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Eastern Europe as a Source of High-Technology Imports for Soviet Economic Modernization

Steven W. Popper

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Eastern Europe as a Source of High-Technology Imports for Soviet Economic Modernization

Steven W. Popper

Prepared for the
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PREFACE

➤ This report assesses the potential for Eastern Europe to provide the high-technology products necessary to further the modernization of the Soviet economy. It examines both traditional trade in high-technology products as well as recent measures to encourage integrated and cooperative technology development within the Council for Mutual Economic Assistance (CMEA). Documented in early 1990, the findings will still be useful to those with an interest in the future of Eastern Europe, Soviet trade relations with Eastern Europe and with the West for products embodying advanced technologies, and prospects for growth in the Soviet economy.

This study is an integral part of an ongoing project on Soviet foreign trade and was sponsored by the Office of the Under Secretary of Defense for Policy. The research was conducted under the auspices of RAND's International Economic Policy program, whose principal focus is the connection between international economics and national security issues, within RAND's National Defense Research Institute, a federally funded research and development center supported by the Office of the Secretary of Defense and the Joint Staff.

SUMMARY

The research herein concentrates on the Soviet Union and the East European members of the CMEA (Council for Mutual Economic Assistance), which at the time of the analysis (early 1990) included the German Democratic Republic, no longer extant. Although these countries have gone through dramatic political revolutions, much of the analysis holds lessons for current and peripheral activities concerning economic relationships between the Soviet Union and East European countries, what to expect of them, and approaches to dealing with them.

Soviet concern over access to high technology has been prompted by military competition, national prestige, and inherent shortcomings in the economic system. Soviet high-technology inputs come from three sources. The first is domestic production, which has never been sufficient to satisfy the aspirations of the Soviet leadership or the needs of the economy. Therefore, two other sources have been tapped. One is imports from the West. Imported Western high-technology capital has most likely had a positive effect on Soviet performance but contributed less to the economy than it could because of inefficient assimilation.

The last source is imports from the East European countries. These manufactures do not need to be state of the art to contribute positively to Soviet economic performance. Indeed, while East European equipment might not possess the capabilities of competitive Western equipment, it may be more easily adapted to Soviet conditions, which resemble East European conditions.

Inputs to the Soviet Union may come as straight commodity trade, but Gorbachev and his predecessors also placed great store in intra-CMEA cooperation in developing and producing high technology. The Comprehensive Program for the Scientific and Technological Progress of the CMEA Member Countries Through the Year 2000 (hereinafter the "Program") was established in 1985. The Program listed five major directions for cooperation in research and development (R&D): computerization, automation, nuclear power, biotechnology, and new materials. Special stress was laid on the interconnections among research tasks. The code phrase most distinguishing the new Program was "direct ties" between production and R&D facilities in the Soviet Union and its partner countries.

Many Program goals would be beneficial to all of the CMEA, but the existence of a formal apparatus raised a possibility of unilateral benefits to the Soviet Union. This was not necessarily a prime interest of the Soviets, but such speculation may have increased foot-dragging

by intended partners. The Program could be utilized to guarantee that output from East European industry was suited to the needs of Soviet industry. Further, if standards were different from those in the West, East European options for technology acquisition would be limited. The Program was read by some East Europeans as a mechanism for making Soviet control over domestic R&D assets more efficient. And with the Soviets becoming outspoken about dissatisfaction with CMEA trading relationships, Program implementation could conceivably provide them with more information on potential East European exports. Finally, an integrated science and technology program would give the Soviets more access to Eastern Europe's existing and future technology contacts with the West. From several perspectives this could have led to a Soviet role not necessarily of restriction, but perhaps of control in the sense of monitoring and advising. Eastern Europe, however, also faced the possibility that participation in the Program would directly or indirectly affect Soviet ability to influence differential access to Western technology.

The Program achieved its goals neither in the scope and coverage of its formal agreements nor in the development and production of critical high-technology products. The Soviet Union has not received the benefits its leadership had hoped. The type of cooperation envisioned by the term "direct ties" was an aspect of only one out of every eight agreements signed. Most agreements were traditional CMEA "shotgun weddings," negotiated and entered into by governmental bodies on behalf of the enterprises involved.

Bulgaria and Czechoslovakia are the countries most represented in science and technology agreements with the Soviet Union. Poland is in the middle range, and the scale of Polish cooperation has not been large. The Polish government accepted closer ties while emphasizing the need to reform the CMEA. The German Democratic Republic was averse to technological cooperation and direct ties. Hungary and Romania have signed the fewest agreements for technological trade and cooperation with the Soviet Union.

Specific aspects of the Program, combined with institutions peculiar to the CMEA, appear to have retarded implementation of the science and technology tasks. Fundamental differences existed in administration, finance, and the application of joint results from cooperative R&D. The more advanced countries were most reluctant because they were most likely to be called upon to provide resources. A successful Program would threaten individual East European countries with decreased ability to protect supplies of vital inputs. There was also a fear that entering fully into the Program could jeopardize relations with Western exporters.

The concept of cross-national direct ties with Soviet enterprises was the most troublesome. Besides the annoyance of having scarce resources bound into a cross-national consortium, differences in economic systems, the need to coordinate plans, pricing problems, and currency inconvertibility made these links unattractive and difficult to put into practice.

Four commodities were examined to determine how high-technology exports to the Soviet Union from Eastern Europe were affected by the Program: machine tool equipment; computer equipment; filtration apparatus, centrifuges, and pumps for nonliquids; and steel pipe.

According to Soviet data, in 1987 imports provided one-third of machine tool investments. Three-quarters of these were of East European origin. CMEA pricing practices make it difficult to assess quality, yet when price data from Western Europe are compared with Soviet data on machine tool imports from East and West, the Soviet data corroborate the value judgments of the West European data, suggesting more realistic CMEA intra-Bloc appraisal of this commodity than conventional wisdom concedes. The Soviet Union is aided by imports from within the CMEA of machine tools relatively superior to Soviet domestic production but relatively inferior in quality by world standards. Eastern Europe also seems to have a large reliance on CMEA deliveries. Its trade patterns do not differ greatly from the Soviets'. For all the CMEA countries, with the exception of Hungary, machine tool imports are skewed in the direction of types not produced within the Bloc.

The Soviet Union places great reliance on Eastern Europe for its imports of computer equipment: nearly 90 percent of Soviet computer imports come from Eastern Europe. Yet during the 1980s the share of CMEA imports from among total computer imports for most non-Soviet CMEA countries declined. By the same token, East Europeans import only a small share of their computer equipment from the Soviet Union. East Europeans rely on each other but are relying increasingly more on the West. A divergence of interests appears to exist between the Soviet Union and its potential trading and cooperative venture partners.

CMEA members rely to a greater extent upon Western sources for filtration apparatus, centrifuges, and pumps for nonliquids than they do for machine-tool and computer equipment. The Soviet Union is somewhat less dependent. Eastern Europe is unlikely to prove a reliable source for satisfying Soviet requirements for these products.

Steel pipe is crucial to energy development. More than three-quarters of the pipe used in the Soviet Union comes from abroad. The data show considerable variation among the East European countries.

Eastern Europe as a whole satisfies only a fraction of current Soviet demand. The Soviets are already in a position to claim the best that Eastern Europe has, or is likely to have, to offer of this commodity.

The shares of total Soviet trade with each East European country have increased since 1980, while the shares of both imports and exports originating from Western countries have declined. Some East European countries have moved in the opposite direction, weakening their ties to the rest of the CMEA. The future may reveal a further divergence of fundamental interests in development of trade.

Gorbachev's policy in 1985 was to increase the quality and quantity of high-technology imports from Eastern Europe. The last four years have been a disappointment: no marked transformation has occurred in deliveries to the Soviet Union. Many CMEA members see their long-term interests lying more with the West. Further, Eastern Europe's capacity limits for becoming a more substantial provider have become apparent. The Soviets also lost ground in providing leadership and gentle coercion.

Soviet policy is to continue to develop technological ties with Eastern Europe but to give them less prominence than they held in the mid 1980s. The Soviets remain interested in seeing the overall technology gap between the Soviet Union and the West decrease and in using any means to demonstrate a commonality with Eastern Europe. The Soviets will emphasize developing trading ties with nontraditional providers of high technology, particularly the developed West.

Radical changes in the CMEA are in prospect, which will affect technology trade with the Soviets. Yet, it is too early to ring the death knell for the East European machine industries. They will be released from the twin shackles of prices based on five-year averages of world prices and unrealistic hard-currency-to-ruble exchange rates. Further, Western equipment stands a greater chance of being unsuited to the Soviet setting than would East European models. Also, how much the Soviet Union stands to gain from the easing of COCOM (Coordinating Committee on Export Controls) restrictions remains unclear.

The Soviet Union will continue to import a portion of its high technology from Eastern Europe. Bureaucratic inertia, problems of obtaining full market information, existing personal contacts and long-standing supply relationships, and lack of adequate resources will erect a transaction cost hurdle that will dampen attempts to shift input sources. It is not clear that Soviet importers, free in theory to purchase equipment from any supplier, will be free in fact to do so. Soviet imports of high technology from the East Europeans will probably drop sharply in the first period after liberalization. Later, disillusionment, expensive errors, and new central controls on imports will make East

European alternatives more attractive. The medium-term trend for East European sales of high-technology commodities to the Soviet Union is likely to be lower than the present level but above the potential dip recorded in the short run after the change in the CMEA.

It may be too early to write the obituary of regional trade arrangements. East European industrial leaders are likely to discover the world markets to be colder and crueler arenas than they are initially prepared to face. Further, each CMEA country will be going through a drastic revamping of its domestic economy; some type of economic union will be necessary to prevent the erection of barriers protecting domestic industries and to ensure that relationships that still make sense will not be terminated. There is also potential for synergy—true mutual economic assistance.

A technological reason to preserve CMEA contacts in some form also exists. All nations today have serious concerns about their technological development; international cooperation is a common response. The CMEA Program exists as but one example within a spectrum of similar efforts. The Program, or something like it, could well survive the radical transformation of the CMEA, impelled in large part by the feeling that a supranational organization will help overcome domestic obstacles to developing and applying new technologies. Reconstituting the Program will not be a simple task. However, complete transformation of the CMEA may be the only way for the Soviets to ensure that the Program ultimately yields to them the benefits they first envisioned.

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CONTENTS

PREFACE	iii
SUMMARY	v
ACKNOWLEDGMENTS	xi
TABLES	xv
Section	
I. INTRODUCTION	1
II. THE INSTITUTIONS OF INTRA-CMEA	
TECHNOLOGY TRANSFER	5
CMEA Science and Technology Integration Plans	5
The Politics of CMEA Science and Technology	
Cooperation	7
Unilateral Soviet Benefits	9
Informal Benefits of a Science and Technology	
Integration Policy	16
Changes to the Soviet Foreign-Trade Apparatus	17
III. SOVIET SCIENCE AND TECHNOLOGY COOPERATION	
WITH EASTERN EUROPE	21
The Science and Technology Program in Practice	21
Barriers to Technology Trade and Integration	
Within the CMEA	31
IV. INTRA-CMEA TRADE IN HIGH-TECHNOLOGY	
GOODS	35
Trade in Metal-Working Machine Tools	35
Trade in Computer and Data Processing Equipment	45
Trade in Filtration Apparatus, Centrifuges, and	
Pumps for Nonliquids	48
Trade in Large-Diameter Steel Pipe	49
Overall Trends in Soviet Trade with Eastern Europe	52
Conclusion	56
V. EAST EUROPEAN SUPPORT FOR SOVIET	
TECHNOLOGICAL DEVELOPMENT	57
The Future of the CMEA	59

Soviet/East European Cooperation in Technology Development	63
REFERENCES	67

TABLES

3.1. Science and technology agreements by year and category	22
3.2. Science and technology agreements by type and category	23
3.3. Science and technology agreements covering joint ventures	24
3.4. Science and technology agreements by country and year	25
4.1. Metal-working machine tool production-and-demand balance in the Soviet Union	36
4.2. Average values by weight of metal-working machine tool exports to the CECIMO area, by exporting country, 1987	38
4.3. Average values of metal-working machine tool exports to the Soviet Union, by exporting country, 1987-1988 . . .	41
4.4. Average prices for CMEA metal-working machine tool exports compared with average prices for Western exports, 1987	42
4.5. CMEA share of imports from among total metal-working machine tool imports, by country	44
4.6. Metal-working machine tool "terms of trade" with CECIMO countries, 1987	46
4.7. CMEA share of imports from among total computer and data processing equipment imports, by country	47
4.8. CMEA share of imports from among total FCPNL imports, by country	48
4.9. Iron and steel pipe balance in the Soviet Union	50
4.10. East European iron and steel pipe deliveries to the Soviet Union	51
4.11. Regional distribution of export shares for East European CMEA countries	53
4.12. Regional distribution of import shares for East European CMEA countries	54
4.13. Regional distribution of foreign trade shares for the Soviet Union	55

I. INTRODUCTION

Concern over access to goods embodying high technology has been a feature of Soviet economic policy for a quarter century. "High technology" in this sense is represented by a heterogeneous group of goods giving the possessor access to capabilities and capacities that lower-technology analogues would not permit.¹ The Soviets' perceived need for high-technology commodities has been prompted by a variety of policy goals including, to name a few, supremacy in military competition, increased national prestige, and the circumvention of inherent shortcomings in their economic system. Any or all of these may operate at a given time with varying degrees of force. Shifts of emphasis have not changed the fundamental desire to improve the performance characteristics of the economy by technology fixes.

Official interest in exploiting this strategy increased with the advent of Mikhail Gorbachev. His primary interest, and that of his allies and advisers, has been to make the economic machinery more productive.² In the view of Gorbachev and his circle, to narrow the gap between the technological base of the Soviet Union and the technological bases of the economies with which the Soviet Union wishes to compete internationally constitutes both end and means. Until the recent priority shift evidenced by transfer of defense industrial assets to the production of consumer articles, this was also seen as the most likely way to improve the level of material well-being for the Soviet population. Improving the technological level of Soviet industry by modernizing the assets at its disposal, especially in the crucial sector of machine building, would eventually have a positive effect on the ability of the economy to satisfy all demands placed upon it by different sectors.

As a practical matter, the higher-technology inputs necessary for improving economic performance could come from three areas.

¹High technology may then be defined as a class of capital goods produced to higher tolerances than is usual for the bulk of manufactured goods or that confer an ability to do things not possible with other goods of that type. Alternatively, high technology may be defined as an arbitrary identifier for commodities whose research and development (R&D) costs represent a sizable portion of fixed costs. Neither definition neatly indicates where the line marking high technology is crossed. For practical purposes, therefore, high technology may also be defined as those goods identified by the U.S. Department of Commerce as such (Lenz and Stiltner, 1985). The commodities treated in this research satisfy all three definitions of high technology.

²See Popper (1989 and 1990) for a fuller discussion.

The first is, of course, domestic production. The ability of domestic R&D and production facilities to satisfy the demand for new and improved products and processes has been an object of great concern domestically and of considerable study by foreign analysts.³ Because the institutions of the economic system have been inadequate to provide incentives for or enforce accountability on both innovators and their potential customers, performance by this sector has never been sufficient to satisfy the aspirations of the Soviet leadership or to provide the economy with a dependable source of reliable high-technology equipment.

Two other sources have been tapped to augment domestic capacities. The first is importation from the West. This, again, has been subject to much discussion and study. Among other things, it is not clear how great a boost imported Western technology gives to the Soviet economy. This is obviously a matter of concern for Soviet planners and for Western policymakers responsible for defense and national security. Yet, the benefit derived from imported Western capital remains an open question largely because of problems of practical assimilation and pricing, making it difficult to determine real resource opportunity costs. Such inputs taken in aggregate most likely have a positive effect on Soviet performance, but individual imports often contribute less to the Soviet economy than they would if operated in another setting.

The third leg upon which the Soviet technological base rests is imports from the East European countries of the Council for Mutual Economic Assistance (CMEA).⁴ This source has received far less Western research attention than have the other two. The volume of technology exports from these countries to the rest of the world is not great. Further, the overall technological level of the economies of Eastern Europe compares unfavorably with the level of Western Europe or of other modern industrial nations. Yet, neither of these reasons is sufficient to reject considering Eastern Europe as a potentially useful source of high-technology inputs for the Soviet Union. Many commodities are manufactured specifically for the Soviet market and may not appear in large quantities outside the region. More important, it is not necessary for East European manufactures to be state of the art to ameliorate Soviet conditions. It is the relative

³The classic study is by Joseph Berliner (1976).

⁴For the purpose of this study, CMEA will be confined to the Soviet Union and the organization's six East European members: Bulgaria, Czechoslovakia, East Germany or the German Democratic Republic (GDR), Hungary, Poland, and Romania. These six are also sometimes referred to as the Non-Soviet Warsaw Pact (NSWP) states. The non-European CMEA members (Cuba, Mongolia, and Vietnam) will not be treated.

difference between what Eastern Europe makes and what the Soviets are able to provide for themselves that matters. Indeed, while East European equipment might not possess the inherent capabilities of competitive Western equipment, it was developed and is used in milieus more closely resembling conditions in the Soviet Union than conditions in the West. Therefore, East European machinery might be more easily adapted to Soviet conditions than would Western analogues. This could lead to a net result not significantly worse than what could be achieved by purchasing considerably more expensive Western imports.

Actions by Soviet policymakers have also bespoken higher regard for Eastern Europe as a source of high-technology products and know-how. Both Gorbachev and his immediate predecessors placed great store in laying a new foundation for intra-CMEA trade. This was to be accompanied by a greater degree of cooperation among the planning authorities of the member states as well as genuine integration of R&D and production resources for specific projects in priority sectors of high technology. In the last half of the 1980s, prominence was given to the formalization of closer ties in order to speed developments in each of these three areas. Here again, the motives for seeking such collaborative relationships have been subject to modification and changes in emphasis, but the Soviet leadership has remained attached to the notion that in some measure the technological progress of the Soviet Union is linked to kindred development of, and trade with, the economies of Eastern Europe. Determining how much Soviet expectations have been, and are likely to be, satisfied by the level of deliveries from Eastern Europe of high-technology products and expertise is one purpose of this study.

The analytical task is complicated considerably by the recent changes in Eastern Europe. At the time of writing,⁵ three East European states had coalition cabinets including former opponents of Communist rule (who constitute a majority in two of the cases), and leadership and policy direction had changed greatly in all six. The elections scheduled for the spring and summer of 1990 will bring further radical change if present trends hold. Soviet hopes for technological assistance from the rest of the CMEA were based on assumptions that must be subject to substantial reevaluation. It is not clear, however, that all previous bets are now off. At present, changes in domestic economic management and international trade flows have lagged behind the rapid transformation of politics and remain more as prospects than accomplished fact. Further, even if the political change is ratified and

⁵January 1990.

made permanent by democratic elections, changes in economic institutions are certain to require more time to take effect even if new policy directions are widely agreed upon. In particular, while trade patterns between CMEA states are likely to change, and even the CMEA itself is likely to be altered if not abandoned altogether, some mutual interests and needs will still be best satisfied by commerce with neighbors.

The purpose of this study is to determine whether Eastern Europe will be able to provide significant assistance to the Soviet Union in the form of high-technology inputs. Such inputs may be supplied through either straight commodity trade or participation in cooperative, integrative, or joint projects providing embodied or disembodied technology assets having a direct effect on productivity performance in the Soviet economy. The study examines the current relations between the Soviet Union and these countries and assesses what change is likely in the near future.

Section II discusses the institutional setting for CMEA trade and for cooperation in developing high-technology goods. It outlines the major CMEA program for science and technology cooperation and also discusses recent changes to the Soviet foreign-trade system.

Section III analyzes the results of the CMEA science and technology program by examining the number and nature of agreements signed to date. The analysis considers the barriers to more extensive contacts.

Section IV looks at trade in four specific high-technology commodities to determine how exports to the Soviet Union have shifted during the late 1980s. It also considers how extensive East European deliveries of these goods are likely to be in the future, and how likely they are to prove a significant source for satisfying Soviet needs.

Section V offers conclusions as well as speculations on the future of the CMEA as a trading bloc and instrument for technological cooperation.

II. THE INSTITUTIONS OF INTRA-CMEA TECHNOLOGY TRANSFER

Past patterns of trade in high-technology commodities between the Soviet Union and its CMEA trading partners may be examined for clues to the likely character of future patterns (see Sec. III), but the environment shaping these flows must also be understood for the full picture to emerge. The idiosyncratic features of CMEA institutions have had a profound effect on trade patterns for each country and for the region in aggregate. Changes in these mechanisms will affect trading patterns as a result.

The formal structure standing out most starkly in the late 1980s has been the CMEA scheme for widespread cooperation and integration¹ among the member states in five main areas of technology development and production. It provides a useful avenue of analysis for this study. While trade in high-technology commodities has often been governed by other agreements on specialization within the CMEA,² the science and technology (S&T) program was consciously intended to be a formal statement, codified in a series of bilateral and multilateral agreements, shaping the pattern of high-technology trade that was to develop within the CMEA between the date of signing and the year 2000. As such it can be analyzed both for its effect on the trade and cooperation that occurred in the second half of the 1980s and as a statement of future policy intent by the signatories. It is useful to explore the intent of the program and its fate in some detail. The object is to determine, on the one hand, whether the forces giving the program impetus are still likely to have validity in light of the massive economic and political changes throughout the region, and, on the other, whether there were barriers to implementation likely to continue as obstacles to future S&T contacts.

CMEA SCIENCE AND TECHNOLOGY INTEGRATION PLANS

Until recently, most CMEA efforts aimed at S&T cooperation proceeded on a bilateral basis or were coordinated by standing CMEA

¹Cooperation (coordination) in CMEA usage suggests that activities by individual member states will be harmonized by a CMEA-wide body acting in concert with national planning bodies. Integration suggests a more organic merging of production activities by enterprises and associations in several countries, perhaps through establishing jointly held assets or facilities.

²See Crane and Skoller (1988) for a full discussion.

committees.³ This led to a profusion of contradictory plans and duplicative efforts. Previous plans for greater technological integration, such as the relevant portions of the 1971 CMEA Complex Program, failed to develop multilateral, coordinated R&D programs. The standing CMEA bodies had little enforcement power. In practice, the ministries and other government organs of individual states carried forward the implementation of both cooperation efforts and straight commodity trade. Joint R&D planning was most often conducted without reference to the national economic plans for the concurrent period. This was partly because of the inherent unpredictability of R&D activities and outcomes, partly the administrative bifurcation of R&D and economic planning within CMEA, and in large part conflicts arising between joint plans and individual national interests and goals.⁴ This lack of coordination with the national economic plans, combined with the endemic lack of incentive on the part of manufacturing enterprises to adopt new processes, meant that the results of joint research projects often failed to find practical application in production. Chronic problems in bridging ministerial and sectorial boundaries further served to restrict the benefits from coordinated R&D and created problems of information dissemination. Finally, it is clear that when the intentions of multilateral approaches affected the interests of individual states, no mechanism guaranteed participation at the previously agreed level of support.

To provide a better basis for science and technology trade and cooperative R&D between member states, an extraordinary economic summit of CMEA party heads, held in Moscow in June 1984, approved for further discussion a draft Comprehensive Program for the Scientific and Technological Progress of the CMEA Member Countries Through the Year 2000 (hereinafter the "Program").⁵ The document was finalized at the 41st Extraordinary Session, in Bucharest, December 1985. The Program listed five major directions for cooperation in R&D and the implementation of scientific findings: computerization, automation of manufacturing, nuclear power, biotechnology, and the development and use of new materials and their associated technologies. Below these were 93 main tasks divided further into 629 specific tasks.

³See Nolting (1983) for a history of CMEA S&T cooperation.

⁴It should be noted that these problems also often arise with purely domestic R&D programs in each CMEA member state.

⁵The word *Kompleksnaya* will be translated as "Comprehensive" in this report. It provides a conveniently short form of the Program title that differs from that of the earlier "Complex" program, even though the Russian word in both titles is the same. It also conveys more fully that the newer program did not cover only international cooperation in R&D activities in many areas but intended to provide a greater degree of integration than had been achieved heretofore.

According to the Soviets, what distinguishes this Program from past programs is the stress laid on the interconnections among the various research tasks.⁶ Rather than merely laying out an agenda of discrete development projects, the goal is to achieve systematic integration leading to significant advances in major areas of technology.

Most important when considering Eastern Europe as a reliable source of high technology for the Soviets, the Program places great emphasis on actually putting the results from these tasks into production. This is a response to the recurring problems plaguing earlier efforts. The Soviets emphasized the need to incorporate the Program tasks into the plans of the CMEA countries to avoid making them tangential to other economic activities. In his address to the CMEA summit, Soviet Prime Minister Ryzhkov said that the Soviet Union had dedicated its entire science and technology administration to the pursuit of the Program's goals and had instituted a new system of statistical reporting to track target fulfillment.⁷

The code phrase most distinguishing the new Program from the old is "direct ties." It connotes direct economic ties among specific production and science production associations, enterprises, and research and design bureaus on a bilateral and multilateral basis, rather than having their interactions coordinated by ministerial-level bodies. It also covers the establishment of new entities—joint ventures specifically designed to carry forward tasks under the Program. Implementation of the Program, particularly in the area of direct ties, is where the interests of the Soviets and the East European CMEA members diverged.

The Politics of CMEA Science and Technology Cooperation

Many of the Program goals would unequivocally benefit all of the CMEA. The Program has value for the Soviets, in part, because it is in the tradition of efforts to increase CMEA integration. There are, therefore, collateral political benefits to whatever the Program may bring forth as technological achievements. Beyond this, if the CMEA could maximize the use of its available resources by true coordination, collaboration, exploitation of comparative advantage, and reduction of redundancies, all members would benefit. This disregards for the moment the institutional barriers affecting performance under similar measures in the past. Individual CMEA states and the CMEA as a whole have benefited from previous efforts at S&T cooperation,

⁶See the interview with G. I. Marchuk, then Chairman of the CMEA Committee for Science and Technology Cooperation, in *Pravda*, 29 December 1985. Marchuk is now the President of the USSR Academy of Sciences.

⁷*Izvestiya*, 18 December 1985, pp. 1, 4.

imperfect as they may have been (Nolting, 1983; Goodman, 1985). Further, a formal goal is to introduce CMEA-wide standards to be applied to new technologies and their production. The stated intent is to ease international technology transfer within the Bloc.

This last goal of common standards may be read several ways. At its simplest, it is a natural consequence of pursuing an international project in technology development and also a prerequisite for its success. In several industries, individual CMEA members use technology originating from different sources. This complicates coordination efforts and in the past has also retarded absorption of technology.

The term "standard" can also be read as addressing a need for uniformity in standards of performance and quality of production. The attempt to delineate a wide range of standards may be seen as a measure to decrease the technology gaps between CMEA member countries and even between sectors within the same country.⁸ One of the problems retarding more rapid change in national technology bases is the seeming futility of raising the standards of quality or performance for a component to be combined in final assembly with others of less exacting manufacture. This problem is especially acute with bilateral or multilateral specialization of the kind the Soviets have tried to promote within the CMEA. Further implications for the setting of standards will be addressed below.

Finally, one of the Program's main purposes was, as emphasized by Premier Ryzhkov at the December 1985 CMEA countries' meeting, to reduce the vulnerability of CMEA countries to Western technology export controls.⁹ In pressing the East European CMEA countries to accept the Program and the need for the Program, the Soviets have emphasized the technology "embargo" being enforced by the United States and "certain of its allies." The case is overstated in the instance of the United States and is considerably exaggerated when referring to Western Europe and Japan (Popper, 1988). Rather, the scope of COCOM (Coordinating Committee on Export Controls) is more restricted, focused on technology that would lead to significant military improvements in the Warsaw Pact.¹⁰ However, the specter of a wide-ranging embargo on technologically advanced trade goods is a useful

⁸The call for CMEA-wide standards may be seen as a reflection of a concurrent call for rigorous state standards emanating from the Soviet leadership. Attempts to tighten domestic quality standards have been characteristic of all recent Soviet administrations but were especially pronounced during the early Gorbachev era.

⁹*Pravda*, 18 December 1985, pp. 1, 4.

¹⁰See Bertsch (1986) for a discussion of the intent of Western export controls. There has been debate in the West over whether COCOM controls are truly limited to militarily significant technology.

further justification for an all-embracing structure such as the Comprehensive Program.

Unilateral Soviet Benefits

Besides the advantages that would clearly accrue to all CMEA partners as a result of successful cooperation in S&T trade and integration, the existence of a formal apparatus itself raised a possibility that it could also serve the particular interests of the Soviet side. This was not necessarily a prime interest of the Soviets in advocating the Program, but speculation along these lines could have led to foot-dragging by their intended partners. Similar difficulties bedevil all such multilateral technology-cooperation projects, East and West, when partners are in unequal positions to exploit potentially valuable results.

Gearing CMEA Production to Suit the Needs of Soviet Industry. There is a further sense of the term "standards" and another potential purpose to be served: a desire to guarantee conformity and compatibility by setting a limited range of technical specifications for components. Depending on the means used to set the standards, it is conceivable that such an approach could be used to guarantee that high-technology products from Eastern Europe are made to suit the needs of Soviet industry. This appears to have been the experience of the East German digital control industry when it agreed to produce to Soviet standards in the 1970s. The decision may have been a factor in restraining the technological development and export competitiveness of that industry.

Further, if the standards were markedly different from those prevailing in the West, the effect would be to reduce East European options for technology acquisition, depending on the specific technology involved. This would seem counterproductive to bettering East European export performance and improving the CMEA's ability to import current state-of-the-art technologies. It could, however, have the effect of increasing the reliance of individual East European states on the mechanism of the CMEA, furthering the goal of CMEA integration, and reducing contacts with Western trading partners.

It is by no means clear that the Soviets intend this when calling for settled CMEA technical standards. In the specific case of telecommunications technology, for example, the Soviets have opted to make the architecture of their new digitalized system congruent with international standards (Selin, 1987). This permits them to upgrade the network with standard Western commercial imports. It also allows the Soviet system to be integrated with those of Eastern Europe, many of which, like Bulgaria, have already made a substantial investment in

obtaining such equipment from the West. It is certainly possible that the Program, conceived under Andropov, initialed under Chernenko, and signed under Gorbachev, was subject to shifting priorities. However, the desire to increase the applicability of East European technology to the Soviet setting would remain.

Soviet Control of East European R&D. The Comprehensive Program could have been read by some East Europeans as a mechanism for making Soviet control more efficient over national R&D policies and technology choice. Each of the head (*golovnoi*) organizations charged with overseeing the 93 main tasks of the Program is a Soviet entity (Sobell, 1986). These include almost all the intersectorial science and technology complexes (MNTKs)¹¹ as well as several science production associations (NPOs) and research institutes. The rest of the CMEA could have questioned whether giving Soviet organs the authority for overseeing implementation was intended to direct East European S&T development toward serving the needs of the Soviet economy. Giving Soviet national organizations a leading role over specific programs of a CMEA joint project was out of step with the previous, common CMEA practice: instituting a special multilateral commission as the governing body. Indeed, this action could have been seen as limiting the influence conferred upon the East Europeans by their presence on CMEA bodies. Whether this was a prime intent or not, the Program established an alternative structure to the creaky CMEA R&D bureaucracy of coordination commissions, permanent branch and interbranch commissions, and permanent conferences. The objective may have been efficiency but the net effect of full implementation would be to give Soviet entities a leading role in the R&D activities of the non-Soviet CMEA.

Managing the Quality of Intra-CMEA Trade. Since 1984, the Soviets have become increasingly outspoken about their dissatisfaction with trading relationships within the CMEA. Previously, the Soviet Union delivered energy and raw materials to the East European CMEA countries on generous terms, receiving in return CMEA machinery deliveries of often questionable quality. The Soviet side has openly expressed its determination to improve its terms of trade with Eastern Europe. When the Program was initiated in 1985, this meant that manufactured goods exported to the Soviet Union were to be of better quality and adhere to a higher technical standard.

The problem faced by the Soviets was how to bring this about in practice. In spite of a great deal of rhetoric, even by 1986 the Soviet difficulty in achieving trade balance was already clear (Vanous, 1987).

¹¹Interview with Prime Minister Ryzhkov, *Izvestiya*, 19 December 1985.

Indications were that the combination of output shortfalls, shifting priorities, and increasing domestic demand coupled with the fall in world energy prices had further reduced the pressures that large account deficits in rubles would place upon the East Europeans. For the present purpose, the most interesting problem is qualitative. The current CMEA mechanism is inadequate to ensure the timely delivery of the higher value-added manufactured goods the Soviets want. Given the ponderousness of the instruments of intra-CMEA trade, the task is not an easy one. Delivery contracts tend to be long-standing and are negotiated on a bilateral basis by higher government bureaucrats who often lack adequate information about demand, supply, and relative value of alternative machine types. The endemic problems of chronic excess demand in the national economies of Eastern Europe also affect the availability of more desired goods irrespective of Soviet wishes. Further, the product mix of the East European industry is becoming more complex, yielding an increasingly varied assortment of machine types. Daunting problems include ascertaining what is available, determining the relative qualitative difference between what is producible by Eastern Europe compared with what is exported to the Soviet Union, and obtaining current information on the availability and relative merits of substitutes. The uncertainties can be made to serve the East Europeans by relieving them of the necessity of complying so fully with Soviet desires that their own hard-currency export earnings are compromised. Such problems would become exacerbated by the degree that Eastern Europe produces more of the high-technology products of most interest to the Soviets.

A Program successfully implemented could conceivably provide more information on potential East European exports. The emphasis on direct ties among enterprises, associations, and institutes, as compared with the traditional contacts through high-level national and multilateral bodies, could greatly improve Soviet ability to monitor the quality of potential East European deliveries to the Soviet Union. In an environment where price is not a meaningful indicator of quality, creating a CMEA-wide set of standards for emerging technologies would also make it easier to monitor the quality of goods shipped to the Soviet Union in exchange for deliveries of more homogeneous commodities like energy and raw materials. One of the main themes in press reports on the Comprehensive Program is the need to guarantee the application of world-class standards to products traded within the CMEA. Again, the Comprehensive Program, with its distinctive role for Soviet head organizations as the organs most responsible for joint research projects and their subsequent industrial application, could provide penetration into East European industry as its output mix

becomes more complex and monitoring by higher-level organs becomes less adequate.

CMEA Technology Imports from the West. By its nature, an integrated S&T program gives the Soviets more access to Eastern Europe's existing and future technology contacts with the West. Clearly, the Comprehensive Program was partly a response to the consequences of the existing high-technology trade between the CMEA and the West. The specific Soviet intent in instituting this structure is subject to alternative interpretations. It may well be that the Soviets themselves were unresolved about the specific course to follow and provided themselves with a series of options to be selectively exercised as events dictated.

The least convoluted reading of the Comprehensive Program would be to take it at its word: the intention is (1) to develop the indigenous capacity within the CMEA to substitute for currently imported Western technology and (2) to take steps to prevent being placed at a disadvantage as new technologies emerge. This is by no means an incorrect interpretation. The ability of the Soviet Bloc to compete in the development and deployment of advanced technologies was clearly an issue of great concern to the Soviet leadership. The portents for direct technology trade between the East European allies and the West are not so straightforward; it has been occasionally argued that Soviet policy is to seek a reduction in these ties.

The signals are mixed. The Soviets would like to avoid the type of reliance on Western import that could be exploited by the West as political leverage. There are also those in the Soviet leadership who see danger in any form of technology reliance because of its damaging effects on the domestic capacity to produce and absorb sophisticated industrial equipment. Before the most recent changes in the East, it had sometimes been argued that the Soviets had a political interest in limiting the intercourse between its CMEA partners and countries of the Western alliance.¹² Therefore, the Program could be read as an attempt to form a technology bloc self-sufficient enough to be able to provide for itself the greater share of high-technology inputs.

This thread certainly was present in the elaboration of the Program, at least in its initial, pre-Gorbachev stages. However, it would seem to contrast with much of the early Gorbachev agenda domestically, within the CMEA, and with respect to the West. Clearly, the Program was intended to promote self-sufficiency in those technologies and applications subject to export controls, but it is not as clear that this intention implied a desire to reduce technology flows from the West for noncontrolled commodities.

¹²See, for example, Zycher (1989).

To limit or restrict such contacts could jeopardize the renovation strategy upon which the Soviet President staked his political program. Gorbachev was well aware of the need to take the best the West would offer and to incorporate it rapidly in the respective economies of the CMEA. To close the CMEA off as a technology island would be to condemn it to permanent technological inferiority.

This leads to a reading of the Program as a more subtle instrument, where the dominant theme with respect to West-East technology deliveries was less one of restriction than one of control. This concept of control may be decomposed into several elements. The first element is more effective Soviet monitoring of East European technology traffic with the West. To the extent that the Soviets may have seen these contacts as undermining their primacy over their NSWP allies, the Program had the prospect of serving as an additional effective means for reporting the extent of such contacts on a standard basis. The comprehensive nature of the Program as intended would have meant that few areas of technology contact would remain where other CMEA members, and the various Soviet head organizations, would not be involved to some degree.

A Soviet desire to increase means for monitoring could spring from genuine concerns for efficiency. Those seeking to reduce the importation of high-technology goods from the West argue that experience using those imports is not uniformly good. There is a perception within the CMEA that considerable damage was done directly to some East European countries such as Poland during the last two decades,¹³ and to the whole of the CMEA indirectly, by failures to adequately absorb imported Western capital goods. The failures affected not only the external financial situation of CMEA countries but intra-CMEA trade flows as well. This was a reason for concern even for those most heartily convinced of the need for profound change in the technological level of East European and Soviet industry. The apparatus established to enact the Program, according to its advocates, could serve to actively moderate the flow of Western technology goods purchased by CMEA countries to better rationalize the acquisition process and ensure that opportunities and scarce resources are not squandered. If this was an intention behind the Program, the prominence of Soviet organizations in heading the various branches of technology acquisition meant, in effect, that the Soviet Union would be vetting the decisions of its other partners in the Program.

¹³This states the origin of the Polish economic crisis in terms commonly used in the CMEA during the early 1980s. A more accurate analysis is that Poland's difficulties did not stem from the technology import strategy so much as from the ineffectual nature of the supporting economic system.

The subject of Soviet anxiety over relations between Eastern Europe and the West also leads to speculation touching longer-term Soviet preoccupations. Soviet interest in control measures may be caused not only by concern over a Western technology embargo applied against the CMEA as a bloc. What may disturb the Soviets more is a concern that some East European states have the potential for greater access than others to Western technology, including "know-how" as well as actual goods. Western selectivity may be exercised because of historical ties, as is the case with East Germany; active policy and reform measures, as with Hungary and Poland; or simply because in the area of dual-use technologies, export control occasionally rests on the judgment of the exporting nation. If, in fact, differential contacts with the West are capable of increasing the technological level of East European industry, the Soviet Union could be placed in a potentially awkward position. Soviet ability to draw the CMEA together economically had partially stemmed from its willingness to deliver adequate energy and other raw material supplies at prices comparing favorably with the alternatives. Increased Soviet domestic demand and the removal of significant price differentials between the CMEA and world markets have reduced whatever the value of this trump may once have been. If at the same time the Soviet Union faces the real prospect of a technology gap between itself and its CMEA partners, not only is leverage reduced but the client states may become more aware of a Soviet dependence upon technology proprietorially marshaled by its CMEA partners. This could make the economic relationship a bit more equal than the Soviets might prefer.¹⁴

Viewed from the outside, this concern may seem chimerical or even paranoiac. But the Soviet leaders may view themselves as possessing a dwindling set of means to pressure their CMEA partners into sharing. By instituting the mechanism of the Program, the Soviets put themselves in a position to avoid employing relatively crude means to obtain what they need. The Program, in its fullest unfolding, would have provided a measure of assurance that the Soviet Union would be functionally linked to the technological development of its trading partners, perhaps even at the expense of some development in the countries best able to rely upon domestic and Western sources for increased productivity. In this sense the Program would have served as an instrument of control, ensuring no detrimental change in the relative technological level of Soviet and East European industry.

¹⁴As an example of explicit linkage, the S&T agreement between Bulgaria and the Soviet Union was signed in 1985. The same document also specifically covers the level of Soviet oil exports through 1990. (*Ekonomicheskaya Gazeta*, No. 26, 1985, pp. 9-10.) The same is true for the agreement with Romania.

This last element is one of present policy interest for the West. The profound changes in Eastern Europe during 1989 verify the prospect of sharper differentials in access to Western technology. As matters currently stand, some East European states have a better chance than does the Soviet Union of receiving direct technological assistance and even, perhaps, formerly restricted commodities. This prospect is almost certainly diminished, however, to the extent that the potential recipient countries or specific industrial sectors are tied into direct, cooperative S&T arrangements with the Soviets. For the favored countries, this may prove perhaps the most powerfully renewed reason for limiting direct ties within the CMEA.

The Soviets may have had a contrary view: that Program-related joint projects meant a greater sharing of Western technology inputs more available to some CMEA countries than to others. If the Program tied all significant R&D work into an international system of control and cooperation, then the differential ability of selected CMEA states to gain access to Western technology would be to the net benefit of all CMEA members. "Spillover" effects could be multiplied even if no actual intra-CMEA transfer of technology occurred. Expansion of such access might even be encouraged for the reasons that made it attractive in the past as well as by virtue of the increased dimension of being more firmly under Soviet supervision. The Soviet Union may have explicitly counted on tying its East European allies into the Program to impose routine and dirigibility upon a process often beyond Soviet power given the instruments available. All CMEA members would conceivably derive whatever benefit to be had in pooling resources and cooperating in R&D efforts, while the Soviets would also be better able to ensure a parity of technological change directly through the differential ability of Eastern Europe to tap Western sources of technology.

Technology deliveries to Eastern Europe by the West will certainly be affected by the recent profound political changes. At present, it appears that such change will more likely benefit the potential recipients than the potential free riders. Talks have begun between the United States and Poland and Hungary to remove barriers to shipment of "middle" and higher technologies. The discussion centers on means for preventing diversion. According to U.S. Commerce Secretary Mosbacher, the policy on releasing previously blocked technologies should be, "Eastern European countries, yes; the Soviet Union, we'd have to be very careful."¹⁵ Means of verification and enforcement, hence the

¹⁵"U.S.-East Bloc Talks Target High-Tech Exports to Soviets." *Los Angeles Times*, 18 December 1989.

extent to which such technology is released, remain to be specified. It should be noted that preempting de facto defections (from the letter of the COCOM agreements) by other Western exporters could accelerate this process of review and dispose it more favorably to the East Europeans.¹⁶

Informal Benefits of a Science and Technology Integration Policy

Beyond the more tangible prospects compelling a move toward integration of technology production within the CMEA, instituting the Program may possibly fulfill other purposes for the member governments. These purposes are closely associated with changes in the political structures that have occurred and loom in prospect.

All the formerly ruling regimes of the CMEA emphasized the need for upgrading the technological base. The press in each country stressed the role technology would play in transforming the economy by cutting through so many current problems. The millenarianism that has always been part of socialist rhetoric received constant reinforcement by the widespread and reflexive use of the phrase "Toward the Year 2000" in agreements, decrees, and resolutions.¹⁷ This is a more sophisticated version of the technology-as-panacea theme of the 1970s. In part, the legitimacy of the former Communist regimes of Eastern Europe was eroded by their perceived inadequacies in bringing about this transformation.

While the main reasons for integrating technology within the Bloc were to surmount COCOM restrictions on technology and to conserve foreign exchange and relieve other economic constraints on foreign purchase,¹⁸ another was the need for each country to develop domestic sources for technology so as not to institutionalize permanent technology dependence. All were valid at the time the Program was entered into and remain so today. In spite of any change that might occur in the economic systems of each country, irrespective of transformations in the external political environment, and even if aspects of a unified

¹⁶"Bush Weighs Easing Limits on Tech Exports to East Bloc," *Los Angeles Times*, 15 December 1989.

¹⁷So common was the phrase that it became a matter for satire (see, e.g., "Diurnus," 1986).

¹⁸A third informal reason, as has been suggested, was for each member to gain by somehow using inputs from other countries to expand its production possibilities without unduly dissipating its own resources or losing control over the disposition and development of national S&T assets. The game theoretic implications from employing this strategy in aggregate are obvious.

market (convertibility, rational pricing policies, etc.) emerge within the CMEA, the last reason is not likely to change in the future. This theme will be considered more fully in Sec. V.

Related but coming from the opposite direction, at this writing (January 1990), is Gorbachev's apparent conception of a higher purpose to be served by ideology. His statements suggest he believes that Eastern Europe still has a remnant of an inclination toward socialism. The people have demanded changes in inefficient and corrupt ruling regimes but still adhere to tenets binding them together in a determination to create more effective and just societies, not mere replications of Western capitalism. One may certainly argue about how real this vision is and is likely to remain after the elections of 1990. But in the Gorbachevian view, it is important that some visible platform exist for exercising and demonstrating concerted action among enlightened socialist states to establish the true spirit of socialism and to demonstrate an inherent solidarity and convergence of interests. Cooperation in development and trade in areas of emerging technology are the best means to exhibit the forward-looking character of Gorbachevian reform throughout the region.

CHANGES TO THE SOVIET FOREIGN-TRADE APPARATUS

Before considering the previous and emerging patterns of high-technology goods deliveries to the Soviet Union, another set of institutions should be considered. The mechanism for conducting Soviet foreign trade is also undergoing change and redefinition. These transformations also carry clues to shifts in Soviet policy priorities. Many of the measures were directed to improving Soviet trade opportunities with the West. At the same time they were intended to provide greater flexibility for fulfilling tasks under the Comprehensive Program by giving operational definition to the concept of direct ties.

One of the earliest changes caused by *perestroika* of foreign trade was the creation of the State Commission on Foreign Economic Relations (GKES) by joint decree of the Central Committee and the Council of Ministers on 19 August 1986. The document creating this institution explicitly cited the need to fulfill Soviet obligations accepted under the CMEA's Comprehensive Program as justification for the measure (*Sov'et Ministrov SSSR*, 1986). The measure broke the Ministry of Foreign Trade's monopoly by granting permission to 20 ministries and nearly 70 designated enterprises to engage directly in import-

and-export activity,¹⁹ transferred foreign trade organizations from the Ministry of Foreign Trade to the jurisdiction of branch ministries,²⁰ and cost that ministry 30 percent of its staff. One analyst describes these moves as amounting to a hostile takeover of the Ministry of Foreign Trade (Aslund, 1989). Further, entities given the right to engage in foreign trade were also entitled to retain hard-currency balances. The legislation also granted extensive rights to establish joint ventures with enterprises in other CMEA countries as well as permitted joint ventures with capitalist firms.²¹

The Law on State Enterprises (Associations) of June 1987 elaborated the areas of enterprise operation that were addressed by the August 1986 decree on foreign trade (*Verkhovnoy Sov'eta SSSR*, 1987). Enterprises were placed on *khovraschet* (economic accounting) for hard-currency dealings as well as for their ruble accounts, and they were allowed to retain a portion of hard currency earnings according to normatives set by the individual branch ministries. These normatives were intended to be long-term, and ministries were enjoined from unauthorized confiscation of enterprise hard-currency reserves. The right of the ministry to set the normatives, however, renders that injunction unenforceable.

These changes appear more sweeping than they were in fact. Few of the enterprises granted foreign trading rights by the measure possessed the expertise, contacts, or resources to use them effectively, and those few represented only a minuscule fraction of Soviet industry. The change left too many issues unresolved, and in the ensuing power vacuum enterprises proved generally incapable of successfully contesting for control. Old customs of subordination and control continued to be imposed on an informal basis, this time by ministries and local party authorities.

The registration and operation of joint ventures was elaborated in decrees issued on 13 January 1987 (*Sov'et Ministrov SSSR*, Nos. 8-9, 1987). The terms were not liberal. A minimum of 51 percent of the equity had to remain in the hands of the Soviet partner, and the director of the enterprise was required to be a Soviet citizen. Foreign nationals were allowed to participate in management. Hard-currency expenditures of the joint venture were to be covered by its hard-currency earnings. Further, only the profits from the joint venture's

¹⁹These numbers have since increased.

²⁰GKES retained 25 foreign-trade organizations to coordinate trade in oil, fuels, food, and other goods identified as fundamentally important.

²¹The function and operations of the GKES, foreign trade organizations, and the rump Ministry for Foreign Trade were further delineated on 22 December 1986 (*Sov'et Ministrov SSSR*, Nos. 5-7, 1987).

foreign sales were eligible for repatriation. Domestic sales profits, usually the matter of greatest interest to prospective Western partners, had to remain with the joint venture in the country. Exemption from taxation for the first two years of operation was offered as an inducement.²² Thereafter, 30 percent of enterprise profits would be taxable, with repatriated profits subject to a further 20 percent tariff. Joint ventures within the CMEA, on the other hand, were to be handled on the basis of equal participation of all partners in all aspects of the joint venture's operation and resulting revenue flows. This decree did not provide for much flexibility in drafting joint venture agreements. Perhaps more important, it did not provide joint ventures with any exemption from present or prospective changes in Soviet enterprise legislation. Therefore, partners were asked to accept a considerable degree of uncertainty when they entered into ventures with potential Soviet colleagues.

The dislocations and disappointments accompanying the earlier decrees have led to more recent measures. In January 1988, the supra-ministerial GKES and the Ministry of Foreign Trade were formally amalgamated into the new Ministry for Foreign Economic Relations. The principal reason for this move was most likely to reduce the amount of bureaucratic infighting and general confusion of authority caused by the initial measures. In January 1989, changes were introduced to increase the attractiveness of joint ventures to potential Western partners and to improve the interest of Soviet enterprises in creating more exports (*Sov'et Ministrov SSSR*, No. 2, 1989). Soviet enterprises, previously constrained to use their hard-currency holdings only for purchase of Western investment goods, may now use their holdings of transferable rubles and CMEA currencies, as well as "up to 10 percent of other [hard-currency] funds," on consumer goods imports. Joint venture regulations were changed to permit up to 99 percent equity participation by foreign partners and to allow foreigners to act as directors, while extending exemption from taxation until the first profitable year (and for the three years thereafter for joint ventures located in the Soviet Far East).

Failure to address several shortcomings in the foreign trade mechanism, coupled with problems organic to the CMEA, have limited the measures' effect on increasing direct ties. For example, stipulating that a share of transferable-ruble or CMEA-currency balances may be used to import consumer goods does nothing to improve the willingness of potential suppliers to increase above plan deliveries of those items. Policy positions taken by the Soviets in the last two years have

²²This was a later amendment to the original decree.

explicitly recognized the need for CMEA change to allow the new trade measures to have an effect on the export behavior of Soviet enterprises. Soviets have called for changes in price mechanisms and convertibility relations within the Bloc. In 1988, the Soviets signed agreements to allow clearing in domestic currencies on a bilateral basis for trade with Czechoslovakia, Poland, and Hungary. While this is a step in the right direction, traditional factors, such as the power and interests of superior bodies and fulfillment of short-term plan goals, more strongly affect the volume of trade turnover between partners within the CMEA. Thus, in spite of the mutual desire for greater trade liberalization between the Soviet and non-Soviet CMEA, and in spite of the measures introduced in the Soviet Union to achieve this end,²³ trade between the Soviet Union and its CMEA partners decreased in 1989 and will curtail even more in 1990.

²³It might even be said that trade has decreased *because* of these and related measures, implemented under the rubric of *perestroika*, which have led to decreases in output, delivery dislocations, and diversion of exports to satisfy domestic demand.

III. SOVIET SCIENCE AND TECHNOLOGY COOPERATION WITH EASTERN EUROPE

THE SCIENCE AND TECHNOLOGY PROGRAM IN PRACTICE

This section assesses the value of the Comprehensive Program to the Soviet Union by examining formal Soviet agreements with CMEA partners. An examination of the agreements suggests that the Program has achieved its intended goals neither in scope and coverage of associated formal agreements nor, more important, in development and production of critical high-technology products.¹ As the prime instigator and the party most likely to be affected positively by the Program's success, the Soviet Union has not received the benefits its leadership had hoped. It must also be noted that the Soviet leadership's views of the utility of Eastern Europe to meet Soviet needs also underwent change during the late 1980s (see Kusin, 1989).

Table 3.1 reports the results of a survey of S&T agreements between the Soviet Union and its CMEA partners by year and category.² It excludes agreements where the Soviet Union was not a signatory. To determine the effect of the Comprehensive Program, the reported agreements are organized in Table 3.1 into columns approximating the five main Program categories, along with a "General" category for non-specific agreements and those covering more than one category and a "Technology" category for agreements falling into sectors not easily categorized under the five main headings of the Program.³ Often, the date of signing was not indicated in the source text.

¹For recent East European statements on the Program's shortcomings, see Smutny (1989) and Kraszewski (1989). It should be noted that both articles, containing negative references to the Program, were made by government officials in power before the 1989 collapse of regimes.

²The full database giving rise to these statistics was culled from a large number of East European and Soviet newspapers and periodicals, either in the original format or in translation. The data collection concentrated on material appearing between 1984 and 1988, inclusive. The cutoff date for active searching was December 1988. Therefore, the totals for agreements signed in the year 1988 may be understated. Often, the existence of an agreement was inferred from the text. While thorough, the database is not necessarily comprehensive. It should be considered primarily as a bibliographic reference for analyzing the degree of Program compliance.

³Agreements were assigned to categories according to the researchers' understanding of the content.

Table 3.1

SCIENCE AND TECHNOLOGY AGREEMENTS BY YEAR AND CATEGORY

Year	Agreement Categories							Total ^a
	Auto- mation	Biotech- nology	Elec- tronics	Energy	Materials	General	Tech- nology	
1977	0	0	1	0	0	0	0	1
1979	0	1	0	0	0	0	0	1
1981	0	0	0	1	0	0	0	1
1982	0	0	0	1	0	0	0	1
1983	0	0	0	0	2	0	0	2
1984	0	0	0	0	1	2	1	4
1985	9	1	0	4	2	7	2	25 (17)
1986	9	2	4	6	13	13	3	50 (31)
1987	20	5	6	5	6	3	23	68 (28)
1988 ^b	5	5	5	1	2	6	6	30 (16)
1989	0	0	1	0	0	0	0	1
NA	0	1	1	1	0	2	0	5
Total	43	15	18	19	26	33	35	189

NOTE: NA means not ascertainable.

^aThe numbers in parentheses in the Total column represent agreements known to be signed in the year indicated. The larger total to the left of this number may be interpreted as the number of agreements either signed or first referred to during the indicated year.

^bTotals for agreements signed in 1988 may be understated.

The table tabulates 189 separate agreements. Agreements on activities according to the 1984 draft Program document began to be signed in 1985. The first full year of the Program, 1986, shows twice as many agreements as the previous year. The number increases again by a third in 1987 but falls off in 1988. The table's 1988 figures may be as much as one-third lower than the true number of agreements because of the data collection cutoff date, but even doubling the table's figures would not yield a number as great as the one recorded the previous year. The largest single category is "Automation." This is not surprising given the considerable emphasis the Soviet Union placed upon industrial modernization. Again, the year 1987 stands out as a high water mark. Nearly half of the Automation agreements were signed that year. This may be because 1987 was the peak year for the campaign to dragoon participation in the Program and when the negotiations of the previous year were finalized. It was also the start of the large-scale modernization campaign in the Soviet Union. After that

year, the shortcomings and drawbacks to the Program became clearer as did the general economic deterioration of the CMEA member states, the Soviet Union included.

In 1987 more agreements appeared to fall outside the Program structure, in the Technology category, or could not be easily categorized. Most General-category agreements were signed in 1986; they would include the new basic bilateral S&T agreements signed in the wake of the Program's implementation. The share of agreements under one of the five main Program headings from 1985-1988 was a surprisingly constant 60-68 percent for each year.

Table 3.2 indicates the types of agreements the Soviet Union signed. Overwhelmingly, the agreements were with only one other country. Only 20 involved all seven potential signatories, while even fewer were multilateral, involving more than two and less than seven. This is not remarkable. The CMEA-wide agreements are more general in character than the other types. More specific agreements entered into for well-defined production purposes naturally become more difficult to negotiate as the number of partners increases. The categories with the largest share of CMEA-wide and multilateral agreements are Energy and Materials. (The actual corresponding Program categories are Nuclear Energy and New Materials. The database uses wide definitions and so includes agreements relating to more prosaic commodities. This partially explains the apparently greater ease of forging multisided agreements in these two areas.) Proportionately, the fewest multisided agreements are to be found under Technology and Automation. Especially under Automation, the greater specificity inherent in its projects and the importance that automation of manufacturing

Table 3.2

SCIENCE AND TECHNOLOGY AGREEMENTS BY TYPE AND CATEGORY

Category	Type			Total
	Bilateral	Multilateral	CMEA-wide	
Automation	41	2	0	43
Biotechnology	12	0	3	15
Electronics	13	1	4	18
Energy	13	0	6	19
New Materials	20	1	5	26
General	31	0	2	33
Technology	35	0	0	35
Total	165	4	20	189

holds for potential signatories would make it difficult to execute a practical agreement with a large number of signatories. However, note that one of the multilateral agreements is to establish the multilateral cooperative venture, INTERROBOT, a flagship undertaking for the Automation task of the Program.⁴

The large number of bilateral agreements could be held up as a sign of Program success. Direct ties between development and production facilities in several countries would appear as agreements of this type. However, the database, such as it can, suggests that this type of relation did not become preponderant. Table 3.3 tabulates the number of agreements apparently involving some form of co-production between enterprises in two or more countries. Cooperation of the type envisioned by the term "direct ties" is an aspect of only one out of every eight agreements signed—less than 15 percent of just the bilateral agreements. Most agreements, when naming specific enterprises, seem to be more the traditional CMEA "shotgun weddings," negotiated and entered into by governmental bodies, than the voluntary unions to be ushered in by the new cooperative design.

Table 3.4 shows the number of agreements signed with the Soviet Union by country and year. The total number of multilateral agreements was four; 12 appear to be listed here because two involved four partners (in addition to the Soviet Union) while two involved two partners.

Bulgaria and Czechoslovakia were the countries most represented in science and technology agreements with the Soviet Union. Bulgaria has traditionally been closely aligned with Soviet interests and was not

Table 3.3

SCIENCE AND TECHNOLOGY
AGREEMENTS COVERING
JOINT VENTURES

Joint Venture?	Total
Yes	24
No	163
NA	2
Total	189

NOTE: NA means not ascertainable.

⁴INTERROBOT is not a true CMEA-wide agreement because of the unwillingness of the GDR, the Bloc leader in industrial robotics, to sign.

Table 3.4
SCIENCE AND TECHNOLOGY AGREEMENTS BY COUNTRY AND YEAR

Year	Country							CMEA-wide
	Bulgaria	Czech.	E. Ger.	Hungary	Poland	Romania	Yugo.	
1977	1	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	1
1981	0	0	0	0	0	1	0	0
1982	0	0	0	0	0	0	0	1
1983	0	1	0	0	0	0	0	1
1984	0	1	2	0	1	0	0	0
1985	2,1	8,2	5,1	2,2	2,2	2	0	2
1986	11	13	5	1	7	7	2	4
1987	15,1	21	9	12,1	5	0	0	5
1988	5	3	2	0,1	12	0,1	2	5
1989	1	0	0	0	0	0	0	0
NA	0	2	0	0	0	2	0	1
Total	35,2	49,2	23,1	15,4	27,2	12,1	4	20

NOTES: NA means not ascertainable. Where two numbers are separated by a comma, the first number is the number of bilateral agreements entered into with the Soviet Union and the second indicates multilateral agreements.

reluctant to enter into the Program in 1985. Bulgaria also benefited considerably from the CMEA computer program often referred to as a model for the type of interaction planned under the Program. This allowed Bulgaria to become a significant exporter of peripheral computer equipment within the CMEA, so its reaction to the more ambitious Comprehensive Program was positive. Bulgaria signed a long-term S&T agreement with the Soviet Union on 7 June 1985, even before the December 1985 Program ratification.⁵ Indeed, the first two joint ventures entered into by the Soviet Union were with Bulgarian machine-building associations. Ostensibly part of the Program, both ventures were apparently established before December 1985. Therefore, Bulgaria was clearly favorably disposed to cooperate and trade in high technology before the Program structure was erected. More recently, Bulgaria's emphasis on high growth rates has led to a deteriorating trade balance with the West, causing it to turn even more fully toward CMEA trade, especially in areas of high technology (Economic Commission for Europe, 1989).

⁵*Ekonomicheskaya Gazeta* (26), 1985, pp. 9-10.

Czechoslovakia was initially a vociferous proponent of the Program. It embraced the concept of direct ties at the enterprise level and unilaterally established a code of conduct for enterprises wishing to set up foreign links to cut through the problems associated with such ventures. ("V.S.," 1985.) Its eagerness to accept the Soviet reading of the Program was conditioned by Czechoslovakia's increasing orientation of trade toward the CMEA. As late as 1980, its share of total exports going to the CMEA was 64 percent, little changed from the 1966 figure of 63 percent. By 1985, its CMEA share was 74 percent; 81 percent of these were mass-produced industrial goods, machinery, and equipment.⁶ The country's industrial base is declining and with it the ability to compete in more competitive markets. Yet, with its exports it still stands in a position to increase the relative technological level of Soviet industry. Czechoslovakia has signed four bilateral agreements with the Soviet Union to provide specialty chemicals and is signatory to a further six multilateral undertakings in this area that include the Soviet Union. It is heavily engaged in nuclear energy tasks and, having largely missed the revolution in electronics that began in the late 1970s, is a major participant in developing robots and other electronic applications.

Czechoslovakia's participation in the Program was not without cost. Participation required adjusting previously established research priorities. Nine of twelve targeted plans had to be ratcheted back to allow proper funding and resources for what remained. The quid pro quo is clear.

If the Czechoslovak leaders have shown themselves favorable to the comprehensive program despite the difficulties which its implementation has occasioned for national projects, it is because they are persuaded that intra-CMEA cooperation represents henceforth the only means available to them for modernizing industry and regaining a key position within the camp. . . . Czechoslovakia is attempting to derive the best advantage possible from the bloc by placing its scientific and technical workforce at the service of the community's needs (Blaha, 1988).

This means, among other things, orienting even more carefully to Soviet needs.

Poland falls into the middle range of participation in agreements with the Soviets, and its situation is ambiguous. Unlike Bulgaria, Poland had a negative experience when it participated in developing the *Ryad* series of computers. Domestic technical experts perceived

⁶*Svet Hospodarstvi*, 9 September 1986, p. 2.

this machine as less sophisticated than the one Poland would have produced by itself and felt that Poland's subsequent accomplishments in the field were retarded. The economic disasters of the 1980s may have removed such objections from the realm of practical discussion. The Polish government accepted the Program obligation of closer ties to Soviet producers and pressed forward legislation to reduce barriers to integration. On the other hand, at the same time many articles began appearing in the Polish press pointing out the need to reform CMEA trading institutions. Poland has benefited uniquely from Soviet forbearance in pressing for repayment of its ruble debts. A public appearance of cooperation would seem a small price to pay for continued favor.

The scale of Polish cooperation and joint ventures in all fields, not just high technology, has not been large. The fact that 450 pairs of directly linked Soviet and Polish enterprises have developed joint-production contracts is heralded by Polish officials. But at the same time it is admitted that not all of them are producing economic results. In fact, these accounted for 90 million rubles in commodity turnovers in 1988—4 percent of total Polish/Soviet trade turnover (Shchukin, 1989). Less than 17 percent of Polish machine deliveries to the CMEA are the result of specialization or co-production contracts (Kraszewski, 1989).

The GDR's lower level of participation in agreements with the Soviet Union seems anomalous at first. The GDR is the Soviet Union's most important trading partner and is an important source of crucial high-technology know-how and commodities. East Germany conducts two-thirds of its trade within the CMEA. Yet, official statements on cooperative technological links to the Soviet Union have either studiously avoided mention of direct ties or have interpreted the term to refer only to traditional cooperation—sharing results between R&D facilities, not joint ventures and direct production links between enterprises.

The GDR's aversion to closer technological cooperation has several sources. Among them are the low regard Berlin holds for the Soviet technological level,⁷ unwillingness to jeopardize the unusually advantaged East German position for obtaining technology from the West.

⁷In a widely quoted interview published in a West German news weekly (*Die Zeit*, 27 June 1986), the editor of the East German magazine *Junge Welt* indicated that the Soviet Union maintains its prominent role in East German life by merit of the Soviet victory in destroying Hitler but not as "a model for us in terms of technology and progress." This was a rare, open expression—seconded implicitly by press reports of difficulties in carrying forward joint extraction and construction projects within the Soviet Union—of what must be a general view of the technological competence of the GDR's senior partner.

and the distaste felt by the former East German regime for aspects of Gorbachev's domestic-reform program.

Perhaps the most important reason for relative lack of involvement in formal S&T agreements stems from the "push-me-pull-you" attitude the GDR leadership held for its own role in the technological hierarchy of the CMEA. In the view of the GDR leadership, based upon past experience, cooperation with less technologically advanced CMEA states could compromise East Germany's position as a technology leader. The area of numerical control technology, for example, suffered a decline in the 1970s when, in order to reorient its standards and production to accord more fully with Soviet needs, the industry's qualitative edge was lost. Similar concerns probably kept the GDR out of the CMEA's INTERROBOT cooperation effort.

This argument may be self-serving, because with equal fervor the GDR, until the recent sharp break with its own former leadership, has long tried to maintain the CMEA as a closed and relatively self-contained trading bloc. The GDR has been vocal in resisting major transformations and innovations in CMEA institutions, calling instead for greater contracting discipline and more closely coordinated planning. The key word has been harmonization rather than liberalization. This attitude is not difficult to fathom. The GDR can remain one of the technological, economic powerhouses of an admittedly less dynamic trading enclave, or it can turn more actively to the rest of the world. In the latter case, the GDR would likely be a bit player on a larger stage because of its small size and relative backwardness. Therefore, 65 percent of the GDR's trade is with the CMEA (Schuller, 1989). The GDR has expended large sums on R&D in high-technology areas while trying to maintain exclusivity within the CMEA for the production of several key technologies. In other words, it wished to play the part of Japan in a well-defined CMEA division of labor.

This propensity for insularity is also a cause of GDR technological decline. It is necessary at least to be present in the international market place to keep pace with developments and ensure progress. A presence provides valuable information and a powerful stimulus to remain current. Neither is available on the traditional CMEA market. Therefore, as with the East German electronics industry during the 1970s,⁸ an exclusive focus on maintaining a position within the CMEA will lead to technological atrophy in the sectors involved.

The prospect of implementing the Program by developing direct ties between enterprises and organizations in the GDR and those in the Soviet Union and other CMEA countries did not strike a responsive

⁸See Rolfo (1986).

GDR chord. The GDR trend had been to increase centralization of decisionmaking, especially in the area of key technologies.⁹ The leadership could not have viewed gladly the loss of exclusive sovereignty over development-and-production decisions, an aversion accentuated by their low esteem for the technical level of their CMEA partners. The delay strategy they employed was to reinterpret the meaning of direct ties. At the December 1985 CMEA meeting, Prime Minister Willi Stoph spoke of the need to "deepen cooperation" within the Bloc, but then spoke only of efforts within the GDR itself to integrate branches of production with research and marketing. Similarly, a contemporaneous report on GDR/Soviet planned integration waxed enthusiastic on the need for the comprehensive development of both economies, as well as "intimate and all-around cooperation with the USSR," and specifically mentioned the bilateral S&T agreement signed by the two countries. However, specifics of the agreement were not outlined, and the report was vaguely worded, mentioning only the need to cooperate in the development of science and technology. Joint modernization and rationalization of existing facilities were discussed, but joint ventures or substantial contact at the enterprise level was not mentioned. The report then lists a number of areas where cooperation could occur. But the list conspicuously avoids any area that would have integrally tied the performance of some sector of the East German economy with that of the Soviet Union (Proft, 1986). The former East German leadership wished to continue as a provider of high-technology commodities to the Soviet Union but on terms that the reforming Soviet leadership was bound to find increasingly unsatisfactory. The GDR was not well-represented in projects under the Program.

Hungary and Romania are at the bottom of the standings regarding S&T trade and cooperation agreements signed with the Soviet Union. At the time of the original signing of the CMEA Program documents, the Hungarians took the tack of quiet opposition and were eloquent in their silence over direct ties. Hungary was second to last in signing an agreement on long-term S&T cooperation with the Soviet Union.¹⁰ Given the different character of Hungarian economic management, their links with CMEA production entities were seen as unlikely to operate smoothly. The Hungarians have long felt burdened even by their regular ties with the inflexible institutions of CMEA trade. In Hungary as nowhere else in the CMEA enterprise, managers speak a

⁹See Nick (1986), for a technological-ideological justification of this tendency.

¹⁰The agreement was signed on 15 January 1986; only Romania was more behindhand (*Nepszabadsag*, 17 January 1986).

different language from their potential colleagues in joint production projects. Such associations would not often arise spontaneously. Joint ventures in cosmetics, pharmaceuticals, and medical technology were widely heralded but were by no means typical.

The Hungarians could see themselves as having much to lose by association with the Program, since they have long engaged in their own "differentiation" policy, occasionally exaggerating their differences with the rest of the CMEA in order to obtain preference from the West. This has applied to the transfer of dual-use technologies as well, particularly from Western Europe. In most fields, Hungarian experts are comparatively well-traveled and familiar with what is available from the West. In the five main areas of emphasis under the Program, with the exception of nuclear energy, local experts would tend to identify less with their Soviet than their Western colleagues. This very familiarity with Western experts would, however, make Hungarian participation in joint development projects particularly welcome.

Romania's position at the bottom of the S&T agreement standings comes as no surprise. Opposition by Ceausescu's Romania to the form of the Comprehensive Program adopted in December 1985 was quite open. The animadversion stemmed from traditional Romanian concern that greater CMEA integration meant a greater role for the Soviet Union in Romanian affairs and reduced Romanian means for national self-reliance. However, it was also a spillover from disagreements over the level of energy and raw material shipments from the Soviet Union. Romania had relied extensively on Western technology before its balance-of-payments difficulties in the early 1980s and the self-inflicted export squeeze of the latter part of the decade. Romania's aloofness from earlier CMEA technology cooperation projects, particularly the joint computer program, left it in a position of relying almost solely on the West in key areas.¹¹

The initial Romanian response to the S&T program proposal was favorable. This may be owing, in part, to the apparently cordial personal relations between Ceausescu and Soviet leader Chernenko, former party secretary of the Moldavian SSR, and perhaps also based upon informal understandings of quid pro quo deliveries from the Soviets in return for Romania's acquiescence. In the event, the Romanians were clearly unsatisfied with the agreement ensuing from the December 1985 meeting. They did not reject direct participation outright, but Romania was the last by far in actually signing a bilateral S&T accord with the Soviets.¹²

¹¹*Economist*, "Survey of Comecon," 20 April 1985, p. 15.

¹²The agreement was signed 16 May 1986.

Given past history, they could not have been expected to view the campaign for direct ties favorably, but Ceausescu went so far as to refer to CMEA joint venture companies as "imperialist multinationals" (Maier, 1986).¹³ Clearly, the bottom line for Romania was not a greater degree of integration into the CMEA, especially if it meant more Soviet-led major investment projects. Rather, any agreement was judged on the basis of how it would help to alleviate the worsening domestic economic situation. The reward for Romania's participation and integration into the Program was to be increased energy and raw material deliveries. However, the Program contained too little of the latter element to interest Romania.

Shortly after its official adoption by the CMEA, the Program document was dismissed by Ceausescu as a preliminary statement because there had been difficulty fulfilling tasks previously agreed to.¹⁴ However, Ceausescu seemed to emphasize Romania's willingness and ability to "coordinate" a number of the themes that had been outlined as Program tasks. In light of other statements, this could be read as a hint of unease at the large Soviet role in coordinating the Program's realization. The statement concluded by making clear Romanian resistance to any enforcement of technological exclusivity envisioned by the Program's Soviet framers.

The bilateral S&T agreement with the Soviet Union was eventually signed but surrounded by circumstances suggesting that Romanian acquiescence may have been more a testament to the nation's need for vital inputs than to the ability of CMEA states to overcome their differences. The articles of the agreement stressing the need for direct ties and the creation of joint entities were left out of Bucharest's report of the agreement. The paucity of later agreements suggests that such cooperation did not develop either because of the political problems or because Romania, in the last analysis, had so little to offer in the high-technology fields.

BARRIERS TO TECHNOLOGY TRADE AND INTEGRATION WITHIN THE CMEA

Specific aspects of the Program, combined with institutions peculiar to the CMEA, appear to have retarded implementation of the S&T tasks. Many of these aspects and institutions also frustrate attempts

¹³The statement was made subsequent to an increased Soviet press campaign promoting direct links. See, e.g., Chukanov (1986), Nikonov and Stromov (1986), Solovyov (1986).

¹⁴AGERPRESS press release dated 27 December 1985, reported in FBIS (Foreign Broadcast Information System) Daily Report Eastern Europe, 30 December 1985.

to increase trade in high-technology commodities. These artifacts of the CMEA's trading mechanism will have to change before improved quality and volume of trade can be promoted in these goods.

To be sure, barriers are inherent in any international integration scheme involving development of advanced technologies, regardless of economic system. These barriers were certainly present and created conflicts in enacting the Program. They included fundamental differences over administration and finance, and most particularly over the application of joint results from cooperative R&D. The Czechoslovaks and East Germans specifically raised questions about pricing policies for new technology.

The lag in implementing Program tasks can be seen in the notable lack of results from the Bucharest CMEA conference in November 1986. As a quick response, an unplanned "working meeting" of party leaders was called in Moscow, 10-11 November, the first since the June 1984 extraordinary summit, to deal with the log jam from the top. This was an indication of both Gorbachev's serious commitment to realizing the type of cooperation intended by the Soviets and the paucity of results to date. The communiqué issued after the meeting was terse. Discussions continued between potential partners, such as those between the East Germans and Soviets held in December 1986. "Concrete measures" for implementation were discussed but none disclosed. The conclusion, borne out by the results shown above, is that the Program could only be carried out on a bilateral, rather than multilateral, basis and only in certain areas.

Some East European leaders were less enthused about the Program because it is to be funded "by the interested states." Because the Program is multinational and directed by Soviet organs, this implies a reduction in national sovereignty over major budgetary decisions. All the states of Eastern Europe face serious fiscal constraints and a need for increased investment in the domestic infrastructure. Reluctance was greatest on the part of the more advanced countries, those possessing the most developed facilities for fulfilling the individual tasks. They were most likely to be called upon to provide a greater share of the costs, but at the same time they would have difficulty retaining a proprietary stake in the results.

This raises a problem at the root of many Soviet attempts to more fully integrate the CMEA to reduce redundancies. Foreign trade has always played a different role in the CMEA than in, for example, a more typical customs union like the European Economic Community (EEC). The EEC was designed to promote mutually beneficial trade, while the CMEA is in practice fundamentally a plan to ensure the adequacy of supply. CMEA leaders have traditionally sought self-sufficiency through vertical

integration to achieve an adequate stream of inputs for their supply-constrained economies. In this light, even if the Program succeeded fully for the CMEA as a whole, it threatened individual CMEA members with decreased ability to protect the supplies of vital inputs. This is a powerful inducement for East Europeans to move slowly when further integrating S&T activities with the Soviet Union. Success would mean even fewer alternatives for input choice and further loss of control over the quality and timeliness of goods delivered.¹⁵

There is also a Western connection. East European members of the CMEA increasingly feel they can do better by expanding their current technology contacts with the West. The East European countries may have feared that entering into the Program in as comprehensive a manner as the Soviets intended might jeopardize relations with Western exporters because of enhanced likelihood of spillover, but more practically to the extent that national R&D assets would be bound into Program projects and thus unavailable for exploiting potential Western contacts.

The concept of cross-national direct ties among Soviet bodies and their own was the most troublesome for the East Europeans. It was an innovation in CMEA relations and captured much of what the more reluctant CMEA members feared most. The result would have been a more organic and tightly woven connection among East European countries and between Eastern Europe and the Soviet Union. The Soviets pushed hard to make direct links—in the forms of co-production, joint ventures, and international associations—the standard for cooperation under the Program.

Besides the annoyance of having specific enterprises and scarce resources bound into a cross-national consortium, a series of hurdles frustrated any chance for rapid exploitation of the direct-links concept. Differences in economic systems among CMEA countries led to different patterns of behavior at the enterprise level. These included the degree of enterprise independence, the relations of enterprises with higher government bodies in matters of reporting and control, and the basic interest of enterprises in pursuing profit. There is no real incentive for spontaneous cooperation without the true chance of mutual gain from such activity. The intensity and nature of this interest vary among countries. As CMEA countries begin to vary more greatly in

¹⁵An ironic example of this has recently come to light. According to testimony from the Minister for the Pharmaceutical Industry, V. A. Bykov (reported in *Meditinskaya gazeta*, 10 December 1989), the Soviet Union imports 60 percent of the medicines it needs. Moscow has invested "several billion" rubles in pharmaceutical joint ventures within the CMEA in the past 15 years while investing just one billion domestically. Now, the partners in these ventures refuse to sell pharmaceuticals produced in domestic facilities to the Soviet Union or will do so only at "very high prices."

the speed and path of individual reform, these problems could increase in the short term.

Although the object of direct ties is to reduce the role of the state apparatus, in most cases only prodding by the state could bring two enterprises into such a relationship. What is more, for the enterprise to operate as efficiently as intended, partners needed to exchange materials and components freely, based upon mutual agreement. This would conflict with foreign-trade monopolies operating in most CMEA states as well as with the basic process of national plan formation. Further, although joint tasks under the Comprehensive Program are to be specifically included in each nation's annual plans, cross-national coordination of annual plans, including the tasks of joint venture enterprises and those involved in direct links, would need to be recast on some basis other than national balances if these enterprises were to achieve their required flexibility. The alternative is an even greater degree of administrative control. For these reasons, it proved difficult to remove state bureaucracies from the realm of direct-link cooperative decisionmaking.

Other inherent obstacles to improved trade within the CMEA are well-known and need only be touched upon briefly. These are the complications caused by pricing problems and currency inconvertibility. Subassemblies and components transferred to an external partner are expensive compared with the domestic cost if the Bucharest formula for price formation, i.e., lagged world market prices, is applied. This is because the price at which the equipment is sold on the market is higher than the internal transfer price. Within the CMEA even finished goods are notoriously difficult to price to accurately reflect the quality of the merchandise. In the case of joint ventures, substantial difficulties remain in repatriating profits and converting one CMEA currency into another. These problems lie at the heart of the institutions forming the pattern of economic relations within the CMEA, and they are not amenable to a solution short of dismantling the Bloc's major trading arrangements.

IV. INTRA-CMEA TRADE IN HIGH-TECHNOLOGY GOODS

This section examines four specific high-technology imports into the Soviet economy. The data are used to assess Eastern Europe's capacity for satisfying Soviet requirements and whether the trends indicate a potential divergence in trading interests between the Soviet Union and the East Europeans.

TRADE IN METAL-WORKING MACHINE TOOLS

Metal-working machine tools are the quintessential machines of modern industry: they are central to the production of most other machinery. The group is quite heterogeneous technologically. At one end of the scale are simple turning and milling machines, not much changed in the last half century, while at the other end are sophisticated numerically controlled devices lying at the heart of modern, highly automated, flexible manufacturing systems. All CMEA countries have laid great emphasis on acquiring installations equipped with modern machine tools, and this is the central object of one of the five main tasks of the Comprehensive Program.

Table 4.1 illustrates the balance of machine-tool production and demand in the Soviet Union in recent years. Imports from all sources provide 7 to 8 percent (in physical terms) of the net requirement for annual domestic investment in metal-working machine tools. In 1987, 69 percent of all such imports came from the six East European members of the CMEA, and in 1988 about 62 percent did. However, the role of imports increases dramatically when considered in terms of value. In particular, according to Soviet data, in 1987 imports provided over one-third of the nation's machine-tool investments by value.

Domestic production is stated in domestic rubles, while import figures are in foreign-trade rubles. This makes comparison something of an "apples and oranges" problem: the relationship between domestic and foreign-trade rubles is unclear. Effective exchange rates vary among sectors and commodity groups and from year to year. Yet, the comparison is not completely without merit. We possess data for only one year so cross-year comparison is not attempted. Further, while it is most likely that price increases for domestic production and for imports move at different rates, Soviet data indicate that per-unit

Table 4.1

METAL-WORKING MACHINE TOOL^a PRODUCTION-AND-DEMAND
BALANCE IN THE SOVIET UNION^b

Category	1980	1985	1986	1987	1988
Physical units					
Production	216,000	182,000	164,000	156,000	147,000
NCMT ^c	8,900	17,800	20,300	21,000	—
Export	14,000	7,900	9,100	8,946	8,971
Import	13,000	14,600	12,600	11,419	11,787
demand share	6.0%	7.7%	7.5%	7.2%	7.9%
CMEA import share	—	—	—	69.0%	61.9%
Value (million rubles)					
Production	1,944	2,681	2,922	2,838	—
NCMT ^c	471	1,076	1,331	1,332	—
Export	—	—	—	267	289
Import	—	—	—	1,296	1,421
demand share	—	—	—	33.5%	—
CMEA import share	—	—	—	75.6%	68.3%

SOURCES: *Narodnoye Khozyaistvo* (1987); *Vneshniye Ekonomicheskiye Svyazi SSSR* (1987, 1988).

^a*Stanki metallovezhushchiye.*

^bDomestic production is stated in domestic rubles; import figures are in foreign-trade rubles.

^cNCMT = numerically controlled machine tools.

values of even the non-NC (non-numerically controlled) portion of domestic machine-tool output, the fraction least likely to exhibit any technological advance, were hardly static. Prices doubled between 1970 and 1980 and again between 1980 and 1987. More important, the differences in rubles for machinery prices may be less of an issue than in other sectors for several reasons. This will be explored below. In the final analysis, however, expediency rules. These are the data we possess. The reader must decide what value to place on them.

These data imply that imported machines are more expensive and presumably more sophisticated than the average machines produced by Soviet industry. More specifically, imports from the European CMEA loom in importance. Taking the data at face value, more than one quarter of the total value of machine tools emplaced in 1987 was of East European origin. When compared with related data on investment in physical units, they suggest that the CMEA is an important source of high-quality machine tools for the Soviet economy.

It may be misleading to use these data as reasonable measures of qualitative differences. The problems of pricing and quality evaluation within the CMEA are well-known. Some studies have suggested that Soviet purchases of machinery in particular contain substantial implicit trade subsidies in favor of the East European partners (Marrese and Vanous, 1983).¹ It is a reasonable hypothesis that the value data reflect inflated prices for imports from Eastern Europe and therefore overstate the quality attributes of these machines.

This receives initial substantiation from the data on exports to Western European nations. Table 4.2 is based on 1987 information collected by CECIMO,² the West European machine-tool trade association. The table shows the average value in thousands of Swiss francs per metric ton for each country's exports to the CECIMO area.³ This is used as a crude proxy for machine quality and technological sophistication.⁴ A rank is assigned to each country based upon this ratio. In addition, total export volume to the CECIMO area is reported for each country.

The first group reported in the table are countries that Soviet data show as the principal exporters of machine tools to the Soviet Union excepting the six East European members of the CMEA. The average for all CECIMO deliveries to all CECIMO nations is also included. The second group comprises the East European members of the CMEA and the USSR itself. Finally, data for an arbitrarily chosen third group of newly industrializing countries are shown for comparison. Since these countries are not major exporters to the Soviet Union they were not included in the rank ordering, but a notional rank is reported in parentheses. This represents the rank each country would be given if it were included in the ordering.

The CECIMO region must certainly be considered a prized market for machine tool exports and one where prices must accurately reflect quality because of the options available to potential importers. The data reflect

¹The reasons the Soviets tolerate this deterioration in their terms of trade are subject to argument. See Crane (1986) for a discussion.

²The *Comité Européen de Coopération des Industries de la Machine-Outil*. The member states of CECIMO are Austria, Belgium, Denmark, France, Italy, the Netherlands, Spain, Sweden, Switzerland, West Germany, and the United Kingdom.

³It is unclear whether these figures include tariffs.

⁴Other studies have demonstrated the highly significant correlation between metal-working machine tool weight and price—the heavier the machine, the more capable (Floud, 1976; Alexander and Mitchell, 1984). Price-to-weight ratios should therefore provide some indication of the quality of machinery being shipped. The claim for price-to-weight as a relative measure of quality would derive from two effects: the shipping of machine types that are heavier per unit than the types shipped by others, and machinery of fixed weight that is more sophisticated than different or similar types of the same weight being produced by others.

Table 4.2

**AVERAGE VALUES BY WEIGHT OF METAL-WORKING MACHINE TOOL
EXPORTS TO THE CECIMO AREA, BY EXPORTING COUNTRY, 1987**

Exporting Country	Average Export Value ^a	Country's Rank	Volume of Exports ^b
Principal Non-CMEA Exporters to the USSR			
Austria	26.29	4	179,024
Italy	19.52	8	793,984
Japan	27.47	2	1,101,129
North Korea	2.03	18	189
Sweden	24.19	5	137,171
Switzerland	44.72	1	1,132,374
United Kingdom	17.18	9	318,626
United States	23.48	6	289,834
Yugoslavia	6.48	13	19,875
Intra-CECIMO average	23.16	7	5,389,141
CMEA Countries			
Bulgaria	4.54	15	9,681
Czechoslovakia	6.98	12	66,501
East Germany	7.77	11	57,764
Hungary	15.37	10	16,248
Poland	5.80	14	18,958
Romania	4.16	16	6,983
Soviet Union	4.07	17	34,712
Random Sample of Newly Industrializing Countries			
Greece	17.72	(8)	567
India	7.46	(11)	2,418
Ireland	11.47	(11)	14,152
South Korea	12.60	(11)	13,586
Spain	14.01	(11)	182,076
Portugal	6.10	(14)	12,657

SOURCE: CECIMO data, August 1988.

NOTE: Trade between East and West Germany is not reported.

^aIn thousands of Swiss francs per metric ton.

^bIn thousands of Swiss francs.

that machine tools from the CMEA area may only be sold at a substantial discount, presumably to compensate for lower quality or performance characteristics, or are of an altogether different mix than other machine tools sold on this market. Only Hungary demonstrates an ability to compete on favorable terms or to sell a more sophisticated product mix within this discriminating market. The prices its products command are comparable to those achieved by Spain, Greece, South Korea, and even the United Kingdom, ignoring the often substantial differences in total sales volume. No other CMEA country comes close. Next best is the GDR, whose exported value per tonne is half that of Hungary. Czechoslovakia shows slightly worse performance. The implications of these data for the quality of the Soviet machine tools offered to the West European market are distinctly unfavorable.

Low technological level could explain the poor revealed performance of CMEA machine tools on the world market, but there are alternative potential explanations. One is a difference in design characteristics, particularly the notorious tendency of machinery from planned economies to be heavier than their Western analogues. This weight is not from added features for which a discriminating purchaser would be willing to pay more. Rather, the excess weight is caused by insensitivity to resource costs (an artifact of the price system) and by a desire to achieve annual output targets, frequently denominated in weight. If so, the superior performance by Hungary may be attributed in part to the more advanced status of its economic reform. The higher price-to-weight ratios would reflect greater Hungarian adherence to cost factors that are given less prominence by factory managers in orthodox command economies. If a Western country and a CMEA country produced precisely the same machine, but the base plate and housing of the CMEA machine were considerably heavier, the ratio for the CMEA exporter would be skewed downward. Note, however, that even if the CMEA exporters are given a 20 percent "weight credit," the relative rankings among all exporters shown in Table 4.2, East and West, would not change. For example, the GDR price-to-weight ratio would change from 7.77 to 9.82 Swiss francs/tonne and the Czechoslovakian ratio from 6.98 to 8.82.

Another explanation is that the phenomenon of "dumping"—selling below production cost—might be relatively more prevalent in CMEA exports to the West. Such dumping might be intentional, designed to increase hard-currency revenues, or unintentional because of difficulty in determining actual production costs. While this phenomenon may occur for both reasons, it does not explain why the CMEA exporters might feel the need to unload their output at a discount compared with

Western analogues if it were, in fact, roughly the equal of that competition.⁵

A final alternative explanation is that the best machinery the CMEA has to offer is either retained for domestic consumption or bound into long-standing CMEA trade agreements. This argument would appear to fly in the face of many East European and Soviet pronouncements on the need to increase the share of manufactured goods in their total exports and to expand trade with the hard-currency area. Nor is the nature of demand on the CMEA market known for calling forth the best performance of the Bloc's participating exporters.

Remarkably, the Western market's judgment about the relative quality of CMEA equipment receives corroboration from the Soviet data series equivalent to the CECIMO series. It suggests a more realistic intra-Bloc appraisal of value, at least for this machinery, than conventional wisdom usually concedes to CMEA pricing policies. Table 4.3 reports average unit values for metal-working machine tools exported to the Soviet Union, along with total volume of deliveries for the most important exporting nations. As in Table 4.2, ranking is developed based upon the average per-unit costs. Note, however, that Table 4.2 develops this rank based upon average price-to-weight ratios, not average unit prices as in Table 4.3. Therefore, an assumption for comparing the two rankings is that the underlying metrics are measuring approximately the same qualities.

Table 4.3 does not demonstrate a systematic upward bias to the relative prices of metal-working machine tools traded within the CMEA. Such a bias might exist in fact; these data are not sufficient to refute the hypothesis. But the degree to which the ranking among the exporters, both East European and non-East European, is preserved is striking. When using only entries duplicated in both tables,⁶ seven exporter rankings are within one place of the equivalent on the other table (including four of the six East European countries), and all but three exporter rankings on one table are within four places of the equivalent ranking on the other.⁷ The direction of rank change, however, is not systematic. Between Tables 4.2 and 4.3 among the non-CMEA group, five exporters move up in relative rank, four move down,

⁵The usually inferior spare part and service repair systems provided by CMEA exporters would, however, suggest that technologically equivalent Western machines should be sold at higher prices.

⁶Entries that are not duplicated are "Intra-CECIMO average" and "Soviet Union" from Table 4.2 and "Other" and "Average, all imports" from Table 4.3.

⁷Specifically, the United Kingdom drops five places from Table 4.2 to Table 4.3 and Switzerland nine, while Bulgaria improves eleven places.

Table 4.3
 AVERAGE VALUES OF METAL-WORKING MACHINE TOOL
 EXPORTS TO THE SOVIET UNION, BY EXPORTING
 COUNTRY, 1987-1988

Exporting Country	Country's Rank		Value per Unit (In thousand rubles)		Total Deliveries (In million rubles)	
	1987	1988	1987	1988	1987	1988
Non-CMEA Countries						
Austria	1	2	1030	841	14.4	11.8
Italy	6	8	286	294	23.1	36.5
Japan	4	6	384	393	25.3	40.1
North Korea	18	18	9	9	15.4	20.7
Other	8	1	225	887	7.7	10.6
Sweden	2	3	945	584	3.8	1.2
Switzerland	11	12	123	151	38.2	77.7
United Kingdom	15	9	101	210	3.8	6.3
United States	5	5	341 ^a	486	0.3	2.4
West Germany	7	7	261	346	111.4	160.1
Yugoslavia	9	11	193	178	72.9	83.5
Average, all imports	12	13	113	121	1296.0	1421.0
East European CMEA Countries						
Bulgaria	3	4	431	534	246.3	268.0
Czechoslovakia	16	16	87	114	178.0	162.6
East Germany	13	15	112	118	337.0	325.8
Hungary	10	10	187	181	40.3	31.6
Poland	14	14	102	120	120.9	120.7
Romania	17	17	41	32	57.3	61.4

SOURCE: *Vneshniye Ekonomicheskkiye Svyazi SSSR*, 1988.

^aEstimate.

and one, North Korea, remains constant. Among the East European group, two move up, two remain constant, and two drop.

The steadiness of relative valuation is illustrated even more clearly in Table 4.4. An average value (416,790 rubles per unit) was calculated for the top five non-East European and non-CMEA exporters by volume to the Soviet Union.⁸ Similarly, the average value (28,920

⁸Although Yugoslavia is among the top five non-CMEA exporters to the Soviet Union, as a (non-CMEA) East European country it was not included in this group; rather, it appears as a separate entry in Table 4.4 to provide a standard of comparison with the East European members of the CMEA.

Table 4.4

AVERAGE PRICES FOR CMEA METAL-WORKING MACHINE TOOL
EXPORTS COMPARED WITH AVERAGE PRICES FOR
WESTERN EXPORTS, 1987

Exporting Country	Price-to-Weight Ratios Compared with Average Western Sample, for Exports to CECIMO ^a		Prices per Unit Compared with Average Western Sample, for Exports to USSR ^b	
	Ratio (1)	Hungary = 1 (2)	Ratio (3)	Hungary = 1 (4)
Bulgaria	0.16	0.30	1.03	2.31
Czechoslovakia	0.24	0.45	0.21	0.47
GDR	0.27	0.51	0.27	0.60
Hungary	0.53	1.00	0.45	1.00
Poland	0.20	0.38	0.25	0.55
Romania	0.14	0.27	0.10	0.22
Yugoslavia	0.22	0.42	0.46	1.04
Soviet Union	0.14	0.26	0.15 ^c	0.33 ^c

SOURCES: CECIMO data, August 1988; *Vneshniye Ekonomicheskkiye Svyazi SSSR*, 1988.

^aThe average Western sample consists of the top five Western exporters to the USSR: West Germany, Switzerland, Japan, Italy, Austria. Ratios are in 28.92 Swiss francs per tonne.

^bSee footnote a for Western sample. Prices are in 416,790 rubles per unit.

^cSoviet values are based on domestic output of NC machine tools only.

Swiss francs per tonne) was calculated for the same five based upon their exports to the CECIMO area.

The first column of figures on Table 4.4 compares the average price-to-weight ratio for each East European country's CECIMO-area exports with the calculated average of the non-CMEA five. The second column normalizes these results by setting Hungary's value equal to one. The third and fourth columns repeat the calculations using Soviet data on imports received from each nation.

Once again, the lack of variation in relative valuations represented in the first and third columns is striking. An appreciable change occurs only for Yugoslavia and Bulgaria, which both improve their

relative export prices on the Soviet market—the latter remarkably.⁹ Note especially the figures reported for the Soviet Union. The data for columns three and four are based only on imputed NC machine tool values, not those for total Soviet domestic machine-tool production. The assumption is that this portion of domestic manufacture most closely matches the technological level of the mix sold in the Western market. The close agreement between the Soviet Union's ratio for unit value in the CECIMO area and that within the Soviet Union itself, while not conclusive, strongly suggests that comparisons between domestic and foreign-trade ruble prices within the Soviet Union for this class of goods are not completely without merit.

Before drawing conclusions, however, it must be noted that we cannot assume that the same types of metal-working machine tools are being exported to both markets by each exporter. The assortment sold may vary greatly both by exporter and by import area. Also, as noted above, prices for East European machines normalized by weight might be biased downward in CECIMO purchase data because of Eastern Europe's tendency to produce heavier machinery. But whatever process may be skewing prices for East European machines downward on the West European and upward on the Soviet markets, the data imply that compensatory, if unrelated, processes are also skewing the prices received by Western exporters in the same direction and by a similar magnitude.¹⁰

For the purpose of this analysis, these data call into question the hypothesis that the large import share for Eastern Europe from among total metal-working machine tool imports to the Soviet Union may be attributed to systemic biases in CMEA pricing systems. Such biases almost certainly exist but do not solely explain the large Soviet reliance on East European machine tool deliveries. If the CECIMO and Soviet price data are accepted as valid and roughly comparable, they suggest that the Soviet Union is substantially aided by imports from within the CMEA of machine tools relatively superior to Soviet domestic production but inferior in quality to world standards.

Table 4.5 compares Soviet reliance upon CMEA machine tool deliveries with that of the six East European allies. These data were compiled from mirror export data reported to the United Nations

⁹The Bulgarian improvement may be a result of price concessions negotiated at the time the highly visible and much-touted machine-tool joint ventures were signed with the Soviet Union.

¹⁰Exchange-rate effects would not help to explain this. Indeed, the ruble is usually considered to be overvalued in domestic conversions from hard-currency prices, thus biasing downward the price paid in rubles for Western imports.

Table 4.5

CMEA SHARE OF IMPORTS FROM AMONG TOTAL METAL-WORKING
MACHINE TOOL IMPORTS, BY COUNTRY
(In percent)

Country	1980	1983	1986	1987
Bulgaria	81.9 (28.8)	57.2 (20.8)	53.0 (30.0)	56.5 (30.4)
Czechoslovakia	59.6 (23.1)	64.3 (17.3)	57.3 (14.8)	57.1 (14.1)
East Germany	67.9 (22.6)	67.2 (22.4)	73.1 (28.4)	59.3 (26.4)
Hungary	55.0 (13.9)	63.6 (15.2)	54.1 (11.3)	55.3 (11.9)
Poland	53.1 (27.5)	74.3 (22.6)	75.1 (22.6)	74.7 (23.1)
Romania	58.3 (16.4)	84.9 (33.5)	90.5 (27.7)	98.4 (32.5)
Soviet Union	44.0 (N/A)	56.4 (N/A)	63.1 (N/A)	63.4 (N/A)

SOURCE: UNECE, *Bulletin of Statistics on World Trade in Engineering Products*, various years.

NOTES: Does not include Romanian exports or West German deliveries to East Germany. Figures in parentheses are the import share from the Soviet Union. N/A means "not applicable."

Economic Commission for Europe (UNECE), which relate the share represented by deliveries from Eastern Europe and the Soviet Union from among total imports of metal-working machine tools, by each country.¹¹ The years shown in the table are the most recent for which the Soviet Union has reported to the UNECE. The figures in parentheses are the share of total imports coming from the Soviet Union.

Table 4.5 does not show a great difference among CMEA members in the level of reliance on the CMEA or in the direction of change in reliance. The Soviet Union's reliance has increased monotonically during the period from less than half of machine tool imports in 1980 to just under two-thirds in 1987. The only nation showing a large decrease in CMEA dependence is Bulgaria, although its level of reliance in 1987 was not much different from that of the Soviet Union. Except for Poland, which receives three-quarters of its machine tool imports from the CMEA, and Romania, almost totally reliant on the

¹¹There is a discrepancy between the figure reported here for the Soviet Union and the corresponding value already reported in Table 4.1. A little less than a third of the difference is accounted for by Romanian exports to the Soviet Union not included in the data in Table 4.5. Other sources of error may be in exchange-rate inconsistencies (the data used in Table 4.5 are reported in dollars), differences in taxonomy because the trade classifications used within the CMEA are rarely the same as the Standard International Trade Classification (SITC) used in the West and by the UN, differences in timing of deliveries, or accounting and definitional discrepancies between booked orders and actual deliveries.

Bloc for these deliveries, the data for 1987 do not show great differences in reliance among the rest of the member-states. No indication of potential conflicts in intentions appears at this level of aggregation.

There are larger variations in the role played by imports from the Soviet Union alone, shown in parentheses in Table 4.5. These range from nearly one-third of total imports received by Bulgaria and Romania in 1987 to the relatively low share accounted for by Soviet deliveries to Czechoslovakia and Hungary.

The Soviet Union relies heavily and continually on Eastern Europe for metal-working machine tools. These machines appear to be of higher quality than those the Soviet Union exports, if not than the full Soviet domestic range. Eastern Europe also seems to rely heavily on CMEA deliveries. No large variation in trade pattern emerges. However, the machines produced for export in both Eastern Europe and the Soviet Union appear considerably less capable, in aggregate, than those imported from Western developed economies.

This last point is illustrated by Table 4.6. For each country that appeared in Table 4.2, Table 4.6 shows the average price-to-weight ratio of machine tools taken as *imports* from the CECIMO countries in the first column. The second column then gives a ratio that is the comparison between this figure and the corresponding export figure from Table 4.2. The result might be termed the machine tool terms of trade with the CECIMO area for each country listed, an index of the relationship between the price paid for imports and the price received for each country's export products. Note that this is not necessarily an index of the absolute quality of machine tool each country could or does produce, only an expression of the trade dynamic that actually occurs. It does indicate that in the case of the CMEA countries, with the exception of Hungary, imports tend to be skewed toward the high-technology end of the spectrum of available Western machinery. This lends support to previous work suggesting that machine tool imports into the CMEA lean in the direction of types not produced within the Bloc itself (Popper, 1988).

TRADE IN COMPUTER AND DATA PROCESSING EQUIPMENT

Electronics, including production and dissemination of sophisticated computer systems, is another of the five broad categories of targeted integration programs under the Comprehensive Program. Table 4.7 reports data on import reliance for computers. The data source is the same as that for Table 4.5 and has the same limitations. Unlike data on

Table 4.6

METAL-WORKING MACHINE TOOL "TERMS OF TRADE" WITH
CECIMO COUNTRIES, 1987^a

Importing Country ^b	Average PWRs ^c of Machine Tools Imported from CECIMO Countries ^d	Average PWRs ^c of Machine Tools Exported to CECIMO Countries ^d
North Korea	42.96	21.14
Soviet Union	50.16	12.32
Bulgaria	37.27	8.22
Czechoslovakia	54.32	7.79
East Germany	54.37	7.00
Poland	36.11	6.22
Romania	21.88	5.26
India	32.05	4.29
Ireland	44.77	3.90
Yugoslavia	23.10	3.57
Portugal	18.22	2.99
South Korea	35.29	2.80
Hungary	35.39	2.30
Japan	47.53	1.73
United Kingdom	25.66	1.49
Spain	20.50	1.46
Italy	28.26	1.45
United States	33.73	1.44
Sweden	26.81	1.11
CECIMO average	25.03	1.08
West Germany	26.34	0.99
Austria	25.24	0.96
Greece	13.81	0.78
Switzerland	25.87	0.58

SOURCE: CECIMO data, August 1988.

^aTrade between East and West Germany is not reported.

^bCountries are ordered according to compared ratios ranking. European CMEA countries are in boldface.

^cPrice-to-weight ratios.

^dIn thousand Swiss francs per tonne.

machine tools, computer data show the possibility of divergent interests between the Soviet Union and at least some of the East Europeans.

Nearly nine-tenths of Soviet computer imports come from Eastern Europe. This fraction has held fairly steady during the decade. It should be noted, however, that these data show the importance of the CMEA for Soviet computer imports, not the role imports play in

Table 4.7

CMEA SHARE OF IMPORTS FROM AMONG TOTAL COMPUTER AND DATA
PROCESSING EQUIPMENT IMPORTS, BY COUNTRY
(In percent)

Country	1980	1983	1986	1987
Bulgaria	82.8 (0.0)	89.4 (26.5)	59.8 (3.4)	59.0 (4.7)
Czechoslovakia	78.8 (0.0)	94.2 (27.7)	85.8 (6.1)	73.1 (5.4)
East Germany	88.0 (0.0)	90.6 (29.3)	71.6 (20.8)	76.6 (23.8)
Hungary	64.3 (0.0)	88.2 (20.3)	24.9 (1.2)	15.3 (1.8)
Poland	53.6 (0.0)	91.9 (20.3)	78.5 (10.2)	66.4 (10.1)
Romania	44.7 (0.0)	95.6 (0.0)	96.0 (0.0)	98.5 (0.0)
Soviet Union	88.3 (N/A)	95.7 (N/A)	89.4 (N/A)	88.5 (N/A)

SOURCE: UNECE, *Bulletin of Statistics on World Trade in Engineering Products*, various years.

NOTES: Does not include Romanian exports or West German deliveries to East Germany. The Soviet Union does not report for 1980; Bulgaria does not report for 1986. Figures in parentheses are the import share from the Soviet Union. N/A means "not applicable."

fulfilling total domestic Soviet demand for computer equipment. Romania displays similar reliance—a considerable change from the late 1970s when that nation deliberately chose to tie its cybernetic future to the West rather than enter into CMEA integrated programs. The others exhibit lesser reliance on the CMEA in varying degrees.

The most important point indicated by the data is that during the 1980s the share of CMEA imports from among total computer imports for most non-Soviet CMEA countries has declined. All increased their share in 1983, probably as a response to liquidity and hard-currency shortages, tightened export controls, and CMEA projects coming into series production, but the trend for all was a decrease from that date through 1987. The rate of decrease has varied, with Hungary's being most precipitate. Even the GDR, however, dropped from the near 90 percent levels of the early part of the decade to 75 percent in 1987.¹²

A second notable point is the low share of Soviet deliveries among the CMEA exports (numbers in parentheses). This may be compared with the larger role played in machine tool deliveries (Table 4.5). Only the GDR places large reliance on the Soviet Union for computer deliveries. The next largest Soviet share of imports goes to Poland, where it accounts for only some 10 percent of the total. Strikingly,

¹²Note that the true level of reliance is likely to be still less because the figures in Table 4.7 do not include deliveries between the two Germanys.

Romania, which receives almost all its computer imports from the CMEA, receives no Soviet equipment.

The Soviet Union places great reliance on Eastern Europe for its imports of computer equipment. East European members, however, rely on each other in preference to the Soviet Union, and even that reliance is decreasing. The aggregate data cannot indicate what drives this process. For example, Soviet equipment may be considered acceptable by potential East European recipients but may largely remain in the Soviet Union to satisfy the demand of the domestic market. Even if this is so, the data suggest that there is a divergence of interests among the potential trading and cooperative venture partners.

TRADE IN FILTRATION APPARATUS, CENTRIFUGES, AND PUMPS FOR NONLIQUIDS

Table 4.8 shows import reliance data for filtration apparatus, centrifuges, and pumps for nonliquids (FCPNL), which are manufactured to high tolerances and therefore embody high technology. However, unlike machine tools and computers, FCPNL are not dual-use and hence not subject to COCOM export control.

CMEA members appear (with the usual exception of Romania) to rely to a greater extent on Western sources for these goods than for the first two classes of goods. For the Soviet Union, which receives 40

Table 4.8

CMEA SHARE OF IMPORTS FROM AMONG TOTAL FCPNL
IMPORTS, BY COUNTRY
(In percent)

Country	1980	1983	1986	1987
Bulgaria	58.5 (16.7)	29.5 (15.0)	40.7 (20.6)	39.0 (15.5)
Czechoslovakia	38.8 (0.5)	42.6 (10.1)	39.2 (16.9)	29.1 (14.9)
East Germany	61.4 (0.0)	32.9 (3.8)	39.5 (3.5)	29.8 (2.7)
Hungary	20.3 (2.6)	11.8 (3.2)	17.1 (5.0)	13.8 (4.3)
Poland	27.1 (4.8)	38.7 (5.1)	50.0 (10.0)	51.5 (10.1)
Romania	32.0 (8.7)	71.4 (24.8)	67.5 (43.8)	78.0 (49.7)
Soviet Union	36.0 (N/A)	25.8 (N/A)	40.3 (N/A)	41.6 (N/A)

SOURCE: UNECE, *Bulletin of Statistics on World Trade in Engineering Products*, various years.

NOTES: Does not include Romanian exports or West German deliveries to East Germany. Figures in parentheses are the import share from the Soviet Union. N/A means "not applicable."

percent of its FCPNL imports from the CMEA, reliance is somewhat less. Several of its partners (Czechoslovakia, GDR, and Hungary) are decreasing their share of FCPNL imports received from the CMEA by building up their share of Western deliveries, as they have done with computer imports. Similarly, the share of Soviet FCPNL exports to the CMEA does not appear large. Even in the economically troubled year of 1983, the CMEA did not fall back on its own resources for this class of machinery. Eastern Europe is therefore unlikely to prove a reliable source for satisfying Soviet requirements in this category. The CMEA will look to the West for continuing shipments of FCPNL goods of higher specifications.

TRADE IN LARGE-DIAMETER STEEL PIPE

Steel pipe is crucial to energy development in the Soviet Union. It permits relatively cheap transport over long distances, allowing economically feasible exploitation of proven reserves far removed from industrial centers. This is vital for the domestic economy, but is just as crucial in providing the major export commodity for both hard-currency and CMEA markets. The pipes themselves do not incorporate high technology, but high-technology production systems are required to produce pipeline-grade pipe, especially in the larger diameters.

Table 4.9 shows the Soviet balance for steel and iron pipes and fittings. This includes high-pressure hydroelectric steel conduits. Imports play a large role in fulfilling domestic demand. Even using the first, and lesser, tonnage reported in the table for Soviet imports,¹³ more than three-quarters of the pipe used in the Soviet Union must come from abroad. Not only does this account for over half of all steel products imported to the Soviet Union (data not shown), but also for a significant share of Soviet imports of all types. Indeed, the data indicate that more than one-third of all steel piping exported in the world is delivered to the Soviet Union. Given the volume of the requirement and the crucial nature of this good, clearly a potential role can be played by the East Europeans in satisfying Soviet demand.

Table 4.10 gives a sense of how likely the other members of the CMEA would be to play a significant part in helping the Soviet domestic steel-pipe balance. The data come from the UNECE sources except

¹³The second number given, in parentheses, is from Soviet sources. It may include goods excluded from the UNECE data series, such as cast-iron pipe.

Table 4.9

IRON AND STEEL PIPE BALANCE IN THE SOVIET UNION
(In thousand tonnes)

Category	1980	1983	1984	1985	1986	1987	1988
Production ^a	1,976	1,862	1,931	1,930	1,963	1,929	—
Exports ^{a,b}	—	—	—	—	437	408	397
Imports ^c	2,815 ^d	4,596	4,753	4,756	5,376	4,764	—
Imports ^a	—	—	—	—	(5,676) ^e	(5,167)	(4,743)
As share of domestic demand	—	—	—	—	77.9%	75.8%	—
As share of all Soviet imports	—	—	—	—	—	2.9%	3.1%
As share of total world trade ^b	17.0%	28.1%	24.7%	24.7%	31.4%	33.9%	—

SOURCES: *Narodnoye Khozyaistvo* (1987); *Vneshniye Ekonomicheskkiye Svyazi SSSR* (1987, 1988); UNECE, *Statistics of World Trade in Steel*, various years.

^aSoviet trade classification 266: "truby."

^bEarlier years are reported only in rubles.

^cSITC numbers 678.2-5: "tubes and fittings."

^dEstimate.

^eNumbers in parentheses are from Soviet sources.

where indicated.¹⁴ The table also shows the tonnage of pipe exported to the Soviet Union by the share this represents for each country's total pipe exports. Finally, East European CMEA pipe deliveries as a share of total pipe imports to the Soviet Union are reported, along with their corresponding share for all types of steel products.

The data show considerable variation among the East Europeans. Czechoslovakia provides large-scale pipe deliveries constituting 70 percent of their export trade in this commodity. Romania also sends large shipments, although it is not clear that these data are symmetric with

¹⁴Neither the GDR nor Romania report these data to the UNECE. The figures reported for them are the Soviet import figures, where available, and may not correspond to precisely the same category of pipes and fittings. They seem to include commodity types not included in the SITC 678.2-5 definition. The corresponding data for Yugoslavia, for example, report figures larger by an order of magnitude or more than the figures given by the UNECE. Again, the problems of combining hard-currency and transferable ruble trade figures to arrive at trade shares must be borne in mind.

Table 4.10
EAST EUROPEAN IRON AND STEEL PIPE DELIVERIES
TO THE SOVIET UNION

Category	1980	1983	1984	1985	1986	1987	1988 ^a
Volume (in thousand tons) ^b							
Bulgaria	4.2	2.5	4.0	4.0	3.0	5.3	—
Czechoslovakia	381.7	414.2	426.1	412.1	407.1	404.0	406.0
East Germany ^a	—	—	—	—	11.8	10.0	0.0
Hungary	12.9	11.5	14.6	18.2	12.3	17.7 ^c	10.5 ^c
Poland	2.3	1.1	1.9	0.3	0.7	0.5	—
Romania ^a	—	—	—	—	232.0	196.3	207.8
Yugoslavia	0.0	5.4	—	2.3	2.8	2.9	1.5
Share of Deliveries to USSR in Total Pipe Exports, ^b by Country (in percent)							
Bulgaria	6.4	5.7	9.6	8.9	8.3	15.8	—
Czechoslovakia	72.7	72.1	68.3	69.4	71.5	68.5	—
East Germany	—	—	—	—	—	—	—
Hungary	18.7	17.4	17.3	22.4	16.9	22.9	—
Poland	4.6	3.1	4.9	0.8	1.9	1.0	—
Romania	—	—	—	—	—	—	—
Yugoslavia	0.0	5.0	NA	1.5	2.4	1.8	—
East European CMEA Share of Soviet Imports (in percent)							
Pipe	14.2 ^d	9.3 ^d	9.4 ^d	9.1 ^d	12.4	13.3	—
All steel	11.1 ^d	17.8 ^d	16.1 ^d	13.2 ^d	19.9 ^d	21.1 ^d	—

SOURCES: UNECE, *Statistics of World Trade in Steel*, various years; *Vneshniye Ekonomicheskkiye Svyazi* (1987, 1988); *Narodnoye Khozyaistvo* (1987); *Kuelkereskedelmi Statisztikai Evkoenyv* (1987).

NOTE: NA means not ascertainable.

^aFigures from *Vneshniye Ekonomicheskkiye Svyazi* (1988); Soviet trade classification 266: "truby."

^bSITC numbers 678.2-5: "tubes and fittings."

^cFrom *Kuelkereskedelmi Statisztikai Evkoenyv*.

^dDoes not include deliveries by East Germany or Romania.

the reporting done under the UNECE guidelines. For the sake of this analysis, we make the conservative assumption that they are. The other countries provide less significant amounts accounting for one-fifth of total pipe exports for Hungary¹⁵ and less for the others for

¹⁵The UNECE reports a suspiciously high number for Hungarian deliveries in 1987: six times greater than in any previous year, jumping total steel exports to a level twice as great as any previously recorded—at a time when large Hungarian steel producers were being closed. The analysis here assumes that the volume reported by UNECE is in error. The figure reported in the Hungarian foreign trade yearbook has been substituted for the

whom we have data. Surprisingly, the Soviet data do not show the GDR as a substantial source of pipe.

Eastern Europe as a whole can satisfy only a fraction of current Soviet demand. Even when using Romanian and GDR deliveries as reported by the Soviets, the figures for 1986 and 1987 do not show the East European share from among total Soviet pipe imports reaching even 15 percent. The true East European share under the SITC (Standard International Trade Classification) nomenclature could possibly be closer to 10 percent.

Does Eastern Europe have the capacity for providing a larger share of Soviet pipe requirements? Clearly, there are questions of both quantity and quality. A partial answer can be had by looking at the size of all CMEA steel deliveries to the Soviet Union. These incorporate a wide range of commodities, few as technically demanding as the larger-diameter pipes of most interest. The UNECE data show that Hungary, Poland, Czechoslovakia, and Bulgaria alone provided 21.1 percent of all Soviet steel imports in 1987. Adding the GDR and Romania would probably bring this total to at least one-quarter of Soviet needs. The barrier, therefore, may be a technological one.

If we notionally transfer all East European pipe exports currently going to the demanding markets of Western Europe and North America, and add them to the amount actually shipped to the Soviet Union, this maximal export rate would still cover only a further 4 percent of the Soviet domestic demand of recent years, that is, 200 tonnes or less. As it is, in recent years for each East European country, except Poland, the share of total pipe exports shipped to the Soviet Union is greater than the corresponding share for aggregated steel-products exports (data not shown). It would appear the Soviets are already in a position to claim the best that Eastern Europe has, or is likely to have, to offer of this commodity. However, this is in no sense sufficient. The Soviet Union will need to look elsewhere to resolve the domestic balance for this crucial good.

OVERALL TRENDS IN SOVIET TRADE WITH EASTERN EUROPE

To provide a better sense of the general direction of Soviet and East European trade, Tables 4.11 through 4.13 show the shares of total trade for each country by region. Shares of total exports going to the rest of Eastern Europe, the Soviet Union, and the developed West are reported for each country in columns 1, 2, and 4 in Table 4.11. Table

UNECE number in Table 4.10. This latter series has, in all previous years, been precisely equal to the numbers reported by UNECE.

Table 4.11
REGIONAL DISTRIBUTION OF EXPORT SHARES
FOR EAST EUROPEAN CMEA COUNTRIES
(In percent)

Country and Year	Exports to				
	Eastern Europe (1)	Soviet Union (2)	Soviet Union Compared with E. European Average (3)	W. Europe and N. America (4)	W. Europe and N. America as Percentage of Non-CMEA Trade (5)
Bulgaria					
1980	16.5	49.9	16.9	15.8	47.0
1985	17.2	56.6	18.6	8.5	32.4
1986	18.5	61.1	22.3	6.9	33.8
1987	18.6	61.1	22.5	6.8	33.5
1988	18.1	62.8	24.9	6.4	33.5
Czechoslovakia					
1980	27.8	35.6	2.6	21.8	59.6
1985	26.6	43.7	5.7	15.8	53.2
1986	28.2	43.3	4.5	15.7	55.1
1987	30	43.3	4.7	15.5	58.1
1988	29.9	43.1	5.2	16.3	60.4
East Germany					
1980	26.2	33.3	0.3	29.3	72.3
1985	22.4	37.2	-0.8	31.5	78.0
1986	24.3	36.2	-2.6	31	78.5
1987	25.9	36	-2.6	30	78.7
1988	26.5	35.5	-2.4	29.9	78.7
Hungary					
1980	21	29.3	-3.7	34	68.4
1985	18.7	33.6	-4.4	30.2	63.3
1986	20.1	33.9	-4.9	31.2	67.8
1987	17.3	32.7	-5.9	35.9	71.8
1988	17	27.6	-10.3	40.5	73.1
Poland					
1980	21.1	31.2	-1.8	34.4	72.1
1985	19.7	28.4	-9.6	34.7	66.9
1986	18.5	27.6	-11.2	33.9	62.9
1987	16.5	24.8	-13.8	41.6	70.9
1988	16.2	24.5	-13.4	43.3	73.0
Romania					
1980	17.7	19.6	-13.4	34.8	55.5
1985	14.5	21.4	-16.6	33.9	52.9
1986	16.7	24.6	-14.2	34.2	58.3
1987	17.5	24.9	-13.7	34.4	59.7
1988	16.4	23.4	-14.5	37.9	63.0

SOURCE: Economic Commission for Europe (1989).

Table 4.12
REGIONAL DISTRIBUTION OF IMPORT SHARES
FOR EAST EUROPEAN CMEA COUNTRIES
(In percent)

Country and Year	Imports from				
	Eastern Europe (6)	Soviet Union (7)	Soviet Union Compared with E. European Average (8)	W. Europe and N. America (9)	W. Europe and N. America as Percentage of Non-CMEA Trade (10)
Bulgaria					
1980	18.1	57.3	24.2	17.2	69.9
1985	17.5	56.1	16	15.2	57.6
1986	17.7	56.4	15.2	15.4	59.5
1987	19.7	57.3	17.5	15.3	66.5
1988	20.1	53.7	17.2	15.5	59.2
Czechoslovakia					
1980	28.7	36	2.9	24.3	68.8
1985	28.6	46	5.9	15.3	60.2
1986	29.1	45.3	4.1	16.5	64.5
1987	30.4	43.6	3.8	17.6	67.7
1988	32.3	40.3	3.8	18.6	67.9
East Germany					
1980	22.4	33.2	0.1	34.6	77.9
1985	22.9	38.8	-1.3	30.2	78.9
1986	22.7	38.7	-2.5	30.7	79.5
1987	23.9	37.9	-1.9	31.3	81.9
1988	24.8	34.6	-1.9	33.2	81.8
Hungary					
1980	19.2	27.7	-5.4	39.5	74.4
1985	19.3	30	-10.1	38.4	75.7
1986	19.9	30.9	-10.3	37.6	76.4
1987	18.8	28.5	-11.3	41	77.8
1988	18.7	25	-11.5	43.6	77.4
Poland					
1980	19.6	33.2	0.1	35	74.2
1985	19.8	34.4	-5.7	32.2	70.3
1986	19.3	35	-6.2	33	72.2
1987	18	27.5	-12.3	39.8	73.0
1988	17.2	23.4	-13.1	45.7	76.9
Romania					
1980	15.1	15.6	-17.5	31.2	45.0
1985	20.4	22.4	-17.7	17.3	30.2
1986	20.4	32.5	-8.7	16.1	34.2
1987	21.3	33.2	-6.6	12.9	28.4
1988	21.3	30.9	-5.6	11.6	24.3

SOURCE: Economic Commission for Europe (1989).

Table 4.13

REGIONAL DISTRIBUTION OF FOREIGN TRADE SHARES
FOR THE SOVIET UNION
(In percent)

Soviet Union	Exports to			Imports from		
	Eastern Europe (1)	W. Europe and N. America (4)	W. Europe and N. America as Percentage of Non-CMEA Trade (5)	Eastern Europe (6)	W. Europe and N. America (9)	W. Europe and N. America as Percentage of Non-CMEA Trade (10)
1980	42.1	32	55.3	42.9	35.4	62
1985	46.8	25.6	48.1	47.6	27.8	53.1
1986	52.6	19.2	40.5	53.2	25.3	54.1
1987	50.4	20.8	41.9	56.5	22.8	52.4
1988	49	21.9	42.9	54	25.1	54.6

SOURCE: Economic Commission for Europe (1989).

4.12 reports the corresponding shares for imports. As an aid to comparison, column 3 in both tables subtracts from the share of each nation's trade with the Soviet Union the average value for the six nations of Eastern Europe. Column 5 in the two tables lists the percentages of the non-East European and non-Soviet trade accounted for by trade with the developed countries of Western Europe and North America. Table 4.13 reports corresponding relevant data for the Soviet Union alone.

The shares of Soviet trade with Eastern Europe have increased since 1980, while the shares of both imports and exports originating from the developed countries have declined. This dynamic is mirrored by similar changes in the trade structures of Bulgaria and Czechoslovakia. The GDR has ended the period with little net change in any of the categories. Romania has increased its share of exports going to the Soviet Union while dramatically lowering its share of imports from the developed world. Hungary and Poland have weakened their ties to the rest of the CMEA. Their exports to the rest of the CMEA have decreased, while their share of imports from the West has increased to the highest values within the Bloc. For both countries, less than half of all imports come from within the CMEA. The data suggest, at least in the case of these two countries, a divergence of fundamental interests regarding trade development.

CONCLUSION

The evidence of this section suggests a widening divergence of trading interests between the Soviet Union and at least some of its erstwhile Bloc allies in Eastern Europe. In some categories of goods, such as computers, though the Soviets may rely heavily on East European deliveries, the East Europeans themselves are turning from their traditional sources of supply to Western alternatives. For other categories, such as large-diameter steel pipe, the capacity of the East Europeans to meet even a fraction of Soviet demand is limited.¹⁶

Yet, there are some commodities, such as machine tools, where a coincidence of interest remains. The Soviets are aided by imports of East European machines, which are apparently superior to much of Soviet domestic manufacture. The East Europeans would be hard pressed to find alternative markets for these machines, yet it is vital, at least in the short term, for their factories and workers to remain employed. The case for the mutual benefits of trade appears strong, at least in this instance, and suggests sweeping political change, and even the cessation of CMEA as a meaningful institution will not totally transform external economic relations between the Soviet Union and the East European states.

¹⁶This is susceptible to change either upward, in the instance of successful economic transformation in several East European countries, or downward if economic turmoil remains a perennial fixture.

V. EAST EUROPEAN SUPPORT FOR SOVIET TECHNOLOGICAL DEVELOPMENT

Gorbachev has gone through a process of learning about East European technology trade as he has with other areas of the Soviet economy. When he entered office in 1985, his attitude could be characterized as wanting to increase the quality and quantity of high-technology imports from Eastern Europe. The Comprehensive Program for the Scientific and Technological Progress of the CMEA Member Countries Through the Year 2000 would help to circumvent hindrances of the past generated by the creaky CMEA institutional apparatus. The emphasis on "direct ties" would lead to better integration both internationally and among sectors involved in high-technology development. Planning for R&D would be more comprehensive and complete. The result would be a reinforced East European segment of the Soviet technology base, allowing that base to achieve its full potential. Gorbachev may well have expected rapid progress in this area since the Program is, if not altruistic, at least mutually beneficial: the more the CMEA apparatus can be made to serve the technological development needs of Eastern Europe, the more likely it is that the Soviets could acquire high-technology inputs within the framework of CMEA trade.

If this was the vision, the last four years have been a disappointment. No marked transformation has occurred in the quantity or quality of East European high-technology deliveries to the Soviet Union. This failure stems from several root causes. During this period it became clear that there was a divergence of interests between Eastern Europe and the Soviet Union. The East Europeans had reasons to doubt the Soviets' intent behind their call for closer integration and saw the Program as potentially jeopardizing national policy goals. Some East Europeans feared, in particular, loss of control over national assets, enforced retardation of their own domestic development, and possible loss of Western input sources. At least two countries, Poland and Hungary, have been substantially redirecting trade away from the East. While Gorbachev was trying to develop technology relations with the CMEA more fully, many of its members were clearly finding their long-term interests lying more in the direction of the West.

A drastic overhaul, associated with differences in fundamental interests, was clearly required of the CMEA institutions if they were to

support the larger intentions of the Program. Trading practices were and remain a barrier to fuller development of trade in desirable high-technology products. Further, Eastern Europe's capacity limits as a more substantial provider of these goods to the Soviet Union became apparent. Changes in trade patterns with the non-Soviet CMEA were not likely to provide the faltering Soviet economy with the boost needed in the short term. Finally, Soviet ability to exert leverage declined, along with the fortunes of its domestic economy. The Soviets began to ring up large trade deficits with Eastern Europe as the terms of trade declined, domestic demand increased, and production stagnated or even declined. They were less in a position to provide leadership and gentle coercion than originally envisioned when the documents were drafted governing new high-technology relations within the CMEA. In recent years, Soviet economic policy has had an overwhelmingly domestic orientation.

The current Soviet stance is to continue to develop technology ties with Eastern Europe but not to give them the prominence they held in the mid 1980s. The Soviets remain interested in seeing the overall technology gap between the CMEA and the West decrease—and in ensuring against any increase in differentials within the CMEA. They also have political reasons to proceed with formal cooperative R&D projects. As the Soviet position in Eastern Europe changes with each passing day and the underlying purpose of the CMEA is called more vocally into question, the Soviets may search for any means to demonstrate a commonality with Eastern Europe and to provide a vehicle for continuing formal contacts with the CMEA member states. This will be explored more fully below. The final reason for continuing Soviet policy is simply that something is better than nothing. If Eastern Europe is unlikely to expand dramatically as a source of desired inputs for the Soviets, it still may be selectively combed for goods best suited to Soviet needs.

What does the future portend? The Soviets will probably emphasize developing trading ties with non-CMEA providers of high technology. However, the full development of these ties will depend on factors such as the international political climate, Soviet access to trade credits, and the state of the Soviet economy. These new trade ties will not replace traditional ties overnight. Further, indications are that the Soviet Union has now abandoned or suspended the modernization drive instigated by Gorbachev. As priority resource allocation is given to producing consumer goods, there will be less emphasis on obtaining high-technology producers' goods from Eastern Europe. This means that a greater share of the best that the East Europeans have to offer will be directed to dollar-denominated trade. It also means serious retrench-

ment in sectors kept afloat largely by the heretofore lack of discrimination in CMEA trading relations.

THE FUTURE OF THE CMEA

The Soviet Union imports high-technology commodities from Eastern Europe exclusively on the basis of trade within the CMEA. The nature of this trade, in the specific commodity categories deemed to constitute high technology, depends on more general questions of how the CMEA will be constituted and how long it will last.

Radical changes in the organization are in prospect. Its cumbersome and artificial pricing method conveys insufficient information and may be scrapped in favor of world market prices. Convertibility remains a thorny problem; all nations are now ill-served by the continued use of transferable rubles. The organization as a whole may follow the prospective change in Hungarian-Soviet practice, beginning in 1991, of denominating all trade in hard currencies.¹ Further, some East European states, as they consider broadening their economic relations outside the region, are making unilateral decisions undermining various CMEA agreements.²

Technology trade with the Soviets will be affected. Volume will, no doubt, drop in overall deliveries from each country to the Soviet Union. When a Soviet purchaser is faced with the prospect of buying either a Western or East European machine for hard currency, and that decision is to be made on the merits of the particular case, the Eastern machine may suffer more by comparison than in the past when it could, or even had to, be purchased through barter arrangements based upon bilaterally agreed to, long-standing covenants between governments. Some argue that this places the Soviets in a favorable position, selling raw materials and energy to Eastern Europe for dollars while purchasing machinery from the West.

On the other hand, it is too early to ring the death knell for all East European machine industries. While machinery exporters were usually in a position to benefit financially from the trade mechanisms and relatively lax quality standards of the CMEA, a few East European exporters will now benefit from shedding the twin shackles of pricing

¹The CMEA session in Sofia, 9-10 January 1990, did, in fact, call for a scrapping of the Bucharest pricing formula and a cessation of trade in transferable rubles. A timetable for implementing these changes has yet to be agreed to. Nor has the Hungarian-Soviet agreement on trade for 1991 been signed.

²The joint venture announced between Hungarian partners and Suzuki Motors of Japan to begin the assembly of personal automobiles is a direct contravention of the CMEA specialization agreement on motor vehicles.

industrial commodities based on a five-year moving average of world prices and translating the result into transferable rubles using unrealistic hard-currency-to-ruble exchange rates. In some cases the comparable Western price used to calculate the price of the CMEA analogue will be higher; certain East European products can be priced competitively in dollars and still leave the producers better off, and holding more hard currency, than before.³ More important, compatibility issues still remain. Western equipment stands a greater chance of causing "indigestion" in Soviet importing enterprises than East European models do because of possibly being less suited to the practical problems of Soviet production. Finally, it remains unclear how many COCOM restrictions on technology transfer to the Soviet Union, as distinct from Eastern Europe, will be retired. For some crucial areas the option of importing from the West might not be available.

There will no doubt be calls to terminate the CMEA organization stemming from negative memories of enforced membership during the CMEA's 1949-1989 period. Certainly, the institution will change drastically and much of the formal structure, especially for coordinating economic planning and development, will disappear. The economic fortunes of the non-European members⁴ will become a nonissue for the bulk of the CMEA. Yet, the change in trading relationships may fall short of the revolution some suggest. Among the loudest calls for scrapping the CMEA entirely are those from the interim Czechoslovak government, which believes its country's manufactured goods will be attractive to international markets. However, Czechoslovakia's output profile is largely geared to the Soviet consumer, is technologically obsolete in many product areas, and is produced by an industry lagging in several crucial respects behind international standards. The Czechoslovaks, and other East European industrial leaders, are likely to discover their current industrial output to be less competitive than they believe and the world markets to be colder and crueler arenas than they are initially prepared to face.

In spite of the dissolution of the bilateral barter mechanism for CMEA trade, the Soviet Union will continue to import a portion of its high-technology requirements from Eastern Europe. Economic factors will hinder the shift away from traditional trading patterns. Bureaucratic inertia, problems of obtaining full market information, existing personal contacts and long-standing supply relationships, and lack of adequate resources will erect a transaction cost hurdle to such a shift.

³This is less likely to be true for emerging technologies, which are characterized by declining current prices in their early years.

⁴Cuba, Mongolia, and Vietnam.

Further, some of the commodities currently being imported by the Soviet Union from Eastern Europe are likely to be priced favorably when compared with potential Western substitutes.⁵ Quality will certainly differ from that of the Western analogues, but if the reforms have their intended effect, the lower cost will be a substantial factor for potential purchasers facing convertible-hard-currency budget constraints. The ability of individual East European enterprises to continue obtaining orders from old customers will certainly vary. This, in fact, is the major reason to shift to dollar-based trade. It appears to be the best way to winnow out the irredeemable clunkers, plants, and products that exist only because the CMEA market has been so undemanding. But booked orders, while certainly decreasing, will not disappear across the board—far from it. Finally, it is not clear whether Soviet importers who become free in theory to purchase their equipment from any supplier will be free in fact to do so. Hard-currency balances will be a major constraint and are possessed by few firms. Although the option of purchasing goods on the transferable-ruble barter account will be gone, an enterprise may still have difficulty justifying the purchase of more expensive Western models when East European alternatives are available. Only a handful of large enterprises currently have the legal right to conduct their own trade, and the government still has many means for placing considerable impediments, both formal and informal, in the way of free import of producers' goods.

The Soviet Union also has technical reasons for continuing to import from Eastern Europe. As mentioned above, the Soviets are not particularly well-prepared to ingest the best technology the West has to offer. East European products may provide a sufficient qualitative edge without straining Soviet absorptive capacities. This is not just a question of lower technical specifications. In many cases East European manufactures were specifically designed with Soviet customers in mind. It may be easier and more productive for the Soviets to continue importing the best and most appropriate of these commodities rather than to try incorporating Western equipment that possesses alien design features.

If we take the economic and technical factors into account and make the substantial assumption that Soviet purchasers possess the means to take advantage of the liberalization in trading arrangements, Soviet imports of high technology from the East Europeans will probably drop sharply in the first two years after liberalization. New import

⁵For a Hungarian analysis on how market shifting will affect Hungary's machine industry, see Hajnoczy and Reti (1989).

possibilities will appear and purchasers will want to test their newfound freedom. Overoptimism about the gains from expensive Western technology is likely to prevail. After this period, several things are likely to occur. A disillusioned reaction to the initial euphoria is likely to set in. A portion of the imported commodities will be seen as expensive errors. Accompanying this, and in part because of it, new central controls are likely. This will have the effect of making presumably cheaper East European alternatives more attractive upon reflection. At the same time, the products offered by the East Europeans will have been upgraded and refined because of the need to compete more earnestly with the West for a share of the Soviet market. The medium-term trend for East European sales of high-technology commodities to the Soviet Union is likely to be less than the present level but above the potential dip recorded in the short run after liberalization. This, of course, assumes less than complete disruption in the Soviet domestic economy.

The present CMEA will be terminated, but the need for some form of regional trading bloc will remain. The European members of the CMEA are facing a period similar to the one at the end of World War I. Then, the liberated states of the region suddenly faced new frontiers and tariff barriers athwart ancient trade routes and lines of supply. The economic dislocation caused by this enforced isolation did much to inhibit maturation of the political institutions in each country during the ensuing two decades. This experience should be remembered. Similarly, each country today will be going through a drastic process of revamping its domestic economy. If GATT (General Agreement on Tariffs and Trade) guidelines are adhered to, the trade regime should be conducive to expansion, but some regional consultative body may need to actively promote this transition and prevent the erection of barriers to protect suddenly quite vulnerable domestic industries.

At the same time, the trend in the immediately neighboring region of Western Europe will be to draw closer together in economic integration. While the hope of the East Europeans is to become part of this process, this is unlikely to occur much before the questions of European security and military Bloc participation are resolved. Further, the EEC is becoming a deeper organization as well as a broader one. Membership, or meaningful associate status, may not be considered before the individual East European countries go through a substantial process of domestic economic transformation to erect the necessary institutions. As stated by Andrej Barcak, Czechoslovak Minister for Foreign Trade, at the January 1990 CMEA summit, "You don't walk out of the home if you do not have another home to move into"

(Haberman, 1990). At least a vestige of the CMEA, including the Soviet Union and the remaining European members, or some subset,⁶ may still have a potential role in making certain the international trading and supply relationships that still make sense under contemporary conditions will not be terminated in haste or to suit a short-term political agenda.

There is also the potential for synergy, true mutual economic assistance, among these states all undergoing similar economic transformations at the same time. If trading and customs union relations are created, boom times in one country will have a better chance of spilling over into its neighbors, and similarly a demand-constrained economic downturn in a country might be prevented from reaching disastrous proportions. Finally, the prospects for attracting foreign investment will be enhanced if potential investors view establishing facilities in one country as a means for gaining access to the entire regional market.

SOVIET/EAST EUROPEAN COOPERATION IN TECHNOLOGY DEVELOPMENT

A pertinent conclusion is that there may be some purpose in sustaining technology contacts among the current European CMEA members, albeit in a greatly modified form. All governments today have serious concerns about their future technological capacity. At root this is motivated by concern about their own international competitive positions, which are often linked to specific technologies. It is a characteristic of the contemporary world for nations to form international cooperations to jointly develop the "winners" of tomorrow. The ostensible reason is to pool knowledge and resources. Fear of being left behind plays as great a role, albeit unspoken, in motivating these coalitions. The Comprehensive Program is not a curious artifact of a moribund trading system, but exists as one example within a spectrum of similar efforts including CERN (the Center for European Nuclear Research), Eureka (a nondefense research group of 18 European countries), ESPRIT (a European R&D program in technology and telecommunications), and even our Strategic Defense Initiative, to name but a few. After unwieldy institutions, such as multiyear bilateral barter treaties and specialization agreements, are discarded and the CMEA

⁶The most probable convergence of interests would be among Czechoslovakia, Hungary, and Poland. Obviously, inclusion of the Soviet Union would cause serious problems of balance and would also presuppose a considerable transformation of Soviet domestic economic institutions.

nations trade with each other at world market prices for convertible currency, each nation will still feel a strong compulsion to be aligned in some form of international technological cooperative effort. They may not be welcomed individually into existing or prospective Western arrangements. These are difficult to bring about when so much is potentially at stake, and the problems increase as the purpose for collaboration becomes more proximate to deployable productive technology than to pure scientific research. It is possible that joint ventures with private Western interests will ensure collaboration, but the East Europeans may find it expedient to turn to each other and to their R&D-resource-laden neighbor, the Soviet Union, as well. They may find it productive to pool their collective resources in some well-specified project areas and incidently increase their individual value to prospective Western partners.

Thus, in spite of the considerable difficulties encountered in bringing the Comprehensive Program into effect, the basic idea, if not the Program itself, could conceivably survive a radical CMEA transformation and even receive more enthusiastic impetus because of those very changes. This idea is not based upon an optimistic assessment of the technological largesse that the CMEA members have, and are willing, to shower on one another. On the contrary, such a transformation would be impelled in large part by the feeling among most if not all these nations that to be part of a supranational organization will in some way help overcome the obstacles they face individually in developing and applying new technologies.

Reconstituting the Program would be far from simple and the outcome by no means certain. The more capable CMEA members will make certain to protect their interests and resources. Cooperation will be motivated by the benefits it is likely to confer upon individual participants. Those East European countries putting off the radical transformations their economies require will find this recalcitrance unappealing to their prospective partners, who will view it as detrimental to their own interest.

Substantial economic transformation is also a prerequisite for successful technological collaboration for technical reasons. Those nations unwilling to change may seek integration because they continue to subscribe to the previous model of CMEA S&T cooperation, namely that the dominant bottlenecks to technological development in one region are material and will be overcome by pooling resources. Collaboration based on this approach is least likely to bear fruit in the areas of electronics and automation, precisely the areas of greatest interest to most

nations in the region.⁷ Any findings or developments resulting from such projects would need to be applied throughout the economy and therefore become intimately bound with the full complexity of manufacturing relations, design problems for existing and prospective facilities, and the general problems of efficiency in economies retaining vestiges of the old system. Collaborative S&T policy will succeed in the presence of inadequate economic reform if the only requirement is pooling resources for development projects otherwise beyond the means of individual states. It will fail under inadequate reform if it is at base prompted by frustration with a lack of domestic technological change and a belief that a supranational network of connections and hierarchies will reduce the systemic dysfunctions instead of multiplying them.

The reformist camp in Eastern Europe now emerging will instead view the bottlenecks in previous cooperative efforts as managerial and institutional in character. It will insist on a complete overhaul of the existing cooperative structure. It will surely want increased technology contact with the West as well. As a practical matter, most current agreements should probably be considered dead in view of the political upheavals of 1989 and the economic transformations in prospect. For collaborative S&T activities to move forward, all Program projects and agreements would have to be completely redrafted. Individual nations may wish to go it alone if they think they have a technological edge that may be converted into commercial success or that will allow them to approach potential Western partners on somewhat equal terms. Complete transformation of the CMEA, leading to the demise of much of the present structure, may be the only way for the Soviets to ensure that the benefits they envisioned from this flagship Program are ultimately forthcoming.

⁷Collaboration would more likely be successful in areas such as biotechnology, new materials, and nuclear energy, fields with stand-alone engineering challenges presenting few organizational complexities. Electronics and automation, however, require complex integration with existing production systems.

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