As has already been shown, the model, even with high agricultural investment, projects a low rate of growth of agricultural output.

The degree of "labor shortage" is affected, of course, by what is happening to labor productivity. In this regard, the projection is not reassuring to Soviet leaders. Over the period 1973-90, labor productivity in the entire economy is projected to grow at a rate of 2.4 percent per year, and in the industrial sector at only 2.0 percent per year. And this is despite the very rapid relative rise in capital stock reflected in rates of growth of capital per worker of 5.6 percent per year in the overall economy and 5.8 percent per year in industry.

4. Factor Productivity

These last comments suggest that the long-term model projection does not envision a substantial increase in Soviet total factor productivity in the next decade and a half. Indeed that is correct. The model projects practically no growth in combined labor and capital productivity in the overall economy (0.2 percent per year). In industry the projection actually indicates a decrease in factor productivity (i.e., inputs growing more rapidly than outputs): -0.2 percent per year in 1973-80, and -0.7 percent per year in 1980-90.

5. Conclusions

The conclusion from these projected problems is rather clear. Soviet leaders must feel a strong pressure to improve the level of productivity in the economy. One of the major ways of accomplishing this is through rapid technological progress. A central aim of the economic reforms introduced in 1965 was to encourage the growth of technology. The results of the reform, however, have, so far, been disappointing. Some, within the Soviet Union and outside in the West, argue that the reforms did not go far enough, and that for the reform to be effective a significant increase in the degree of economic decentralization is required. Apparently, the Soviet leaders feel that such radical reform would involve economic and political risks which they are reluctant to assume. Instead, they appear to be placing major reliance on a program of importation of advanced technology and capital equipment from the developed industrial nations.

The Soviets have benefited from imported technology in the past, and stand to do so in the future. While a quantification of the gain from technology transfer is difficult to acquire, in SOVMOD I an approach to such quantification was developed through the disaggregation of capital stock in production equations into domestically produced capital and capital imported from abroad. Imported capital was shown to be more productive than domestic capital and the difference was statistically significant. In one of the long-term scenarios run with SOVMOD I, the effects of continued high Soviet hard currency earnings from increased oil and gold prices were measured through the period 1973 to 1990. The model's foreign trade equations generate increased machinery imports (among other things) from the hard currency earnings, and the foreign machinery is then allocated to producing sectors. The superior productivity of imported machinery raised the rate of growth of industrial output, over the 1973-90 period, by almost 10 percent per year (from 4.7 percent per year to 5.1 percent). Though this was designed as a measure of the effect of high oil and gold prices, it does indicate the potential quantitative significance of imported advanced technology, and the reason that Soviet leaders are so anxious to acquire it.

C. Role of Foreign Trade

To proceed with the development of an assessment of potential Soviet competitiveness in foreign markets resulting from technology transfer, it is necessary to have some conception of the role that international economic relations will play in the overall Soviet economic strategy. An historical overview illustrates the past record. Two major alternative conceptions or scenarios are then used to analyze future Soviet policy regarding integration with the international economy.

1. Historical Overview

The transfer of advanced foreign technology into Russia on a massive scale actually occurred as early as the beginning of the 18th century, during the reign of Peter the Great. Peter brought in not only foreign technology, but foreign technologists by the thousands, and built an economic base for the support of his military, foreign policy ambitions.

Within the past hundred years there have been two major periods of concentrated effort in Russia to acquire advanced foreign technology. The first of these was connected with the industrialization spurt in the 1890s. It was led, against the opposition of many among the Russian nobility, by the Russian minister of finance, Count Witte, whose policy was to encourage foreign investment in Russia. Foreign capital, especially French and Belgian, accounted for almost 50 percent of all new capital invested in Russia during the industrialization drive of the 1890s. In 1900, foreign companies owned more than 70 percent of the capital in mining, metallurgy and machinebuilding in Russia.

As a result of this foreign investment, not only was the capital stock of Russia greatly expanded, but also foreign technology was brought into Russia, both in the form of advanced capital equipment itself and in the form of human capital. Foreign technologists, experienced businessmen, managers and engineers came to Russia as foreign companies were set up

within Russia. Direct foreign investment was thus responsible for the implantation of advanced techniques in several key industries. New technology was often incorporated with little or no adaptation. For example, the steel mills built in southern Russia after the mid-1880s were of the same technological level and size as those being built in Western Europe. And, in this period, with the continuing participation of foreigners in management, these steel mills kept up with West European progress and remained in the mainstream of world progress in steel making. Moreover, the foreign firms competed with Russian firms inside Russia and forced the latter to be more efficient if they were to survive.

A second period of major importation of foreign technology occurred during the 1920s and, especially, the early 1930s. During the relatively free market-oriented period of the New Economic Policy of the 1920s, the Soviets attempted to import foreign technology through the program of foreign concessions. The quantitative importance of this program is a matter of debate. Nevertheless, the actual number of business arrangements with foreign concerns was larger than has been commonly believed.[1] However, it was during the period of the first five year plan, 1928 to 1932, that major efforts were made to import foreign technology in connection with the industrialization program that was then being initiated.[2] With the emphasis on industrial capital formation, imports of machinery and equipment began to assume greater importance. By 1932 the imports of machinery and equipment rose to a level of more than half of the total imports of the Soviet Union, and imports of certain types of machines--turbines, generators, boilers, machine tools, metalcutting machines--accounted for between 50 and 90 percent of the growth in the supply of these machines during the

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[1] See Anthony C. Sutton, Western Technology and Soviet Economic Development, 1917 to 1930, Vol. 1 (Stanford, California: Hoover Institution Press, 1968).

[2] See Franklyn Holzman, "Foreign Trade," in A. Bergson and S. Kuznets, eds., Economic Trends in the Soviet Union, pp. 287-320 (Cambridge, Mass., Harvard University Press, 1963).

period of the first five year plan. On the whole, imports of capital goods from abroad amounted to almost 15 percent of gross investment in the Soviet Union during this period. Furthermore, imports of certain basic industrial materials--lead, tin, nickel, zinc, aluminum, rubber--accounted for perhaps 90 to 100 percent of these materials consumed in the Soviet industrialization program.

After the completion of the first five year plan, Soviet involvement in this type of trade decreased. The decrease can be attributed to several factors. Among the direct economic factors were, first, trade was aimed at building import substitution capacity and was severely reduced after the delivery of necessary machinery. Second, in the recession of the thirties, terms of trade worsened for the Soviet Union, i.e., the prices of raw materials dropped significantly relative to machinery prices. Third, the attitude in the United States toward trade with the USSR shifted, after the granting of MFN status, away from the granting of credit on favorable terms and toward conditioning trade terms on political concessions.

In the next five year plan--that is, the period 1933-37--imports of foreign capital goods fell to about 2 percent of gross investment. Dependence upon the West for major products decreased dramatically. In some cases, imports of equipment fell rather suddenly. For example, imports of tractors in 1931 accounted for about 60 percent of the growth of the tractor stock in that year, and in the next year they fell to zero.

The 1940s saw the war years and economic aid from the Allies to keep the two-front war in Europe going. After the war, the Soviet Union drew on German technology available to them in occupied territory. In the decade following the war, the Eastern bloc was formed, and intra-bloc trade grew. However, the Soviet Union and the East European nations did not stress the role of foreign trade. Instead national sovereignty was stressed, each nation striving for self-sufficiency.

After the death of Stalin, the Soviet Union sought to deal with slowing rates of growth by taking a technological approach to modernizing

industry and by relying increasingly on incentive mechanisms to improve productivity. Trade with the West, then, was encouraged to provide technological and later consumer requirements. Soviet imports from the Industrial West surged in the late 1960s. Official pronouncements encouraging expanded East-West economic relations came with the Twenty-Fourth Party Congress under Brezhnev in the spring of 1971. Further impetus for expanded East-West economic relations was provided by improved political relations with the United States and the FRG. Apart from massive grain imports in 1972-73 and again in 1975, the USSR purchased technology and equipment in the West, financed by shipment of raw materials and to a significant degree by medium and long-term credits.

2. The Future Role of Foreign Trade: Scenario One vs. Scenario Two

In considering the future role of foreign trade in the Soviet economy, two scenarios may be employed. One is a traditional, widely-held view focused on the Soviet desire to be free of dependence on other nations. The other is a nontraditional, not so widely held view, embodying a significant increase in Soviet interrelatedness with other nations.

a. Scenario One

The first scenario is drawn from the historical overview just presented. It reflects a traditional Russian pattern of periodic procurement forays into the international economy, associated with an overall fitful pattern of economic development. Intense periods of rapid economic growth, in which Russian leaders attempt to catch up with the advanced nations of the West, are followed by periods of withdrawal and relative stagnation.[1] For the past 500 years, the history of Russia has been dominated by the theme of territorial expansion: originating in the small principality of Muscovy just emerging from Mongol rule, Russia has grown

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[1] A. Gerschenkron, Economic Backwardness in Historical Perspective, pp. 17-18 (Cambridge, 1972).

to its present size. During this process of expansion, the Russian state frequently came into contact and conflict with more advanced and more powerful Western nations. In such confrontations, the expansionary ambitions of the Russian leaders were thwarted, primarily because of the relative backwardness of the Russian economy. The tension between ambition and ability would lead to the State's taking on the role of initiator of economic development. The State would apply pressure to the internal economy to get it to grow rapidly to be able to support the foreign policy aims of the State. Thus the fitful nature of economic development observed in Russian history: when the military needs of the State were pressing, the economy was pressured into rapid growth; when a degree of power parity was reached with the West, the need for rapid growth subsided and the State removed its pressure for growth; as a consequence, a period of rapid growth was followed by a period of little or no growth.[1]

This pattern is seen in the periods described above: the period of Peter the Great at the beginning of the 1700s, the period of rapid growth of the 1890s, and the period of massive industrialization launched by Soviet leaders in the 1930s. In these past periods of importation of advanced technology, the Russians were able, within a compressed period of time, to approach contemporary economic development levels in the West and, to some extent, even the levels of contemporary technology in the West. Yet in the longer run, as the advanced nations of the West continued to develop new technology, the Russians were not able to maintain their relative position, and they fell back.

At the base then of this spasmodic pattern of development has been the desire to catch up economically with advanced Western nations, to achieve military parity with them, and in this way to protect and increase the national sovereignty and power of Russia. This objective of

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[1] For a fuller discussion of the influence of pressure on the behavior of the Soviet economy, see H. S. Levine, "Pressure and Planning in the Soviet Economy," in H. Rosovsky, ed., Industrialization in Two Systems, pp. 266-285 (New York, 1966).

assuring national independence, of avoiding dependence on other nations has been of paramount importance.

In the 1890s, Witte's opponents charged that his program of bringing in foreign capital was endangering the national independence, and was leading Russia into a position of colonial dependency on foreign capitalists (and Jews). Witte, in defending his program, also appealed to Russian nationalism. His program was aimed at freeing the country from dependence on foreign supplies of manufactured goods.[1] Only by building up its productive forces, he argued, could Russia remain independent and attain the position of a world power. He spoke of "the invigorating effects which foreign capital has upon the productive resources of our entire national economy."[2] He also assured critics that Russia had the means and the power to control foreign investors who were being used to develop the economy: "Only a disintegrating nation has to fear foreign enslavement. Russia, however, is not China."[3]

Soviet industrialization in the 1930s was imbued with the goal of gaining economic independence and strengthening the defense capabilities of the nation. In a famous speech, in 1931, Stalin stated: "One feature of the history of old Russia was the continual beatings she suffered for falling behind, for her backwardness... Do you want our socialist fatherland to be beaten and to lose its independence? If you do not want this you must put an end to its backwardness in the shortest possible time. We are fifty or a hundred years behind the advanced countries. We must make good this distance in ten years. Either we do it, or they crush us."[4]

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[1] M. Miller, The Economic Development of Russia, 1905-1914, p. 219 (London, 1967).

[2] T. Von Laue, Sergei Witte and the Industrialization of Russia, p. 181 (New York, 1963).

[3] Ibid., p. 182. Soviet historians generally side with Witte's critics and argue that Russia at the turn of the century was a colonial dependency of western capitalist nations.

[4] J. Stalin, Selected Writings, p. 200 (Moscow, 1942).

The pursuit of nondependence was written into the USSR Constitution, and according to Soviet foreign trade authorities, became the guiding objective in the formulation of Soviet foreign trade policy and planning.[1] Though, as indicated above, there were also other factors at work, the political policy of nondependence, perhaps more than anything else, accounted for the drastic drop in Soviet trade in the middle and late 30s.

As a result of this drop, Soviet trade policy is often characterized in the West as "autarkic." This, however, is an unfortunate phrase since it implies that Soviet policy was to reduce foreign economic relations to zero, whereas what a policy of nondependence signifies is that a country not be dependent on another country for any goods crucial to its existence. Soviet economists today argue that the Soviet Union is not now, and was not in the 1930s, interested in autarky: "While seeking economic independence from capitalist countries, the Soviet Union has never tried to achieve autarky..."[2]

This may seem to be merely a semantic distinction, but it actually embodies an important issue. The scale describing the degree of involvement of a nation's economy in the world economy is a continuum. Increasing degrees of international involvement reflect the dependence of an economy on external relationships as determined by the extent of economic disruption that would be entailed in the breaking of these relationships. The zero point on the international involvement scale is "autarky." The point or range above that is "nondependence." The range above that, it may be useful to call "interrelatedness," and the highest range to call "interdependence."

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[1] P. Chervyakov, Organizatsiya i tekhnika vneshney torgovli SSSR, p. 62 (Moscow, 1958) and D. Mishustin, ed., Vneshnyaya torgovlya Sovetskogo Soyuza, p. 9 (Moscow, 1938).

[2] G. Rubinshteyn, Vneshnyaya torgovlya, 1960:5.

b. Scenario Two

The second scenario for analyzing future Soviet trade behavior differs from the first in that it focuses on the more general pattern of trade and development among industrial nations rather than solely on a unique Russian pattern. And it argues that as Russia progresses further along the path of industrialization it will come increasingly under the influence of this general pattern of industrial development.

According to the long-term data compiled by Kuznets, the international flow of goods and resources grew at rapidly accelerating rates in the period from the 1820s to World War I, declined in the interwar period, and then accelerated again in the post-World War II period.[1] In the pre-World War I and post-World War II periods, international trade flows for developed industrial nations appear to grow more rapidly than does domestic product, and while the share of total trade accounted for by the advanced nations remains at a fairly constant high level in the pre-World War I period, it shows marked growth in the post-World War II period.[2] Thus, the general pattern for industrialized nations appears to be one of increasing international involvement as economic development proceeds (the interwar period can be viewed as a recession-ridden anomaly in regard to the role of international trade).

That this is the pattern for capitalist nations has always been asserted in the Marxist-Leninist literature. It was not so clear whether it also applied to socialist nations. The Soviet foreign trade literature, following the political positions taken in the 1930s, did not stress the economic efficiency advantages of foreign trade and thus

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[1] S. Kuznets, Modern Economic Growth: Rate, Structure, and Spread, Ch. 6 (New Haven, 1966).

[2] Ibid., and M. Maksimova, Osnovnyye problemy kapitalisticheskoy integratsii, (Moscow, 1972). (Also English translation: M. Maximova, Economic Aspects of Capitalist Integration, Moscow, 1973.)

did not argue that international economic relations of a socialist economy would increase with economic growth. Although clearly the advantages of the international division of labor within the post-World War II socialist bloc and the expansion of intra-CMEA trade were stressed, the emphasis on the advantages of trade was muted. But after the death of Stalin and his official burial at the 20th Party Congress (1956), such arguments began to be made with more force, by economists and in official pronouncements. And from the beginning of the 1970s, major emphasis has been placed on the expansion of Soviet economic relations with developed capitalist nations.[1]

To a significant extent, the technical economic literature has been concerned with the calculation of the effectiveness of foreign trade. In the past, foreign trade theory was very simple. Imports were used primarily to fill temporary gaps in the capital stock and in the supply of inputs required in the domestic economy (as determined through the elaboration of material balances).[2] Traditional exports, primarily raw materials, and goods in temporary surplus supply were then exported in amounts "necessary to pay for the imported goods, to form foreign exchange reserves, and to meet obligations for mutual deliveries and deliveries on credit."[3] But current discussions on the effectiveness of trade are becoming more sophisticated. Even aspects of the doctrine of comparative advantage, regarded in the past as an insidious capitalist tool to maintain imperialist domination over underdeveloped countries, are being treated in a positive manner.[4]

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[1] See for example Kosygin's speech at the November 1971 meeting of the Supreme Soviet in Gosplan SSSR, Gosudarstvennyy pyatiletniy plan razvitiya narodnogo khozyaystva SSSR na 1971-1975 gody (Moscow, 1972).

[2] For a further discussion of this, see H. S. Levine, "The Effects of Foreign Trade on Soviet Planning Practices," in A. Brown and E. Neuberger eds., International Trade and Central Planning, pp. 255-279 (Berkeley, 1968).

[3] P. Chervyakov, op. cit., p. 66.

[4] In one mid-1960s article, a Soviet economist rather enthusiastically explained the principles of comparative advantage, though without tying it to its Ricardian past. See G. Shagalov, "Ekonomicheskaya effektivnost' vneshney torgovli sotsialisticheskikh stran," in Voprosy ekonomiki, pp. 89-99, 1965:6.

The advantages of trade were stressed recently in the annual report of Minister of Foreign Trade Patolichev:[1]

> Mutual advantage is one of the leading principles of Soviet foreign trade associations, and they adhere to this principle in trade with their Western partners. In developing economic ties with Western Europe, our country receives an opportunity to make fuller and more rational use of its own resources and possibilities and at the same time to acquire, by way of commercial exchange, goods of other countries that are not produced in our country or whose production would cost more than it does to import them. Thus, foreign economic ties offer a more efficient solution to a number of problems arising in the course of economic construction.

An important theme running through current Soviet discussions of the advantages of trade is the role played in contemporary developed economies by the "scientific-technical revolution."[2] The development of modern science and its application through modern technology to economic activity, it is argued, has profoundly increased the role of international economic relations in advanced economies, primarily due to the effects of the international nature of science and the way in which it develops. This argument is similar to Kuznets' fundamental point about the crucial importance of the internationalization of knowledge.[3]

Do these recent pronouncements on the advantages of international economic relations mean that the Soviets have abandoned their policy of nondependence on foreign countries and have adopted a policy of interdependence? The answer to that question, at the present time, is clearly no.

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[1] Pravda, p. 4 (27 December 1973). [Translation from Current Digest of the Soviet Press XXV:52 (23 January 1974) p. 3.]

[2] This phrase is likely to appear in almost every current Soviet discussion of or pronouncement on foreign trade. For an extensive treatment, see M. Maksimova, op. cit., Chapter 2.

[3] S. Kuznets, op. cit., pp. 286-294.

First of all, much of the Soviet discussion of the advantages of foreign trade has been directed toward trade within the socialist bloc, and thus has not involved the issue of interdependence with capitalist countries. Furthermore, the literature on intra-CMEA trade and planning consistently stresses the maintenance of the sovereignty of the individual nations within the bloc, rather than stressing the growth of their interdependence.[1]

This is, however, only a partial answer, for increasingly in the current period, Soviet discussions have emphasized the need for extending Soviet economic relations beyond the socialist camp into the capitalist camp. The key pronouncement here was Kosygin's speech at the November 1971 meeting of the Supreme Soviet in which he openly invited Western participation in the development of the Soviet economy:[2]

> With the transition to the practice of long-term agreements, which guarantee stable orders for industry, new possibilities are opened up in our relations with Western nations. Consideration can be given to the mutually beneficial cooperation with foreign firms and banks in the working out of a number of important economic problems, connected with the use of the natural resources of the Soviet Union, the construction of industrial enterprises, and the search for new technologies.

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[1] "International economic relations between socialist countries take the form of relations between sovereign owners of the means of production, and not as relations built on the base of unified international property ... this is one of the basic differences between CMEA and imperialist economic organizations like the "common market" which aspire to take for themselves functions of supra-national institutions." V. Ladygin and Iv. Shiryaev, "Voprosy sovershenstvovaniya ekonomicheskogo sotrudnichestva stran SEV," Voprosy ekonomiki, p. 82, 1966:5.

[2] Gosplan SSSR, op. cit., p. 56.

A second point is related to the level of economic development that has been attained by the Soviet Union. It is the argument that the original objective of Stalin to acquire sufficient economic development to guarantee the national independence of the Soviet Union has been achieved. The development of economic relations with capitalist nations at this stage extends this core of economic power. In other words, under present conditions, expanded economic relations with the West do not involve capitalist countries in the basic core of the Soviet economy (which is now sufficiently developed to guarantee the independence of the Soviet Union), but operates at the margin to improve the performance of the Soviet economy. Thus the expansion of economic relations with the West represents for the Soviet Union an increase in what we have called interrelatedness with Western economies, but does not involve, in a significant sense, an increase in Soviet-Western interdependence, or in Soviet dependence on the West.

Thirdly, this distinction between interrelatedness and interdependence is further brought out when account is taken of the type of international specialization or division of labor which has been developing among industrialized nations and which is envisioned by the Soviets. In an important article, in 1966, Bela Balassa argued that postwar trade among advanced European economies, especially after the founding of the Common Market, has not followed the precepts of traditional comparative cost specialization; it has been marked by intra-industrial specialization rather than inter-industrial. In discussing the consequences of a general multilateral tariff reduction, he stated:[1]

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[1] B. Balassa, "Tariff Reductions and Trade in Manufactures Among the Industrial Countries," American Economic Review, p. 469, LVI:3 (June 1966), On the role of product differentiation in the commodity composition of trade, see I. Kravis, "'Availability' and Other Influences on the Commodity Composition of Trade," Journal of Political Economy, pp. 143-155 (April 1956).

> Only a few manufactured goods (e.g., steel ingots, nonferrous metals, paper) traded among the industrial countries are standardized commodities, while the large majority are differentiated products... In the presence of national product differentiation, multilateral tariff reductions may lead to an increased exchange of clothing articles, automobiles, and other consumer goods, for example, without substantial changes in the structure of production. Further, the expansion of trade in machinery and in intermediate products at a higher level of fabrication ... may entail specialization in narrower ranges of products rather than in the demise of national industries. These changes, then, would involve intraindustry rather than interindustry specialization.

This leads to different conclusions about the advantages of trade. The economies of scale resulting from long production runs associated with narrow specialization within industrial branches replace the more general productive efficiency advantages which in the traditional explanation result from intersectoral specialization.

Soviet trade authorities have long stressed the principle of intra-industrial specialization. It is reflected in the 1962 CMEA "Basic Principles of International Socialist Division of Labor,"[1] and it is emphasized in discussions of contemporary capitalist trade and development, and in discussions of the expansion of Soviet trade with the West.[2] It is a very important principle, for it means, as Balassa indicated, that trade between countries can expand without necessitating substantial changes in the internal structure of production of the trading partners.

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[1] M. Kaser, Comecon, p. 194 (London, 1965). See also articles by P. Ivanov, Kommunist, pp. 74-81, 1964:18 and N. Zotova, Planovoye khozyaystvo, pp. 66-70, 1967:1, cited in C. H. McMillan, "Soviet Specialization and Trade in Manufactures," Soviet Studies, p. 529, XXXIV:4 (April 1973).

[2] M. Maksimova, op. cit., Ch. 2; M. Maksimova, "Vsemirnoye khozyaystvo i mezhdunarodnoye ekonomicheskoye sotrudnichestvo," Mirovaya ekonomika i mezhdunarodnyye otnosheniya, pp. 13-14, 1974:4; Patolichev in Pravda (27 December 1973).

If the principle of intra-industrial specialization were pursued in Soviet-Western trade, this would again mean that the Soviets could increase their international interrelatedness with little immediate danger of becoming dependent upon capitalist nations.

The Soviet Union is not looking for these same sorts of economic relationships with less developed countries. Such relationships with LDCs could not be justified by marginal improvements in Soviet economic performance or by benefits of intra-industrial specialization, given the very different levels of economic development.

The implications of Scenario Two are then quite different from those of Scenario One. Instead of another periodic Russian expedition into the international economy, the expectation would be a greater and more lasting Russian involvement in the international economy. It would also be expected that the Soviets would press for intra-industrial trade, and would thus try to develop the production of exportable manufactured goods of a relatively high level of fabrication, rather than continue to rely on their traditional raw material exports.

Though Scenario Two may appear radically different from past Russian experience, it is not totally so. During the period 1905-13, the traditional Russian, state-dominated, inwardly focused pattern of development did show signs of giving way to the more general, international involvement pattern of Western industrialized nations. After 1903, with the removal of Witte, the Russian state withdrew from its role as initiator of economic development. Its place was taken over by Russian banks who began to perform managerial and entrepreneurial functions, and who also began to take over these functions from foreign managers, leading to a process of Russification of industrial management. With the encouragement of the banks, cartels and syndicates were formed giving the banks and a growing group of Russian industrialists significant control over the Russian economy. These bankers and industrialists, while supporting the need for the Russian economy to become independent in crucial areas of manufacturing,

opposed as medieval the "desire to shut oneself off from the world by a Chinese Wall."[1] They advocated that Russia follow the path marked out by the advanced nations of the West, and they called for the development of foreign markets for the products of Russian industry.[2] During the 1905-13 period, Russian trade increased significantly and Russian banks and corporations began to participate in West European capital markets.[3]

This process was cut off by the Communist Revolution and the return to inwardly focused economic development under the Soviets. Scenario Two argues, now that the Soviet economy has attained a level of development which assures national independence, the underlying forces which gave rise to the short, pre-revolutionary period of growing Russian international interrelatedness may again move the Russian economy in that direction.

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[1] R. A. Roosa, "Russian Industrialists Look to the Future: Thoughts on Economic Development, 1906-17," p. 201.

Ibid., pp. 202, 204.

[2] M. Miller, op. cit.; O. Crisp, "Russia 1860-1914," in R. Cameron, ed., Banking in the Early Stages of Industrialization, pp. 183-238 (New York, 1967); and J. McKay, Pioneers for Profit: Foreign Entrepreneurship and Russian Industrialization 1885-1913 (Chicago, 1970).

3. Foreign Trade as an Instrument of National Purpose

Top decisionmaking power in the Soviet Union is concentrated in the leadership of the Communist Party. Due to this concentration, foreign trade policy can be formulated not only as an instrument of economic purposes, but as an instrument in the overall orchestration of national purposes.

Thus, Soviet trade patterns are a result of economic and strategic considerations. A decade ago, almost two-thirds of Soviet trade was with CMEA nations. In recent years, this share has been consciously decreased. If this decrease continues, whether due to changing relationships within the CMEA, or in reaction to changing world-CMEA price ratios, the Soviets will become more active in Western markets.

Soviet trade agreements and credit extension are also instruments of overall strategic policy. These practices can ensure access to markets, particularly in LDCs, and may serve as a competitive advantage. Such a course may be pursued for other than economic purposes.

Lastly, an export drive could be launched as an instrument of national purpose. This could result from a desire to gain prestige, to acquire influence, or to importune a Western country. This could be accomplished in a product area where national purpose was high, regardless of economic loss, regardless of the considerable effort required to penetrate that competitive market. This sort of drive could not, however, be pursued across the board, for the economic costs would be prohibitive.

4. Hard Currency Strategy

In designing the future role of foreign trade in the Soviet economy, planners must, if the option is taken to maintain international economic relations over the long run, formulate a strategy to obtain additional sources of hard currency earnings.

In the short run, the Soviets appear to be able to earn sufficient hard currency funds to pay for their desired flow of current imports (although the economic recession in the West has apparently reduced Soviet hard currency exports). This is not true, however, for the long term given an expanded pattern of interrelatedness. The past record of Soviet (and Russian) exports shows a consistent dominance of raw materials. One possible element of a hard currency strategy, then, would be the development of the raw material export base. Even more effective, however, would be a movement to a higher stage of fabrication of those materials (e.g. wood pulp and paper instead of timber), the value added thus gaining for the Soviets higher hard currency earnings.

Another possible element of strategy would be the exercising of what might be called a dual external/internal option.[1] That is, contrary to a commonly held view, the Soviets might well try to generate exports of a product for which internal demand is very high rather than using the entire output to meet the high internal demand. If the attempt to export the product should fail, the investment in expanded productive capacity would still be justified because of the high domestic demand. Such a strategy would have great appeal given the risk-averting nature of the Soviet, or any, bureaucracy.

D. Specific Factors Bearing on the Soviet Ability to Compete

1. Ability to Absorb and Maintain Advanced Technology

As indicated above in the brief history of past Russian borrowing of Western technology, the Russians have had trouble in fully assimilating advanced technology and have been particularly weak in maintaining technology at world levels. Certain aspects of the situation under the Soviets

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[1] An important contribution to our thinking about this possible approach by the Soviets to generating hard currency was made by Ms Margaret Dray, of the interagency working group that monitored this study.

have been amply discussed in the literature on the Soviet economy. We will mention these briefly and will add some additional observations which will help explain Russian difficulties in evidence also before the Revolution.

Among the Soviet economic institutions which affect the ability of the economy to absorb, master, and create new technology, the one which has received primary emphasis in both the Western and Russian literature on the Soviet economy is the managerial incentive mechanism that has more or less dominated the Soviet scene since the 1930s. Since 1965, the Soviet economy has undertaken certain economic reforms, including the material incentive system, and while the picture is not totally clear, the incentive mechanism is still based on the fulfillment of performance targets. In any situation such as this there are two ways of assuring success or increasing the possibility of success: (1) performance, and (2) keeping that target within reasonable distance. The second aspect of target-type rewarding is detrimental to the innovation process. Innovation always involves risk. The compensation for risk, contained in the reward for possible over-plan fulfillment, is reduced by the fact that success today will mean a higher target tomorrow, and success in the system requires the rather regular meeting of targets. Thus, managers resist innovation and try to keep targets low. There is much discussion in the Soviet Union on how to get around this problem, but nothing very effective has been introduced so far. Professor David Granick, in a recent SRI study,[1] argues that, indeed, nothing very effective should be expected. He maintains that attempts to improve Soviet technology assimilation through the modification of specific forms of success indicators, cost sharing and pricing devices, and the length of the plan time period against which enterprise results are evaluated will at best have limited results. For they are primarily cosmetic. What is necessary is to change the basic managerial philosophy, to move from making managerial income

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[1] D. Granick, Soviet Introduction of New Technology: A Depiction of the Process, SSC-TN-2625-7, SRI/Strategic Studies Center (1975).

and promotion rewards direct and immediate functions of measurable objective performance indicators,[1] to a system where these rewards are decided upon by superiors, using subjective evaluation criteria. The latter is the system used in East Germany and in many capitalist economies including the United States. Soviet leaders, Granick argues, could adopt this approach without doing violence to their socio-political beliefs and without running the major economic and political risks of radical economic reform. However, there is nothing in the Soviet literature to indicate that such a change in managerial philosophy is in the offing.

A second factor involves the organization of research and development (R and D). A great deal of effort is put forth on research and development in the Soviet Union, but to a large extent it is separated from production, and insufficient attention is paid to development in comparison with research. As a result, a fair amount of new technology is generated, but the implementation and the diffusion of it are limited. For the reasons just discussed; the managers of industrial enterprises try to avoid incorporating new technology because it will cause problems and will not lead to sustained rewards. Thus, simply giving the control of R and D to the production managers is not an acceptable solution, since the expectation is that they will not encourage the development of new products and processes. One of the reforms currently underway, the creation of large "scientific production associations," offers the promise of bringing the Soviet organizational relationship between research, development, and production into line with the pattern dominant in the West. In this regard, it appears that the practice is to have a scientific institute as the managerial unit in the association, so as to give primacy to technical change as an objective. Whether this will have significant results, operating within the present incentive, planning, and control environment, is difficult to say, though it might be considered one of the more promising current reforms.

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[1] This is essentially Taylorism, which was originally designed to increase the direct productivity of semiskilled workers, not the administrative and innovational activity of managers.

Third, the technology transfer process is primarily a people-process. That is, technology is best transferred from firm to firm and from country to country by people (managers, engineers, sales engineers, etc.) rather than by publications (including blueprints) or products themselves. The Soviets have, in the postwar period, concentrated on the latter approaches while making minimal use of the former. Currently, however, they appear to be paying more attention to the people part of the process. The people process has played a large role in the implementation of recent country-to-country scientific and technological cooperation agreements which facilitate the exchange of personnel as well as information between the USSR and the West.

Related to this, but also directed toward increasing Western interest and participation in effective technology transfer to the Soviet Union, is the current Soviet discussion of new forms of industrial cooperation with Western businesses. As Kosygin recently stated, "We are convinced that for the realization of such cooperation there can be found various organizational forms which would be to the interest of all participants."[1]

The elements discussed so far have related to Soviet institutions and practices. But the Russians under the Tsars also had trouble mastering modern technology and maintaining its dynamic change. What common elenents in the pre- and post-revolutionary Russian scene may explain these common difficulties?

One such factor concerns the creative destruction aspect of technical change--that is, when something new is done and it is successful, the old is destroyed. In a politicized, bureaucratized economy, such as existed under both the Tsars and Communists, those who operate the existing types of activities are much better able to protect themselves against the threat of new types of activities and new technologies. One of the operational advantages of a private enterprise system is that the destruction of the old is not internalized within the state decision sector. The

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[1] Kosygin at November 1971 meeting of the Supreme Soviet in Gosplan SSSR, op. cit., p. 56.

price paid for new technology is absorbed by individual elements in the society rather than the society as a whole.

In the Soviet Union, and in Tsarist Russia, creative destruction has been limited by the bureaucracy; this has been an important and difficult aspect of the whole process of technical change in the Russian economy. In general, bureaucracies tend to exhibit a high degree of risk aversion and ability to protect themselves against the pains of change. Established bureaucratic rules hamper change and experimentation with new forms. Bureaucracies tend to penalize failure more than they reward innovational success. Bureaucracies tend to favor large-scale output--this has always been true in Russia--and large-scale output itself increases the cost of change. Finally, bureaucracies establish firm lines of administration preventing "invasion" of a stagnant branch by groups from a more dynamic branch. Such "innovation by invasion" has been a significant source of technology diffusion in the West.

Furthermore, the absence of a threat of bankruptcy in the non-competitive Soviet economy has its effect. In competitive economies, the innovational process responds in a positive way to high rewards for successful innovation; it also responds to the fear of being driven out of business by dynamic competitors. Indeed, the spur to innovation from the latter is probably stronger than the former. The absence of defensive innovation from the Soviet economy thus removes an important contribution to technical change.

Frequently, dynamic men do appear in leadership positions in a bureaucracy who press for change. While they may enjoy some success through the exercise of their power, they are not at the production level, and thus their influence over day-to-day operations is limited.

A final factor in the Soviet picture is that the Soviets have primarily imported foreign technology for domestic purposes rather than for exports which would have to be internationally competitive. Thus, once the new technology was in place, there was no pressure on those

using it to keep it up to changing foreign levels, and the technology languished. This was also important in the Tsarist period. The success experienced by the Japanese in developing a self-sustaining technological advancement through the import of technology for international competitive purposes highlights the influence of the purpose of imported technology. The extent to which foreign technology is imported by the Soviets and financed through a buy-back arrangement, then, may well influence the success in maintaining the currency of technology since this production must be marketed in the West.

2. Soviet Economic Processes and Foreign Trade Practices

The Soviet ability to compete with U.S. firms in foreign markets will vary with the nature of the product being traded, in terms of the characteristics of competition in that market compared with the characteristics of Soviet economic and foreign trade practices. In brief, the Soviets will have the best chance of being competitive in those products where quality differentials are not significant, and which can be produced under standardized, mass production methods (which in a sense represents the Soviet Union's comparative advantage). These types of products are primarily raw materials and basic industrial commodities.

The Soviet Union has an added advantage in these same types of commodities, since price considerations are critical in their sale. Soviet trade practices do not require a direct calculation of profit on foreign trade sales and, in any case, it is difficult to establish a direct relationship between internal Soviet prices and external prices. While the ability to undercut the world prices due to bureaucratic foreign trade pricing gives the Soviets a competitive edge where price is a key variable, Soviet trade policy cannot treat all goods as "loss leaders." Overall export planning requires thinking in terms of opportunity costs. Given the weaknesses of the Soviet price system, this is difficult for a Soviet bureaucrat to do. It offers one explanation of why the practice of being hard bargainers, coupled with the willingness to drop prices when necessary, has developed among Soviet foreign trade officials.

Where quality is an important characteristic of competitive advantage, however, the Soviets will be at a disadvantage. Poor quality standards are the rule in the Soviet economy, outside the high-priority defense sector, as a result of the absence of internal competition and the constant pressure of excess internal demand which have led to the continual presence of a "sellers' market" condition in the Soviet economy. These same conditions have led Soviet producers to be insensitive in general to the needs of the users of their products. Given the sellers' market, the Soviet producer does not have to worry about being able to sell its output. It is able to concentrate its efforts on procuring its needed inputs and making sure it is able to meet its production and established sales targets. Among other things, this accounts for the Soviet firms' greater aversion to innovation in products than in processes. Under the conditions stipulated, a producing firm has little incentive to improve its product in order to make it more useful to the purchaser. This is a decided disadvantage in international markets where design of products and services to the specific requirements of purchasers is a key to competitive advantage.

Spare parts, maintenance and other forms of after-sales support services are not at all well developed in the Soviet economic system. In areas where time constraints make equipment down-time very costly for the user, after-sales support plays a major role in the choice of an equipment supplier. The Soviets will, again, be at a disadvantage in competition in these markets.

A number of product markets are dominated by rapid technological change. The Soviet economic processes which inhibit rapid technological advance have been outlined above. Furthermore, the intervention of the cumbersome foreign trade bureaucracy between the Soviet firm and its Western trading partner adds a further handicap. In these markets, perhaps more than anywhere else, the Soviets will be at a competitive disadvantage.

E. Conclusions

In drawing some brief conclusions from the analysis presented in this chapter, we begin with the possible impact and observation of Scenarios One and Two. While the working out of the differences between the two scenarios are long-run phenomena, Soviet behavior in the medium run (10 years) will be affected by which scenario is dominant. For example, to the extent that Scenario One is currently felt by Soviet leaders to be dominant, major decisions in regard to long-term hard currency earnings will be put off and reliance will be placed on the current composition of exports. However, it is wrong to view Soviet policymaking as a monolithic, totally centralized process. Within a dominant environment of Scenario One, some appearances of Scenario Two are possible, especially in regard to intra-industrial specialization and the external/internal options strategy.

A second conclusion concerns the difference between interrelatedness and interdependence. Decisionmaking in regard to Scenario Two involves the former rather than the latter, although, in the long run, aspects of the latter might develop.

Third, it is sometimes argued that central planning itself inhibits trade and thus would reduce the possibility of Scenario Two. While there are some arguments in favor of this position, there are also arguments that, since under planning the entire national interest can be viewed, trade will be increased, The issue is not settled, but clearly central planning does not lead to the destruction of trade. Furthermore, trade is not as inhibited by the establishment of specific plans as some think. As Kosygin and others have made clear, plans can be adjusted to meet the changing demands and opportunities in the international market.[1]

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[1] Kosygin at November 1971 meeting of the Supreme Soviet in Gosplan SSSR, op. cit.

A fourth conclusion concerns the possible ways of observing the development of Scenarios One and Two. First, it may be said that the greater the degree of decentralization in a society, the greater the possibility that decentralized decisionmakers will pursue economic rationality and develop interrelationships with foreign economic units. Thus one sign to look for as to the emergence of Scenario Two is the degree of decentralization in regard to foreign trade that is being permitted. The recent slight increases in the role played by using ministries in import decisions is relevant here.

Another indication of the emergence of Scenario Two would be the commitment of productive capacity and R&D efforts to export purposes. According to one of the Soviet participants at the June 1975 SRI-IMEMO/IUSA Joint Symposium, the present Gosplan practice is to spread export orders widely over many producing enterprises. As a result, the enterprises have little incentive to gear up for foreign markets. Gosplan is being urged to concentrate its orders on a few enterprises, so that each will have enough interest in exports to adjust its production practices to world standards.

Closely related to this would be signing of long-term contracts not only for Western sales to the Soviet Union but for Soviet sales of manufactured products to the West. The Soviets support such long-term arrangements, at least in theory.[1] So far, however, practice is lagging.

A final conclusion concerns the process of change in Soviet policymaking. When Khrushchev visited the United States in 1959 and observed automobile traffic on American highways, he indicated that it was Soviet policy to avoid the wastes of the automobile age, that the Soviets would limit the production of private automobiles. Yet a decade later that

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[1] Soviet economists appear to be very concerned about the possible communication of Western instability to the Soviet economy as a result of increased economic relations with the West. And they are searching for methods to reduce this danger.

policy was changed. It can be argued that the imperatives of industrialization, in this case the obvious fact that Soviet industry could have the capacity to mass produce automobiles plus the workings of the "demonstration effect" on Soviet demand (especially elite demand), led to the alteration of Soviet policy.

In similar fashion, it can be argued that, while it may well be true that most Soviet leaders today are supporting expanded economic relations with the West with Scenario One in mind, there are forces at work moving Scenario Two forward. As time passes, more members of the Soviet decision-making strata will become involved in economic relations with the West. To the extent that they are successful relations, these decisionmakers will benefit directly in their own work. Given a long enough period without a major world crisis breaking East-West relations, the size of this group may approach a critical mass. As the environment of Scenario Two takes hold, increasing priority will be given to overcoming Soviet economic and trade weaknesses in order to make Soviet products more competitive on world markets. The full development of Scenario Two is not expected within the 10-15 year period but the shift toward that Scenario may have important consequences in the 1975-85 time frame even beyond Soviet trade competitiveness.

IV SOVIET TECHNOLOGY REQUIREMENTS

A. Methodology and Sources

The purpose of this chapter is to identify areas in which the Soviet Union may benefit from foreign technology (U.S. in particular) by examining economic activity rather than merely licensing in order to include the broader range of activities for technology acquisition. To accomplish this, two surveys were made: the first of Soviet contracts and agreements for imports of U.S. technology from 1970 to September 1974;[1] and the second of technologies imported by the USSR from France, Great Britain, Italy, West Germany, and Japan in 1974. The purpose of the second survey, conducted in considerably less depth than the first, was to compare the general pattern of technology acquisition and trade with Europe and Japan with that of the United States.

This study was originally to span the 1975-80 time period. However, as research progressed it was concluded that the impact of imported technology would be realized more in the 5-10 year period, given the lead times necessary for importation, adaptation, production, and introduction of new equipment or processes. The focus of the study was changed accordingly.

The data on Soviet contracts and agreements for imports of U.S. technology are not available in any one source. The principal sources are threefold: (a) U.S. Government agencies, (b) private research or consulting groups, (c) Soviet and U.S. publications. Among the Government agencies which provided data were the Bureau of East-West Trade and other divisions of the Department of Commerce, the Library of Congress, the Office of Economic Research of the CIA, the Office of Science and Technology of the State Department, and the National Science Foundation. Private agencies contacted include the U.S.-USSR Economic and Trade Council, the Hudson Institute, and the National Association of Manufacturers.

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[1] Due to the necessary role that this survey played early in the conduct of the study, the information cut-off date was September 1974.

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The third source, English and Soviet scholarly or technical publications, required a systematic search through issues dating from 1970 to 1974. Particularly useful were recent issues (since 1972) of such publications as Business International's East European Report, East-West Markets put out by Chase World Information, Soviet Business and Trade put out by Porter International and Tass, and the Moscow Narodny Bank Press Bulletin.

B. Overview of U.S.-USSR Trade and Economic Relations

Ample evidence exists of increasing Soviet interest in expanded trade relations especially with countries in the developed West. During 1960-74, Soviet foreign trade grew from $11.2 billion to $52.3 billion (see Figure IV-1). Trade with the developed West, which was only 18 percent of total Soviet foreign trade in 1960, now comprises 31 percent of the total, primarily at the expense of the shares of Eastern Europe and other communist countries whose shares have fallen from 73 percent to 54 percent. The signing of the Basic Principles of Relations between the U.S. and the USSR in May 1972 is the point from which recent significant trade expansion and liberalization of economic relations can be noted. At the same time and subsequently, a series of major government-to-government agreements were signed, covering three basic areas: grain, science and technology and commercial relations. Figure IV-2 charts the volume of USSR trade with the United States and indicates substantial growth since 1971.[1] Although the Soviet Union abrogated the trade agreement in January 1975, their tone seemed to imply that this was a temporary setback, and orders which will result in future trade are continuing.

The total volume of U.S.-USSR trade in the 1950s was below $50 million per year. In the years from 1960 to 1968, it remained below $110 million per year except in 1964 when total trade turnover was $167 million ($146.4 million of which were Soviet imports), due primarily to large grain

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[1] The 1973 peak of Soviet imports from the U.S. represents the high deliveries of grain purchased in the summer of 1972. Soviet imports in 1974, although lower than in 1973, are above the 1972 level.

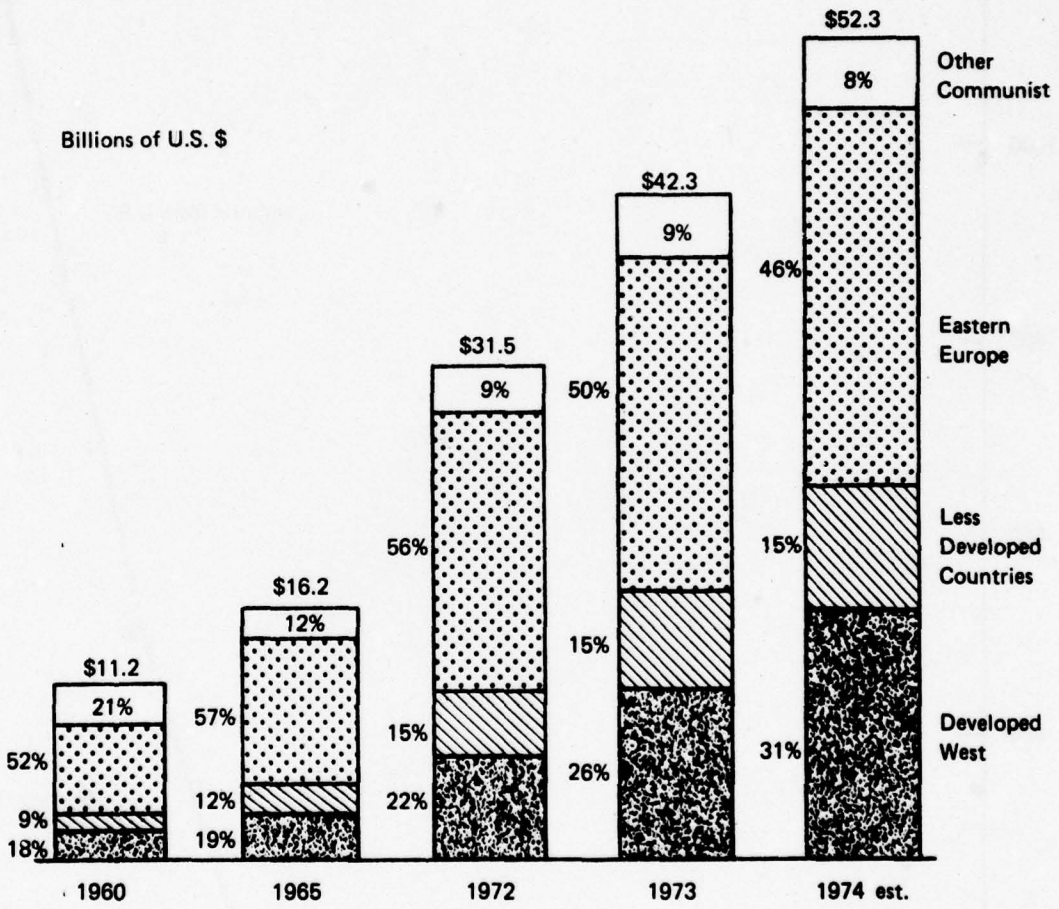


Figure IV–1 USSR: FOREIGN TRADE, BY MAJOR AREA
EXPORTS PLUS IMPORTS

Source: The Soviet Economy: 1974 Results and 1975 Prospects, CIA Research Aid, A(ER) 75–62, March 1975, p.15.

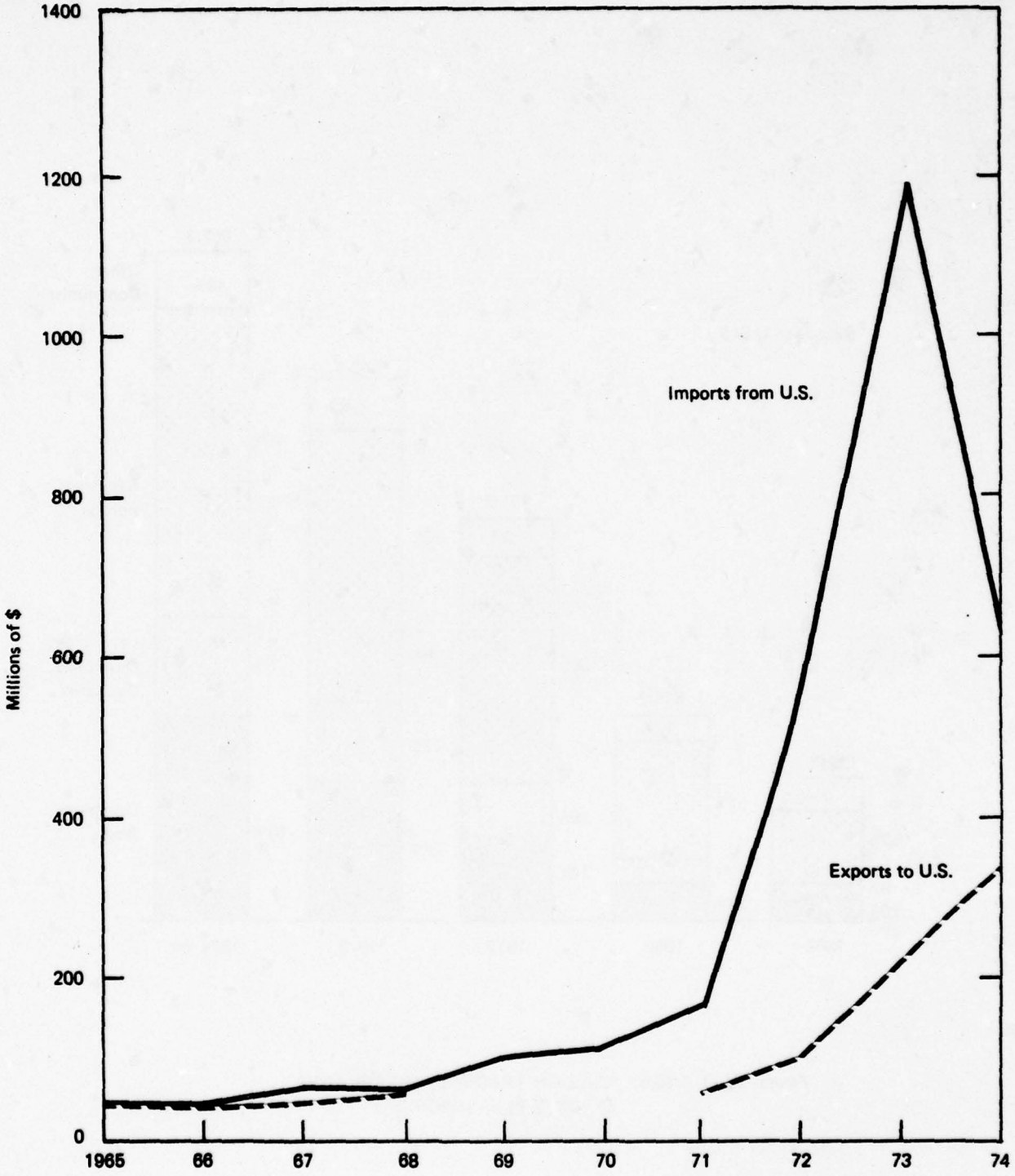


Figure VI–2 USSR TRADE WITH THE U.S. 1965–1974

Source: Selected Trade and Economic Data of the Centrally Planned Economies, U.S. Department of Commerce Domestic and International Business Administration, Bureau of East-West Trade, 1975, p. 12.

imports by the Soviets.[1] During this period, U.S. exports to the USSR averaged $58.5 million, compared with $2.4 billion average annual exports from all noncommunist countries. U.S. imports from the Soviet Union during this period averaged $34.7 million, compared to $2.6 billion imported by the noncommunist countries as a whole.[2]

The growth in trade turnover began in 1969 when total trade reached a value of $157 million (from $116.2 million in 1968). More moderate growth occurred in 1970 and 1971, with total turnover reaching $191.0 million and $219.2 million respectively. In 1971, the United States ranked sixth of the nations from the industrialized West exporting to the USSR. In 1972, the total U.S.-USSR trade volume almost tripled, reaching $637.7 million and the United States became the Soviet Union's second largest Western exporter after West Germany. The volume of trade turnover more than doubled again in 1973, totalling $1414.8 million, $1194.7 million of which were U.S. exports, and the United States, for the first time since 1946, became Russia's largest noncommunist seller (followed by West Germany which exported $1184 million[3]). However, a large part of the increase in 1972 and 1973 was due to Soviet grain and soybean imports from the U.S. which totalled approximately $334 million in 1972 and $836 million in 1973, as seen in Table IV-1. Nonetheless, when grain exports are subtracted from total exports, a steady increase is indicated. In 1974, primarily because of the decrease in these shipments, total trade turnover fell to $959.4 million, $609 million of which were U.S. exports. When figures for grain shipments in 1974 are subtracted, exports show a small decline, from $358 million in 1973 to $332 million in 1974. However, by June 1975, in spite of the USSR's decision in early 1975 to

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1 International Economic Report of the President, p. 101 (Washington, D.C.: U.S. Government Printing Office, February 1974)

2 "Background Materials Relating to the United States-Soviet Union Commercial Agreements," prepared for the Committee on Finance, United States Senate, p.1 (Washington, D.C.: U.S. Government Printing Office, 1974).

3 Marshall Goldman, "American-Soviet Trade," SSC-IN-75-14, SRI/Strategic Studies Center (July 1974).

Table IV-1

U.S.-USSR FOREIGN TRADE*
(Millions of U.S. dollars)

	Total USSR Imports from the U.S.	USSR Imports of Grain from the U.S.	Total USSR Imports from the U.S. less Grain Imports	USSR Imports of Food from the U.S.	Total USSR Imports from the U.S. less Food Imports	Total USSR Exports to the U.S.	Total U.S.-USSR Turnover
1950	0.8					38.3	39.1
1951	0.1					27.5	27.6
1952	Negligible					16.8	16.8
1953	Negligible					10.8	10.8
1954	0.2					11.9	12.1
1955	0.3					17.1	17.4
1956	3.8					24.5	28.3
1957	4.6					16.8	21.4
1958	3.4					17.5	20.9
1959	7.4					28.6	36.0
1960	39.6					22.6	62.2
1961	45.7					23.2	68.9
1962	20.2					16.3	36.5
1963	22.9					21.2	44.1
1964	146.4	110.0	36.4			20.7	167.1
1965	45.2					42.6	87.8
1966	41.7			.1	41.6	49.6	91.3
1967	60.3			.3	60.0	41.2	101.5
1968	57.7			.9	56.6	58.5	116.2
1969	105.5			1.2	104.3	51.5	157.0
1970	118.7			2.3	116.1	72.3	191.0
1971	162.0	14.3	147.7	16.9	145.1	57.2	219.2
1972	542.2	334.1	208.1	365.8	176.4	95.5	637.7
1973	1,190.0	836.4	353.6	842.7	347.3	214.8	1,406.1
1974	609.2			242.3	366.9	350.2	959.4
(Jan-June)	315.6					187.7	503.3
1975 (Jan-June)	521.2					133.8	655.0

* *Data from International Economic Report of the President*, February 1974, p. 101, IMF Direction of Trade, November 1974, and East-West Trade, Export Administration Report, U.S. Department of Commerce, 2nd qtr.1973, 1st qtr. 1974, 4th qtr. 1974. Defense Hearings before the Subcommittees on Europe of the Committee of Foreign Affairs, U.S. House of Representatives, May, June, July 1974, p. 248. Values have been rounded.

abrogate the trade agreements, trade appeared to be growing again, reaching a level of $655.0 million, compared to $503.3 million for the same period in 1974. Of course, 1975 shipments result from contracts signed earlier, so the impact of the abrogation of the trade agreements did not show up in the data.

Tables IV-2 and IV-3 show the growth patterns of major USSR imports and exports from and to the U.S. In general, the trend has been toward substantial growth in Soviet imports of machinery, both electric and non-electric, in transport equipment, and, since 1974, in chemicals. (From January to June 1975, U.S. exports of chemicals to the Soviet Union were $26.0 million, compared to $11.1 million for the same period in 1974).[1] In 1974, the USSR ordered $4.1 billion worth of Western machinery and equipment as well as $2.5 billion worth of large-diameter pipe for oil and gas pipelines,[2] indicating continued future growth of imports in these industries. Included in the Soviet orders for machinery and equipment were $765 million in contracts for mining and construction equipment (38 times the 1973 level) and $1.1 billion in equipment for the chemical industry.[3] Other items ranking high on the Soviet trade lists are agri-business and agricultural products, computers, energy extraction and processing equipment, mass production equipment such as foundries for truck production, and transportation equipment of all kinds.

Although the USSR can find most of what it wants to purchase in West European and Japanese markets, it is still turning to the United States for a number of high technology goods, especially computers and electronic

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[1] U.S. Trade Status with Socialist Countries, Trade Analysis Division, Bureau of East-West Trade, U.S. Department of Commerce, p. 11 (13 August 1975).

[2] The Soviet Economy: 1974 Results and 1975 Prospects, CIA Research Aid, A(ER) 75-62, p. 17 (March 1975).

[3] Ibid.

TABLE IV–2

TOP 10 USSR IMPORTS FROM THE U.S. (1974)[1]
(Millions of Dollars)

SITC	DESCRIPTION	1972	% of Total	% of Total Grain	1973	% of Total	% of Total Grain	1974	% of Total	% of Total Grain	% Increase 1973–1974
04	Cereals & Prep. of Cereals, Flour	368.9	68.0	–	836.7	70.0	–	277.9	45.6	–	.75
71	Machinery, non-electric	53.4	9.8	25.7	181.9	15.2	50.8	188.2	30.9	56.7	3.52
72	Electric Machinery and Equipment	7.2	1.3	3.5	14.5	1.2	4.0	27.6	4.5	8.3	3.83
51	Chemical Elements and Compounds	18.0	3.3	8.6	10.0	0.8	2.8	14.2	2.3	4.3	.79
21	Hides, Skins, Furskins –Undressed	10.4	1.9	5.0	1.0	0.1	0.3	12.4	2.0	3.7	1.2
89	Misc. Manufactured Articles	6.8	1.2	3.3	6.3	0.5	1.8	8.8	1.4	2.6	1.3
73	Transport Equipment	1.4	0.3	0.7	8.0	0.7	2.2	8.8	1.4	2.6	6.3
05	Fruits and Vegetables	1.1	0.2	0.5	4.7	0.4	1.3	8.4	1.4	2.5	7.6
62	Rubber Mfgs – Finished & Semifinished	1.9	0.4	0.9	4.9	0.4	1.4	8.1	1.3	2.4	4.3
67	Iron and Steel	.2	0.0	0.1	13.9	1.2	3.9	7.8	1.3	2.4	3.9
	Total USSR Imports from U.S.[2]	542.2			1194.7			609.2			1.1
	Total Less Grain Only[2]	208.1			358.3			331.8			1.6

1 Source: Selected Trade and Economic Data of the Centrally Planned Economies, U.S. Department of Commerce, Domestic and International Business Administration, *Bureau of East-West Trade*, 1974, p. 13.

2 Grain figures taken from Table 1 and are only a portion of SITC 04 (Col 1).

TABLE IV–3

TOP TEN EXPORTS TO THE U.S. (1974)[1]

(Millions of Dollars)

SITC	DESCRIPTION	1972	% of Total	1973	% of Total	1974	% of Total	% Increase 1972–1974
68	Nonferrous Metals	46.6	48.8	93.8	42.6	186.9	53.4	4.0
33	Petroleum and Petroleum Products	7.5	7.8	75.6	34.4	103.4	29.5	13.8
66	Nonmetallic Mineral Manufactures	15.6	16.3	20.6	9.4	13.6	3.9	0.9
28	Metal Ores and Metal Scrap	14.1	14.8	6.0	2.7	12.2	3.5	0.9
51	Chemical Elements and Compounds	1.1	1.2	1.7	0.8	8.3	2.4	7.6
21	Hides, Skins, Furskins – Undressed	3.0	3.1	3.1	1.4	4.7	1.3	1.6
89	Misc. Manufactured Articles	2.8	2.9	3.6	1.6	3.4	1.0	1.2
59	Chemical Products and Materials, NES	.0	–	.5	0.2	2.4	0.7	–
32	Coal, Coke, & Briquets	.0	–	.0	–	2.4	0.7	–
56	Fertilizers and Fertilizer Materials	.0	–	.0	–	1.5	0.4	–
	Total USSR Exports to U.S.[2]	95.5		220.1		350.2		

[1] Source: Selected Trade and Economic Data of the Centrally Planned Economies, U.S. Department of Commerce, Domestic and International Business Administration, Bureau of East-West Trade, 1974, p. 13.

[2] Figures taken from Table 1.

equipment. Soviet interest in U.S. technology apparently results from a variety of reasons:

- In some areas, such as computer technology, the U.S. clearly possesses the most advanced and thus the most desirable technologies;
- In many instances, the Soviets would prefer to purchase a whole package from one place rather than from an international consortium;
- The U.S. has a successful history of mass production for large markets;
- The Soviets are interested in building on a large scale and the U.S. is often the only place which can supply the capital necessary to finance the projects the Soviets desire; however, without the help of the Export-Import Bank, the ability of the U.S. to extend requisite credit magnitudes is questionable.
- The added psychological effect of two giants dealing with each other, implying acceptance of the USSR as an economic superpower, also enhances the appeal to the Soviets of doing business with the United States.

C. Soviet Imports of U.S. Technology and Goods

A survey was made of contracts and agreements signed by the Soviets and U.S. companies between 1970 and September 1974. (See Appendix) It must be noted that a distinction should be made between identification of contracts and agreements signed and actual measurement of the quantity and value of trade flows between the two countries. Such an unweighted measure as number of agreements only indicates areas of interest, providing a profile of possible future economic activity; it does not measure actual trade nor does it provide a quantitative measure of relative interest. These unweighted numbers were chosen because dollar values were not consistently reported in the source material. The data have been arranged in two formats in the Appendix. First the U.S. companies involved are listed alphabetically and second, the technologies are listed by Standard Industrial Classification (SIC) number. Both

sets of tables contain a brief description of the product being exported or the terms of the agreement signed, an approximate dollar value which usually indicates the potential value of the deal to the Western partner, and sources. Because of the nontechnical descriptions of the terms of contracts and agreements in the source materials, some of the technologies may have been misclassified or a major project may have been misrepresented in the survey by having only part of its SIC profile categorized. For example, technologies in an agreement signed by one company may cover a variety of SIC areas which, due to the limitations of the data assembled for this study, may not all have been pinpointed.

The results of the survey, summarized in Table IV-4, show that of the almost two hundred contracts and agreements documented during the time period, the majority (135) came under the category of nonelectric machinery to be used in numerous sectors of the industry. Within this major group, large numbers of agreements were signed for such industries as metalworking machinery and equipment (36), construction, mining, and materials handling machinery and eqiupment (29), general industrial machinery and equipment (25), special industry machinery except metal-working (20), and office and accounting machines (13). A further subdivision indicates that the technologies for which agreements were signed cover such diverse areas as automotive equipment (especially for the Kama River truck plant), agricultural equipment, earthmoving equipment, oilfield equipment, foundry equipment, food-processing equipment, textile equipment, chemical equipment, and medical equipment. The second largest major group, transportation equipment, contained only 18 contracts and agreements. In other categories 13 each were signed for fabricated metal products and electric machinery; 11 for the category containing measuring, analyzing and controlling instruments, photographic, medical and optical goods, watches and clocks, and less than 6 for the remaining classifications in which trade took place.

This study does not include the indirect transfer of technology from the U.S. to the USSR--that is, technology which is transferred from

Table IV-4

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS *

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements: SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
13	OIL AND GAS EXTRACTION			1
16	CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION--GENERAL CONTRACTORS			1
• 162	• Heavy Construction, Except Highway & Street Construction		1	
- 1623	- Water, Sewer, Pipeline, Communication and Power Line Construction	1		
20	FOOD AND KINDRED PRODUCTS			2
• 206	• Sugar and Confectionary Products		1	
- 2067	- Chewing Gum	1		
• 208	• Beverages		1	
- 2086	- Bottled and Canned Soft Drinks and Carbonated Waters	1		
22	TEXTILE MILL PRODUCTS			1
• 229	• Miscellaneous Textile Goods		1	
- 2295	- Coated Fabrics Not Rubberized	1		
26	PAPER AND ALLIED PRODUCTS			1
• 263	• Paperboard Mills		1	
- 2631	- Paperboard Mills	1		

* The survey sources were primarily nontechnical. As a result some misclassification of technology may have occurred. The information cut-off date was September 1974.

Table IV-4 (Continued)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements		
		SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
28	CHEMICALS AND ALLIED PRODUCTS			2
• 281	• Industrial Inorganic Chemicals		1	
- 2819	- Industrial Inorganic Chemicals, Not Elsewhere Classified	1		
• 282	• Plastics, Materials and Synthetic Resins, Synthetic Rubber, Synthetic & Other Man-Made Fibers, Except Glass		1	
- 2822	- Synthetic Rubber	1		
33	PRIMARY METAL INDUSTRIES			5
• 336	• Nonferrous Foundries (castings)		3	
- 3369	- Nonferrous Foundries (castings), Not Elsewhere Classified	3		
• 339	• Miscellaneous Primary Metal Products		2	
- 3398	- Metal Heat Treating	2		
34	FABRICATED METAL PRODUCTS EXCEPT MACHINERY AND TRANSPORTATION EQUIPMENT			13
• 341	• Metal Cans and Shipping Containers		2	
- 3412	- Metal Shipping Barrels, Drums, Kegs, and Pails	2		
• 344	• Fabricated Structural Metal Products		4	
- 3443	- Fabricated Plate Work (Boiler Shops)	4		
• 346	• Metal Forgings and Stampings		1	
- 3469	- Metal Stampings, Not Elsewhere Classified	1		

Table IV-4 (Continued)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements		
		SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
• 347	• Coating, Engraving, and Allied Services		1	
- 3479	- Coating, Engraving, and Allied Services, Not Elsewhere Classified	1		
• 348	• Ordnance and Accessories, Except Vehicles and Guided Missiles		1	
- 3482	- Small Arms Ammunition	1		
• 349	• Miscellaneous Fabricated Metal Products		4	
- 3494	- Valves and Pipe Fittings, Except Plumbers Brass Goods	2		
- 3497	- Metal Foil and Leaf	1		
- 3498	- Fabricated Pipe and Fabricated Pipe Fittings	1		
35	MACHINERY, EXCEPT ELECTRICAL			135
• 351	• Engines and Turbines		2	
- 3511	- Steam, Gas and Hydraulic Turbines and Turbine Generator Set Units	1		
- 3519	- Internal Combustion Engines, Not Elsewhere Classified	1		
• 352	• Farm and Garden Machinery and Equipment		5	
- 3523	- Farm Machinery and Equipment	5		

Table IV-4 (Continued)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements		
		SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
• 353	• Construction, Mining, and Materials Handling Machinery and Equipment		29	
- 3531	- Construction Machinery and Equipment	8		
- 3532	- Mining Machinery and Equipment, Except Oil Field Machinery and Equipment	5		
- 3533	- Oil Field Machinery and Equipment	9		
- 3535	- Conveyors and Conveying Equipment	3		
- 3536	- Hoists, Industrial Cranes, and Monorail Systems	3		
- 3537	- Industrial Trucks, Trailers, and Stackers	1		
• 354	• Metalworking Machinery and Equipment		36	
- 3541	- Machine Tools, Metal Cutting Types	17		
- 3542	- Machine Tools, Metal Forming Types	10		
- 3545	- Machine Tool Accessories and Measuring Devices	4		
- 3546	- Power Driven Hand Tools	1		
- 3547	- Rolling Mill Machinery and Equipment	2		
- 3549	- Metalworking Machinery, Not Elsewhere Classified	2		
• 355	• Special Industry Machinery, Except Metalworking Machinery		20	
- 3551	- Food Products Machinery	2		
- 3552	- Textile Machinery	3		
- 3555	- Printing Trades Machinery and Equipment	1		
- 3559	- Special Machinery Equipment, Not Elsewhere Classified	14		

Table IV-4 (Continued)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements: SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
• 356	• General Industrial Machinery and Equipment		25	
- 3561	- Pumps and Pumping Equipment	3		
- 3563	- Air and Gas Compressors	5		
- 3565	- Industrial Patterns	1		
- 3567	- Industrial Process Furnaces and Ovens	9		
- 3569	- General Industrial Machinery and Equipment, Not Elsewhere Classified	7		
• 357	• Office, Computing, and Accounting Machines		13	
- 3573	- Electronic Computing Equipment	10		
- 3574	- Calculating and Accounting Machines, Except Electronic Computing Equipment	2		
- 3579	- Office Machines, Not Elsewhere Classified	1		
• 358	• Refrigeration and Service Industry Machinery		2	
- 3586	- Measuring and Dispensing Pumps	1		
- 3589	- Service Industry Machines, Not Elsewhere Classified	1		
• 359	• Miscellaneous Machinery, Except Electrical		3	
- 3592	- Carburetors, Pistons, Piston Rings and Valves	2		
- 3599	- Machinery Except Electrical, Not Elsewhere Classified	1		
36	ELECTRICAL AND ELECTRONIC MACHINERY, EQUIPMENT AND SUPPLIES			13
• 362	• Electrical Industrial Apparatus		1	
- 3629	- Electrical Industrial Apparatus, Not Elsewhere Classified	1		

Table IV-4 (Continued)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements: SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
• 364	• Electric Lighting and Wiring Equipment		1	
- 3641	- Electric Lamps	1		
• 366	• Communication Equipment		6	
- 3662	- Radio and Television Transmitting, Signaling, and Detection Equipment and Apparatus	6		
• 369	• Miscellaneous Electrical Machinery, Equipment, and Supplies		5	
- 3693	- Radiographic X-ray, Fluoroscopic X-ray, Therapeutic X-ray and Other X-ray Apparatus and Tubes; Electromedical and Electrotherapeutic Apparatus	5		
37	TRANSPORTATION EQUIPMENT			18
• 371	• Motor Vehicles and Motor Vehicle Equipment		16	
- 3711	- Motor Vehicles and Passenger Car Bodies	1		
- 3714	- Motor Vehicle Parts and Accessories	10		
• 372	• Aircraft and Parts		1	
• 375	• Motorcycles, Bicycles and Parts		1	
- 3751	- Motorcycles, Bicycles and Parts	1		
38	MEASURING, ANALYZING, AND CONTROLLING INSTRUMENTS; PHOTOGRAPHIC, MEDICAL AND OPTICAL GOODS; WATCHES AND CLOCKS			11
• 381	• Engineering, Laboratory, Scientific, and Research Instruments and Associated Equipment		2	
- 3811	- Engineering, Laboratory, Scientific, and Research Instruments and Associated Equipment	2		

Table IV-4 (Continued)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements: SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
• 382	• Measuring and Controlling Instruments		7	
- 3823	- Industrial Instruments for Measurement, Display, and Control of Process Variables; and Related Products	2		
- 3824	- Totalizing Fluid Meters and Counting Devices	1		
- 3825	- Instruments for Measuring and Testing of Electricity and Electric Signals	2		
- 3829	- Measuring and Controlling Devices, Not Elsewhere Classified	2		
• 383	• Optical Instruments and Lenses		1	
- 3832	- Optical Instruments and Lenses	1		
• 384	• Surgical, Medical, and Dental Instruments and Supplies		1	
- 3841	- Surgical and Medical Instruments and Apparatus	1		
39	MISCELLANEOUS MANUFACTURING INDUSTRIES			3
• 391	• Jewelry, Silverware, and Plated Ware		2	
- 3914	- Silverware, Plated Ware, and Stainless Steel Ware	2		
• 394	• Toys and Amusement, Sporting, and Athletic Goods		1	
- 3949	- Sporting and Athletic Goods, Not Elsewhere Classified	1		
44	WATER TRANSPORTATION			1
49	ELECTRIC, GAS, AND SANITARY SERVICES			1
• 492	• Gas Production and Distribution		1	
- 4922	- Natural Gas Transmission	1		

Table IV-4 (Concluded)

SOVIET IMPORTS OF U.S. TECHNOLOGY BY SIC GROUPS

Major Group, Group and Industry Numbers	Major Heading	Number of Companies Signing Contracts and Agreements: SIC 4-Digit Subtotal	SIC 3-Digit Subtotal	SIC 2-Digit Total
50	WHOLESALE TRADE--DURABLE GOODS			1
• 508	• Machinery, Equipment and Supplies		1	
- 5081	- Commercial Machines and Equipment			1
73	BUSINESS SERVICES			6
• 731	• Advertising		2	
- 7311	- Advertising Agencies	2		
• 737	• Computer and Data Processing Services		1	
- 7372	- Computer Programming and Other Software Services	1		
• 739	• Miscellaneous Business Services		3	
- 7392	- Management, Consulting, and Public Relations Services	3		
89	MISCELLANEOUS SERVICES			2
• 891	• Engineering, Architectural, and Surveying Services		1	
- 8911	- Engineering, Architectural, and Surveying Services	1		
• 893	• Accounting, Auditing, and Bookkeeping Services		1	
- 8931	- Accounting, Auditing, and Bookkeeping Services	1		

the U.S. to Eastern or Western Europe and from there to the Soviet Union. In selected areas, this indirect route could be the means by which the Soviet Union acquires technology used to compete with the U.S. in third country markets. While transfer of technology to Eastern Europe was included in the original scope of the study, the Working Group, due to time and resource constraints, decided that the research effort would focus on the USSR alone.

D. Overview of Soviet-West European-Japanese Trade

In addition to U.S.-Soviet trade, a more limited survey was made of Soviet trade with Western Europe and Japan in 1974 (see Appendix). This survey was made in order to compare patterns of U.S.-USSR trade with those of Western Europe/Japan-USSR trade. The Appendix contains a listing of contracts and agreements by technology area and gives the company name, approximate dollar value and source. In general, a pattern similar to that observed for U.S.-USSR trade emerges. Table IV-5 summarizes the data, listing the agreements by technology area. There is heavy concentration in the metallurgy and metalworking, automotive, chemical, heavy machinery, and power industries, as was noted in U.S.-USSR trade flows. The major difference is the larger number of Soviet-West European/Japanese contracts and agreements under the headings of chemical equipment and light industry, especially synthetic fibers, textile equipment and clothing.

E. Soviet Priority Needs

Soviet imports and cooperative agreements reflect both what they actually need and what they perceive they can purchase abroad considering current foreign exchange constraints, current world prices, bilateral trade agreements, export controls, etc. However, these conditions are subject to change, in which case the Soviet shopping list may change. One way to check on possible future purchases which may impact on U.S. commercial positions within the study time frame, therefore, is to compare Soviet domestic economic priorities and problems with actual contracts and agreements and actual orders identified in the survey.

Table IV-5

USSR TECHNOLOGY IMPORTS FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY AND JAPAN IN 1974*

Industry	Number of Contracts
Automotive	18
Chemical	20
Communications	5
Construction	5
Food	10
Freight and Transport	10
Heavy Machinery	19
Instrumentation	4
Light Industry	26
(Synthetic Fabrics, Textile Equipment, Clothing)	(18)
Lumber and Paper	5
Materials Technology	8
Metallurgy and Metalworking	30
Power, Petroleum and Pipeline	14
Miscellaneous	11

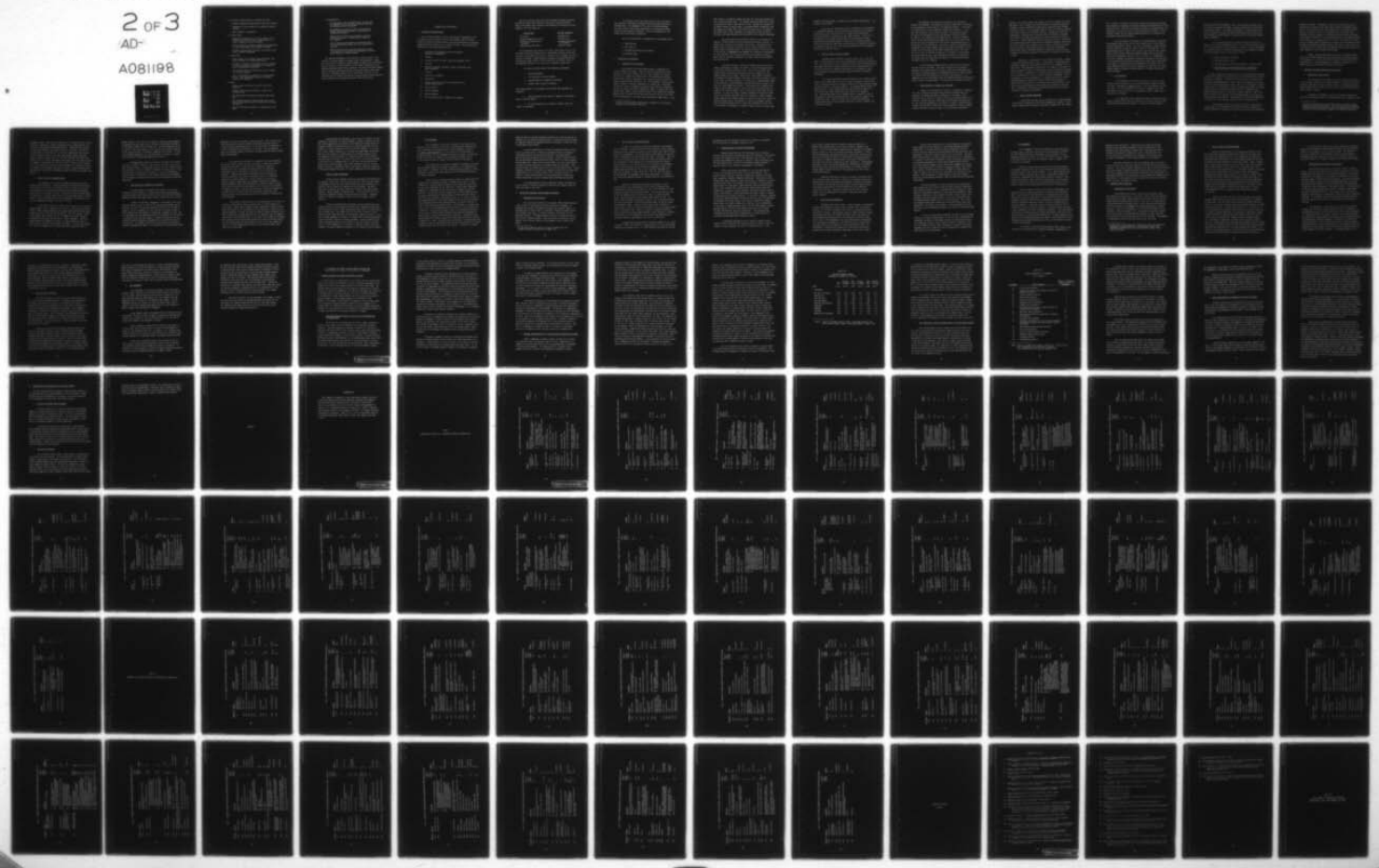
* The focus of this study has been imports from the U.S. Data on Soviet contracts and agreements with West European firms were surveyed to be sure that the Soviets were not dividing their technology sources in such a way that looking at U.S. data would lead to gross errors.

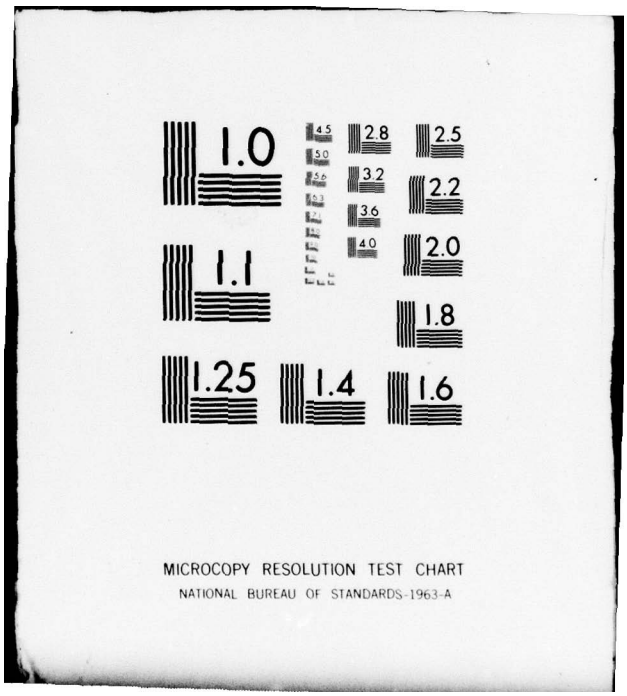
SSC's research on the Soviet economy, particularly that associated with the development of the SRI/WEFA Soviet econometric model, leads to the conclusion that there is a strong relationship between domestic economic problem areas and the recent Soviet pattern of imports and S&T agreements. Priority problems include:

- Agriculture
  - Basic contribution to standard of living; promises of leaders of rising standard of living
  - Perennial problem of sluggish growth of output
  - Cyclical bad weather causes severe harvest drops which have led to heavy hard currency expenditures on grain imports from the West
  - Substantial user of economic resources: about 30 percent of labor force and more than 20 percent of total investment
  - Plagued by low labor and capital productivity.
- Chemicals
  - A basic industry in a modern economy; chemicals used widely throughout economy (e.g., alloyed steels)
  - Fertilizers for agriculture critical to increased output in that sector
  - Man-made materials and fibers (petrochemicals)
  - Priority problems in industry and consumer goods sector
  - Soviet chemical and petrochemical industries relatively backward; modernization and expansion campaign began in mid-50s.
- Computers
  - Strategic role of information handling in the Soviet centralized economy
  - Data processing needs in planning and management intensify as economy develops
  - Myriad direct industrial uses of computers in servomechanisms, automated machinery, guidance equipment, scheduling and ticketing systems.

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- Electronics (semiconductors, integrated circuits)
  - Rapidly changing technology affects many other branches
  - Components of final products for consumers, industry, military
  - Basic component in computers.
- Consumer Goods
  - Commitment of leadership to provide rising level of consumer welfare must be met, to some extent, in order to maintain political stability
  - Present capacity to produce consumer goods insufficient and capital equipment technologically backward
  - Consumer services poorly organized, low social recognition, backward technology.
- Construction
  - Basic industry in any modern, growing economy, integrally involved in the investment process
  - Has been a consistent problem area in Soviet economy: low quality of output, low productivity, growth of stock of uncompleted construction
  - Low technical level of construction; need for modern construction equipment
  - Role of construction in expansion of transportation sector: road construction, airport and railway construction, pipelines.
- Energy
  - Domestic needs growing more rapidly than current production
  - Present energy sources operating in ranges of decreasing return
  - New sources must be developed--requires high investment
  - New technology needed to improve efficiency in production from current sources of energy and to develop new sources
  - Pipeline construction needed for transporting oil and gas.

- Transportation
  - As Soviet Union enters automobile age, critical need for expansion of auto and truck production capacity, road system, and auto facilities
  - With expansion of Soviet economy, regional spread becomes increasingly important putting pressure on transportation system
  - Massive size of Soviet Union intensifies need for efficient provision of transportation, especially air transport
  - With increased specialization of productive facilities in an advanced economy, need for transportation increases
  - Modern transportation technology important in order to reduce cost as provision of transportation services grows rapidly in a modern economy

The apparent willingness of the Soviets to import as part of the solution of priority domestic problems raises the possibility of using the "dual options" strategy to expand domestic production but concurrently export a portion of total production to test export feasibility and to generate additional hard currency earnings. For each of the above domestic priority economic problems an analysis of specific product areas would need to be undertaken, probably at the three digit SIC level, of the feasibility of the Soviets pursuing the external/internal options approach. Such an effort was not possible within the scope of this study.

V PRODUCT AREA CASE STUDIES

A. Selection of Product Areas

From a general analysis of Soviet technological requirements, both as expressed in actual import activity and through a review of Soviet economic literature, thirteen product areas were identified as potentially having significant impacts on U.S. market positions. The thirteen technology areas (listed alphabetically) are:

1. Agriculture (agribusiness and food processing machinery and equipment)
2. Alumina
3. Automotive (both for heavy trucks and passenger autos)
4. Aviation
5. Chemical production (synthetic fibers, fertilizers, and basic chemicals)
6. Computer
7. Construction equipment
8. Electronics
9. Energy production (electric power generation and nuclear power plants)
10. Forest products
11. Medical equipment
12. Mining equipment
13. Oil and gas extraction, transport and refining

After an in-process review with the interagency working group which monitors the study, four areas were selected for in-depth analysis. Within each general area a subsector was identified to receive particular emphasis. The four areas are:

General Area	Specific Subsector
Electronics	semiconductors
Aviation/commercial aircraft	wide-body jets
Construction machinery and equipment	earthmoving machinery and equipment
Chemicals/man-made fibers	synthetic fibers

The interagency group chose not to reject electronics as one of the case study areas even though there are considerable current restrictions on export of technology in this area. There are also stringent controls on aircraft technology. These areas were retained on the grounds that the working group wanted inputs to their internal-to-Government studies of the commercial aspects of U.S. policy as it applies to these areas.

For each of the four areas, four issues were addressed:

1. Product definition
2. U.S. position in the world market
3. Characteristics of competitive advantage
4. General state of Soviet technology.

From these analyses a net assessment was prepared that addressed two questions:

1. Would the Soviet Union choose to compete in this product area in the world market?

2. If the decision were to be made to compete, would the effort be successful?

The research on the first three issues of the case studies was conducted by industrial economists from the Economics Division at SRI/Menlo Park. The assessment of the state of Soviet technology was done jointly by the Soviet specialists of the Strategic Studies Center and the industrial economists. The net assessments were conducted by the SSC's Soviet specialists.

The case study material is summarized in the following order:

- Semiconductors
- Wide body jets
- Earthmoving machinery and equipment
- Synthetic fiber.

B. Semiconductor Technology

1. Description of the Product[1]

Semiconductors are solid-state switches or amplifiers for electric current and voltage. They are important components in a wide variety of electronic equipment used in private industry and defense, as well as in a number of consumer goods. The semiconductor industry produces both discrete components, e.g., signal and power transistors, signal diodes and power rectifiers, etc., and integrated circuits, which combine a number of discrete components on a single chip. Integrated circuits are loosely classified, according to the density of components per chip, as small scale (SSI), medium scale (MSI), or large scale integration (LSI). While the SSI and MSI sectors of the industry are reaching maturity, the LSI sector did not show great promise until the late 1960s with the development of the metal-oxide semiconductor (MOS) device. Since

[1] In this study, the industry described is designated by the Standard Industrial Classification number 3674.

1968, however, the MOS/LSI industry has been one of the most dynamic factors in the electronics area. U.S. MOS/LSI production grew from a figure of $6 million in 1968 to $554 million in 1974. Because of the growth in the MOS/LSI sector in recent years, and because MOS/LSI technology is being sought by the USSR, this sector served as the focus of the analysis. The Soviet Union is also interested in acquiring all types of bipolar technology and light emitting diode and liquid crystal display technology.

The major products of the MOS/LSI industry are semiconductor memories, microprocessors, and other dedicated functional circuits, i.e., random logic circuits for specialized application. Chip production is highly capital intensive and complex, and is usually performed in the United States or Western Europe. The assembly process, on the other hand, in which chips are aggregated into packages for inclusion in end-products is labor intensive and is often performed in less developed countries, where labor is relatively inexpensive and where certain tariff benefits are often derived.

Production process technology for MOS/LSI devices consists of design, fabrication, assembly, and testing. The silicon planar process is the basic technique currently in use. The circuit is drawn, and reduced copies are made into photomasks which are aligned to a thin, highly polished silicon wafer, usually about three inches in diameter. To transfer the circuit design to the wafer, the surface of which is coated with a light sensitive emulsion, it is exposed to a high-intensity light. In the next step, called diffusion, selected impurities are added to the wafer in a high-temperature furnace. This process may be repeated many times for very complex circuits. Next, electrical interconnections are formed on the wafer by adding a layer of aluminum and the wafer is then oxidized. to avoid the costly continued processing of defective wafers, visual and automated electrical tests are conducted at various stages. Having completed the oxidation stage, the wafers are split into as many as several thousand chips. The assembly of chips into packages, usually done by bonding selected chips on a base and attaching fine lead wires, all done under a microscope, is normally a manual process, although some

automatic and semi-automatic equipment is now available commercially. The package is then sealed.

The concept of "production yield" is important in the economics of the MOS/LSI industry. The fraction of wafers and chips that survive the process can vary from 80 percent for simple devices with mature process technology to 5 percent for new, complex devices. The yield is much higher for the assembly process than for the fabrication stage. Raising the yield through technical change and the learning economies derived from production experience have accounted for significant decreases in production costs for U.S. firms and have contributed to the strong U.S. position in the MOS/LSI market.

2. The U.S. Role in the World Market

Worldwide sales of MOS/LSI grew from almost zero, in the late 1960s, to $725 million in 1974, and are projected to exceed $1.2 billion by 1977. The rapid growth of the LSI market has been due to the technological innovations, which have improved capabilities while lowering costs, and the rapid application of MOS/LSI technology in a wide variety of electronic equipment, providing increased design flexibility and superior performance.

U.S.-based semiconductor producers dominate the worldwide MOS/LSI market, with a market share, in 1974, of about 85 percent. American control of the North American and European markets (the first and third largest regional) markets, is virtually complete. The Japanese MOS/LSI market is second in size. Japan has maintained protective quotas on imports of LSI circuits, but these restrictions were reduced as of December 1974. The American share of the Japanese market is expected to grow at the expense of domestic producers who have been operating largely on an unprofitable basis. Many U.S. firms sell to Japan from subsidiary assembly operations in less developed countries in order to benefit from preferential tariffs.

New companies are responsible for much of the significant progress in technology. The industry is fiercely competitive in the areas of new technology, product quality, and especially pricing. Within the U.S. MOS/LSI sector, 10 new companies (founded since 1966) account for more than 60 percent of the industry's sales. In less than a decade, the price of an average LSI circuit has declined from about $100 to $4, while circuit capacity has increased 64-fold. Large LSI customers usually accept bids for parts from suppliers, who, in most cases, quote prices for future deliveries well below current manufacturing costs, in anticipation of cost reductions. The scale of component integration has increased, in less than a decade, from a few hundred transistors to over 10,000, and the forecast for the 1980s, unbelievable just a few years ago, is for over one million transistors to be packed on a one quarter-inch-square silicon chip. New technological advances, the application of bipolar logic and linear LSI, are expected to provide added impetus for growth of the U.S. industry.

A trend toward increased vertical integration of the industry has been noted in the 1970s. Since many circuits must be specially designed to the specification of the user, firms have established production lines for finished goods and semifinished goods (e.g. memory systems for already installed computers and subsystem microcomputers.) U.S. companies have also established design and engineering support capabilities abroad, close to foreign markets, to provide better interface with users.

3. Characteristics of Competitive Advantage

Success in the worldwide LSI market is attributed to technological lead, competitive pricing through passing on manufacturing cost reduction, and design flexibility responsive to the market. These attributes can be traced to a number of factors in the development of the industry. Several early key technological breakthroughs were exploited by very large R&D expenditures, facilitated by readily available venture capital, and an initial technological base established. Vital personnel, creative and mobile, played a large role in diffusing technological

advances. The venture capital was adequate not only to exploit the initial R&D results, but to finance the heavy investment in automated production equipment to realize significant reductions in production costs through economies of scale. (It is estimated that the cost of LSI devices declines by at least 25 percent as production doubles.) Economies of scale were compounded by "learning curve" economies, both in production techniques and yields and in design technology which reduced assembly and testing labor costs. Another important factor was the role of the U.S. government in conducting R&D projects and production refinement programs and the key function of serving as a consumer for new circuits, initially too expensive for industry. These characteristics of competitive advantage--dynamic R&D, critical scientific manpower, significant production scale economies and learning economies--are expected to continue in the industry to 1985.

Therefore, to participate in the worldwide LSI market, a number of important conditions must be met. A large block of financing must be available, adequate to cover negative cash flows for a minimum of two to three years. R&D expenditures, especially in a company's early years, to maintain momentum in product innovation may require as much as 30 percent of net revenue. Acquisition of a sufficient base of scientific personnel who have experience in current or recent technology development efforts is mandatory. Efficient integration of technology know-how and manufacturing operations is required in order to benefit from economies of scale and the "learning curve" to maintain price competitiveness. This effort also requires highly trained technical and managerial personnel. And, a marketing strategy must be developed based on pricing, product reliability and product performance.

4. State of Soviet Technology

A definitive data base was not available for a broad assessment of the state of technology of the Soviet semiconductor industry. From a general consideration of similar technological capabilities, there appear

to be a number of factors of the Soviet economy and industrial environment which impede the development of advanced semiconductor technology on a mass production basis. These factors include the material incentive system, the resistance of a bureaucracy to the creative destruction inherent in technological change, and the organizational separation of the research and development and production efforts.

The Soviet Union is interested in acquiring advanced technology and equipment from the West for the serial production of a wide range of advanced semiconductor devices. The sort of technology in which interest has been expressed includes all types of bipolar technology, MSI to LSI, light-emitting diode, liquid crystal display, and especially MOS [complementary (MOS), positive (PMOS) and negative (NMOS)] which is the most widely used technology in the West for LSI circuits. A consideration of the factors impeding the adoption of advanced technology in the USSR leads to the conclusion that should the Soviet Union acquire these technologies on a turnkey or other short-term relationship with a Western firm, the Soviet producers would not be able to maintain the rapid rates of technological change in process and design required to compete successfully in the world market.

5. Net Assessment

A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the world semiconductor market concluded that such a development is highly unlikely. The net assessment involves two issues: (1) will the Soviet Union choose to compete in the world semiconductor market, and (2) if the decision is made to compete, will the effort be successful.

It is improbable, given competitive market conditions and Soviet goals in foreign trade, that the decision will be made to compete in the high technology semiconductor market. In view of the rapid change in

technology and high developmental costs, the semiconductor industry does not hold out the promise of being a large net contributor to the Soviets' hard currency balance. This market, furthermore, is characterized by extreme fluctuations in sales and rapidly declining prices, and thus does not represent the stable pattern of trade which the Soviet Union normally seeks to establish.

It is even more improbable, should the Soviet Union decide to compete in the world semiconductor market, that the effort would be successful. Soviet industry's past performance in a number of aspects determined to be characteristics of competitive advantage in the semiconductor market has been consistently poor. These aspects include:

- Rapid technological innovation
- Efficient quality control
- Responsiveness, in design and production, to users' needs
- Overseas design and engineering support capabilities effectively mated with production and sales efforts.

The unique managerial-technical skills which enable Western producers to meet these competitive requirements are not well developed in the Soviet industrial environment. Incentives to Soviet managers for technological innovation and responsiveness to users' needs are outweighed by the need to fulfill planned targets for output. Much of the cost-reducing technical change in the U.S. semiconductor industry involves improvements in manufacturing efficiency and results primarily from the "learning" process. Manufacturing efficiency is a weak area in Soviet industry. Even in the Western industry, the transfer of advanced semiconductor technology is a difficult and complex problem. This transfer has often been accomplished in the past by hiring away key personnel from the originating firm.

International technology transfer, via sales of equipment and turnkey plants, and licensing, would not provide Soviet producers with the prerequisites for successful competition in the world high-technology

semiconductor market. Technology acquisition in the lower spectrum of semiconductor technology could still seem attractive for domestic applications. Since joint ventures could provide some of the market-oriented know-how the Soviets lack, it is conceivable the Soviet Union could establish itself as a supplier of semiconductors well below the frontier of technology, especially to less developed countries. This might pressure other countries, e.g. Japan, who are now active in this part of the market to move to develop higher technologies for export, and thus might indirectly increase the competitive pressure on the United States. Such a joint venture approach by the Soviets would be compatible with the export/import options component of their foreign trade strategy.

Clearly, both high (and some non-frontier) technology semiconductors have defense applications and could provide potentially significant assistance in a variety of domestic economic sectors resulting from low productivity. These assessments, also bearing on formation of U.S. export policy, are not within the scope of this study.

C. Commercial Aircraft Technology--Wide Body Jets

1. Description of the Product[1]

The case study of the commercial aircraft industry was limited to the airframe, propulsion and avionics systems of large jet aircraft for commercial passenger and cargo transport service. The analysis excluded ground systems, such as traffic control, and aircraft in the business and general aviation classes.

The market for commercial aircraft is actually a grouping of specialized submarkets which can be differentiated along a number of lines:

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[1] The study concerned activities designated by the following Standard Industrial Classification numbers: 3721 (manufacturing or assembling complete aircraft) 3742 (aircraft engines and engine parts), and 3728 (aircraft parts and auxiliary equipment, not elsewhere considered).

passenger service, cargo service; replacement of outmoded aircraft in existing fleets, additions to fleets, scheduled service, charter service, and service in developed and developing countries. Wide-bodied jet aircraft, in the period 1968-1974, accounted for 660, or 47 percent, of 1,400 jet aircraft added to world fleets. Due to their capabilities, they account for a much greater share of seat and cargo capacity added during that period. Because the majority of jet aircraft that have been built since 1968 are still in service (although not necessarily for the original owner), the demand for wide-bodied jet aircraft cannot be traced to every submarket. These aircraft do, however, offer advantages to a significant number of operators with long-haul, high-density routes: reduced operating costs per seat-mile, and relief for congested ground facilities and airspace near airports.

2. The U.S. Role in the World Market

U.S. commercial jet airframe and engine manufacturers clearly dominate the world market. Aircraft produced in the United States account for 87 percent of turbofan and turbojet aircraft in service and on order for world airlines, excluding the Soviet Union (the figure including the Soviet Union is 73 percent), in 1974. This reflects both the large domestic market for U.S.-manufactured aircraft and strong penetration of foreign markets. The world market position in jet engines is very similar, with the corresponding percentages of 84 and 74, in 1974.

In the 1970-74 period, the Middle East proved to be the liveliest regional market for U.S. commercial jet aircraft. Africa and the Far East/Pacific regions exhibited greater than average market growth, Europe about average, and North, South and Central America, less than average. Europe is the largest export market for the U.S. commercial aircraft industry, accounting for more than half the value of export shipments. While the European market for commercial aircraft is rather competitive, the U.S. share is more than twice that of domestic producers. In the period 1970-74, U.S. exports of commercial jet aircraft grew more rapidly than the U.S.

domestic market. The ratio of U.S. exports to industry total shipments of commercial aircraft was 0.37 for the entire period 1964-1974, while for the period 1970-74, the ratio was 0.48. In 1970 foreign orders were 44 percent of the total, while, in 1973, foreign orders were 64 percent of the total orders for U.S.-produced commercial jet aircraft. In 1974, total shipments amounted to $4.2 billion, while U.S. exports of commercial jet aircraft totalled approximately $2.8 billion.

In recent years, exports of commercial aircraft have accounted for about 4 percent of total U.S. exports, and 40 percent of U.S. aerospace industry exports. The aerospace industry has been a large positive net contributor to the U.S. balance of payments for several years. This activity does not involve only the giant U.S. aircraft manufacturing concerns which, on the whole, act as systems integrators and assemblers, but also numerous subcontractors who deal in detail design and subsystem fabrication.

3. Characteristics of Competitive Advantage

The requirement for successful participation in the world commercial aircraft market is a competitively priced, technologically innovative product which offers reliable, safe, and efficient performance. Marketing know-how and strong product support services are also critical.

A number of historical, demographic, and economic factors have provided a basis in the U.S. industry for meeting these market requirements and can serve to illustrate requisite capability for the USSR to compete. The U.S. commercial aircraft industry has enjoyed a large domestic market which has resulted in significant economies of scale. The U.S. government has encouraged the growth of the industry in the interests of national security and its balance of payments contribution, and has provided favorable financing arrangements and promotional activity for foreign sales. The industry has benefited from civilian and military aerospace programs which added to its technological base and has developed

management techniques for complex technical projects. The system of subcontracting which the industry employs distributes financial risk and technical design responsibilities but, on the other hand, is dependent on a broad technological base throughout the economy. This technological base, once created, provides a large pool of highly skilled, highly trained workers and managers.

The production process must be accompanied by strong marketing and product support efforts in order to maintain a competitive position. Because carriers prefer to maximize fleet commonality, demand for a particular aircraft is somewhat self-perpetuating and displacing established aircraft procurement relationships can be difficult and expensive. Feedback from skillful marketing staffs in designing an aircraft responsive to the needs of individual carriers is extremely important for market penetration. Product support, in the form of warranty programs, replacement parts systems, modification programs to improve longevity, safety, and performance, and general technical assistance, plays a large role in the decision of air carriers on the purchase of commercial aircraft. Effective product support can ensure minimum out-of service time for aircraft and thus a satisfied customer who will make additional future purchases and serve as a reference in dealing with other customers.

Past overall sales patterns of a given generation of aircraft, as detailed in the previous section, however, are not a good indicator of future sales. Early sales are made for mass replacement of older aircraft, while later sales are for new markets and the expansion of capacity in established markets. On these criteria, the domestic market and Europe do not offer a great deal of sales potential for U.S. commercial aircraft manufacturers in the near (1977-78) term. It is espected that demand in the Middle East, African, and Far East/Pacific markets will remain relatively high in the next several years and some promise is held out that this demand will carry U.S. aircraft manufacturers until U.S. and European demand rises again in the early 1980s.

Rising design and development costs, desire of airlines for fleet commonality, versatility of existing designs, ecological concerns, and the fuel crises suggest that new entries to the commercial aircraft market will be mainly technically advanced derivatives of existing aircraft, with an emphasis on cleaner burning and more fuel efficient engines. It is a matter of doubt whether conditions in the market and high design and development costs will permit U.S. manufacturers to profitably embark on major new commercial aircraft programs on a competitive basis in the future as they have done in the past. One trend to be noted in new aircraft programs is the desire of U.S. manufacturers to seek joint venture opportunities abroad due to high development costs, high investment risk in a volatile market, reduced U.S. government support, and growing competition supported by foreign governments that face U.S.-based commercial aircraft manufacture.

4. State of Soviet Technology

Soviet aircraft designers have dealt adequately with meeting their own domestic needs, from a technical point of view. While the main thrust of development efforts has been toward meeting the same requirements as U.S. aircraft, Soviet aircraft are somewhat less sophisticated. The Soviet Union has not mastered the mass production of Western-style miniaturized avionics. Product support is generally poor. Soviet aircraft tend to be heavy with overpowered engines requiring frequent overhauls. Passenger comfort, in addition, has played a minor role in the design of Soviet aircraft.

Visits by representatives of Western aircraft manufacturers have found most Soviet aircraft manufacturing facilities employing outmoded production methods and poor tooling and manufacturing control, but some improvement has been noted. The Soviets have not been able to produce a high-thrust turbofan engine essential for wide-bodied commercial aircraft. Their use of system components in avionics is outmoded and the resulting equipment is bulky and heavy relative to Western equipment. Quality production personnel, including production line workers, in the Soviet Union, according to U.S. aircraft engineers, are recruited for military aviation and space programs, creating an important deficiency in the civilian aircraft industry.

5. Net Assessment

A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the sale of wide-body jets concluded that such a development was unlikely unless a major commitment is made at the highest political level for an all-out effort in the interest of national prestige. The net assessment involves two issues: (1) will the Soviet Union choose to compete in the wide-body jet market, and (2) if the decision is made to compete, will the effort be successful.

The probability of a political commitment to penetrate the wide-body jet market, given the stringent requirements of the commercial aircraft market, is unlikely. Yet, for national prestige purposes it may be sufficient to export only 50-75 planes; thus the possibility should not be totally discounted.

While there is a strong political rationale to compete with the United States, the dominant producer of commercial aircraft, a large commitment of resources would be required, even though the Soviet Union has the basic technology and the capability to produce most individual components of commercial aircraft that would be competitive with U.S. products. The factors which would make Soviet aircraft competitive are not major considerations in meeting domestic needs--passenger comfort, reduced sot per seat-mile, after-sales service, etc. For air carriers in the industrialized West, these shortcomings in current aircraft packages have outweighed lower prices; skepticism about the Soviets' ability to correct these deficiencies would inhibit the willingness to purchase aircraft early in the development/production process, as is the normal case in the West. In the future, however, sales to less developed countries could be tied to Soviet credits extended under bilateral agreements, or even be part of special fuel subsidies or purchases. Although the LDC market potential to 1985 is large, two factors limit the Soviets' ability to exploit it. First, low prices have contributed to successful past sales programs to LDCs, but poor maintenance and after-sales service have caused dissatisfaction and even return of the aircraft. Secondly, the "haves"

among the LDCs are already purchasing wide-body jets, and are expected to continue to do so during the 1975-80 period. The Soviets could not absorb the requisite engine and passenger-related technologies in sufficient time to meet market opportunities.

A second consideration of potential competition from the Soviet Union is airline service. Problems of passenger comfort, including air conditioning failure and faulty pressurization, now plague Aeroflot service, but these problems could be overcome. Aeroflot operates profitably on Moscow-Tokyo and Moscow-Western Europe routes, but taken together, barely breaks even. Many routes are unprofitable due to low load factors; the routes are maintained more for national image than for profit. Most Aeroflot flights to foreign airports are on a revenue-sharing basis. If performance is improved it is likely that Aeroflot could prove to be much more competition for U.S. and other carriers than at present; there is no reason to conclude that this will not occur particularly if some price cutting is employed or tourist "package deals" developed and stressed.

As in semiconductors there are important defense considerations in the transfer of aircraft technology; these factors, however, were not within the scope of this study.

D. Construction Machinery and Equipment Technology

1. Description of the Product[1]

The construction machinery and equipment (CME) industry produces a wide variety of specialized and general application equipment. In examining this industry, earthmoving machinery and equipment (EME), i.e. equipment used to prepare land for subsequent building (excluding excavation) served as the focus. In Western industry, this latter class of equipment includes: off-highway wheeled tractors, track-laying tractors, road rollers, scrapers, graders, compactors, dozers, rippers and rooters, integral tractor shovel loaders, and off-highway trucks, trailers, and wagons.

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[1] In this study, CME was equated to products designated by the Standard Industrial Classification number 3151.

2. The U.S. Role in the World Market

In 1974, U.S. exports of construction machinery and equipment were $2.3 billion, or about 30 percent of world exports. Other principal exporters of CME to Western countries in 1974 include (with share of world exports in parentheses): the UK (20 percent), West Germany (15 percent), France (12 percent), Italy (8 percent), and Japan (3 percent). Thus, the U.S. is the dominant exporter of CME, and is also the leading producer with the shares of world production of CME approximating the shares of world exports. If we add to the U.S. 1974 industry total shipments figure of $7.42 billion, the $6.2 billion in shipments of CME of U.S. design manufactured abroad in 1974, U.S. firms were responsible for well over 50 percent of total world sales. The U.S. share for earth-moving machinery and equipment alone may be even higher. In addition, U.S. firms have supplied licenses to Japanese firms for the production of EME.

Imports of construction machinery and equipment by OECD countries grew at an average annual rate of about 16 percent, from $2.85 billion in 1968 to $5.21 billion in 1972. About 30 percent of this figure were imports from the United States. Total world imports of CME in 1972 are estimated at $8.34 billion or about 1.6 times the OECD total. The United States is the largest single market for CME. U.S. firms in 1974 purchased $4.8 billion in CME for use in the United States and in projects abroad. The fastest growing markets for CME are Canada and the United States. Growth in world trade in CME is expected to slow, however. And, U.S. exports are expected to drop to an annual growth rate of 5 percent in 1975. This is a result of increased production abroad, especially in Europe (West Germany), Japan, Australia, and Brazil, the recession, and the shortage of hard currency for imports by less developed countries, exacerbated by the rise in world prices.

Foreign-based operations are an important element of U.S. firms' activities. Most U.S. CME firms' foreign ventures are in the earthmoving machinery and equipment field. U.S. EME manufacturing operations abroad,

subsidiaries and joint ventures, accounted for sales of an estimated $3.6 billion worth of equipment overseas in 1974.

3. Characteristics of Competitive Advantage

Manufacturing efficiency and high productivity, including effective quality control and advanced production techniques, are required to offer the consumer good value, high efficiency, and low cost. U.S. producers have exhibited an ability to respond to these requirements over the last fifteen years. The size of the domestic market has been an important factor in the historical development of the industry.

While technological improvements in the world CME industry, and the U.S. industry in particular, have not been dramatic, over a period of years, they have resulted in significant advances in performance, capability, comfort, reliability and safety. Specifically, these advances have been directed to higher productivity in response to increasing construction labor costs (larger units in general, with specialized smaller units for urban work), bigger payloads, greater installed horsepower, faster transfer time, greater reach, higher pressure hydraulic systems, more versatility, better mobility, and greater operator comfort, safety, and efficiency. These improvements have made a number of demands on manufacturing and design technology. In the area of materials, improved alloys, more durable elastomers and better lubricants had to be developed. In machining and casting, larger, more complex castings and forgings, better welds, and closer tolerances are required. Better engineering, in the areas of tighter hydraulic seals, more efficient engines, improved bearings, gears, and pumps, and increased electrical and electronic fittings contributed to improved capabilities. Group manufacturing techniques and increased parts standardization in modern production facilities provide significant economies of scale.

A competitive manufacturer must continually improve product design in close cooperation with marketing efforts in order to offer the customer the best equipment with which to accomplish his job. This

effort requires market surveys and market testing and makes use of feedback from representatives in the field--salesmen, engineers, and dealers. Effective local dealer organizations are important in providing product services, as well as marketing and design information. Product services--maintenance and repair operations, replacement and spare parts, and other after-sales services--are indispensable in helping customers avoid delays in industry where purchasers are normally contractors for whom tight time and cost constraints are most significant. Foreign-based operations, as well as providing significant contributions to earnings, extend after-sales services and responsiveness to customers' needs to foreign markets through facilities, field personnel, and local dealer organizations abroad.

Competitive EME products require a minimum of maintenance and offer operator comfort and safety. Pricing is an important factor and lowering prices through efficient manufacturing, marketing and distribution operations and through innovative design, offering single machines with multiple applications, provide manufacturers with significant competitive advantage. Competitive pricing and efficient operation, however, must be accompanied by provision of important after-sales product services.

4. State of Soviet Technology

Although Soviet plants produce a wide assortment of earthmoving machinery and equipment, the best Soviet equipment (with the possible exception of the BelAz off-highway trucks) must be compared unfavorably with the U.S. product. More powerful tractors, larger capacity scrapers, larger wheel-type front end loaders and wheel dozers, and larger off- and on-highway dump trucks than are now produced are required to meet Soviet needs. The development of the Soviet EME industry was neglected for a long period, probably due to the priority given to agricultural equipment which could be adapted for construction work as well. The development of manufacturing capability for specialized construction equipment was seriously undertaken, apparently, only as late as 1960.

Serious limits were placed on the development of this manufacturing capability by the inability of the machine building amd metal working sector to provide sufficient capital equipment for all the projects that were required, particularly given the high priority of the development of the motor transport sector in the past decade. The first Soviet tractors were U.S. models produced with the aid of U.S. engineers. As a result of Soviet R&D, in response to their own farming conditions and to operational experience with Soviet-and foreign-produced tractors in the most adverse climates, Soviet construction equipment has evolved into a unique assortment of products of indigenous design. This assortment, however, is much smaller than is available in the West and in a number of aspects fails to meet the requirements for competing in world markets. The vast majority of Soviet exports of CME are to Eastern Europe and less developed countries to whom the Soviet Union has extended tied-credits.

The wide assortment of products manufactured by Western CME firms requires the use of small series and batch production techniques with versatile machine tools. In the USSR, CME are produced by a small number of large-volume enterprises using specialized tooling on a mass production line basis. Model changes, therefore, require costly, time-consuming retooling causing reduction of output for long periods and affecting managerial bonuses paid for plan fulfillment. Thus, Soviet plan managers resist model changes which would make their output more responsive to the needs of the consumer. Soviet enterprises have also been known to ship substandard equipment in an effort to meet fulfillment targets.

Not only is Soviet EME unavailable for export in an *assortment* equivalent to Western manufacturers, for the most part underpowered and cumbersome, and often of substandard quality, but after-sales service is an important problem. In an industry in which a contractor's time and cost margins are often tight, purchasers of Soviet CME find their equipment tied up for repair and lack of manufacturer's technical and parts services for long periods.

5. Net Assessment

A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the world CME and EME markets concluded that the likelihood of such a development is only marginal. The net assessment involves two issues: (1) will the Soviets choose to compete in the world market, and (2) if the decision is made to compete, will the effort be successful.

Analysis of Soviet domestic needs for construction machinery and equipment indicates that very large investment in the CME sector is required in order to meet internal demand. It is, indeed, apparent that the Soviet Union is embarked upon creating a wide-spectrum CME production sector, independent from agricultural equipment production. This production capability, then, provides the opportunity to test foreign markets, without much risk, since the production facilities can be converted to domestic use, should profitable trade fail to materialize.

Given a decision to enter the world CME and EME market, only marginal success is likely, particularly in trade with the developed West. Most purchases of CME and EME in the developed West are by contractors who must meet tight time and cost constraints and as a result reliable, productive, often multi-use equipment and strong after-sales services, including spare parts service, are major considerations in choosing suppliers. As has been noted, Soviet CME and EME are weak in these areas relative to Western equipment. After-sales service has been a major weakness of the Soviet industrial environment. Price undercutting has not been an effective tool for market penetration in the case of the developed West, so that successfully meeting the stringent demands of this market in the industrialized West would require a major overhaul of Soviet manufacturing and servicing methods, and thus, the likelihood of success is deemed only marginal.

In the case of the CME and EME markets in LDCs, however, price may play a more important role, mitigating somewhat considerations of

reliability and productivity. Lower prices for Soviet CME and EME, possibly reflecting simpler equipment, may prove attractive to LDCs, especially given their generally cheaper labor rates and hard-currency constraints introduced by inflated oil bills. Soviet-produced construction machinery and equipment also represents an attractive product line to be marketed to LDCs through bilateral trade agreements.

The major uncertainty in the net assessment lies in the possibility that the Soviet Union may organize CME and EME production dedicated to export. While special quality standards cover export production and special export sales support organizations exist, firms producing for export would then have an important stake in meeting the demands of the world market, i.e., increasing reliability and productivity of the equipment and providing after-sales service. Joint ventures could be utilized to facilitate after-sales service and parts distribution abroad.

E. Man-Made Fibers Technology

1. Description of the Product[1]

The man-made fiber industry produces both cellulosic (rayon and acetate) and noncellulosic, or synthetic, fibers. While the cellulosic fiber industry has shown little growth since the 1950s, the noncellulosic fibers have been developed more recently. The latter are mainly derived from petrochemicals and include acrylic, nylon, polyester and polyolefin. These fibers enter as raw materials in a manufacturing chain to thread and yarn, to textiles, to garments or for use in other finished products (furniture, vehicle interiors, etc.). The synthetic group has provided most of the growth in the man-made fiber industry in recent years and is the area in which the Soviet Union is the most deficient. The synthetic or noncellulosic sector is the major focus of the case study.

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[1] In this study, the man-made fiber industry includes those activities designated by Standard Industrial Classification numbers 2823 (Cellulosic Man-Made Fibers) and 2824 (Synthetic Organic Fibers, Except Cellulosic).

2. The U.S. Role in the World Market

While the United States is not the dominant exporter of man-made fibers (West Germany and Japan export double the U.S. figure and U.S. exports are equalled by the U.K. and the Benelux countries, with France and Italy close behind), it is the leading producer in the world, accounting for almost one-third of total world output. Japan, in second place, produces about one-half of the U.S. output, while all of Western Europe, taken together, has an output level of man-made fibers about equal to that of the United States. U.S. producers, however, are actively involved in overseas production--10 percent of nylon and polyester manufacturing capacity abroad is wholly or partially U.S. owned, while the figure for acrylic manufacturing capacity is about one-third. If only noncellulosic fiber output is considered, the relative importance of the U.S. in production is even more pronounced, while the share of Eastern Europe (including the USSR) drops from 15 to 8 percent of world output and other producers retain about the same shares. In 1972, total shipments by the U.S. synthetic fiber industry were valued at $4.3 billion.

Exports are a major factor in the West European and Japanese man-made fiber industries, but are much less significant for producers in other areas. For the United States, exports of man-made fibers are about 5 to 10 percent of domestic production, whereas one-third of Japan's production is exported. A fairly large portion of U.S. exports are to U.S. subsidiaries and affiliates abroad and serve to round out the product lines of overseas operations. The existence of equivalent or more advanced technology in Western Europe and Japan, except in the case of acrylic fiber, has reduced U.S. company overseas involvement there. U.S. involvement is significant in Canada and Latin America, however, where U.S. companies have both technology and investment capital to offer. The situation in Western Europe and Japan reflects their advanced textile industries and legal barriers to foreign investment and imports. U.S. exports of base man-made fibers in 1973 were valued at about $200 million, and if yarn and thread exports are added, total about $470 million.

The United States leads in per capita consumption of man-made fibers and is followed by Japan and Western Europe, with the respective figures for 1973 being 33.1, 23.7, and 17.0 pounds. The figures for per capita consumption of noncellulosic fibers show sharp disparity between East and West, with a 1973 figure of 27 pounds per capita in the United States vs. 3.5 pounds in Eastern Europe (including the USSR).

3. Characteristics of Competitive Advantage

The United States has been a technology leader in synthetic fibers, but as has been indicated above, except in the case of acrylics, Western Europe and Japan also employ advanced technology. In the 1950s and 1960s, the introduction of new synthetic polymers had an important expansive impact on world man-made fiber markets. The trend established in the late 1960s, however, was technological advancement of existing base fibers--their chemical or physical modification, and improvement of fiber and textile processing. This trend is likely to remain dominant in the next decade, although slower growth of synthetic fiber demand may lessen technological efforts in that area, while in the areas of textiles, opportunities for technological advance will offer competitive advantage. It is expected that the United States, Western Europe and Japan will maintain their positions as technological frontrunners in this area.

The penetration of the market for a given fiber by Western concerns has, in the past, taken at least five years. Successfully establishing a position in world fiber markets requires the development of a substantial sales and technical service force to develop rapport with fiber users, mainly small firms lacking resources for extensive R&D and marketing and therefore dependent on producers for technical and research assistance. This is particularly true for specialty fibers. New producers must undercut existing prices in the commodity fiber (low-priced) end of their product line (a 10-15 percent discount may be considered minimal, from past experience). An adequate supply of raw

materials at a reasonable price is thus a necessity. Significant capital investment is involved as well as the development of the technology. Existing fiber producers are reluctant to license their unique technologies, and a turnkey plant would be 3-5 years behind competing facilities in technology, if no effort is made to update the operation while it is being completed. The U.S. man-made fiber industry, particularly in the area of advanced synthetic fibers, relies on its strong technology base, technical service and marketing capabilities, plentiful supply of resins, and investment sources provided by huge parent chemical firms, to maintain a competitive position.

4. State of Soviet Technology

The Soviets are short of capacity in many resins, and are, as well, short of fiber spinning capacity. The apparent unsatisfied domestic demand, particularly for acrylics, has prompted direct imports. The Soviets also lack the technology for the production of noncellulosic fiber and are seeking this technology from the West. Basic spinning technology is available from producers in Western Europe and Japan, as well as the United States. This is distinct from technology for specialty fibers. Several German, Japanese, and British companies have sold or are negotiating sales of technology to the USSR in the synthetic fiber and textile areas. A British firm built a turnkey synthetic fiber plant for the Soviets at Mogilev.

Production for the Soviet and Eastern European markets would seem to be the major objective of these facilities given the demand there for the standard commodity fibers, with less rigorous quality standards than apply on Western markets, and the ability to sell without a substantial sales/technical service network. Should the Soviet Union and other East European industries attempt to develop a massive capacity to broach Western markets on a large scale, which in the commodity fiber area could be accomplished with the technology they already possess, this effort would require a minimum of 5-10 years. In the commodity fiber

area, aside from developing the capacity, in order to penetrate Western markets, Eastern bloc producers would need to establish sales and technical service organizations in the West, prove their ability to meet minimum Western standards, establish confidence in the continuity of supply, and undercut existing prices. To sell specialty fibers, a major sales and technical services effort would be required and eventually there would be the need to create their own unique fibers and technologies.

5. Net Assessment

A net assessment of the factors relevant to the Soviet Union becoming a major competitor in the man-made fibers market concluded that it is not likely that the USSR will be an effective competitor in the high technology specialty fiber market, but it is probable that some competition will be offered in the commodity fiber market. The net assessment involves two issues: (1) will the Soviet Union choose to compete in the world man-made fiber market, and (2) if the decision is made to compete, will the effort be successful.

Soviet domestic demand for man-made fibers is high and, as yet, unsatisfied. The Soviet Union is engaged in developing a man-made fiber industry and a decision to test the foreign market, as in the case of construction machinery and equipment, is likely.

Given a decision to enter the world man-made fiber market, it is also likely that the Soviet Union could meet the requirements for success in the commodity fiber end of the market, i.e., establish some sales and technical service abroad, meet minimum product specifications, provide assurance of a continuous supply, and undercut existing prices.

In the area of specialty fibers, price-cutting is less of a factor, while a major sales and technical service effort is required with extensive producer-user feedback and technical cooperation. In addition, it is more difficult to master the highly specialized technologies than the basic spinning processes for commodity fibers.

The commodity fiber field offers a large, readily-served market. While the basic spinning technology is readily available from fiber producers in Western Europe, Japan, and the United States, the expansion of fiber-spinning capacity and alleviation of resin shortage problems necessary to make a significant impact on world commodity fiber markets would require from five to ten years. This area has been given priority in the USSR for quite some time, yet its performance in mastering and developing new technology has been less than impressive. Solving the problems in the man-made fiber industry may prove rather important, given the increased emphasis on consumers goods and the significance of this industry in their expanded production, and may benefit from a highly concerted effort in the 10th Five-Year Plan (1976-80).

The major uncertainty in this assessment is the degree to which the Soviet Union will devote an expanded man-made fiber sector to the satisfaction of domestic demand and the needs of other CMEA nations. The commodity fiber market could prove an attractive source of hard currency earnings for high-priority imports.

VI PROSPECTS FOR SOVIET ECONOMIC COMPETITION WITH THE UNITED STATES AS A RESULT OF ACQUIRING U.S. TECHNOLOGY

A. General Prospects for Soviet Trade Competitiveness

In this section, the implications of the various lines of inquiry undertaken in this study are correlated in order to provide an assessment of the prospects for Soviet trade competitiveness in the 1975-85 time frame. The relevant implications proceed from the foregoing consideration of economic pressures on Soviet decisionmakers in the mid- and long-term, the future role of foreign trade in the Soviet economy, the effects of Soviet behavioral characteristics on trade competitiveness, and the specific case studies of potential impact on Soviet competitiveness of the transfer of advanced U.S. technology. The discussion is organized into four issue areas: (1) the interaction between economic pressures and the changing role of foreign trade, (2) dominant characteristics of potential market penetration strategy, (3) new initiatives to solve competitive disadvantage problems, and (4) major uncertainties in assessing the ability to compete.

1. Interaction Between Economic Pressures and the Changing Role of Foreign Trade

The future role of foreign trade in Soviet economic strategy is viewed, in this study, in two alternative, but not mutually exclusive, scenarios. The first scenario, as outlined in Chapter III, involves the continued traditional view of Soviet foreign trade as short-term gap-filling on which is superimposed a pattern of spurts of technological borrowing during intermittent attempts to catch up with the West. The second scenario, drawing upon general characteristics of an industrialized nation rather than the unique Russian pattern, provides for an increasing degree of interrelatedness of the Soviet economy with the world economy. While nondependence on the West has been a guiding principle of Soviet development strategy,

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if this second scenario is viewed as a greater degree of interrelatedness involving no real dependence on relations with the West, it is increasingly plausible as an option for future development strategy and would have strong implications for future Soviet trade competitiveness.

A possible rationale for the realization of the second scenario, whether by conscious policy decision or through evolution as a result of decisionmaking on narrower issues over time, is the relief from significant economic pressures which increased economic relations with the West would hold out for Soviet leaders. The econometric model projections presented in Chapter III highlighted the potential long-term problems facing the Soviet economy by examining the consequences of the continuation of past behavior by Soviet decisionmakers. These problems include the deterioration of the relative growth and position of consumption, a steady climb in the investment share of GNP, shrinking sources of able-bodied labor relative to employment requirements, and little or no growth in total factor productivity in the overall economy. These results can be summarized as the depletion of resources for extensive development of the economy, i.e., increased factor inputs, and very little success with intensive development, i.e., increasing productivity, given current behavior patterns.

An injection of advanced technology from the West, embodied in a traditional spurt of purchasing, could supply some capability for accelerated intensive development. Without increased interrelatedness with the West, however, the behavioral and institutional aspects of the Soviet economy which inhibit technological advance are operative and the technology transfer does not become a self-sustaining factor for economic growth. Additional inputs of technology and equipment would be required with greater frequency.

To finance a program of imports of technology and equipment from the West, increased sources of hard currency and credit would have to be developed. If the program is of short duration, in the nature of the spurt envisioned in Scenario One, the existing export base would serve. If, on the other hand, a prolonged program of imports is undertaken, an expanded

export operation would be required. In satisfying this need, in turn, there would be a movement toward increased interrelatedness and this would impact on Soviet trade competitiveness.

The impact on competitiveness would depend both on the strength of the political commitment to penetrate world markets and on the response of decisionmakers to increased interrelatedness. It was evident in the assessment of the case studies that the strength of the commitment is a vital factor in successfully competing in world markets, given the level of effort required to overcome the disadvantages of the Soviet industrial environment. If, as a result of increased interrelatedness, a segment of Soviet production is devoted to export and managers thus develop a vested interest in providing a competitive product, the effect of such a commitment would be self-reinforcing.

Overcoming the competitive disadvantages of the industrial environment, moreover, would be facilitated by new forms of economic interaction, such as joint venture operations with Western firms that have experience in meeting the requirements of world markets. The buy-back, or compensatory agreement, in which purchases from the West are financed by future deliveries of the production of the capacity represented by the purchases is significant in two ways. First the involvement of the Western firm is relegated not to the core of the economy, but to the margin--added capacity. Secondly, a degree of continuing involvement of the Western firm in the production process is ensured to provide for the marketability of deliveries to the West. This sort of arrangement has formed the basis for a number of recent major deals, but the impact on Soviet industry remains to be demonstrated.

2. Dominant Characteristics of Potential Market Penetration Strategy

Given a commitment to expand economic relations with the West on a long-term basis, the potential impact of Soviet competition on U.S. commercial interests would depend on the strategy employed in attempting to penetrate world markets. In formulating such a strategy, Soviet planners would need to assess the strengths and weaknesses of Soviet

production relative to the demands of the world market, the potential modifications to the existing Soviet export base, the resources involved in developing the characteristics of competitive advantage in various markets, and the relation of this effort to internal development needs. In analyzing the characteristics of this potential strategy, this study considers both the general characteristics of the Soviet economy and the world market and the specific requirements for competing in a number of representative product areas. The aims and options dictated by general considerations and the sorts of specific capabilities and concerns indicated by the case studies as representative of classes of production lines which would benefit from the acquisition of U.S. technology provide insights into the types of markets likely to be selected.

The conclusion drawn from both general analysis and the case studies is that within the 1975-85 time frame it is highly unlikely that the USSR could offer serious competition in a product area involving advanced design and production technology. This indication is supported by studies of both the semiconductor and commercial aircraft areas and is borne out, as well, by examination of the past record of Soviet production and the behavioral and institutional characteristics of the Soviet economy. Areas which not only involve high technology, but are dominated by rapid technological change, are least promising for the USSR. The absorption of advanced technology is a complex process and one in which, for the reasons outlined in this study, the Soviets have not enjoyed great success. Even in the case of a turnkey acquisition in a product area where technology is very dynamic, unless the development of the technology can be made self-sustaining, a competitive position determined by level of technology could not be maintained. In the 10-year time frame, such a high-technology export capacity could not be developed to represent a significant competitive force without a very-high-level commitment of resources and thus a very-high-level political decision. As was indicated in the case studies, such a commitment and thus the development of competitive potential cannot be ruled out in any specific product area, but, at least in the

specific cases examined, such a political commitment is not deemed likely, given the level of resources relative to potential reward, i.e., flow of hard currency and national prestige, particularly in light of the economic pressures that will face Soviet leaders. Obviously, a large commitment of resources to penetrate world markets across a broad range of high-technology production can be ruled out.

A rational point of departure for Soviet decisionmakers in formulating an export strategy is the current export base of the USSR. An examination of the major sources of Soviet hard currency reveals a pattern of product areas in which the Soviets have had success (see Table VI-1). That pattern is heavily weighted toward primary production for which the problems encountered by Soviet manufactures in the world market are not a factor. Expansion of the existing major hard currency export base, i.e., primary products, could involve three non-mutually exclusive options: increase primary product export capacity, divert primary product exports from the Socialist bloc to hard currency countries, and/or increase the degree of fabrication of primary exports one level in order to gain hard currency from the increased value added. The first option is likely to be pursued to some extent, but this entails a large commitment of resources, while domestic claims on investment resources and primary product output are expected to grow rapidly. The second option, to divert exports from the Socialist bloc, is already being pursued but is limited by the effect of such a diversion on the East European economies which would then face world prices (in convertible currency) for primary products. The last option does appear tenable and is likely to be pursued along with expansion of primary product output for export. This latter option appears particularly attractive in light of the dual external/internal options strategy described below, especially given that the export of semifabricates involved would not make demands on production characteristics that would be superfluous from a domestic use point of view.

The dual external/internal options strategy for the development of new export bases should be attractive to Soviet decisionmakers. This strategy involves the expansion of productive capacity in areas where there

Table VI-1

USSR HARD CURRENCY EXPORTS
(Millions of Current U.S. dollars)

	1973	Percent of Total	Est. 1974	Percent of Total	Proj. 1975	Percent of Total
Total	4,817	100.0	7,500	100.0	9,300	100.0
Including:						
Oil and oil products	1,250	25.9	3,050	40.7	3,675	39.5
Natural gas	26	0.5	100	1.3	250	2.7
Coal and coke	125	2.0	200	2.7	250	2.7
Ores and metals	400	8.3	550	7.3	650	7.0
Wood and wood products	625	13.0	1,050	14.0	1,525	16.4
Chemicals	108	2.2	135	1.8	155	1.7
Diamonds	450	9.3	500	6.7	600	6.4
Platinum	260	5.4	350	4.7	400	4.3
Machinery and equipment	300	6.2	375	5.0	475	5.1

Source: Office of Economic Research, "USSR: Long-Range Prospects for Hard Currency Trade," Central Intelligence Agency, January 1975.

is a significant unsatisfied domestic demand. A portion of this productive capacity would then be dedicated to export in order to determine the potential for penetration of the world market. Should the initial effort prove rewarding, the portion of capacity justified by the utility of hard currency earnings balanced against the opportunity cost of diverting the output from the domestic economy, would continue to be devoted to export. Should the export effort prove unrewarding, the capacity could easily be converted to domestic use. In view of the risk-averting tendencies of a bureaucracy, such a relatively safe strategic economic option should be attractive. The development of a Scenario Two environment would increase the probability of serious Soviet efforts to develop exports related to imported technology.

In the case studies, the logic of the dual external/internal option prompted the assessment that both in construction machinery and equipment and the commodity group of synthetic fibers, the extent of domestic demand and potential hard currency earning would most likely recommend an attempt to test foreign markets in these areas. The technology needs of the domestic Soviet economy and thus the areas in which this dual option might be attractive are described in Chapter IV of this study, especially in relation to agreements signed with U.S., West European, and Japanese firms. The distribution of the agreements by SIC groups is indicated in Table IV-4. The U.S. agreements are summarized at the two-digit SIC level in Table VI-2.

3. New Initiatives to Solve Problems Related to Trade Competitiveness

Major disadvantages in Soviet competition for world markets result from the behavioral and institutional characteristics of the Soviet economy. While significant reforms of the Soviet economic system have been initiated in the past, they have not dealt successfully with major impediments to efficiency and responsiveness of enterprises to the needs of the users of the production. The round of economic reforms initiated in 1965 had considerably less impact than first anticipated by Western observers of the Soviet economy. The implication of recent reforms creating industrial associations is still uncertain, but it is not anticipated that the characteristics adversely affecting Soviet trade competitiveness will be altered to any significant extent.

Table VI-2

SOVIET IMPORTS OF U.S. TECHNOLOGY

By SIC Groups

SIC Groups	Major Headings	Number of Companies Signing Contracts or Agreements
13	Oil and gas extraction	1
16	Construction other than building construction--general contractors	1
20	Food and kindred products	2
22	Textile mill products	1
26	Paper and allied products	1
28	Chemicals and allied products	2
33	Primary metal industries	5
34	Fabricated metal products except machinery and transportation equipment	13
35	Machinery except electrical	135
36	Electrical and electronic machinery, equipment, and supplies	13
37	Transportation equipment	18
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	11
39	Miscellaneous manufacturing industries	3
44	Water transportation	1
49	Electric, gas and sanitary services	1
50	Wholesale trade--durable goods	1
73	Business services	6
89	Miscellaneous services	2

NOTE: Data at a 4-digit level appear in Chapter IV. Those data are more illuminating in the machinery categories.
The information cut-off date was September 1974.

Although overall reform of the economic system is not likely to be accomplished in favor of Soviet trade competitiveness, the Soviets have given strong indications that new initiatives are under consideration in specific areas related to foreign economic interaction. While the specific initiatives now under consideration may or may not have broad impact on Soviet success in penetrating foreign markets, the willingness to consider altering institutions to meet the requirements of trade competitiveness is significant. The degree of interrelatedness with Western economies which is implied as well as the possibility that serious efforts to mount marketing programs, after-sales service programs, etc., will be made are also significant.

Regarding new initiatives in the internal conduct of foreign economic relations, reports are reaching Western specialists of a number of institutional changes under consideration or in process. Joint appointments of deputy foreign trade ministers, by the Ministry of Foreign Trade and industrial ministries with significant import-export operations, will be made. Furthermore, producing enterprises will play a greater role in trade negotiations, which in the past have been conducted solely by the Foreign Trade Organizations.

New external forms of interaction with foreign economies are also being developed. The compensation agreement has been discussed above. The expanded use of joint ventures with Western firms is actively being explored. Soviet leaders also have under consideration proposals from U.S. firms to establish joint venture operations on Soviet territory in which the Western partner would share management functions as well as profits.

These new initiatives would provide the Soviets with foreign trade know-how accumulated by Western firms. The infrastructure abroad necessary for after-sales service and other product support activities could be established through joint ventures with Western distributors. Furthermore, entering into such a venture is a form of commitment to produce an item marketable in the West. The involvement of producing ministries

and enterprises in the conduct of foreign economic organizations carries the commitment, to some extent, down to the production level.

These new initiatives and the willingness on the part of the Soviets to consider other new forms of economic interaction with the West may or may not be viewed as evidence in favor of Scenario Two as the future role of foreign trade. They will, however, impact on the ability of Soviet exports to meet the requirements of the world market and should mitigate, somewhat, the view that Soviet foreign trade practices and economic processes are immutable limitations on the future trade competitiveness of the USSR on world markets.

4. Major Uncertainties in Assessing the Ability to Compete

The major uncertainties in assessing the ability of the Soviet Union to meet the competitive requirements of the world market involve both political developments and economic conditions in the West and high-level political decisionmaking and the timing of those decisions in the Soviet Union.

The likelihood that the Soviet Union would follow the path observed for most industrialized nations, that is, increasing interrelatedness with other developed countries, will depend on a reasonable normalization over time of political relations between the Soviet Union and the industrialized West. Should relations return to those at the height of the Cold War era, it is unlikely that Soviet exports would be well received in the West, that Soviet needs would be fulfilled by Western firms, or that the Soviet Union or Western nations would opt for a greater degree of interrelatedness.

Another external consideration is the economic stability of the West. If the relevant time frame is marked by rapid and extreme fluctuations in the Western economies, the increased role of the Soviet Union in international markets would be in doubt. Soviet leaders seek to insulate

the Soviet economy from the wide fluctuations in the world economy. The leaders would be very reluctant to increase the role of foreign trade given conditions of extreme economic instability in the West. Furthermore, periods of contraction in the West would not be conducive to successful Soviet market penetration. In these same periods, on the other hand, it is conceivable that demand for Soviet goods would fall, reducing hard currency receipts and, thus, Soviet purchases in the West would also be curtailed. In periods of rapid inflation, while low-priced Soviet goods might find a market, the overall terms of trade might well turn against the USSR. The actual effects of cyclical movements in Western economies on Soviet trade, however, would depend on specific price movements and commodity flows.

The internal uncertainties concern political decisionmaking in the Soviet Union and the decisionmakers. The current policy of detente with the West is strongly associated with General Secretary L.I. Brezhnev. It can be seen in the preceding discussions of the recent historical record of East-West economic interaction and in the consideration of foreign trade as an instrument of Soviet national purpose, that economic as well as political relations with the West will depend on the Soviet leadership. Thus, the potential competition for world markets offered by the Soviet Union is tied to the question of leadership succession.

Apart from the normalization of foreign economic relations, Soviet trade competitiveness will depend as well on government policies relevant to the role of foreign trade as envisioned in Scenario Two. By properly orchestrating an increased role for foreign trade, perhaps in response to economic pressures, the impact on Soviet trade competitiveness, as has been outlined above, will be created. These policies will concern a wide range of economic activity: resource allocation; incentive mechanisms; the organization of foreign trade; appropriate hard currency strategies; and the establishment of long-term relationships with Western firms in order to establish self-sustaining technological change as well as other management techniques involving quality control and product support services. These government policies, while they may not be in evidence to Western observers until the latter part of the 1975-85 time frame, must be instituted earlier in the period in order to tool up for a significant market penetration effort in the 1980s.

B. Qualifications and Limitations of the Study Results

Two sets of qualifications bearing on research methods employed in the study also bear on the interpretation of the study results. These qualifications are necessitated, on the whole, by limitations imposed by the availability of data, time, and research funding.

1. Survey and Classification Techniques

The data available for the survey of contracts and agreements signed by the Soviet Union and U.S. firms were limited to nontechnical reports in a variety of published sources. The data on the agreements were not reported in any consistent manner. The survey must be viewed, then, as a profile of potential activity and not as a measure of trade flow or a quantitative measure of relative importance.

A second issue concerns the classification scheme employed. While Standard Industrial Classification groupings proved a useful method of illustrating interest areas, the nontechnical nature of the published reports may have resulted in some misrepresentation of individual agreements. This would have been due to a general description of the activity having appeared as a catchall for activities involving a broad range of classifications. Despite these qualifications, the survey proved a valuable tool for formulating further analysis.

2. Case Study Techniques

Due to limited time and funds, a small number of representative case studies could be conducted. By careful selection of product areas, however, a broad range of technology was considered. The technological levels considered ranged from very sophisticated semiconductor devices to basic commodity synthetic fibers. The range of complexity of product support services, which in several of the studies proved to be a most important factor, also was broad--from aircraft maintenance systems and spare parts logistics to basic commodity fibers which require little beyond

acceptable quality and dependable delivery. The representative nature of the case studies notwithstanding, a subsequent effort involving a larger number and broader range of product areas is needed for the further testing of generalized conclusions in order to establish their validity.

Appendix

INTRODUCTION

This Appendix is composed of three tables which identify the areas in which the Soviet Union has been importing technology and equipment from the United States, Western Europe, and Japan in recent years. Table I is an alphabetical list of Soviet contracts and agreements for imports of U.S. technology from 1970 to August 1974. Table II regroups the contracts and many of the agreements in Table I by Standard Industrial Classification categories. Table III is a list of technologies imported by the USSR from France, Great Britain, Italy, West Germany, and Japan in 1974.

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Table I

ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM

Company	Technology	Million of Dollars Value	Source
1. Abex Denison Division of Abex Corporation	Hydraulic presses Presses for steel and iron casting with a capacity of 75 and 100 tons (Kama)	1 9.715	8 (12-14-73)
2. Ajax Magnethermic Corp.	(a) High-frequency induction crucible melting furnaces (Kama) (b) Set of furnaces for melting and holding of bronze, brass, and zinc scrap with charging and handling system (Kama)	1.410 1.413	23 (74)
3. Albany International Corp.	15 automatic forging machines and related tooling	3	35 (12-24-73)
4. Albany Machine	Carousel automatic forging process	3.083	1; 23
5. Alliance Tool Co.	Tableware and dishware	26	37
6. Alliance Tool & Die Corp. & Atlas Fabricators Inc.	Flatware and hollow ware	55	2; 16
7. Allis-Chalmers	Iron ore pellet plant	36	1
8. Ambac Industries, Inc.	Automated assembly lines	6	32
9. American Air Filter Co., Inc.	Air filters (scrubbing devices) (Kama)	.905	35 (12-24-73); 10 (11-26-73)
10. American Broadcasting Co.	Agreement: exchange of radio and television programs covering sports news and entertainment fare	-	38 (11-5-74)
11. American Can Co.	Agreement: Packaging;	-	1

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Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (continued)

Company	Technology	Million of Dollars Value	Source
12. American Chain and Cable Co.	Material handling equipment and controls	5.5	25 (7-31-74)
13. American Continental Ore Corp	800 tons of Kenyan fluorite	.3	30 (4-29-74)
14. American Ford Machinery Corp.	Cooperation in food processing petroleum equipment, material handling, construction equipment and mining machinery	-	8 (6-28-74); 13
15. American Home Products	Cooperation agreement: pharmaceuticals, medical instruments and consumer goods	-	30 (9-30-74)
16. American Instrument Co. (Division of Travenol Laboratories Inc.)	(a) Magne-gages (plating thickness gauges)	6.8 thou	23
	(b) 5 plating thickness gauges	6.7 thou	23
17. Amtel Inc. (French Litwin)	Petrochemical plant	100	35 (1-7-74)
18. Anderson	Drying & packing--synthetic rubber	10.3	40
19. Applied Research Laboratories (A subsidiary of Bausch & Lomb)	Quality control instruments for spectrochemical analysis	1.139	23
20. Armco Steel	Metallurgical, chemical and oil-field equipment	-	35 (9-23-74)
21. Arthur Anderson and Co.	Accounting	-	18

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
22. Bank of America	—	180 (loan)	35 (10-1-73)
23. Baxter Labs	Med. equip., enzyme plant	20	35 (11-5-73)
24. Bechtel Corp.	(a) Cooperation agreements (fuel petrochemical, mining, pipelines)	-	32; 13
	(b) Trade Center	80	37
25. Black-Russell-Morris	Representation agreement: placement of Soviet advertising in U.S. publications for industrial and technical products	-	9 (6-17-74)
26. Black, Sivalls and Bryson Inc. (sub. of International Systems and Controls)	Agreement on sale of high volume gas filtering equipment for use on natural gas pipelines	25	30 (10-16-74)
27. Blaw-Knox Equipment	Cement guns for electric arc furnaces (Kama)	.1	1; 23
28. E. W. Bliss	Automated line for forged truck parts	20	40
29. Boeing	Cooperation agreement: joint work groups to handle problems in engineering, manufacturing and certifying aircraft operation of passenger planes and ATC system	-	8 (6-14-74)
30. Booz, Allen & Hamilton	Advanced management computer systems	-	4 (7-28-73)
31. Borg-Warner Corp.	Oil well pumps	6	35 (2-19-73)
32. Brown and Root	Agreement: engineering and construction in gas and transmission	-	13

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
33. Brown & Sharp	Coordinate measuring machine and vertical N/C machining center	.150	9 (6-3-74)
34. Brunswick Division of Brunswick Corp.	Bowling alley	.200	9 (9-23-74)
35. Bryant Grinder	Machine tools	-	30 (3-18-74)
36. Burroughs	Computers (protocol)	-	8 (7-26-74)
37. Byron Jackson	Submersible electric pumps	5.903	1
38. Camco	Gas-lift extraction equipment and machine for preparing gas and oil for market	-	30 (2-18-74)
39. Cameron Iron Works	Balanced drilling rig	-	30 (2-18-74)
40. Carborundum Co.	(a) Shot blasting equipment (b) Dust & gas control systems in foundries	9.9 ---	13 13
41. Cardinal Scale International	Self-propelled electronic transfer cars, electronic melt shop scales, and electronic counting scales	.635	1; 23
42. Caterpillar & Internat'l Harvester	(a) Tractors & pipeline laying equipment (b) Bulldozers	108 (68 of which are Caterpillars) -	13; 16 8 (7-26-74)
43. C-E Cast Equipment (A division of W. S. Tyler, Inc., a subsidiary of Combustion Engineering, Inc.)	(a) Complete systems for automatic and mechanized pouring of cast iron (five automatic molding lines)	4.1	23; 13

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
43. C-E Cast Equipment (continued)	(b) Complete systems for mechanized pouring of steel (two automatic molding lines)	.7	23; 13
	(c) Automatic molding systems for automotive casting of gray and malleable iron, with electric equipment	22.613	23; 13
	(d) Automatic molding systems for automotive castings of steel, with electrical equipment	7.032	23; 13
	(e) Mechanisms for the punchout and transfer of castings to shakeout grids	.206	23
	(f) Complete mechanical pouring system for one automatic flaskless molding line ("Disamatic")	.114	23
44. Ceres Internat'l	Equipment for 3 feedlot units	5	9 (7-1-74)
45. Chemico (Chemical Constr. Corp., subdivision of General Tire and Rubber Co.)	Ammonia Plants	200	4 (7-13-74); 37
46. Chicago Pneumatic Tool Co.	(a) Automatic lines for assembly of flyweel casings and induction manifolds	-	23
	(b) Assembly line for hydraulic clutches	1.315	23

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
47. Chromalloy Kessler (Subsid. of Chromalloy American Corp.)	(a) Agricultural equipment and computerized diagnosis systems for electrocardiograms	-	8 (8-23-74); 10
	(b) Tools and designs for steel castings	3.4	30 (9-3-74)
48. Cincinnati Milacron, Inc.	Negotiate for sale of machine tools to be used for machining turbine blade	6.5 (TASS estimate)	30 (9-3-74)
49. Clark Equipment Co.	(a) 8 sweepers	16.1 thou	23
	(b) Port equipment (25 van carriers)	7.2	30 (8-5-74)
50. Cleveland Crane & Engineering	Monorail systems for transporting molten metal and core sand in gray and malleable iron, steel foundry, and nonferrous foundry buildings	10.420	13; 32; 1; 23
51. CMI Corp.	Rd. building and paving machinery	9.5	8 (9-6-74)
52. Coca Cola	(a) Coop. agreement: research in cultivation of waste lands, water purification and de-salination, soft drink production, experimental vegetable growing in swamps, deserts and other arid zones as well as in the advanced types of environmental farming	-	25 (7-10-74)
	(b) 2 protocols with food and dairy industries: specific cooperation in processing products from tea and making protein-enriched drinks from milk waste	-	25 (7-10-74)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
53. Codevintec Pacific	25 different computer systems	15	30 (10-16-74)
54. Coherent Radiation	Lasers for use in eye surgery	.04	35 (11-5-73)
55. Colonial Broach & Machine Co.	Pneumatic presses (Kama)	.014	23
56. Combustion Engineering (with Monsanto)	(a) Acetic Acid Plant (b) Molding machines	45 30	37 4 (11-17-73)
57. Container Transport International Inc.	Containers	3	32; 8 (5-31-74) & (1-25-74)
58. Continental Can	Can making equipment	11	8 (4-5-74)
59. Control Data	10 yr. agreement for transportation, education, and medical computer applications		32; 26 (10-24-7
60. Cooper-Bessemer Co.	Agreement: large gas compressors	-	2
61. Crankshaft Machine	(Kama River) automatic line for machining camshafts (lathes)	3.360	1; 23
62. Criminal Research Products, Inc.	Mobile crime lab and equipment	.028	30 (9-3-74)
63. Cross Co.	(a) Machine brake drum tools (b) Brake drums and wheel hub production line	20	40 40

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
64. Cross Frazer	(Kama River) A multiple system for deburring cylinder blocks with provision for automatic loading and unloading	1.533	1; 23
65. John Deere	One self-propelled silage harvester one straw-compacting baler, one stacker, and one self-propelled swathing mower	.065	30 (8-19-74)
66. Diano Corp.	5 Industrial x-ray units	1	30 (6-10-74)
67. Dresser Industries	Compressors: agreement for joint production Increase well logging efficiency	27.5	37; 13
68. DuPont	(a) Protocol: joint work in development of insulation materials	-	30 (4-1-74)
	(b) Sales of synthetic rubber, textile fibers and film for auto glass	-	30 (4-1-74)
69. Dynamic Air Inc.	Dense phase pneumatic conveying systems (Kama)	.932	23
70. Eaton Corp. (through an Italian subsidiary)	Truck engine valves	4.3	35 (2-19-73)
71. El Paso Natural Gas & Occidential Petroleum	Natural gas pipeline (under negotiation 8/74)	2000. to 3000.	37
72. Electronucleonics, Inc.	2 ultra-centrifuges	.200	30 (8-5-74)
73. Elliott Co.	Compressors	-	8 (11-30-73)
74. Elwell-Parker Electric Co.	Truck for transporting dies (Kama)	.085	23

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company		Technology	Million of Dollars Value	Source
75.	Ex-Cell-O Corp.	(a) (Kama River) Pilot line for the machining and processing of cylinder liners	3.935	1; 23
		(b) Automated line for the complete machining and processing of cylinder lines for diesel engines (Kama)	16.11	23
		(c) Transfer lines and other equipment for manufacture of diesel engine parts	20	30 (1-7-74)
76.	Federal Products Corp. (Unit of Esterline Corp.)	(a) Instrument	2.7 thou	23
		(b) Measuring instrument	2.8 thou	23
77.	Fiat-Allis Construction Machinery, Inc.	(a) Bulldozers	-	8 (7-26-74)
		(b) 50 hauler tractors to be used in strip mining	12.5	30 (7-8-74)
78.	Food Machinery Corp.	(a) Food processing machinery	2.7	30 (1-21-74)
		(b) Protocol--cooperation in food processing, soft drink bottling and packaging	-	30 (1-2-74)
		(c) Scientific and technical agreement machines for planting, thinning, collection, transportation and canning of vegetables	28	29 (9-17-73)
79.	Gardner Denver Co. (through German subsid.) With Continental EMSCO	(a) Parts for transmission plant for Kama River	-	35 (2-19-73)
		(b) Pump for injection of drilling fluid into oil wells		8 (12-14-73)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
80. Gearhart-Owen	Oil well equipment	1	40
81. General Dynamics Corp.	Agreement on ships, telecommunications, asbestos mining and processing, aircraft computers, microfilm navigation and weather buoys, and LNG ships	-	16
82. General Electric	(a) Gas turbine compressors	250	4 (8-17-74);
	(b) Cooperation in power engineering, elec. engineering and atomic power	-	30 (6-10-74)
	(c) Diagnostic, therapeutic and surgical instruments, including artificial hearts and lungs	-	30 (6-10-74)
	(d) Production of high-pressure sodium lamps	-	30 (6-10-74)
83. General Motors	(a) Earth moving equipment	100	37
	(b) Truck factory (under negotiation 8/74)	1000	37
84. Giddings & Louis	Transfer lines for machine flywheels	7.458	1
85. Gleason Works	(a) Gear production machinery	11.4	8 (5-31-74)
	(b) Rear-axle production equipment	15	32
	(c) Previous orders	60	30 (5-28-74)
	(d) Gear testing machines (Kama)	10.115	23
86. Glidden Machine & Tool Inc.	Drilling machines and other machine tools	-	34
87. Gould Inc.	Electrodeposited copper foil for printed circuit boards	1/yr.	30 (9-30-74)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
88. Gulf Oil	(a) Agreement	-	38 (10-11-74)
	(b) Agreement in principle to participate in exploration for oil and natural gas off Sakhalin Island	-	30 (8-19-74)
89. Gulf & Western Ind. Inc.	Production line to manufacture parts	20	16
90. Herman Corp.	Automated molding lines for steel foundry	34.5	30 (9-30-74)
91. Hewlett-Packard Co.	Agreement: medical electronics, scientific measuring instruments & mine computers	-	12
92. Holcroft & Co. (Div. of Thermo Electron Corp.)	(All for Kama River)	19.9	13
	(a) Heat treating furnaces	23.120	1
	(b) Heat treating furnaces	1.747	23
	(c) Carburizing systems	5.646	23
	(d) Furnaces for tempering crankshafts	.929	23
	(e) Heat treating unit for automatic stamping line	.380	23
	(f) Heat treating equipment for automatic line to process intake and exhaust valves	.900	23
	(g) Isothermal annealing unit for ring gears	.854	23
	(h) Accessories for heat treating equipment of diesel-engine plant	.140	23
	(i) Heat treating equipment for expansion cams, connecting rods, etc.	2.507	23
	(j) Stress-relief annealing furnaces with loading and unloading system	.944	23

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
92. Holcroft & Co. (continued)	(k) Heat treating furnaces for steel castings with loading and unloading equipment	2.250	23
	(l) Set of furnace systems for heat treating aluminum castings	3.560	23
	(m) Equipment for heat treatment of piston pins	1.300	23
	(n) Equipment for heat treatment of cylinder liners	1.470	23
93. Honeywell, Inc.	(a) Computers	65	37
	(b) (Kama River)	-	32
	(c) Siberian gas devel. project	-	32
	(d) Radio controlled activators	2.25	40
94. Honeywell-Bull	12 computers	10	32
95. Imprex, Inc.	Vacuum-pressure impregnation system (Kama)	.141	23
96. Industrial Nucleonics	Agreement: paper, pulp, rubber, plastics and steel	-	8 (5-17-74)
97. Infinetics	Metal detection equipment (used by airports to detect hijackers)	-	30 (9-3-73)
98. Ingersoll Milling Machine Co.	(a) Engine block machining line	22.5	8 (9-20-74); 8 (2-8-74)
	(b) Integrated system for machining cylinder-block bases	.508	23
99. Ingersoll Rand Co.	(a) Auto engines	3.8	8 (3-22-74);
	(b) Air compressor installations, cinderblock equip., machine tools, auto. lines & installation assistance	20	1; 14; 32; 40
(Ingersoll-Rand Gmbh. Automatic Production Systems Group)	(c) Automatic assembly line for V-8 diesel engines	7.103	23

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
100. Instrument Sys. Corp.	In-plane audio and communications equipment	.250	35 (1-7-74)
101. Intercontinental Hotels and Skanska (Sweden)	Hotels	-	8 (7-26-74)
102. Internat'l Bus. Machines	(a) Computers (370 system) for Intourist Hotels	10	32
	(b) 360/50 for Min. of Chem.	250	32
	(c) Air traffic control system (under negotiation 8/74)	-	37
	(d) Model 158 system subject to approval by appropriate authorities	-	25 (7-17-74)
103. Internat'l Harvester (with Caterpillar)	(a) Tractors and pipeline equipment	108	13
	(b) Gas turbine powered gas compressors	25 26.262	13; 32 1
	(c) 15 tractor loaders	14	8 (7-26-74)
	(d) Farm machinery	3	8 (7-26-74)
(R.A. Hanson Disc Ltd.)	(e) Canal lining machinery	6.6	8 (6-14-74)
104. Internat'l Paper	Joint research-U.S. help construct plants & perhaps provide machinery, know-how & licenses	-	8 (6-14-74)
105. Internat'l Tel & Tel	(a) Exchange on telecommunications, electrical & electrical mechanical components and consumer products	-	13
	(b) Satellite communications transmitting and receiving facilities	1.34	40

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
105. International Tel. & Tel. (continued)	(c) Transmitting and receiving facilities	1.0	40
	(d) 1st direct satellite communications "hotline" between U.S. and USSR to modernize original cable hotline between Moscow and Washington	-	10 (11-26-73)
106. Internat'l Utilities Corp. (through Walworth-Aloyco & Grave S.P.A., a 2/3 owned Italian subsidiary)	Ball valves for a natural gas pipeline	31	10 (7-22-74)
107. Interpool	Purchase contract to link sea container routes	2	40
108. Intertex Internat'l	(a) Equipment for annealing nickel and stainless steel in dry hydrogen	2	30 (8-19-74)
	(b) Heavy metallurgical equipment for a pipe-making plant	2.5	30 (8-19-74)
109. Jones & Lamson (Division of Waterbury Farrel Co.)	Machine friction drums	5.580	1
110. Joy Manufacturing	Exchange: mining machinery	-	13
111. Kaiser Corp.	(a) Agreement in aluminia & aluminum, ferrous metals, coal engineering, cement and gypsum production & seaport construction		13 8 (2-8-74)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
Kaiser Resources Ltd. (owned 39% by Kaiser Steel Corp. which is controlled by Kaiser Industries)	(b) Coop. agreement: industrial application of science and technology in coal mining	-	25 (7-24-74)
112. M. W. Kellogg (subsidiary of Pullman)	Will handle engineering for French Creusot-Loire ammonia plant	-	30 (8-19-74)
113. Kevex Corp	3 X-ray spectrometry systems under general agency agreement with Japan's Maurbeni Co.	.120	9 (9-9-74)
114. Kingsbury Machine Tool Corp.	Valve making machines & equipment for petrochemical industry and sets of cutting tools	4.7	8 (6-14-74)
115. Kocour Co.	2 thickness gauges	4.0 thou	23
116. Landis Tool	Production equipment for crankshafts and other machine tools	8.7	12; 13
117. LaSalle Machine Tool	(All for Kama River)		
	(a) 2 assembly lines for manufacturing pistons	6.441 6.461	1 1
	(b) Transfer line for same	15.722	1
	(c) Automatic line for machining crankshaft bearing caps	2.682	23
	(d) Transfer line for manufacturing of pistons	9.716	23
118. Lear Seigler	Machine Tools	-	40

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
119. Lifesavers Internat'l (Div. of Squibb Corp)	Lemon and spearmint flavored lifesavers gum	.100	30 (5-14-74)
120. Link Engineering Co.	Stand (Kama)	.020	23
121. Litton Industries (Swedish unit)	Cash register factory	18	35 (10-1-73)
122. Lockheed Aircraft	Cooperation agreement: navigation systems, oceanographic apparatus, medical electronics & possibly air traffic control system	-	8 (2-22-74)
123. Logos Develop. Swindell-Dressler	Computer translation services		40
124. Lummus Co.	Acetic acid plant	51	35 (12-24-73)
125. Marsteller, Inc.	Agreement: advertising	-	1
126. McKinsey & Co.	Agreement on management practice	-	30 (9-30-74)
127. Meter Systems (Div. of A. D. Smith)	(a) Turbine meters (with Camco Inc.)	-	9 (9-9-74)
	(b) Capacitance probes (under contract with British Solartron)	-	9 (9-9-74)
128. Monarch Machine Tool	N/C vertical machining center and an NC turning machine	1	9 (6-3-74)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
129. Monsanto	Agreement: computers for use in chemical and rubber compound products, production of herbicides, fertilizers and fiberglass	-	35 (9-23-74); 10 (11-2-73)
130. MTS Systems	(Kama River) Pulsators	.645	1; 23
131. Nat'l Broadcasting Co.	Agreed to exchange radio and TV programs and personnel	-	16
132. Nat'l Cash Register	Business machines	-	40
133. Nat'l Engineering Co.	(a) Equip. to manufacture castings	-	1
	(b) Equip. to make rear-axle parts	13.751	12; 13
	(c) License for multistation automated sand-preparing system	.997	23
	(d) Complete equipment for automatic mold sand systems for preparation of molding mixtures for five automatic flask (molding) lines and four flaskless (molding) lines in the gray iron foundry and for two flask (molding) lines in the steel foundry	14.443	23
134. New Brunswick Scientific Co.	(a) Computer controlled fermentation system	.8	40
	(b) Fermentation equipment	.02	30 (8-5-74)
135. Norton Co.	(a) Sell manufacturing, know-how and consult in construction of an abrasives plant	-	35 (2-19-73)
	(b) Calcinating kiln devices for producing grinding mixtures	.45	40

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
136. Occidental Petroleum (with Bechtel and Welton Beckett Associates)	(a) International trade center	8	8 (5-17-74); 30 (4-29-74)
(With El Paso Nat'l Gas)	(b) Yakutsk gas fields	3 bil.	13
	(c) Chemical fertilizers	8 bil.	35 (6-25-73); 4 (5-19073)
	(d) Metal finishing gear and process	80	35 (5-30-74); 4 (7-13-74)
	(e) Effluent Control System	3.6	40
	(f) Equip. for galvanizing metal articles	.5	8 (11-30-73)
137. OK Machine & Tool Corp.	Wire wrapping tools and equipment for precision electronic assembly	-	30 (8-5-74)
138. Olin Corp. (Winchester International Div.)	Shot guns and ammunition, Olin skis and Weaver scopes and mounts for rifles	-	8 (5-31-74); 30 (5-14-74)
139. Oxy Metal Finishing (Affiliate of Occidental Petroleum)	Equipment for metal finishing mainly for galvanizing and polishing parts in automotive manufacture	40	30 (1-7-74)
140. Pepsi Cola Co.	Pepsi plant	-	16
141. Philip Morris Inc.	Agreement: tobacco products chemicals, packaging paper materials	-	13
142. Piker International	X-ray systems	.75	35 (11-5-73)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
143. Pitney Bowes	Postage meters and mailing machines and addresser-printer equipment	-	30 (8-19-74)
144. Platt-Lumbus	Cotton processing units	-	40
145. PPG, formerly Pittsburgh Plate Glass	Letter of intent: plastic resin manu. complex	-	16
146. Pratt and Whitney Machine Tool (Division of Colt Industries)	(a) Drilling and tool-griding machines	.214	23
	(b) 2 copying milling machines	.578	23
147. Prefinish Metals	Coil coating technology	12	40
148. Prichard Rhodes	Gas-lift extraction equipment and machine for preparing gas and oil for the market	-	30 (2-18-74)
149. J. F. Pritchard	Gas treatment plant	53	37
150. Pullman, Inc.	Production equipment (Kama River)	-	12
151. Raycon Corp.	(Kama River) Machine tools to bore fuel diffused holes in tractor engine injectors	1.117	1; 8 (1-25-74)
152. Raymond Loewy/ Wm. Snaith, Inc.	Agreement: industrial design; boats, cars, household appliances	-	37
153. Raytheon	Air traffic control system (negotiation 8/74)	80	8 (1-25-74)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
154. Redapump (Div. of TRW)	Submersible electric pumps	20.034	1
155. Rockwell International	Circular knitting machines	5.620	1
156. Rockwell Valves International	Nuclear valves for Soviet plant in Finland	-	35
157. Rotaprint	Offset printing machines	.82	40
158. Satra	(a) Motorcycles	19	32
	(b) Oil drilling equipment	-	32
	(c) Synthetic rubber	11	30 (8-5-74)
159. Setco Industries, Inc.	Infinitely variable speed snagging grinders for 12,500 SFPM for cleaning of steel and iron castings (Kama)	.327	23
160. Shalco Systems	(Kama River) 10 core-making machines and one complete automatic unit for preparing coated core mixture	.683	35 (6-25-73); 1;
161. Singer	Data collection and communication education and training devices, aerospace and marine electronic instrumentation, advanced sewing machines, textile machinery, climate control and industrial controls and metering		13

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
162. Sperry Rand (Univac, Remington, and New Holland divisions)	(a) Cooperation with computer systems, farm equipment, office machine and consumer products, hydraulic and pneumatic systems and marine navigation guidance and control systems	—	13; 30 (5-28-74
(New Holland Div.)	(b) One grain harvester, one baler one self-propelled forager)	.065	30 (8-5-74)
(Univac Div.)	(c) Supply aeroflot with computerized reservation system. Delayed until export administration approval is granted.	-	30 (8-5-74)
163. Stanford Res. Inst.	Cooperation agreement on business opportunities and managerial techniques	-	13
164. Strick (Div. of Fruehauf Corp.)	96 refrigerated containers	1.5	8 (5-3-74)
165. Sutter Products	(a) Hot-box core-making machines (Kama)	4.040	23
	(b) Unit for cleaning cylinder block and surfaces	.328	23
	(c) Sand preparation system for core-making shops for casting of iron and non-ferrous metals	2.500	23
166. Swindell-Dressler	(a) Kama foundry	10	32
	(b) Elec. arc foundry furnaces	16	32
		42.6	13
		33.624	1
	(c) Project report for foundry of Kamaz plant	9 thou.	23
	(d) Equipment for melting shop (for gray malleable iron)	5.4	23

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
166. Swindell-Dressler (continued)	(e) Electric arc furnaces (nine gray-iron melting furnaces rated at 50 metric tons capacity each and eight holding furnaces rated at 75 metric tons capacity each)	15.929	23
	(f) Heat treating furnaces, with handling equipment	8.250	23
	(g) Lifting mechanisms for holding furnaces	94.7 thou	23
	(h) Set of furnaces for melting and holding of aluminum with charging and handling system	3.950	23
167. Teknis Inc.	Reed switch assembly machines and infrared sealing equipment	-	30 (7-8-74)
168. Teledyne Pines	Tubular products: hydraulic rotary benders; hydraulic vertical benders, end-finishing and cut-off equipment; end-crimping and end-forming machinery for assembling fittings on tube ends. Marking machine for imprinting numbers.	1.256	23
169. Texas Eastern Transmission Corp., Tenneco, Inc., Brown & Root, Inc.	Gas gathering and treating system Under negotiation 8/74	-	32; 13
170. Thermo-Electron	22 heat treating furnaces	5.0	32; 40

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Continued)

Company	Technology	Million of Dollars Value	Source
171. Thompson Grinder Division of Waterbury Farrel (Div. of Textron, Inc.)	Grinding machine	.061	23
172. Timken Co.	Bearings	.400	30 (9-16-74)
173. TRW Inc. (Rede div.)	Petroleum pumping systems	20	35 (2-19-73)
174. Union Carbide	(a) Chemicals		35 (11-26-73)
	(b) Gas phase process for the production of high density polyethelene	-	27 (7-18-74)
175. Universal Oil Products	(a) Agreement for installation of petroleum processing units 3 different refineries		9 (8-26-74)
	(b) Ethyl benzene unit		8 (1-11-74)
176. Vacuum Industries, Inc.	(a) Semicontinuous induction vacuum melting furnace, capacity 500 kg.	.509	23
	(b) 100-kw electron-beam furnace	.411	23
177. Varian Associates	(a) Computers and analytical instruments which define the chemical and physical properties of gases, liquids, and organic substances	10	30 (8-5-74)
	(b) 5 year exchange of information and joint research: accelerators, scientific instruments and vacuum products	-	30 (8-5-74)

Table I ALPHABETICAL ORDER BY U.S. COMPANY AS ORIGIN OF TRADED ITEM (Concluded)

Company	Technology	Million of Dollars Value	Source
178. Warner-Swazey & Co.	Production equipment for crank shafts and other machine tools	1.529	12; 1
179. Webb Corp	Truck conveyor system	13.4	40
180. The Wickes Corporation	(a) Special-purpose lathes for automatic crankshaft line	2.144	23
	(b) Supplement No. 1 (machine-tool model change)	25.7 thou	23
181. Willi Passer Co.	Cooperation in medical electronics small computers and instruments	-	12
182. Winslow Mfg. Co.	Tool grinding machines (Kama)	61 thou	23

Table II

ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM

SIC Group	Company	Technology	Million of Dollars Value	Source
13	Texas Eastern Transmission Corp. Tenneco, Inc., Brown & Root, Inc.	Gas gathering and treating system Under negotiation 8/74	-	32; 13
1623	Brown and Root	Construction in gas and transmission	-	14
2067	Lifesavers International	Lemon and Spearmint flavored Lifesaver gum	.100	30 (5-14-74)
2086	Pepsi Cola Co.	Pepsi plant	-	16
2295	Imprex, Inc.	Vacuum-pressure impregnation system (Kama)	.141	23
*2631	International Paper	Joint research—U.S. help construct plants and perhaps provide machinery, know-how and licenses	-	8 (6-14-74)
2819	Union Carbide	Chemicals	-	35 (11-26-73)
2822	Satra	Synthetic rubber	11	
336	Sutter Products	Sand preparation system for core-making shops for casting of iron and non-ferrous metals	2.500	23
3369	Nat'l Engineering Co.	(a) Equip. to manufacture castings	-	1; 12
		(b) Equip. to make rear-axle parts	13.751	1; 12
3369	Swindell-Dressler	(a) Kama foundry	10	32
		(b) Elec. arc foundry furnaces	16	32

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3398	Holcroft & Co. (Div. of Thermo Electron Corp.)	(a) Isothermal annealing unit for ring gears (b) Stress-relief annealing furnaces with loading and unloading system	.854 .944	23 23
3398	Intertex International	Equipment for annealing nickel and stainless steel in dry hydrogen	2	30 (8-19-74)
3412	Container Transport International Inc.	Containers	3	32; 8 (5-31-74)
3412	Strick (Div. of Freuhauf Corp.)	96 refrigerated containers	1.5	8 (5-3-74)
*3443	Bechtel Corp.	Cooperation agreements (fuel petrochemical, mining, pipelines)	-	32; 13
3443	Jones & Lamson (Division of Waterbury Farrel Co.)	Machine friction drums	5.580	1
3443	New Brunswick Scientific Co.	(a) Computer controlled fermentation system (b) Fermentation equipment	.8 .02	40 30 (8-5-74)
3443	Rockwell Valves Internat'l	Nuclear valves for Soviet plant in Finland	-	32
3469	Abex Denison (Div. of Abex Corp.)	(a) Hydraulic presses (b) Presses for steel and iron casting with a capacity of 75 and 100 tons (Kama)	1 9.715	8 (12-14-73) 8 (12-14-73)
3479	Prefinish Metals	Coil coating technology	12	40

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3482	Olin Corp. (Winchester International Div.)	Shot guns and ammunition, Olin skis and Weaver scopes and mounts for rifles	-	8 (5-31-74) 30 (5-14-74)
3494	Internat'l Utilities Corp. (through Walworth-Aloyco & Grave S.P.A., a 2/3 owned Italian subsidiary)	Ball valves for a natural gas pipeline	31	10 (7-22-74)
3494	Kingsbury Machine Tool Corp.	Valve making machines & equipment for petrochemical industry	4.7	8 (6-14-74)
3497	Gould Inc.	Electrodeposited copper foil for printed circuit boards	1/yr.	30 (9-30-74)
3498	Intertex International	Heavy metallurgical equipment for a pipe-making plant	2.5	30 (8-19-74)
3511	General Electric	Gas turbine compressors	250	4 (8-17-74)
3519	Ingersoll Rand Co.	Auto engines	3.8	8 (9-20-74) and (2-8-74)
3523	Caterpillar & Internat'l Harvester	Tractors	108 (68 of which are Caterpillar's)	13; 16
3523	Ceres Internat'l	Equipment for 3 feedlot units	5	9 (7-1-74)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3523	John Deere	One self-propelled silage harvester, one straw-compacting baler, one stacker, and one self-propelled swathing mower	.065	30 (8-19-74)
3523	Internat'l Harvester (with Caterpillar)	(a) Tractors	108	13
		(b) 15 tractor loaders	14	8 (7-26-74)
		(c) Farm machinery	3	8 (7-26-74)
3523	Sperry Rand (New Holland Div.)	One grain harvester, one baler one self-propelled forager	.065	30 (5-28-74)
*3531	American Ford Machinery Corp.	Cooperation in construction equipment	-	8 (6-28-74); 13
3531	Caterpillar & Internat'l Harvester	(a) Bulldozers	-	8 (7-26-74)
		(b) Pipeline laying equipment	108	13; 16
3531	Chromalloy Kessler (Subsid. of Chromalloy American Corp.)	Agricultural equipment	-	8 (8-23-74)
3531	Clark Equipment Co.	Port equipment (25 van carriers)	7.2	30 (8-5-74)
3531	CMI Corp.	Road building and paving machinery	9.5	8 (9-6-74)
3531	Fiat-Allis Const. Machinery Inc.	Bulldozers	-	8 (7-26-74)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3531	General Motors	(a) Earth moving equipment (b) Truck factory (Under negotiation 8/74)	100 1000	37
3531	Internat'l Harvester (R. A. Eanson Disc. Ltd.)	Canal lining machinery	6.6	8 (6-14-74)
3532	Allis-Chalmers	Iron ore pellet plant	36	16
* 3532	American Ford Machinery Corp.	Cooperation in mining machinery	-	8 (6-28-74)
3532	Fiat-Allis Const. Machinery Inc.	50 hauler tractors to be used in strip mining	12.5	30 (7-8-74)
3532	Joy Manufacturing	Exchange: mining machinery	-	13; 14
*3532	Kaiser Corp.; Kaiser Resources Ltd. (owned 59% by Kaiser Steel Corp. which is controlled by Kaiser Industries)	(a) Coal engineering (b) Coop. agreement: industrial application of science and technology in coal mining	- -	14 25 (7-24-74)
3533	Armco Steel	Oil-field equipment	-	35 (9-28-74)
3533	Borg-Warner Corp.	Oil well pumps	6	35 (2-19-73)
3533	Camco	Gaslift extraction equipment	-	30 (2-18-74)
3533	Cameron Iron Works	Balanced drilling rig	-	38 (2-18-74)
3533	Gardner Denver Co. (with Continental EMSCO)	Pump for injection of drilling fluid into oil wells	-	35 (2-19-73); 8 (12-14-73)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3533	Gearhart-Owen	Oil well equipment	-	40
3533	Prichard Rhodes	Gas-lift extraction equipment	-	30 (2-18-74)
3533	Satra	Oil drilling equipment	-	32
3533	TRW Inc. (Redapump Div.)	Petroleum pumping systems	20	35 (2-19-73)
3535	Dynamic Air Inc.	Dense phase pneumatic conveying systems (Kama)	.932	23
3535	Ingersoll Rand Co. (Ingersoll-Rand Gmbh. Automatic Production Systems Group)	Automatic assembly line for V-8 diesel engines	7.103	23
3535	Webb Corp.	Truck conveyor system	13.4	40
3536	American Chain and Cable Co.	Material handling equipment and controls	5.5	25 (7-31-74)
3536	Cleveland Crane & Engineering	Monorail systems for transporting molten metal and core sand in gray and malleable iron, steel foundry, and nonferrous foundry buildings	10.420	14; 32; 1; 23
3536	Swindell-Dressler	Lifting mechanisms for holding furnaces	94.7 thou	23-
3537	Elwell-Parker Electric Co.	Truck for transporting dies (Kama)	.085	23

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3541	Bryant Grinder	Machine tools	-	9 (9-23-74)
3541	Chromalloy Kessler	Tools for steel castings	3.4	30 (9-3-74)
3541	Cincinnati Milacron, Inc.	Negotiate for sale of machine tools to be used for maching turbine blade	6.5 (TASS estimate)	30 (9-3-74)
3541	Crankshaft Machine	(Kama River) automatic line for machining camshafts (lathes)	3.360	1; 23
3541	Cross Frazer	(Kama River) A multiple system for deburring cylinder blocks with provision for automatic loading and unloading	1.533	1; 23
3541	Ex-Cell-O Corp.	(a) (Kama River) Pilot line for the machining and processing of cylinder liners	3.935	1
		(b) Automated line for the complete machining and processing of cylinder lines for diesel engines (Kama)	16.11	23
		(c) Transfer lines and other equipment for manufacture of diesel engine parts	20	30 (1-7-74)
3541	Gleason Works	Gear production machinery	11.4	8 (5-31-74)
3541	Ingersoll Milling Machine Co.	(a) Engine block machining line	22.5	8 (9-20-74); (2-8-74)
		(b) Integrated system for machining cylinder-block bases	.508	23
3541	Ingersoll Rand Co.	Cinderblock equipment	20	14; 32; 40; 1

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3541	Kingsbury Machine Tool Corp.	Sets of cutting tools	4.7	8 (6-14-74)
3541	Landis Tool	Production equipment for crankshafts and other machine tools	8.7	14; 12
3541	OK Machine & Tool Corp.	Wire wrapping tools and equipment for precision electronic assembly	-	30 (8-5-74)
3541	Pratt and Whitney Machine Tool (Div. of Colt Ind.)	Drilling and tool-griding machines	.214	23
3541	Raycon Corp.	(Kama River) Machine tools to bore fuel diffused holes in tractor engine injectors	1.117	1; 8 (1-25-74)
3541	Thompson Grinder Division of Waterbury Farrel (Div. of Textron, Inc.)	Grinding machine	.081	23
3541	The Wickes Corporation	(a) Special-purpose lathes for automatic crankshaft line	2.144	23
		(b) Supplement No. 1 (machine-tool model change)	25.7	23
3541	Winslow Mfg. Co.	Tool grinding machines (Kama)	61 thou	23
3542	Abex Denison (Div. of Abex Corporation)	(a) Hydraulic presses	1	8 (12-14-73)
		(b) Presses for steel and iron castings with a capacity of 75 and 100 tons (Kama)	9.715	23
3542	Albany Internat'l Corp.	15 Automatic forging machines and related tooling	3	35 (12-24-73)
3542	Albany Machine	Carousel automatic forging process	3.083	1; 23

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3542	Chromalloy Kessler (Subsid. of Chromalloy American Corp.)	Tools for steel castings	3.4	30 (9-3-74)
3542	Colonial Broach & Machine Co.	Pneumatic presses (Kama)	.014	23
3542	Combustion Engineering Inc.	Molding machines	30	4 (11-17-73)
3542	Continental Can	Can making equipment	11	8 (4-5-74)
3542	Herman Corp.	Automated molding lines for steel foundry	34.5	30 (9-30-74)
3542	Nat'l Engineering Co.	(a) Equip. to manufacture castings	-	1
		(b) Equip. to make rear-axle parts	13.751	12; 13
		(c) License for multistation automated sand preparing system	.997	23
		(d) Complete equipment for automatic mold and sand systems for preparation of molding mixtures for five automatic flask (molding) lines and four flaskless (molding) lines in the gray iron foundry and for two flask (molding) lines in the steel foundry	14.443	23
3542	Teledyne Pines	Tubular products: hydraulic rotary benders hydraulic vertical benders, end-finishing and cut-off equipment; end-crimping and end-forming machinery for assembling fittings on tube ends. Marking machine for imprinting numbers.	1.256	23

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3545	Brown & Sharp	Coordinate measuring machine and vertical N/C machining center	.150	9 (6-3-74)
3545	Ingersoll Rand Co.	Auto lines and installation assistance	20	1; 14; 32; 40
3545	Lear Seigler	Machine tools	-	40
3545	Pratt and Whitney Machine Tool (Div. of Colt Ind.)	2 copying milling machines	.478	23
3546	Setco Industries, Inc.	Infinitely variable speed snagging grinders for 12,500 SFPM for cleaning of steel and iron castings. (Kama)	.327	23
*3547	Kaiser Corp.	Agreement in aluminia & aluminum, ferrous metals	-	14
3547	Occidental Petroleum (with Bechtel and Welton Beckett Assoc.)	Equipment for galvanizing metal articles	.5	8 (11-30-73)
3549	Gulf & Western Ind. Inc.	Production line to manufacture parts	20	16
3549	Sutter Products	Unit for cleaning cylinder block and surfaces	.328	23
*3551	American Ford Machinery Corp.	Cooperation in food processing	-	8 (6-28-74); 14
*3551	Food Machinery Corp.	(a) Food processing machinery	2.7	30 (1-21-74)
		(b) Protocol—cooperation in food processing soft drink bottling and packaging	-	30 (1-2-74)
		(c) Scientific and technical agreement machines for planting, thinning collection, transportation and canning of vegetables	28	30 (9-17-73)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3552	Anderson	Drying & packing—synthetic rubber (equipment)	10.3	40
3552	Platt-Lumbus	Cotton processing units	-	40
3552	Rockwell International	Circular knitting machines	5.620	1
3555	Rotaprint	Offset printing machines	.82	40
*3559	American Ford Machinery Corp.	Cooperation in petroleum equipment	-	8 (6-28-74); 14
3559	Amtel Inc. (French Litwin)	Petrochemical plant	100	35 (1-7-74)
3559	Applied Research Laboratories (A subsid. of Bausch & Lomb)	Quality control instruments for spectro-chemical analysis	1.139	23
3559	Armco Steel	Chemical equipment	-	35 (9-23-74)
3559	Baxter Labs	Enzyme plant	20	35 (11-5-73)
3559	Chemico (Chemical Constr. Corp. subdivision of General Tire and Rubber Co.)	Ammonia plants	200	4 (7-13-74); 37
3559	Combustion Engineering (with Monsanto)	Acetic Acid plant	45	37
*3559	Kaiser Corp.	Agreement in cement and gypsum production	-	14
3559	Lummus Co.	Acetic acid plant	44.515	35 (12-24-73)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3559	Occidental Petroleum	(a) Chemical fertilizer (equipment)	8 bil.	35 (6-25-73); 4 (5-19-73)
		(b) Metal finishing gear and process	80	35 (5-30-74); 4 (7-13-74)
3559	Oxy Metal Finishing (Affiliate of Occidental Petroleum)	Equipment for metal finishing mainly for galvanizing and polishing parts in automotive manufacture	40	30 (1-7-74)
*3559	PPG, formerly Pittsburgh Plate Glass	Letter of intent: plastic resin manufacturing complex	-	16
3559	Union Carbide	Gas phase process for the production of high density polyethelene	-	35 (11-26-73); 29
3559	Universal Oil Prod.	Ethyl benzene unit	-	9 (8-26-74)
3561	Byron Jackson	Submersible electric pumps	5.903	1
3561	Redapump (Div. of TRW)	Submersible electric pumps	20.034	1
3561	Swindell-Dressler	Equipment for melting shop (for gray malleable iron)	5.4	23
*3563	Cooper-Bessemer Co.	Agreement: large gas compressors	-	2
3563	Dresser Industries	Compressors: agreement for joint production	27.5	37
3563	Elliott Co.	Compressors	-	8 (11-30-73)
3563	Ingersoll Rand Co.	Air compressor installations	20	14; 32; 40; 1
3563	International Harvester (with Caterpillar)	Gas turbine powered gas compressors	25 26.262	13; 32 1

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3565	Chromalloy Kessler (Subsid. of Chromalloy American Corp.)	Designs for steel castings	3.4	30 (9-3-74)
3567	Ajax Magnethermic Corp.	(a) High-frequency induction crucible melting furnaces (Kama)	1.410	23
		(b) Set of furnaces for melting and holding of bronze, brass and zinc scrap with charging and handling system (Kama)	1.413	23
3567	Blaw-Knox Equipment	Cement guns for electric arc furnaces (Kama)	.1	1; 23
3567	C-E Cast Equipment (A division of W. S. Tyler, Inc., a subsidiary of Combustion Engineering, Inc.)	(a) Complete systems for automatic and mechanized pouring of cast iron (five automatic molding lines)	4.1	23
		(b) Complete systems for mechanized pouring of steel (two automatic molding lines)	.7	23; 14
3567	Holcroft & Company (Div. of Thermo Electron Corp.)	(a) Heat treating furnaces	23.120	1
		(b) Heat treating furnaces	1.747	23
		(c) Furnaces for tempering crankshafts	.929	23
		(d) Heat treating unit for automatic stamping line	.380	23
		(e) Heat treating equipment for automatic line to process intake and exhaust valves	.900	23
		(f) Accessories for heat treating equipment of diesel-engine plant	.140	23
		(g) Heat treating equipment for expansion cams, connecting rods, etc.	2.507	23
		(h) Heat treating furnaces for steel castings with loading and unloading equipment	2.250	23
		(i) Set of furnace systems for heat treating aluminum castings	3.560	23
		(j) Equipment for heat treatment of piston pins	1.300	23
		(k) Equipment for heat treatment of cylinder liners	1.470	23

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3567	Norton Co.	Calcinating kiln devices for producing grinding mixtures	.45	40
3567	Sutter Products	Hot-box core-making machines (Kama)	4.040	23
3567	Swindell-Dressler	(a) Electric arc furnaces (nine gray-iron melting furnaces rated at 50 metric tons capacity each and eight holding furnaces rated at 75 metric tons capacity each)	15.929	23
		(b) Heat treating furnaces, with handling equipment	8.250	23
		(c) Set of furnaces for melting and holding of aluminum with charging and handling system	3.950	23
3567	Thermo-Electron	22 heat treating furnaces	5.0	32; 40
3567	Vacuum Industries, Inc.	(a) Semicontinuous induction vacuum melting furnace, capacity 500 kg.	.509	23
		(b) 100-kw electron-beam furnace	.411	23
*3569	American Can Co.	Agreement: Packaging	-	1; 10 (11-26-74)
*3569	Black, Sivalls and Bryson Inc. (subsidiary of International Systems and Controls)	Agreement on sale of high volume gas filtering equipment for use on natural gas pipelines	25	30 (11-16-74)
3569	Camco	Machine for preparing gas and oil for market		
3569	Carborundum Co.	Dust & gas control systems in foundries	-	14
3569	Electronucleonics, Inc.	2 ultra-centrifuges	.200	30 (8-5-74)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3569	Prichard Rhodes	Machine for preparing gas and oil for the market	-	30 (2-18-74)
3569	J. F. Pritchard	Gas treatment plant	53	37
3573	Booz, Allen & Hamilton	Advanced management computer systems	-	4 (7-28-73)
*3573	Burroughs	Computers (protocol)	-	8 (7-26-74)
3573	Codevintec Pacific	25 different computer systems	15	30 (10-16-74)
*3573	Control Data	10 yr. cooperative agreement in computers, software, etc. for transportation, education, and medical application		32; 26 (10-24-73)
3573	Honeywell, Inc.	(a) Computers (b) (Kama River) (c) Radio controlled activators	65 - 2.25	37 32 40
3573	Honeywell-Bull	12 computers	10	32
3573	International Bus. Machines	(a) Computers (370 system) for Intourist Hotels (b) 360/50 for Min. of Chem. (c) Model 158 system subject to approval by appropriate authorities	10 250 -	32 32 25 (7-17-74)
3573	Sperry Rand (Univac, Remington, and New Holland divisions)	Supply aeroflot with computerized reservation system. Delayed until export administration approval is granted	-	30 (8-5-74)
3573	Varian Associates	Analog computers and analytical instruments which define the chemical and physical properties of gases, liquids, and organic substances	10	30 (8-5-74)
*3573	Willi Passer Co.	Coop. in medical electronics, small computers and instruments	-	34

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3574	Litton Industries (Swedish unit)	Cash register factory	18	35 (10-1-73)
3574	Nat'l Cash Register	Business machines	-	40
3579	Pitney Bowes	Postage meters and mailing machines and addresser-printer equipment	-	30 (8-19-74)
3586	Occidental Petroleum	Effluent Control System	3.6	40
3589	American Air Filter Co., Inc.	Air filters (scrubbing devices: Kama)	1.905	35 (12-24-73); 10 (11-26-72)
3592	Holcroft & Co. (Div. of Thermo Electron Corp.)	Carburizing systems	5.646	23
3592	LaSalle Machine Tool	(a) 2 assembly lines for manufacturing pistons (b) Transfer line for same (c) Transfer line for manufacturing of pistons	6.441 15.722 9.716	1 1 23
3599	LaSalle Machine Tool	Automatic line for machining crankshaft bearing caps	2.682	1
3629	Carborundum Co.	Shot blasting equipment	9.9	14
3641	Teknis Inc.	Reed switch assembly machines and infrared sealing equipment	-	30 (7-8-74)
3662	Infinetics	Metal detection equipment (used by airports to detect hijackers)	-	30 (9-3-73)
*3662	Internat'l Bus. Machines	Air traffic control system (Under negotiation 8/74)	-	37

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3662	Instrument Sys. Corp.	In-plane audio and communications equipment	.250	35 (1-7-74)
3662	Internat'l Tel & Tel	*(a) Exchange on telecommunications, electrical & electrical mechanical components and consumer products	-	14
		(b) Satellite communications transmitting and receiving facilities	1.34	40
		(c) Transmitting and receiving facilities	1.0	40
		(d) 1st direct satellite communications "hotline" between U.S. and USSR to modernize original cable hotline between Moscow and Washington	-	10 (11-26-73)
3662	Lockheed Aircraft	Navigation systems, oceanographic apparatus, air traffic control system	-	8 (2-22-74)
*3662	Raytheon	Air traffic control system (Negotiation 8/74)	80	37
3693	Coherent Radiation	Lasers for use in eye surgery	.04	35 (11-5-73)
3693	Diano Corp.	5 Industrial x-ray units	1	30 (6-10-74)
3693	Hewlett-Packard Co.	Medical electronics	-	34
3693	Lockheed Aircraft	Medical electronics	-	8 (2-22-74)
3693	Piker International	X-ray systems	.75	35 (11-5-74)
371	Ambac Industries, Inc.	Automated assembly lines	6	32
371	E. W. Bliss	Automated line for forged truck parts	20	40

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
371	Link Engineering Co.	Stand (Kama)	.020	23
371	Monarch Machine Tool	N/C vertical machining center and an N/C turning machine	1	9 (6-3-74)
371	Pullman, Inc.	Production equipment (Kama River)	-	12
3711	Clark Equipment Co.	8 sweepers	16.1 thou	23
3714	Chicago Pneumatic Tool Co.	(a) Automatic lines for assembly of flyweel casings and induction manifolds	-	23
		(b) Assembly line for hydraulic clutches	1.315	23
3714	Cross Co.	(a) Machine brake drum tools	20	40
		(b) Brake drums and wheel hub production line		
3714	Eaton Corp. (through an Italian subsidiary)	Truck engine valves	4.3	35 (2-19-73)
3714	Gardner Denver Co. (through German subsid.)	Parts for transmission plant for Kama River	-	35 (2-19-73);
3714	Giddings & Louis	Transfer lines for machine flywheels	7.458	1
3714	Gleason Works	(a) Gear production machinery	11.4	8 (5-31-74)
		(b) Rear-axle production equipment	15	32
		(c) Gear testing machines (Kama)	10.115	23
3714	Landis Tool	Production equipment for crankshafts and other machine tools	8.7	14; 12

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3714	Shalco Systems	(Kama River) 10 core-making machines and one complete automatic unit for preparing coated core mixture	.673	1; 35 (6-25-73)
3714	Timken Co.	Bearings	.400	30 (9-16-74)
3714	Warner-Swassey	Production equipment for crankshafts and other machine tools	1.529	12; 1
*372	Boeing	Cooperation agreement: joint work groups to handle problems in engineering, manufacturing and certifying aircraft operation of passenger planes and ATC system	-	8 (6-14-74)
3751	Satra	Motorcycles	19	32
3811	Criminal Research Products, Inc.	Mobile crime lab and equipment	.028	30 (9-3-74)
3811	Honeywell, Inc.	Radio controlled activators	2.25	40
3823	Hewlett-Packard Co.	Mine computers	-	12
*3823	Monsanto	Agreement: computers for use in chemical and rubber compound products, production of herbicides, fertilizers and fiberglass	-	35 (9-23-74); 10 (11-2-73)
3824	Meter Systems (Div. of A. D. Smith)	(a) Turbine meters (with Camco Inc.) (b) Capacitance probes (under contract with British Solartron)	- -	9 (9-9-74) 9 (9-9-74)
3825	MTS systems	(Kama River) Pulsators	.645	1; 23

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Continued)

SIC Group	Company	Technology	Million of Dollars Value	Source
3825	Hewlett-Packard Co.	Scientific measuring instruments	-	12
3829	American Instrument Co.	(a) Magne-gages (plating thickness gauges) (b) 5 plating thickness gauges	6.8 thou 6.7 thou	23 23
3829	Kocour Co.	2 thickness gauges	4.0 thou	23
3832	Kevex Corp.	3 x-ray spectrometry systems under general agency agreement with Japan's Maurbeni Co.	.120	9 (9-9-74)
3841	Baxter Labs	Medical equipment	20	35 (11-5-73)
3914	Alliance Tool Co.	Tableware and dishware	26	37
3914	Alliance Tool & Die Corp. & Atlas Fabricators Inc.	Flatware and hollow ware	55	2; 16
3949	Brunswick Division of Brunswick Corp.	Bowling alley	.200	9 (9-23-74)
4400	Interpool	Purchase contract to link sea container routes	2	40
*4922	El Paso Natural Gas & Occidental Petroleum	Natural gas pipeline (Under negotiation 8/74)	2000 to 3000	37
5081	Cardinal Scale International	Self-propelled electronic transfer cars, electronic melt shop scales, and electronic counting scales	.635	1; 23
*7311	Black-Russell-Morris	Representation agreement: placement of Soviet advertising in U.S. publications for industrial and technical products	-	9 (6-17-74)

Table II ARRANGED BY STANDARD INDUSTRIAL CLASSIFICATION OF TRADED ITEM (Concluded)

SIC Group	Company	Technology	Million of Dollars Value	Source
*7311	Marsteller, Inc.	Agreement: advertising	-	1
7372	Logos Development Swindell-Dressler	Computer translation services	-	40
*7392	McKinsey & Co.	Agreement on management practice	-	30 (9-30-74)
*7392	Raymond Loewy/William Snaith, Inc.	Agreement: industrial design; boats, cars, household appliances	-	8 (1-25-74)
*7392	Stanford Res. Inst.	Cooperation agreement on business opportunities and managerial techniques		14
8911	Intercontinental Hotels and Skanska (Sweden)	Hotels	-	8 (7-26-74)
8931	Arthur Anderson and Co.	Accounting	-	18

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I and II

SOURCES FOR TABLES

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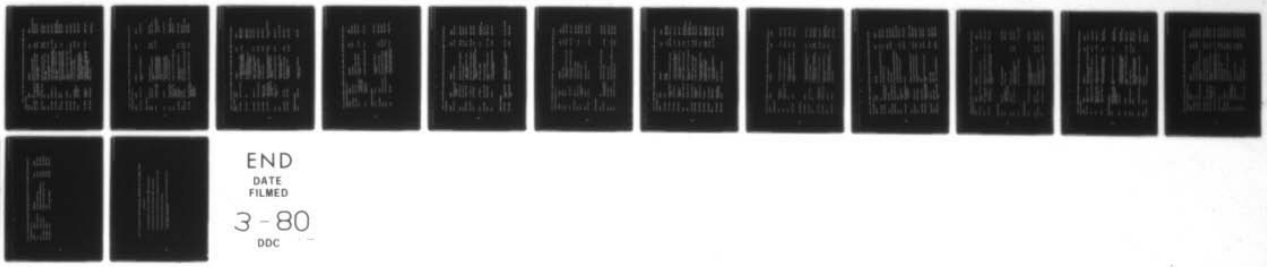
Table III

SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE,
GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN

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TRANSFER OF U.S. TECHNOLOGY TO THE SOVIET UNION: IMPACT ON U.S.--ETC(U)
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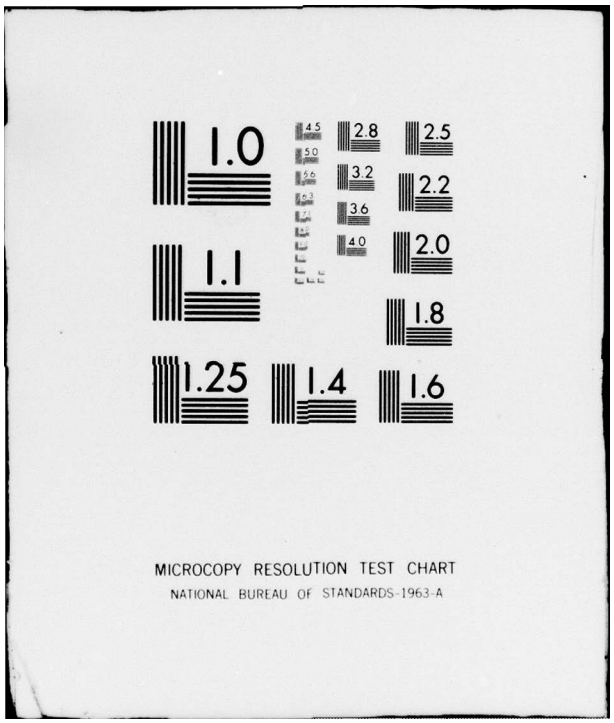

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Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN

AUTOMOTIVE INDUSTRY

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
Italy	Fiat	Auto Plant at Togliatti (1966)	-	EK. Gaz. 8/24/74 #32
Great Britain	Stavely Machine Tools	Machining complex at Zil Truck Works	$33 Mil.	SB&T 2/14/74
Great Britain	W. E. Sykes (Member of the George Cohn Group)	Gear shaping machines and associated equipment (KAMA)	&500,000	BIEER 2/21/75
Great Britain	George Angus and Co.	Automotive industry machine tools	$300,000	SB&T 8/19/74
Japan	Ataka	Machine tools for truck plant repair shop (KAMA)	$5.8 Mil.	SB&T 8/8/74
Japan	Ataka	Flow line that forges nozzle bodies for auto engines	$1.7 Mil.	SB&T 9/16/74
West Germany	Rheinstahl A. G.	Automotic line for mechanical processing of diesel fuel pump camshafts (KAMA)	Dm. 3.3 Mil.	BIEER 2/7/75
West Germany	Rheinstahl A. G.	Forging lines for crankshafts and front axles (KAMA)	$60 Mil.	SB&T 10/29/74 EK.Gaz. 11/74 #48
France	Renault	Conveyor system for engine plant (KAMA)	-	SB&T 2/18/74
West Germany	Modler	Equipment for fine grinding needles for fuel injection atomizers for a tractor plant	$ 4 Mil.	SB&T 9/16/74
West Germany	Diedesheim	Automatic line to process tractor engine sleeves	-	SB&T 9/30/74
West Germany	Burr	Automatic line to produce cylinder sleeves for large tractor engines	$13 Mil.	SB&T 9/30/74
West Germany	Carl Schenk Maschinenfabrik	Test beds for tractor engines	R 900,000	BIEER 2/21/75
France	Zelant-Gazuit	Equipment to manufacture protectors and sides of car tires and two lines for production of tire sides of heavy duty trucks	R 4 Mil.	BIEER 2/21/75
West Germany	Kiserling and Albrecht	Two automatic lines to manufacture wheel rims for trucks & tractors (KAMA and CHELYABINSK Tractor Works)	R 11 Mil.	BIEER 1/24/75
Great Britain	Pirelli-Dunlop	Radial ply tires	-	SB&T 10/29/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

AUTOMOTIVE INDUSTRY (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
Great Britain	Locomotors Ltd.	Vehicles for the transportation of jewelry	-	SB&T 10/29/74
CHEMICAL INDUSTRY				
Japan	Mitsui Co. Ltd.	Three ammonia plants	$30 Mil.	SB&T 2/18/74
France	Creusot-Loire	Four factories for production of ammonia	$200 Mil.	Ek.Gaz. 9/74 #37
France	Constructions Metalliques de Provence	Reservoir for storing, cooling & transporting liquified ammonia. Intended for new chemical plant built by Creusot-Loire & M.W. Kellogg	Ffr. 80 Mil.	E-W Tr Coun Newsletter 1/11/75; Ek. Gaz. 9/74 #37
Italy	Montedison	Seven large factories to produce ammonia, urea, titanium dioxide & others with payback in output	-	Ek.Gaz.8/74 #32
Italy	Snam Progetti (Subsidiary of ENI)	1500 tons per day Urea plant	-	E-W Tr. Coun. Newsletter 1/11/75
Italy	Tecnimont SPA (Subsidiary of Montedison)	Equipment for 1500 tons per day Urea plant	-	BIEER 2/21/75
West Germany	Pohlig-Heckel-Bleichert	Equipment for storing, shipping and receiving Urea	$50 Mil.	SB&T 10/29/74
France	Plastimer	Synthetic rubber	$3.5 Mil.	SB&T 8/5/74
Great Britain	Simon Carves	Rubber mixing plant for Kama Tire Factory	$52 Mil.	SB&T 9/3/74; Ek.Gaz. 12/74 #51
West Germany	Consortium: Werner-Pfleiderer, Buehler-Miag, Krupp, Berstorff, and Continental	Rubber mixing equipment for tire plant	$50 Mil.	SB&T 9/30/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

CHEMICAL INDUSTRY (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
West Germany	Werner and Pfleiderer	(a) Rubber mixers for tire plant	-	SB&T 10/14/74
		(b) Triaxane-diaxsalane copolymerization & polymer granulation plant	$1.3 Mil.	SB&T 10/14/74
West Germany	BASF	(a) An acetylene plant	-	SB&T 4/15/74
		(b) A caprolactam raw material plant	-	SB&T 4/15/74
		(c) An artificial fiber plant (Product buyback agreement)	-	SB&T 4/15/74
West Germany	Hoechst A.G.	Pigments, stabilizers, phosphoric salts & other chemicals	$4 Mil.	SB&T 10/29/74
West Germany	Buttner-Schilde-Haas	Construction of phosphogypsum processing plant	$40 Mil.	SB&T 9/30/74
West Germany	Hoechst A.G. and Frederich Uhde	Vinyl chloride plant	$40 Mil.	SB&T 8/19/74
Great Britain	Instem's Industrial Products Division (on subcontract from John Brown)	Computer system to monitor process cycle of a 200,000 TPA high-density polyethylene plant at Prinkonsk	£21.35 Mil.	E-W Tr. Coun Newsletter 1/11/75
France	Nordon et Cie and Rapidase	Turnkey enzyme production plant	$20 Mil.	SB&T 4/1/74
France	-	Construction of plant to produce styrene and polystyrene	-	EK. GAZ. 9/74 #37
Great Britain	John Brown	Equipment for a plastics plant	$48 Mil.	SB&T 4/15/74
Great Britain	Axel Johnson	Heat exchanges to be used in processing glue	$115 Thou.	SB&T 3/18/74

COMMUNICATIONS INDUSTRY

France	Thomson CSF	30 secam color TV cameras and 7 mobile units	-	SB&T 8/8/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

COMMUNICATIONS INDUSTRY (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
West Germany	Robert Bosch	TV equipment	$8 Mil.	SB&T 8/8/74
West Germany	Rudolf Hell	Equipment enabling newspapers	-	BIEER 1/24/75
France	Cie Generale de Constructions Telephoniques (CGCT)	Electronic message switching systems	$8.1 Mil.	EWM 2/24/75
Japan	Sumitomo Shoji Kaisha Ltd.	Microwave communications equipment	$8 Mil.	SB&T 3/4/74

CONSTRUCTION TECHNOLOGY

France	Poclain	12 crawler-mounted hydraulic excavators	-	SB&T 8/19/74
West Germany	Lipherr	2 lattice jib truck cranes	$2 Mil.	SB&T 9/16/74
Japan	Tadano Iron Works Co.	180 truck cranes and spare parts	$11.8 Mil.	EWM 2/24/75
Japan	Caterpillar-Mitsubishi	500 bulldozers of the CATCD 6C type together with accessories	Y10.7 Bil.	BIEER 2/21/75
Japan	Wako Koeki	210 hydraulic shock absorbers to be built into atomic power stations	R 2 Mil.	BIEER 1/24/75

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

FOOD INDUSTRY

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
Great Britain	Metal Box Ltd. (Under Continental Can contract)	Can-making equipment	$1.7 Mil.	SB&T 5/13/74
Japan	Sanyo Electric Co.	Prefabricated cold storage warehouses	$700 Thou	SB&T 5/13/74
Japan	Taiyo Fisheries	Fish processing plant	$3.5 Mil.	SB&T 8/5/74
West Germany	Friederich Krupp	7 automatic canning lines for Soviet fishing industry	$8 Mil.	SB&T 8/5/74
Great Britain	A. Johnson & Co.	Edible gelatine chilling & drying line	$350 Thou.	SB&T 10/14/74
Italy	Carlo Montanari	Equipment for confectionery industry (formula-mixing installations for making chocolate)	$6 Mil.	SB&T 5/28/74
France	Air Industrie	Pastry making equipment	$2 Mil.	SB&T 9/16/74 Ek. GAZ. 7/74 #29
West Germany	Seitz Werke GmbH	Wine bottling equipment	-	SB&T 3/4/74
France	Machines Chambon	Equipment for the production of sugar cubes	Ffr. 75 Mil.	BIEER 2/21/75
Italy	Intercoop	10 lines for producing reinforced boxes for crating foodstuffs	$5.2 Mil.	SB&T 2/18/74

FREIGHT AND TRANSPORT

West Germany	Kloeckner-Humboldt-Deutz	Freight cars with 10 - 16 ton capacity, equipped with air-cooled engines	Dm 1 Bil+	Ek. Gaz. 11/74 #48
West Germany	Kloeckner-Humboldt-Deutz	Diesel trucks	$40 Mil.	SB&T 10/29/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

FREIGHT AND TRANSPORT (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
Japan	Sumitomo	Forklift trucks	R 7 Mil.	BIEER 2/7/75
France	Fenwick	7 Battery operated trucks for iron and steel plant	$100 Thou	SB&T 9/30/74
Japan	Nissan Motors	250 truck trailers capable of carrying 30 ton loads	$8.24 Mil.	SB&T 4/1/74
Great Britain	Henley Co.	25 ton capacity loaders	-	SB&T 2/4/74
Japan	Mitsui Co. Ltd.	Unitized pier equipment	$27 Mil.	SB&T 2/18/74
France	La Seine-Sur-Mer Shipyards	Ocean-going vessels	-	SB&T 10/29/74
Japan	Nichimen	Baggage and railway cars	-	SB&T 9/3/74
Great Britain	Molins Ltd.	Packing lids	$200 Thou.	SB&T 10/29/74

HEAVY MACHINERY

Japan	Itoh	Machinery and other industrial equipment	-	SB&T 2/18/74
West Germany	Carl Hurth Maschinen Und Zahnradfabrik	Machine tools (KAMA)	Dm 30 Mil.	BIEER 2/7/75
Japan	Toko Trading	Industrial robots	-	BIEER 2/21/75
Japan	(4 companies)	Industrialized robots for assembly line use	$150 Thou.	SB&T 8/5/74
Italy	Worthington Pump Int'l	20 giant pumping units	$15 Mil.	SB&T 4/29/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued

HEAVY MACHINERY (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
West Germany	Gentil	100 pumps	-	SB&T 7/22/74
		365 pumps	$1.3 Mil.	SB&T 7/22/74
West Germany	Gerhardt Messmaschinenbau	Injection pump production line units	Under $1 Mil.	SB&T 4/1/74
West Germany	Gildemeister A.G.	2 transfer lines for the manufacture of parts for fuel metering equipment	$2.7 Mil.	SB&T 1/21/74
West Germany	Kieserling and Albrecht	7 transfer lines for the manufacture of rail fastenings	$16 Mil.	SB&T 1/7/74
Japan	Kanematsu Gosho Ltd.	Equipment to manufacture dry batteries	$17 Mil.	SB&T 9/16/74 Ek. Gaz. 12/74 #51
Japan	Kanematsu osho Ltd.	Auxiliary equipment for a dry manufacturing plant	Y1.5 Bil.	E-W Tr Coun. Newsletter 1/11/75
Great Britain	Chloride Group Ltd.	Equipment to manufacture batteries	$1.7 Mil.	SB&T 3/18/74
West Germany	Traub Maschinefabriker	20 semi-automatic lathes (KAMA)	R 400,000	BIEER 1/24/75
West Germany	Gildemeister & Co.	Multispindle automatic turning lathes for automotive industry	R 5 Mil.	BIEER 2/7/75
West Germany	Max Mueller	(a) Program controlled lathes	$6.5 Mil.	SB&T 9/30/74
		(b) Earlier order for same	$13 Mil.	SB&T 9/30/74
West Germany	Alfred Schuette	29 Automatic lathes	$4.2 Mil.	SB&T 9/3/74
France	CNMP-Berthiez	4 vertical grinding machines and 3 vertical lathes	Ffr. 11.4 Mil.	BIEER 2/7/75
West Germany	Kunkel Wagner & Heinrich Wagner	Molding lines	-	SB&T 9/3/74
West Germany	Rexroth	Hydraulic distributor sets	-	SB&T 9/30/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
INSTRUMENTATION				
Italy	Marposs Finike Italiana	Instrumentation and measuring sets	L 5 Bil.	BIEER 2/7/75
Japan	Japan Electron Optics Laboratories	Ultra-high voltage microscope	$900 Thou.	SB&T 3/18/74
Italy	DEA	Machines for high-precision measuring of large components	R 20 Mil.	BIEER 2/21/75
Great Britain	Vickers	Equipment to test airplane brakes, wheels and tires	$10 Mil.	SB&T 8/5/74
LIGHT INDUSTRY				
West Germany	Buderus	6 automatic transfer lines for manufacturing stainless steel dinnerware	$7 Mil.	SB&T 2/18/74
West Germany	Franz Berrenberg	Cutlery making equipment	$1 Mil.	SB&T 6/10/74
Italy	Siti	(a) Modernization of two china plants (b) 10 ovens capable of baking 50 million plates per year	$10 Mil. $2.6 Mil.	SB&T 2/18/74 SB&T 2/18/74
Great Britain	Littlejohn Graphic Systems Ltd.	Advanced color reproduction cameras	$400 Thou.	SB&T 8/19/74
West Germany	Wolfgang Bogan GmbH	Equipment to produce magnetic heads for tape recorders	$10 Mil.	SB&T 6/10/74 Ek.Gaz. 6/74 #26
France	Sorice S.A.	Equipment and technology to produce up to two million plastic suitcases per year	$7 Mil.	SB&T 3/18/74
Great Britain	Courtaulds	Synthetic fabrics	-	SB&T 11/11/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

LIGHT INDUSTRY (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
West Germany	SKF	Textile equipment (mostly production lines)	$2 Mil.	SB&T 8/5/74
West Germany	Herman Berstorff GmbH and J.H. Benecke	Artificial fiber plant	$3 Mil.	SB&T 5/13/74
Italy	Consortium	3 textile factories	$85 Mil.	SB&T 3/18/74
Great Britain	Richford Engineering	Textile looms	$135 Thou.	SB&T 3/18/74
Great Britain	Andrew Engineering Ltd	4 vacuum Steam textile processing machines	-	SB&T 4/15/74
Italy	Konetex	169 Spinning machines for wool industry	-	Ek.Gaz. 8/74 #33
Japan	Chori and Gunze Sangyo	Equipment for uncoiling raw silk	$5.5 Mil.	SB&T 7/22/74
Great Britain	Fine Jersey Division of Carrington Viyella Ltd.	Textiles	$500 Thou.	SB&T 3/18/74
Italy	-	Machines for applying designs on fabric	-	Ek.Gaz. 6/74 #30
West Germany	Schoen and Co.	25 automatic lines for shoe industry	Dm 10 Mil.	BIEER 1/24/75
Italy	Central Adamas	Plant to make shoe soles from leather scraps	$14 Mil.	SB&T 8/19/74
Great Britain	Norvic Shoe Co.	Shoes	$1 Mil.	SB&T 4/1/74
Great Britain	Porvair Ltd. (Subsidiary of Inmont Corp. of N.Y.)	Material for the manufacture of men's shoes	$3.6 Mil.	SB&T 5/13/74
Great Britain	Lotus Ltd.	Women's shoes	$450 Thou.	SB&T 8/19/74
France	Andre & Marbo	Women's shoes	-	SB&T 1/21/74
Great Britain	George Ward Holdings Ltd.	Women's fur-lined sheepskin boots	£250,000	BIEER 1/24/75

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

LIGHT INDUSTRY (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
Great Britain	Cooperative Wholesale Society	Women's shoes and certain fabrics	-	BIEER 1/24/75
France	Sogo (a mixed French-Soviet Co.)	Essential oils and synthetic aromatic substances	R 4.5 Mil.	BIEER 2/21/75
West Germany	Industrie Werke Karlsruhe-Augsburg	Packaging equipment (tube-filling line for packaging cosmetics and various chemical products)	$1.2 Mil.	SB&T 3/18/74
LUMBER AND PAPER				
Japan	Mitsubishi	Timber loading machinery	-	SB&T 7/22/74
France	Latil-Batignolles, under contract from Parsons & Whittenmore	12 timber loaders	-	SB&T 9/30/74
Japan	Marubeni Ltd.	250 lumber tractors	$7 Mil.	SB&T 3/18/74
France	Stein Industrie S.A.	2 specialized boilers used in the manufacture of cellulose	$12 Mil.	SB&T 3/4/74
France	-	Plant for cellulose - paper complex	-	Ek. Gaz. 9/24 #37
MATERIALS TECHNOLOGY				
France	Fives-Lille-Cail Co.	Unit for simultaneous drying & milling of raw materials used in the cement industry	-	SB&T 2/4/74
Japan	Nissho-Iwai	Tungsten filament	$1.4 Mil.	SB&T 1/21/74
Great Britain	Thermal Syndicate	Plant and knowhow for production of fused quartz tubes	£4.5 Mil.	BIEER 2/21/75
Japan	Kyoto Ceramic Co.	Equipment and knowhow to produce ceramics for electronic appliances	Y 5 Bil.	BIEER 2/7/75

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

MEDICAL TECHNOLOGY

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
West Germany	Siemens Electrogerate GmbH	Medical equipment, including cardiological, X-Ray & Dental Machines	$330 Thou	SB&T 2/4/74
Japan	Mitsubishi & Konishiroku Photo Co.	Equipment to manufacture X-Ray Film	$53 Mil.	SB&T 10/29/74
Italy	Edward Alto Vuoto SPA (Division of the British Oxygen Co. Ltd.)	6 Complete lines for large-scale freeze-drying of vaccines	L 700 Mil.	BIEER 2/7/75
France	Serie Renault Engineering	Equipment for production of surgical suturing material made from sheepgut	$6 Mil	SB&T 2/4/74 Ek.Gaz. 8/24 #33

METALLURGY AND METALWORKING

Japan	Daido Steel Co., Aichi Steel, Mitsubishi Steel Sanyo Special Steel & Koshuha Kogyo	15,000 Metric tons of special steel by 3/31/75	Y 2 Bil.	E-W Tr. Coun. Newsletter 1/11/75
France	Creusot-Loire	2 Composite installations for producing finishing and electrically insulating cold-rolled, grain oriented steel	-	SB&T 9/30/74; Ek. Gaz. 8/74 #34
Japan	Nichimen	Equipment to produce 50,000 TPA of ship plate	R 3.5 Mil.	BIEER 2/21/75
France	Wheelabrator-Allevard	Steel abrasives plant	Ffr. 48 Mil.	BIEER 2/21/75
Italy	Metecno	Plants to produce steel and aluminum panels lined with polyurethane and spun glass	$11 Mil.	SB&T 10/29/74
France	Pechiney-Eugene Kuhlman	Aluminum plant with capacity of 500,000 tons/year	-	Ek.Gaz.#37 9/24/74
France	Cofale	Aluminum foil	-	SB&T 1/7/74
West Germany	Junker	28 aluminum pouring plants	-	SB&T 8/22/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

METALLURGY AND METALWORKING(cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
West Germany	Woehr	4 Steel pouring plants	$260,000	SB&T 8/22/74
West Germany	Junker	8 Cast-iron pouring plants	$800,000	SB&T 8/22/74
West Germany	Schloemann-Siemag A.G.	Tandem mill to roll cold aluminum strips and alloys	-	SB&T 8/22/74
West Germany	Maho	40 All-purpose milling machines	$1.04 Mil.	SB&T 7/3/74
West Germany	Keller und Knapich	Welding equipment for auto plant	$8 Mil.	SB&T 10/29/74
Great Britain	Federal Welder and Machine Co., Ltd.	Automatic arc and resistance welding equipment	$1.2 Mil.	SB&T 5/28/74
Great Britain	Stone Wallwork Co.	Automatic foundry equipment and mold blowing machinery (for Moskvich plant)	$1.7 Mil.	SB&T 3/18/74
Great Britain	Birlec	2 Continuous heat treatment furnaces	$750,000	SB&T 11/11/74
Japan	Ataka	Forge-Presses (for KAMA)	R 10 Mil.	BIEER 2/21/75
West Germany	Hasenclever	Hot Forging unit	$2 Mil.	SB&T 11/11/74
West Germany	Ring Co.	Steel fittings, shutters, and valves	$650,000	SB&T 1/7/74
Italy	Walworth Aloyco & Grove International	Ball valves	$30 Mil.	SB&T 8/8/74
Japan	Japan Steelworks	372 gate and ball valves	$18 Mil.	SB&T 10/29/74
Japan	Ataka	Bearings	$500,000	SB&T 10/29/74
France	Sufa	Precision bearings	$200,000	SB&T 10/29/74
Japan	Mitsui & Co. et al.	6,000 tons wire rope (by 3/75)	-	BIEER 1/24/75

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
MINING INDUSTRY				
West Germany	Gutehoffnungshuette-Sterkrade	40 shovel dumpers for stripmining non-ferrous metals & potash	-	SB&T 5/13/74
West Germany	Westfalia Lunen	Coal mining equipment	$5.3 Mil.	SB&T 1/7/74
West Germany	Olemann	Vehicles for transportation of personnel in coal-drift mines	$1 Mil.	SB&T 1/7/74
Japan	Nichimen & Co.	Mining tools and 30 drilling rigs	-	BIEER 2/7/75
Japan	Mitsubishi Motors Corp.	600 crane carriers for South Yakutia coal development project	-	BIEER 1/24/75
France	ANF	Coal mining equipment including face-cutting machines	Ffr. 50 Mil.	BIEER 1/24/75
POWER, PETROLEUM & PIPELINE TECHNOLOGY AND EQUIPMENT				
Great Britain	Solartron-Schlumberger	Flow control equipment for oil pipelines	$1.2 Mil.	SB&T 9/30/74
Italy	Worthington	20 booster pumps to maintain pressure in oil pipelines with 5,000 M^3/hr.flow.	$6 Mil.	SB&T 7/22/74
Italy	MSM & Italtrafo	Transformers for electric power substations	$500,000	SB&T 8/19/74
Italy	ENI	Gas field construction and 6 petrochemical plants	-	Ek.Gaz.#32 8/74
France	Constructions Metalliques de Provence	Equipment to filter and refrigerate natural gas	-	East-West Coun. Newsletter 1/11/75
France	Speichim (member of Schneider Group)	25,000 tons per annum motor oil additive plant	Ffr. 95 Mil.	East-West Tr. Coun. Newsletter 1/11/75
France	Caterin	25 sets of loading equipment for oil tankers	-	SB&T 9/30/74
France	Creusot-Loire	2 complete natural gas drying plants & aircooling installations for trunk gas pipelines	$16 Mil.	SB&T 5/28/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Continued)

POWER, PETROLEUM, PIPELINE TECHNOLOGY AND EQUIPMENT (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
France	Bignier Schmid-Laurent S.A.	600 motorized oil pipeline valves	$10 Mil.	SB&T 4/15/74
West Germany	Prematechnik	Filtration equipment to remove sediment & paraffin from 1200 & 1400 mm gas pipelines	$6.5 Mil.	SB&T 9/30/74
West Germany	Bran und Lubbe	Injections pumps for introducing corrosion inhibitor into gas lines	-	SB&T 7/22/74
West Germany	Mannesman A.G.	Large diameter pipes	-	SB&T 3/4/74
West Germany	Kraftwerke Union A.G.	4 atomic power plants (to be repaid in deliveries of electric power)	-	SB&T 4/15/74
Japan	Sumimoto Shoji Kaisha, Ltd.	Steel pipe for oil and gas industry	-	SB&T 3/4/74
MISCELLANEOUS				
France	Teleflex & Ceumi	Luggage handling equipment for airports cables	$1 Mil.	SB&T 9/16/74
France	Les Cables de Lion	Cables	$21 Mil.	SB&T 9/13/74
France	Ensa Div. of Creusot-Loire	Equipment to manufacture gas stoves	-	SB&T 2/18/74
Italy	diGiacintie Qranata	Equipment for cattle-breeding	$3.5 Mil.	SB&T 7/22/74
Italy	Moneta SPA	Stove plant	-	SB&T 9/16/74
Italy	Breda	Fountain fittings and shutoffs for gas mains	$1.7 Mil.	SB&T 2/18/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN (Concluded)

MISCELLANEOUS (cont'd.)

COUNTRY	COMPANY	TECHNOLOGY	VALUE	SOURCE
Italy	Imprex International	Corrosion resistant tape	$13 Mil.	SB&T 3/4/74
Japan	Mitsui Co. Ltd.	Equipment for air conditioning plant	$75 Mil.	SB&T 2/18/74
West Germany	Herman Berstoff	Equipment which applies glue to film	$603,000	SB&T 10/14/74
West Germany	Siemens	Cables	$2.6 Mil	SB&T 9/3/74
West Germany	Gutbrot	Street cleaning equipment	$530,000	SB&T 1/7/74

Table III SOVIET IMPORTS OF TECHNOLOGY FROM FRANCE, GREAT BRITAIN, ITALY, WEST GERMANY, AND JAPAN

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1. East European Report, Business International (BIEER), various issues.

2. East-West Markets, Chase World Information, (EWM), various issues.

3. East-West Trade Council Newsletter (E-W Tr. Coun Newsletter), various issues.

4. Ekonomicheskaya Gazeta (Ek.Gaz) various issues.

5. Soviet Business and Trade: A Porter International and Tass Biweekly Economic Review (SB&T), various issues.