EAST-WEST TRADE AND THE REGIONAL DEVELOPMENT OF SIBERIA AND THE SOVIET FAR EAST

By

MICHAEL JOSEPH BRADSHAW

B.Sc. (Hons.), The University of Birmingham, 1980
M.A., The University of Calgary, 1982

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Department of Geography

The University of British Columbia
1956 Main Mall
Vancouver, Canada
V6T 1Y3

Date 28th April, 1987

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Abstract

Studies of the role of East-West trade in Soviet economic development often assume that Siberia and the Far East play an important role in trading relations, but few studies have examined the extent of that role and the relationship between trade and economic development within the region. This study addresses two interrelated questions: firstly, what is the role of Siberia and the Far East in trade with the West, and secondly, what is the role of East-West trade in Siberian development.

Regional trade participation data are not available. The study therefore examines the composition of Soviet trade with the West and the industrial structure of the Siberian economy, in order to deduce the extent of regional participation in trade. Soviet exports to the West are dominated by natural resources, while imports from the West comprise machinery and equipment, manufactured goods and agricultural products. Analysis of the Siberian economy reveals a specialisation in the production and processing of natural resources. Estimates of export participation show that since the late 1970s the region has become the Soviet Union's most important source of foreign currency. Imports of Western technology are shown to play an important part in natural resource production and in the creation of Siberia's Territorial-Production Complexes. In many instances compensation agreements tie the use of imports to export production.

Overall the value of Siberian exports exceeds the cost of imports of Western technology, so that the region generates a

sizeable foreign currency surplus. In conclusion, a simple model of the trade and development process is presented which relates the pattern of foreign trade participation to the process of regional development. The impact of Western imports is felt mainly in the European core region where they provide additional resources to feed the population and renovate the industrial base; the impact of exports to the West is felt mainly in Siberia and the Far East where they increase demands for natural resource production. Thus, East-West trade serves to perpetuate the existing core-periphery pattern of Soviet regional development.

Table of Contents

	Page
Abstract	ii
Table of Contents	iv
List of Tables	ix
List of Figures	xii
Acknowledgment	xiv
Transliteration System	xv
Chapter 1 East-West Trade and Siberian Development: An Introduction	1
1.1. The National Economic Context	3
1.1.1. Economic Slow Down	3
1.1.2. Intensification of the Economy	6
1.1.3. The Shift Eastwards	8
1.2. Approaches to the Study of East-West Trade and Soviet Economic Development	10
1.3. A Study of East-West Trade and Siberian Development	17
1.4. Data Sources and Problems	21
Notes	26
Chapter 2 Soviet Trade Relations with the West	27
2.1. Foreign Trade Under Central Planning	27
2.1.1. The Organisation of Soviet Foreign Trade	28
2.1.2. The Foreign Trade Pricing System	31
2.1.3. Countertrade and Compensation Agreements	33
2.2. The Pattern and Structure of East-West Trade	38
2.2.1. The Geographical Distribution of Soviet Foreign Trade	39
2.2.2. The Structure of Soviet Foreign Trade	47
2.3. Soviet Trade with the Industrialised West	52

Table of Contents (continued)

Page

2.3.1. Soviet Fuel Exports to the Industrialised West 55

2.3.2. Soviet Non-Fuel Exports to the Industrialised West 60

2.3.3. Soviet Imports from the Industrialised West ... 74

2.3.4. Machinery and Equipment Imports 74

2.3.5. Pipe and Pipeline Equipment Imports 81

2.3.6. Grain Imports 85

2.4 Conclusions 85

Notes 87

Chapter 3 The Role of Siberia and the Far East in the National Economy 88

3.1. The Structure of the Economies of Siberia and the Far East 88

3.2. The Fuels-Energy Complex 95

3.2.1. The Oil Industry 98

3.2.2. The Natural Gas Industry 102

3.2.3. The Coal Industry 105

3.2.4. Electricity Generation 108

3.3. Raw Material Production and Processing 112

3.3.1. Ferrous Metallurgy 112

3.3.2. Non-Ferrous Metallurgy 113

3.3.3. The Chemical Industry 117

3.3.4. The Forest Industry 121

3.4. Production of Finished Goods 128

3.4.1. The Machine-Building Industry 128

3.4.2. The Food Industries 131

3.5. Conclusions 134

Notes 137

Table of Contents (continued)

Page

Chapter 4 The Spatial Structure of the Siberian Economy 138

4.1. The Concept of the Territorial-Production Complex.... 139

4.2. Territorial-Production Complexes and Siberian..... 146
Development

4.2.1. The West Siberian TPC..... 149

4.2.2. The Angara-Yenisey System..... 153

4.2.3. BAM and the South Yakutian TPC..... 157

4.2.4. Summary: The Role of TPCs in Siberia..... 159

4.3. The Siberian Transportation System..... 160

4.4. The Spatial Structure of Siberian Development..... 162

Notes..... 179

Chapter 5 Siberia and the Far East and Exports to the West 180

5.1. The Role Of Siberia and the Far East in Exports to... 181
the West

5.2. Siberian Fuel Mineral Exports to the West..... 182

5.2.1. Siberian Oil Exports..... 184

5.2.2. Siberian Natural Gas Exports..... 187

5.2.3. Siberian Coal Exports..... 190

5.3. Siberian Non-Fuel Mineral Exports to the West..... 193

5.3.1. Nickel, Platinum Group Metals and Aluminum.... 194
Exports

5.3.2. Diamond Exports..... 201

5.3.3. Gold Exports..... 203

5.4. Siberian Forest Products Exports..... 205

5.5. Other Siberian Exports..... 214

5.5.1. Fish Exports..... 214

5.5.2. Fur Exports..... 216

5.5.3. Chemical Exports..... 217

Table of Contents (continued)

Page

5.5.4. The Trans-Siberian Landbridge..... 219

5.6. The Role of Siberia and the Far East in Exports to... 221
the West: A Summary

5.7. The Spatial Distribution of Siberian Export.... 225
Production

5.8. Conclusions..... 230

Notes..... 233

Chapter 6 Soviet Imports of Western Technology and Siberian Development 234

6.1. The Role of Western Technology in the Industrial.... 234
Development of Siberia and the Far East

6.2. Western Technology Imports to the Siberian Fuel.... 235
Minerals Industries

6.2.1. Oil and Gas Exploration..... 237

6.2.2. Oil and Gas Production..... 247

6.2.3. Oil and Gas Transportation..... 253

6.2.4. The Urengoy Export Pipeline..... 260

6.2.5. The Siberian Coal Industry..... 265

6.2.6. The South Yakutian Coal Complex..... 268

6.3. Western Technology Imports and Mining..... 274

6.3.1. The Noril'sk Metallurgical Combine..... 277

6.3.2. The Sayan Aluminum Complex..... 280

6.4. The Forest Industry..... 282

6.4.1. Soviet-Japanese Forestry Agreements..... 285

6.4.2. Conclusions..... 291

6.5. Western Technology in the Siberian Chemical..... 293
Industry

6.6. Transportation..... 309

6.6.1. The Northern Sea Route..... 309

6.6.2. Nakhodka-Vostochnyy..... 320

Table of Contents (continued)

Page

6.6.3. The Baykal-Amur Railway..... 322

6.7. The Spatial Distribution of Western Technology in.... 324
Siberia and the Far East

6.8. The Role of Western Technology in Siberian.... 328
Development: Conclusions

Notes..... 330

Chapter 7 Conclusions 334

7.1. East-West Trade and Siberian Development..... 334

7.1.1. The Role of Siberia in East-West Trade..... 334

7.1.2. The Role of East-West Trade in Siberian.... 335
Development

7.1.3. The Role of Western Technology in Siberian.... 338
Development

7.2. East-West Trade and Soviet Economic Performance..... 342

7.2.1. The Trade and Development Process..... 343

7.2.2. East-West Relations: Policy Implications..... 350

7.3. Industrial Location and Regional Development..... 352

7.3.1. Contemporary Soviet Regional Development..... 353

7.3.2. The Soviet Industrial System and Spatial.... 359
Decision-Making

References 368

Appendix 1 Exchange Rates 389

Appendix 2 Siberia and the Far East in National 390
Economic Plans

List of Tables

		Page
2.1	Soviet Trading Partners, 1970-1985.....	42
2.2	Distribution of Soviet Foreign Trade Among the... Industrialised Capitalist Nations, 1970-1985	44
2.3	Structure of Soviet Exports, 1970-1985.....	48
2.4	Structure of Soviet Imports, 1970-1985.....	49
2.5	Structure of Soviet Foreign Currency Trade, 1970-... 1983	51
2.6	Role of Foreign Currency Trade in Total Soviet... Foreign Trade, by Commodity, 1970-1983	53
2.7	The Commodity Structure of Soviet Trade with the.... OECD Nations	54
2.8	Soviet Oil Exports, 1971-1984.....	56
2.9	Soviet Production and Trade in Gold, 1970-1983.....	61
2.10	Soviet Production and Trade in Platinum Group.... Metals, 1975-1984	64
2.11	Soviet Diamond Production and Trade, 1976-1984.....	67
2.12	Soviet Output and Trade in Selected Forest.... Products, 1970-1984	69
2.13	Role of Machinery and Equipment Imports in Soviet... Trade with the Industrialised West, 1970-1985	75
2.14	Machinery Orders Placed with the Hard Currency.... Countries, 1976-1978	79
2.15	Soviet Imports of Wheat and Coarse Grain, 1972-... 1983	85
3.1	The Structure of Siberian Industry, 1960-1975.....	90
3.2	The Structure of Siberian Industry, 1970-1985.....	91
3.3	The Share of Siberian Industrial Production in.... the National Economy	93
3.4	Siberia's Share in the Growth of Industrial.... Output by Five-Year Plan Period	94
3.5	The Role of Siberia in the National Economy at.... the End of the Ninth Five-Year Plan (1975)	96

List of Tables (continued)

		Page
3.6	The Geographical Shift in Soviet Oil and Gas... Production	99
3.7	The Geographical Distribution of Soviet Coal... Production, 1965-1985	106
3.8	Regional Distribution of Chemcial and..... Petrochemical Production	118
3.9	The Geographical Distribution of Major Coniferous... Species	123
3.10	The Role of Siberia and the Far East in the.... Soviet Forest Products Industry	126
3.11	The Branch Structure of the Machine-Building.... Industry in the USSR and West Siberia	130
3.12	The Role of Siberia and the Far East in the.... National Economy	135
4.1	Officially Recognised Territorial-Production.... Complexes, 1970-1990	147
4.2	Regionalisation Scheme for Siberia and the Far.... East	171
4.3	Population Characteristics of Siberia and the Far... East, 1970-1985	172
4.4	Geographical Distribution of Siberian Investment,... 1966-1980	177
5.1	Key Soviet Exports to the OECD.....	183
5.2	The Role of Siberia in Soviet Oil Exports to the.... West	185
5.3	The Role of Siberia in Soviet Gas Exports to the.... West	189
5.4	Soviet Coal Exports to the West.....	192
5.5	Siberian Non-Ferrous Metal Exports to the OECD.....	196
5.6	Estimated Capacity and Production of Aluminum... Plants in Siberia	200
5.7	The Spatial Distribution of Soviet Gold..... Production	204
5.8	Siberian Forest Products Exports to the West.....	211

List of Tables (continued)

		Page
5.9	Estimated Foreign Currency Earnings from the Trans-Siberian Landbridge	222
5.10	Siberia's Share of Exports to the OECD	223
5.11	The Spatial Distribution of Siberian Export Production in 1980	232
6.1	Soviet Pipe Imports, 1975-1985	256
6.2	Major Equipment Orders for the Urengoy Export Pipeline	263
6.3	Equipment for the South Yakutian Coal Complex	270
6.4	Heavy Equipment Imports for Non-Fuel Minerals Mining	275
6.5	Japanese Equipment Deliveries under the Far Eastern Forestry Development Agreements	287
6.6	Soviet Chemical Equipment Imports from the West, 1970-1984	295
6.7	Western Equipment Imports to the Siberian Chemical Industry	297
6.8	Soviet Production of Selected Chemicals, 1970-1983	304
6.9	Icebreakers Supplied to the Soviet Union by Wartsila, 1960-1986	311

List of Figures

		Page
1.1	Siberia and the Far East	2
1.2	Approaches to the Study of East-West Trade and Technology Transfer	11
1.3	A Schematic Framework for the Study of East-West Trade and Siberian Development	19
2.1	The Foreign Trade Bureaucracy	29
2.2	The Structure of a Compensation Agreements	35
2.3	The Recent Growth of Soviet Foreign Trade, 1970-1985	40
2.4	The Geographical Distribution of Soviet Foreign Trade, 1970-1985	41
2.5	The Role of Machinery and Equipment Imports in Trade with the Industrialised West, 1975-1985	77
2.6	The Role Grain Trade in Imports from the West, 1975-1985	82
3.1	Energy Resources in Siberia and the Far East	97
3.2	The Changing Role of Siberia and the Far East in Soviet Oil and Gas Production	100
3.3	The Development Of the Soviet Oil and Gas Pipeline Networks	104
3.4	The Siberian Power Generation and Transmission System	109
3.5	Major Mineral Deposits and Ore Bodies in Siberia and the Far East	115
3.6	The Petrochemicals Industry	120
4.1	The Linkages within a Territorial-Production Complex	144
4.2	The West Siberian TPC During the 11th Five-Year Plan	150
4.3	The Angara-Yenisey System During the 11th Five-Year Plan	154
4.4	The Siberian Transportation System	162
4.6	Economic Regionalisation of Siberia and the Far East	170

List of Figures (continued)

Page

6.1 Icebreakers Supplied by Wartsila, 1960-1986..... 312

6.2 Noril'sk Class SA-15 Ice-Strengthened Freighter..... 318

7.1 The Trade and Development Process..... 344

7.2 A Simple Classification of Industrial Systems..... 360

7.3 The Forces Influencing Soviet Regional Development... 366

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I would like to dedicate this thesis to my parents and to the memory of my grandparents.

Transliteration System

The transliteration system used in this study is one approved by the U.S. Board of Geographic names.

А а	*А а*	a
Б б	*Б б*	b
В в	*В в*	v
Г г	*Г г*	g
Д д	*Д д*	d
Е е	*Е е*	ye, e[1]
Ё ё	*Ё ё*	ye, e
Ж ж	*Ж ж*	zh
З з	*З з*	z
И и	*И и*	i
Й й	*Й й*	y
К к	*К к*	k
Л л	*Л л*	l
М м	*М м*	m
Н н	*Н н*	n
О о	*О о*	o
П п	*П п*	p
Р р	*Р р*	r
С с	*С с*	s
Т т	*Т т*	t
У у	*У у*	u
Ф ф	*Ф ф*	f
Х х	*Х х*	kh
Ц ц	*Ц ц*	ts
Ч ч	*Ч ч*	ch
Ш ш	*Ш ш*	sh
Щ щ	*Щ щ*	shch
Ъ ъ	*Ъ ъ*	"
Ы ы	*Ы ы*	y
Ь ь	*Ь ь*	'
Э э	*Э э*	e
Ю ю	*Ю ю*	yu
Я я	*Я я*	ya

[1]Transliterated as ye at the beginning of a word, after vowels, and after b and ": elsewhere as e.

Chapter 1

East-West Trade and Siberian Development: An Introduction

In recent years the question of the role of East-West trade in Soviet economic development has become the source of considerable disagreement among the governments of the industrialised West. The issue of Siberian development, and in particular Western involvement in Siberian energy projects, has been at the centre of this political debate. Many studies of foreign trade and Soviet economic development have assumed that Siberia and the Far East play an important role in Soviet trade with the industrialised West, but few have actually focused on the relationship between East-West trade and Siberian development. This study addresses two interrelated questions: firstly, what is the role of Siberia and the Far East in Soviet trade with the West, and secondly, what is the role of East-West trade in Siberian development? To answer the first question the study examines the contribution of Siberian industry to Soviet exports to the West and the share of Western imports used within the region. In answer to the second question the study describes and evaluates the role of export production and Western imports in the economic development of Siberia and the Far East. In this study Siberian development refers to the development of the West Siberian, East Siberian and Far Eastern Economic Regions (see Figure 1.1).

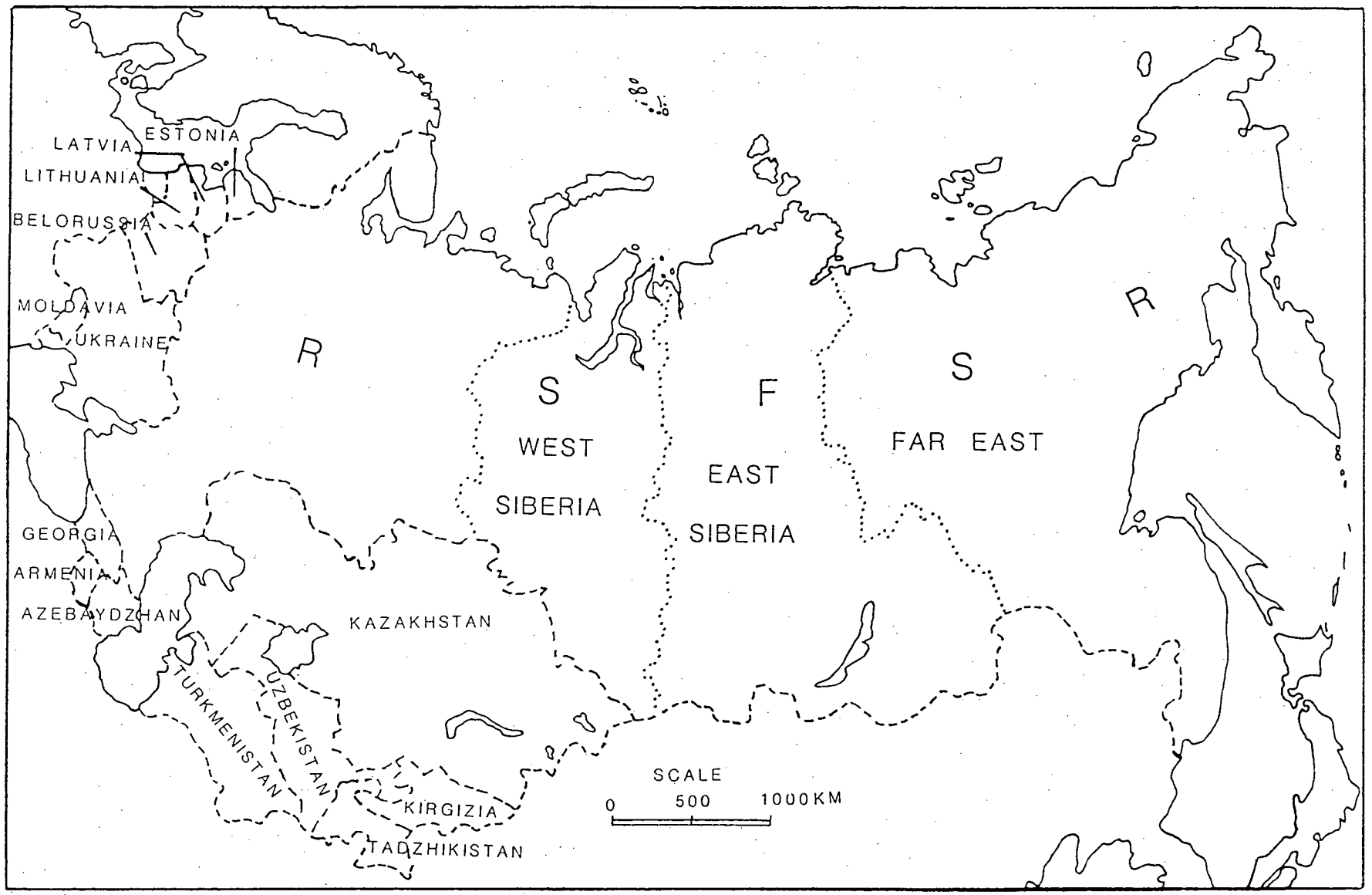


Figure 1.1 Siberia and the Far East

This introductory chapter provides the general context for the study and description of the research procedure and the structure of the thesis. The first section presents a brief review of Soviet economic development since the mid-1960s, placing the study within the national economic context. The second section reviews the various approaches to the study of foreign trade and Soviet economic development, providing the academic context. The approach adopted by this study and the structure of the thesis are described in the third section. The final section discusses the data sources used and the problems associated with them.

1.1. The National Economic Context

Both Siberian development and the Soviet trading relations with the industrialised West need to be seen within the general context of Soviet economic development. The following discussion focuses upon the factors that have influenced the pattern of Siberian development and the role of foreign trade in the Soviet economy.

1.1.1. Economic Slow Down

Since the early 1970s the Soviet economy has experienced faltering growth rates. While the economy has continued to grow it has been at much reduced rates. Both Soviet and Western measures indicate this (Ellman, 1986). The growth rate of net material product has declined from 7.7 percent during the 1966-1970 period to 5.7 percent during the 1971-1975 period and 4.2 percent between 1976 and 1980 (Hanson, 1985, p. 31).[1] Estimates of Soviet gross national product made by the U.S. Central Intelligence Agency (CIA) show a similar downward

trend, from 5.3 percent in 1966-1970 to 2.7 percent between 1976 and 1980 (Hanson, 1985, p. 31). Other economic indicators such as industrial output and labour productivity exhibit similar declines in growth rates during the 1970s. While there does seem to have been some improvement during the early 1980s, it is unlikely that growth rates will increase substantially during the second half of the 1980s.

No single factor can explain the slow down of the Soviet economy. Rather it is the result of a combination of factors. First is the aging of the capital stock. In the Soviet Union productive capacity is kept in operation for much longer periods than is the practice in the West. The average retirement rate of Soviet capital stock was 1.3-1.7 percent per annum during the 1961-1981 period, when the average annual retirement rate in the United States was 3.7 percent (Leggett, 1983, p.143). As a consequence much of Soviet industry is antiquated by Western standards and produces obsolete products. Because of the age of the plant and equipment large expenditures on maintenance and excessive consumption of energy and material inputs have reduced the efficiency of production and the productivity of labour.

The second contributing factor is the failure of the labour force to yield significant productivity increases. This is due partly to the aging of the capital stock, but it also reflects a lack of discipline and work ethic. A failure to deliver the necessary consumer goods to reward higher productivity has led to apathy on the part of the workforce. When the labour force continued to grow, a lack of individual

productivity could be compensated for by increasing the size of the labour force. However, the rate of growth of the labour force declined to less than 2 percent per annum in the late 1970s and in the 1980s to less than 1 percent per annum (Hohmann, 1986, p. 131). These aggregate figures hide large regional variations in population growth, with the European regions experiencing almost zero population growth and the Central Asian republics experiencing rapid population increases. As a consequence Western analysts predict a substantial net decrease in the size of the labour force of the Russian Federation (RSFSR) during the late 1980s and early 1990s. The significance of these demographic trends is even more apparent when one realises that the European regions (including the Caucasus) accounts for over 75 percent of the total population and 80 percent of the industrial capacity of the Soviet Union. The net result is that the industrial heartland of the Soviet Union is experiencing a labour shortage.

Third is the fact that capital input/output ratios have deteriorated--that is more and more investment has been required to sustain or increase output. The input/output ratio for Soviet industry as a whole has increased from 1.9 in 1965 to 3.3 in 1980.[2] Growth in the fuel industries has been particularly expensive with the input/output ratio increasing from 3.4 in 1965 to 4.8 in 1980 (Leggett, 1982, p. 133). Further indication of the increasing cost of obtaining energy resources is the fact that the energy sector's share of total industrial investment increased from 18.4 percent in 1975 to

26.6 percent in 1984 (Feytel'man, 1985, p. 50). Increases in agricultural production have also been very costly with ratios rising from 0.8 in 1965 to 2.9 in 1980. The increasing capital intensity of agriculture has not been matched by increases in labour productivity and production. The poor performance of Soviet agriculture has not only been a drain on the domestic economy, but has required costly imports. In general, the deterioration of input/output ratios reflects both the aging of the capital stock and the necessity of having to develop new resources in undeveloped regions. Such development requires substantial investment in non-productive items including transportation and socio-economic infrastructure.

Finally, the increasing cost of resource production has been an even greater burden because the rate of growth of capital investment has declined. The growth rate of funds commited to capital investment declined from 6.0 percent per annum in 1968 to 2.2 percent in 1980 (Rumer, 1982, p. 54). As a result increasing demands for investment were placed upon the economy at a time when the economy was unable to meet those demands. As a consequence plan targets were not met, even though they had been reduced, and growth rates declined.

1.1.2. Intensification of the Economy

Faced with the situation of being unable to increase output by increasing inputs, recent economic policy has stressed the need to make better use of available resources. Thus, throughout the 1970s policies were aimed at converting the Soviet economy from an "extensive" mode of development to an "intensive" mode that emphasizes increased labour

productivity and technological efficiency. Under the banner of the "Scientific Technical Revolution" (STR) emphasis has been placed on the quality of production, labour productivity, renovation of existing industrial capacity, and the introduction of modern technology. In 1970 the share of industrial investment allocated to renovation and expansion of existing enterprises was 58 percent, but by 1980 that figure had risen to 78 percent. Rumer (1982, p. 59) has concluded that despite increased investment, none of the goals of the 1970s renovation policy were met. The reason for this failure probably lies with the fact that the intensive mode of development was simply grafted upon the existing system without major economic reforms. The industrial ministries were able to circumvent the renovation policy and use renovation funds to build new plants, but without retiring old plants since that would have led to short-term reductions in output. Geographically the policy of intensification has worked to the advantage of the European regions simply because 80 percent of the existing industrial capacity is located there.

The import of Western technology has also been an important part of the intensification process. Western technology has been imported as an alternative to domestic innovation, in the hope that it would provide rapid increases in productive capacity and technological efficiency. However, in the late 1970s imports were reduced because Western technology did not seem to be providing the desired results, and competing demands on foreign currency arising from the need to import food were draining foreign currency reserves. In

many instances the lack of radical economic reform eroded the benefits of imported Western technology.

In the period since Brezhnev's death (November 1982), intensification has remained the basis of Soviet economic policy. Andropov's brief leadership aimed to improve labour discipline and the efficiency of the planning system, but his successor Chernenko failed to carry these policies through. In March 1985 Mikhail Gorbachev inherited a near-stagnant economy that had succeeded in resisting change. Gorbachev's economic policy also stresses intensification through increased labour discipline and technological renovation (Kontorovich, 1985, p. 18). It is too early to judge whether Gorbachev has the political power to convince the economic bureaucracy of the benefits of the intensive mode of development.

1.1.3. The Shift Eastwards

At the same time as the intensification strategy was being applied to the European core region, the changing geography of resource production forced the Soviet Union to initiate new resource developments in its eastern regions. As the more accessible industrial resources, such as the Donbass coalfield and the Volga-Urals oilfield, became depleted, resources in Siberia and Central Asia have had to be developed. Regional interest groups saw the changing geography of resource production as an opportunity to lobby for greater regional self-sufficiency and economic diversity. In particular academics and planners concerned with the development of Siberia pushed for the comprehensive development of the Siberian economy. They argued that the most efficient way to

develop Siberian resources was to create a diversified regional economy that both produced and processed the region's natural resources. In response to this pro-Siberian lobby, in what has become known as the "East-West debate", pro-Europeans countered that the comprehensive development of Siberia was too costly and that the full potential of European resources was yet to be realised. In actuality neither side has been able to claim total victory, but the pattern of events has favoured the European regions. The STR has led to the renovation of existing capacity in the European regions, while investment in Siberia has been concentrated on the production of resources for the national economy, paying minimal attention to diversification.

Thus, it is within a context of declining economic growth and increasing and competing demands for labour and capital that this study is set. In a regional development context Soviet planners have been faced with the task of having to renovate the industrial heartland of the European USSR at the same time as having to extend the resource production frontier into remote northern and eastern regions. Increased trade with the West is an important component of both the renovation of the European USSR and the development of Siberian resource potential. It is the task of this study to examine the interrelationship between East-West trade and Siberian development, and assess its implications for Soviet regional and industrial development.

1.2. Approaches to the Study of East-West Trade and Soviet Economic Development

Studies of the role of foreign trade in Soviet economic development have been conducted at different scales, using a number of different approaches. Figure 1.2 provides a framework for evaluating the writings by both Western and Soviet authors on foreign trade and economic development, and serves to illustrate the various approaches that have been adopted in the last 15 years.

Three scales of investigation are identified: the macro-scale of the national economy of the USSR, the meso-scale of the individual industry or region (which could include Union Republics and/or Economic Regions) and the micro-scale of individual industrial complexes, territorial-production complexes (TPCs) or sub-regions such as the Kuzbass or the Angara-Yenisey system. In addition to these scales, two basic approaches are identified. The sectoral approach examines the impact of trade and technology transfer from the point of view of the various industrial sectors that comprise the national economy, while the spatial approach is concerned with the role of trade and technology transfer in the various geographical regions that comprise the Soviet Union. A brief review of the research conducted at the various scales serves to clarify the distinction between the sectoral and spatial approaches and also provides the academic context for the present study. The various categories on Figure 1.2 are not mutually exclusive, and some research projects have combined a number of different scales and approaches.

Sectoral studies at the macro-scale have employed

	SECTORAL	SPATIAL	
MACRO	Soviet Industry	Soviet Space Economy	NATIONAL ECONOMY
MESO	Specific Industry	Specific Region	REGIONAL ECONOMY
MICRO			INDUSTRIAL COMPLEX

Figure 1.2 Approaches to the Study of East-West Trade and Technology Transfer

econometric models to determine the aggregate impact of machinery imports from the West on the performance of Soviet industry. Gomulka and Nove's (1984) review of these studies indicates that they are fraught with methodological problems; analyses using similar data sets have produced contradictory results. In the context of the present study these econometric analyses are of limited use because they are based on abstract models of the Soviet economy.

Spatial studies at the macro-scale have attempted to determine the role of foreign trade in the regional development of the USSR. They are classified here at the national scale because they focus upon the entire national economy, rather than a specific region. North's (1983, pp. 99-100) study of the regional implications of Soviet foreign trade with both the socialist and capitalist nations suggests a scheme of direct and indirect impacts to assess the role of foreign trade on Soviet regional development. Direct impacts are "typified by investment in mines and factories, and in the transportation facilities serving them in order to enable them to export." The use of imported factory equipment is also considered a direct impact. Indirect effects are more complex and include investment in transportation that not only enables trade but benefits a region by increasing its attractiveness to domestic industry. In addition, the increased demand generated by exports may enable the shift to a new technology or the shift to an alternative pattern of supply. The spatial distribution of such impacts is dependent upon the structure of foreign trade and the sectoral structure of the various regions within

the Soviet Union. Despite specific mention of imports, North's study was concerned mainly with the spatial impact of export production, and relatively little attention was paid to the impact of imports. A similar bias towards export production is found in Soviet work on foreign trade and regional development, for example, Avdeichev and Zaytsev (1976) and Nekrasov (1981). Not suprisingly, Soviet authors tend to concentrate on the spatial implications of "socialist integration" and the "international division of labour". Discussion of Western imports is usually confined to the description of compensation agreements, as in the work of Kromyshev (1983, pp. 152-162). Soviet studies of the regional distribution of foreign trade participation seem more concerned with what should be exported from certain regions rather than what is actually exported, and consequently they provide little data on regional trade participation.

The vast majority of sectoral studies have been case studies conducted at the meso-scale. Most have examined the role of Western technology in the development of particular industries, and they have concentrated upon those sectors that have been the major recipients of Western technology (Holliday, 1984). For example, Holliday (1979) examined the automotive industry, Sobeslavsky and Beazley (1980) the chemical industry, and Hanson (1980) the mineral fertilizer industry. These sectoral case studies suggest that, despite being a very small component of total investment, imports of Western machinery and equipment can have a significant impact on the performance of target industries. Within particular industries Western imports

are thus used to overcome "sectoral bottlenecks", by providing the technology necessary to rapidly improve and expand productive capacity. Hanson (1981, p. 144) has defined the "net impact" of Western technology upon the Soviet economy as being:

> "... the contribution to output of the imported technology over and above what could have been achieved with the same quality of capital and labour inputs, utilising the best technology domestically available at the same time as importation."

Hanson further subdivides this net impact into direct and indirect impacts. Direct impacts are the "net increment in output attributable to the superiority of imported technology." Indirect impacts refer to the "knock-on" effect that results from the use of superior, more productive, inputs in associated industry and in the economy in general. Hanson has suggested that the higher efficiency associated with Western technology is often reduced by systemic problems within the Soviet economy, such as poor coordination, low quality inputs, long lead times and so on. In an attempt to overcome such problems, projects using Western technology are often assigned high priority. Hardt and Holliday (1977), on the basis of Holliday's study of the Soviet automotive industry, have provided an alternative conceptual framework for evaluation of the impact of Western imports. They have suggested that imports of Western technology provide "resource-releasing" benefits by reducing the requirements for domestic machinery in a particular context; but at the same time imports are "resource-demanding" in the sense that they generate additional demands for inputs (above and beyond that which would be demanded by a domestic equivalent). Therefore, for imports to

be beneficial to the Soviet economy resource-releasing benefits must be greater than resource-demanding costs. Hardt and Holliday were also concerned with the dynamic impact of technology transfer and suggested that imports are often used to meet priority targets within a particular time frame. Thus, imports provide a "quick fix" enabling more rapid development of particular industries or regions than would be possible using domestic resources alone. Given that most case studies have examined high-priority sectors that exhibit a relatively high degree of import dependence it is not suprising that they identify a positive impact. Other case studies, such as Braden's (1981) study of the relatively low priority forest products sector, which employed an econometric analysis at the sectoral level, have concluded that imported technology does not necessarily perform any more effectively than domestic equipment.

A somewhat different approach is taken by some of the studies in the Association of American Geographers Project on Soviet Natural Resources in the World Economy (Jensen, R.G. et al. 1983). The contribution of individual resource sectors to foreign trade was evaluated and particular attention was paid to the regional distribution of production, thus combining both sectoral and regional approaches. However, these studies were organised by sector rather than region.

There are few meso-scale spatial studies that concentrate on the role of East-West trade in the development of a particular region. A recent Economist Intelligence Unit study by Kirby (1984) has assessed the resource potential of Siberia

and the Far East from the point of view of its present and potential contribution to foreign currency trade, but it neither addresses the role of imports in any detail, nor considers the impact of foreign trade on Siberian development. An earlier study by Mathieson (1979) provided a description of Japanese involvement in Siberian development, but failed to evaluate the importance of such trade in the regional development of Siberia and the Far East. Soviet studies on the role of East-West trade at the regional scale seem to concentrate on the role of Pacific Basin trade in the economic development of the Soviet Far East, for example, Alexandrov, (1984) and Shlyk (1986). This reflects the fact that because of the large size of the region and its remoteness, expansion of the export base of the Far East is an officially accepted development policy, whereas in other regions the only external influence that is acknowledged is the impact of economic integration within the Council for Mutual Economic Assisstance (CMEA). Again these studies tend to concentrate on the role of exports, paying little attention to the impact of Western imports beyond the description of compensation deals.

At the micro-scale the distinction between sectoral and spatial approaches is not as apparent since both approaches focus upon individual plants and complexes. At present most micro-scale studies are a component of sectoral case studies, the best example being Holliday's (1979) study of the automobile industry which examined the Volga automobile plant and the Kama River truck plant. Other studies have made passing reference to the role of Western technology in the

creation of TPCs and the importance of foreign currency earnings from the West Siberian oil and gas complex or the Noril'sk metallurgical combine, but few attempt to determine the exact nature of that contribution.

In sum, it can be said that the existing studies of East-West trade and economic development seldom present a comprehensive picture of the trade and development process. Sectoral studies are predominantly case studies that focus on the role of imported technology in a particular industry; while spatial studies tend to concentrate on the impact of export production and pay little attention to the role of imports. As a result few studies address the question of the interrelationship between imports and exports and the sectors and regions that produce goods for export or receive imports.

1.3. A Study of East-West Trade and Siberian Development

This study combines the sectoral and spatial approaches described above to examine the impact of East-West trade on Siberian development. The starting point is the idea that Soviet trade with the West has a distinct spatial impact upon the Soviet economy. Just as studies by Western economists have focused on the role of East-West trade in the development of particular industries, this study examines the role of East-West trade in promoting the development of a particular region. The central hypothesis of this study is that Soviet trade with the industrialised West has promoted a higher level of economic development within Siberia and the Far East; firstly, by creating additional demands for Siberia's natural resources; and secondly, by providing some of the technology and equipment

required to develop the region's natural resources,

A lack of regional industrial production and trade participation data make it impossible to calculate directly the role of foreign trade in the Siberian economy. Therefore it is necessary to examine the commodity composition of East-West trade and the sectoral structure and national share of Siberian industry to arrive at estimates of regional trade participation. The general approach and structure of this study are illustrated in Figure 1.3. The starting point is an examination of the structure of Soviet trade relations with the industrialised West. Chapter 2 provides a general introduction to foreign trade under central planning and describes the pattern of Western involvement and the commodity structure of exports to and imports from the industrialised West.

The structure of East-West trade having been determined, the next step is to examine the structure of the Siberian economy and its role in the national economic system. The first part of Chapter 3 examines the general structure of the regional economies of West Siberia, East Siberia and the Far East. The remainder of the chapter presents a detailed sectoral analysis of Siberian industrial development and the role of the various sectors in the national economy. The conclusion to Chapter 3 identifies the national specialisations of Siberia and the Far East.

To enable evaluation of the impact of trade participation on the various sub-regions and industrial complexes that comprise the Siberian economy, Chapter 4 focuses upon the spatial distribution of Siberian industry. The first section

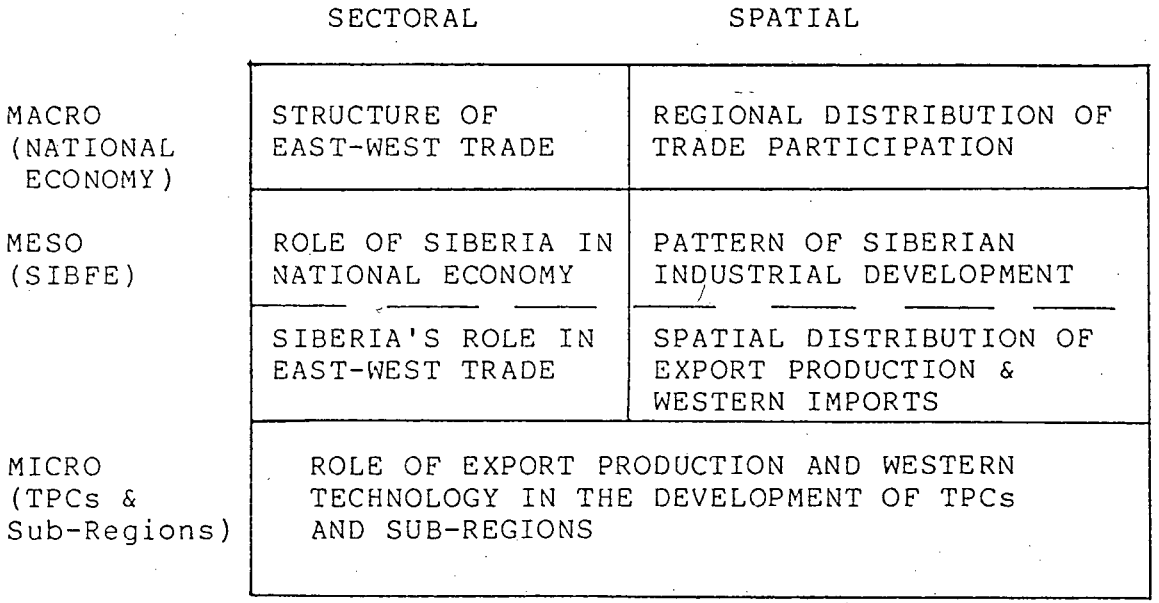


Figure 1.3 A Schematic Framework for the Study of East-West Trade and Siberian Development

of Chapter 4 examines the concept of the Territoral-Production Complex (TPC). The second section examines the role of the TPC in Siberian development. The third section examines the Siberian transportation system which plays a crucial role in shaping the pattern of Siberian development and enabling foreign trade. In the final section the findings of Chapters 3 and 4 are combined to develop a regionalisation scheme that describes the structure of Siberia's regional economies.

Having determined the commodity structure of Soviet trade with the West, and the pattern, structure, and national importance of the Siberian economy, it is possible to estimate the role of the region in East-West trade. Chapter 5 examines Siberia's contribution to exports to the industrialised West. The chapter analyses the contribution of Siberia and the Far East to the production of commodities for export to the industrialised West; and, using the regionalisation scheme presented in Chapter 4, describes the spatial distribution of export production within Siberia and the Far East.

Chapter 6 examines the role of Western technology imports in Siberian development, following the same procedure as with exports. The chapter examines the role of Western technology in Siberian development, and describes the spatial distribution of Western technology within Siberia and the Far East. The study adopts a broad definition of technology which includes both industrial processes and the import of equipment, such as bulldozers and pipelayers.

In conclusion, Chapter 7 returns to the two questions posed at the beginning of the study and discusses the

relationship between East-West trade and Siberian development. A simple model of the trade and development process is presented that relates foreign trade participation to the pattern of regional development in the Soviet Union. The final section of Chapter 7 discusses the various forces that influence the process of regional development under Soviet socialism.

1.4 Data Sources and Problems

Any geographical study on the Soviet Union inevitably faces the problem of a lack of information on the spatial distribution of economic activity. This section describes the various sources of information that have been used in this study and the problems associated with them.

The information in this study can be classified in two ways: first, information from Soviet sources and information from Western sources; and second, information on East-West trade and information on Siberian development. Statistics on Soviet trade with the industrialised West have been obtained from the Soviet Foreign Trade Handbook Vneshnyaya torgovlya v SSSR (Foreign Trade in the USSR), which is published annually. Other Soviet sources on trade include articles in the foreign trade journal Vneshnyaya torgovlya, which is published monthly. While there are scholarly books and articles by Soviet authors on Soviet foreign trade, these are of limited use because they tend to concentrate on trade with other socialist nations. For political reasons, Soviet studies of East-West trade tend to exaggerate the "mutual benefits" of trade and seldom provide much detail on the use of Western

technology in the Soviet economy. Because Soviet foreign trade statistics do not provide complete coverage of trade relations with the West, it is necessary to supplement Soviet sources with Western data on foreign trade. In this study foreign trade statistics from the Organisation for Economic Co-operation and Development (OECD) are used, as well as CIA statistics and data from more specialised sources such as the U.S. Bureau of Mines and the academic literature on Soviet trade. There exists no comprehensive source of information on Western sales of plant and equipment to the Soviet Union. Therefore, it has been necessary to conduct an exhaustive search of Western trade and industrial journals to obtain information on sales. Specialist trade journals, such as Business Eastern Europe and EastWest Markets, provide information on contracts and sales. Specialist government reports, such as the U.S. Office of Technology Assessment's (OTA) study of technology transfer and Soviet energy availability, provide a useful source of information, as do studies by Western scholars. By combining Soviet and Western sources it has been possible to obtain a clear understanding of the structure of trade and the role of Western technology in Siberian industry.

Information on Siberian development has proved harder to obtain, mainly because of the absence of regional production statistics. A five-month research fellowship to the Department of the Economic Geography of the USSR, at Moscow State University, provided an opportunity to conduct a detailed survey of the Russian-language literature on Siberian

development. Unfortunately bureaucratic problems thwarted attempts to talk with academics at Siberian research institutes at Novosibirsk and Irkutsk. While the review of the Soviet literature provided little in the way of concrete statistical information, it did provide a general description of the structure of the Siberian economy and the role of the region in the national economy. The majority of the Soviet works used in this study have been published by the Siberian branch of the Academy of Sciences. Unfortunately, even these studies rely upon percentages and indices to describe economic structure and performance rather than absolute figures. Due to this lack of hard data, Western studies on Siberian development present little in the way of rigorous empirical analysis but have to rely on detailed description and anecdotal evidence.

In addition to the basic problem of data availability, one must also be aware of the problems of reliability and comparability of the data that have been obtained. In the West we tend to assume that Soviet statistics are not reliable because they have been manipulated to serve political ends. (For a discussion of Soviet statistics and their accuracy see Jasny, (1962), Treml and Hardt, (1972), and Nove, (1978), pp. 348-359). No doubt many Soviet measures are inaccurate, probably as a result of poor measurement as much as disinformation, and statistical handbooks hide absolute data with percentage measures and indices. As a result, the Soviet economic handbooks provide some of the best examples of how to manipulate data. In recent years the question of inflation has become particularly problematic, with some Western analysts

suggesting that if inflation were properly accounted for then the Soviet economy ceased to grow in 1979. Nevertheless, it appears that many Soviet academics and planners have to rely on those same handbooks, suggesting that they are the best available. Of course, the reliabilty of Western measures of Soviet economic development is also an issue. In order to minimize these difficulties both Soviet and Western data are used whenever possible.

The problem of comparability arises when using a variety of data sources. Soviet foreign trade data and Western OECD trade data are not directly comparable. Firstly, they use different commodity classification systems. The Soviet data are organised according to the Foreign Trade Nomenclature (FTN) and the OECD data by the Standard Industrial Trade Classification (SITC). (For an explanation of the FTN system see Kostinsky, 1974.) Secondly, they use different monetary units. The Soviet trade data are reported in foreign trade roubles, and the OECD data in U.S. dollars. Although there is a dollar conversion rate for the rouble, it is not an international currency and the rate is set by the Soviet State bank. To further complicate the situation, the foreign trade rouble is not comparable with the domestic rouble. The foreign trade pricing system is discussed in Chapter 2. Throughout this study values of imports and exports are expressed in U.S. dollars and/or foreign trade roubles (See Appendix 1 for conversion rates). Similar problems of comparability occur when using physical measures. The United States uses different units from Western Europe, Japan and the Soviet Union (the U.S. billion is used in

this study). Unless otherwise stated, metric units are used in this study; when measures are converted from U.S. units both the imperial and metric measures are provided.

Because of the problems of availability, reliability and comparability, attention must be paid to the sources of information and the types of measure used, particularly when comparing data. Despite these problems it has been possible to collect sufficient information to examine the relationship between East-West trade and Siberian development.

Notes

1. Net material product is the Soviet equivalent of GNP, but excludes services not directly connected with physical production.

2. These ratios are based on CIA statistics and were calculated by dividing values of gross fixed capital stock by values of output. The increase in the ratios suggests an increasing level of capital intensity in Soviet industry.

Chapter 2

Soviet Trade Relations with the West

The first step in this study of East-West trade and Siberian development is to examine the nature of Soviet trading relations with the industrialised West. This Chapter provides the necessary information on the structure and pattern of East-West trade to estimate the level of Siberian participation. The organisation of Soviet foreign trade, the bureaucratic and financial system controlling trade, and some of the more imaginative forms of trading agreement, such as compensation agreements, are described in the first section. The remainder of the chapter presents information on the nature of Soviet foreign trade, the pattern of Western involvement and the commodity structure of exports to and imports from the industrialised West.

2.1. Foreign Trade Under Central Planning

The foreign economic relations of the Soviet Union are managed and controlled by the central planning system through the Ministry of Foreign Trade and not the industrial ministries or industrial enterprises, This state monopoly of foreign trade has been in existence since the early days of the Soviet Union, and its structure has remained essentially the same since the 1930s. However, in September 1986 the foreign trade bureaucracy underwent a limited reform, giving the industrial ministries and enterprises greater freedom to manage their own trading relations. Since these changes did not come into effect until January 1, 1987 they are not considered in this study.

2.1.1. The Organisation of Soviet Foreign Trade

Soviet foreign trade is managed by a complex bureaucratic system. Only a brief overview of the major agencies is presented here. (For more detailed analysis see Gruzinov, 1975 and Gardner, 1982.) Figure 2.1 offers a simplified view of the foreign trade bureaucracy.

At the pinnacle of the system stands the leadership of the Communist Party of the Soviet Union. For the Soviet leadership foreign economic relations have an important part to play in both domestic economic policy and foreign policy (see Parrott, 1983). At the next level are the various bodies responsible for planning the Soviet economy. Foreign trade policy is integrated into national economic plans by Gosplan USSR (the state planning committee) while the financial interactions associated with trade are the responsibility of the financial planning agencies, which also determine the pricing system used to account for foreign goods in the domestic economy. At the base of the system are the various agencies that implement foreign trade policy, the most important being the Ministry of Foreign Trade (MFT).

The MFT integrates the foreign trade policy dictated by the Party and Gosplan with the operations of the industrial ministries and their associated enterprises. The MFT is instrumental in both the formulation and the implementation of foreign trade plans. The state planning agencies and the MFT prepare a number of plans related to foreign trade, the most important being export and import plans, plans for transactions between Foreign Trade Organisations and the

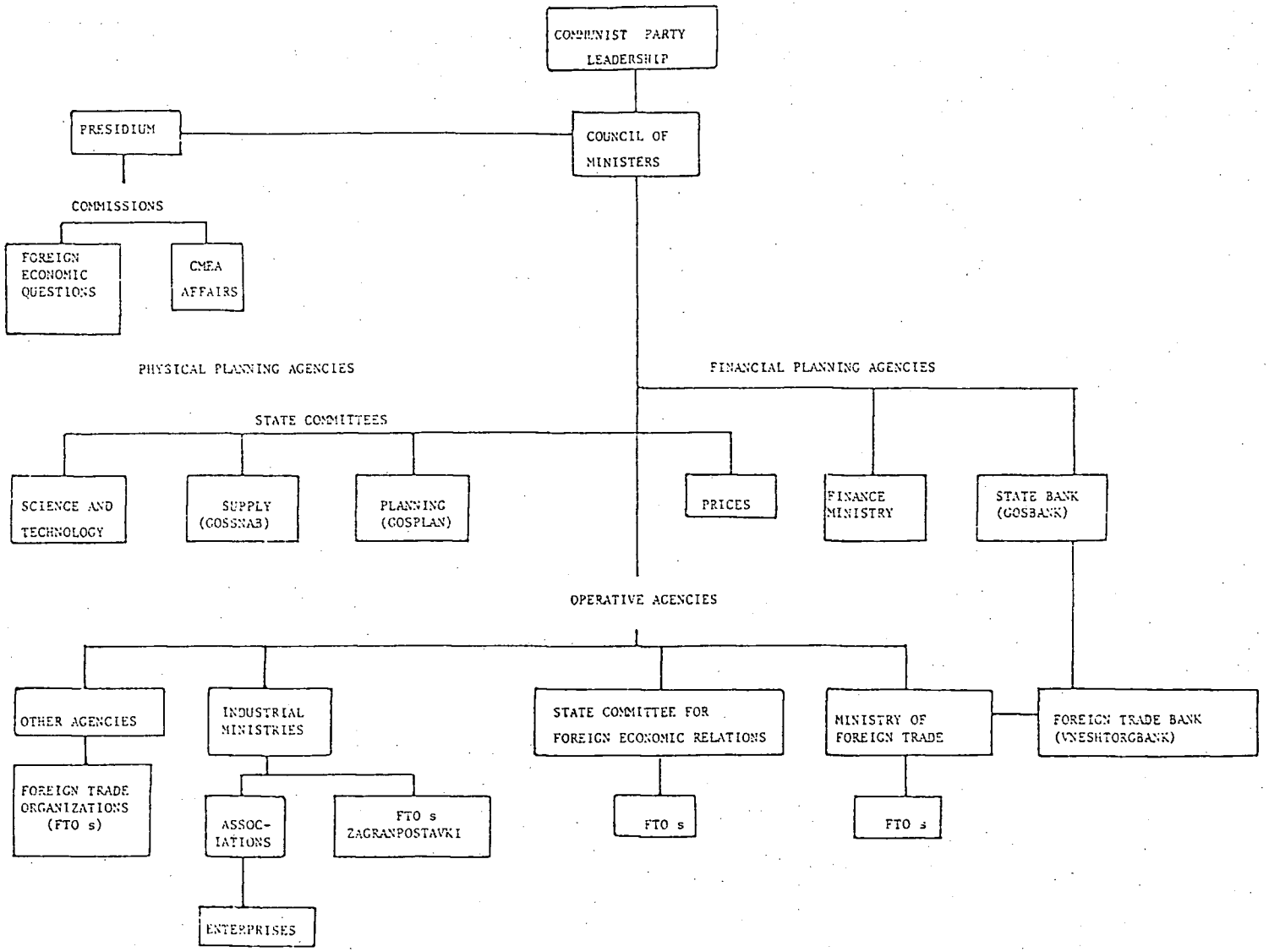


Figure 2.1 The Foreign Trade Bureaucracy
Source: Gardner, H.S. (1982), Soviet Foreign Trade: The Decision Process. The Hague: Kluwer-Nijhoff Pub., p. 2.

domestic economy, plans for delivery of equipment and materials for projects built abroad with Soviet technical participation, and plans for CMEA integration (Gardner, 1982, p.8). Once the plans have been drawn up the MFT is responsible for their implementation. The most important actors at this stage are the Foreign Trade Organisations (FTO). The majority of FTOs are subordinate to the MFT but are financially independent, covering their costs with fees and commissions (Treml and Kostinsky, 1982, p.3). The FTOs alone are responsible for negotiating and signing contracts with foreign companies; therefore, the industrial ministries have to conduct their foreign trade through the FTOs. The most important feature of the FTO system is that it serves to insulate the Soviet industrial enterprise from the international economic environment. An industrial enterprise producing goods for export has little or no contact with the foreign purchaser, because the FTO handles the transaction. Likewise the FTO handles the purchase of foreign plant and equipment--while industrial ministries and enterprises may request equipment, the FTO is responsible for its procurement (Nove, 1977, p.269). Because of this isolation exporters are unable to react quickly to the needs of a foreign buyer and imported goods often fail to meet the needs of the recipient enterprise. Because of the complex bureaucratic system regulating trade, problems of poor integration and departmentalism plague foreign economic relations as much as they do the domestic economy. It is these types of problems that the recent changes in the foreign trade bureaucracy are intended to solve. Sectors that export goods

which earn foreign currency may have a greater chance of receiving Western technology than sectors serving the domestic market. However, because goods produced for export usually have to meet much higher quality control standards they are often more expensive and troublesome to produce, so, despite the bonuses and higher prices offered, enterprise managers may consider export production to be more trouble than it is worth. Production of raw materials for export is a relatively simple task and may reap substantial economic and political rewards for the ministries involved. It is clear that the management of foreign trade is a very complex task and involves a great number of actors, each with their own vested interests.

2.1.2. The Foreign Trade Pricing System

Because the system of prices used in the Soviet economy is based on different concepts and serves a different purpose than prices in Western market economies, it is necessary to have separate external foreign trade prices and internal domestic prices (Bornstein 1976). The situation is further complicated by the fact that the rouble is not a convertible currency, so that when dealing in international markets Soviet traders have to use a convertible currency, usually U.S. dollars. This also means that to buy goods in the international market the Soviet Union must first earn the necessary convertible currency. For any good traded in foreign markets by the Soviet Union there are three prices: first, the price paid or received for a good in the world market expressed in the relevant foreign currency; second, the same price converted into foreign trade roubles on the basis of an official exchange rate

(see Appendix 1) and third, the domestic price paid to the producer of an export item or paid by the recipient of an imported good.

Treml and Kostinsky (1982) have suggested that domestic rather than foreign trade rouble prices should be used to evaluate the role of foreign trade in the Soviet economy. On the basis of such calculations they have concluded foreign trade plays a much greater role in the Soviet economy than previously thought. For example, Treml (1983, p. 40) has concluded that in 1980 more than 20 percent of capital investment in machinery and equipment was of foreign origin. The domestic rouble price of an imported good is likely to be higher than the foreign trade rouble purchasing prices. In other words the government exerts a tax on imports. At the same time, the price paid to enterprises for export goods may differ from the foreign trade price obtained in world markets. For example, the domestic price for oil has been below the world price. If planning decisions are based on domestic prices, the role of Siberian oil exports is undervalued. Treml's conclusions regarding the level of foreign trade participation are not universally accepted by Western economists. Vanous (1983, p. 97) has suggested that "world prices" and foreign trade roubles should be used when calculating the role of foreign trade in the Soviet economy. Whatever the correct position, it is important to realise that there are considerable differences between foreign trade prices and domestic prices. The spatial conseqences of such price distortions may be to reduce the impact of resource exports in

certain sectors and regions, or to inflate the cost of investment in complexes using imported plant and equipment. In methodological terms, one must exercise caution when using foreign trade data to determine the value of export production in certain regions or sectors, particularly when relating it to data based on domestic prices.

2.1.3. Countertrade and Compensation Agreements

Given that the Soviet Union must first export to pay for imports, the level of technology transfer is largely determined by the amount of revenue earned by exports. Until the late 1970s the Soviet Union purchased as much Western technology as it could afford and sought other means to purchase technology without spending foreign currency earned by exports. The Soviet Union has participated in various forms of countertrade that enable Western goods and technology to be paid for with deliveries of product. The most important forms of countertrade are counterpurchase and compensation agreements (Zaleski and Weinert, 1980, pp. 262-271).

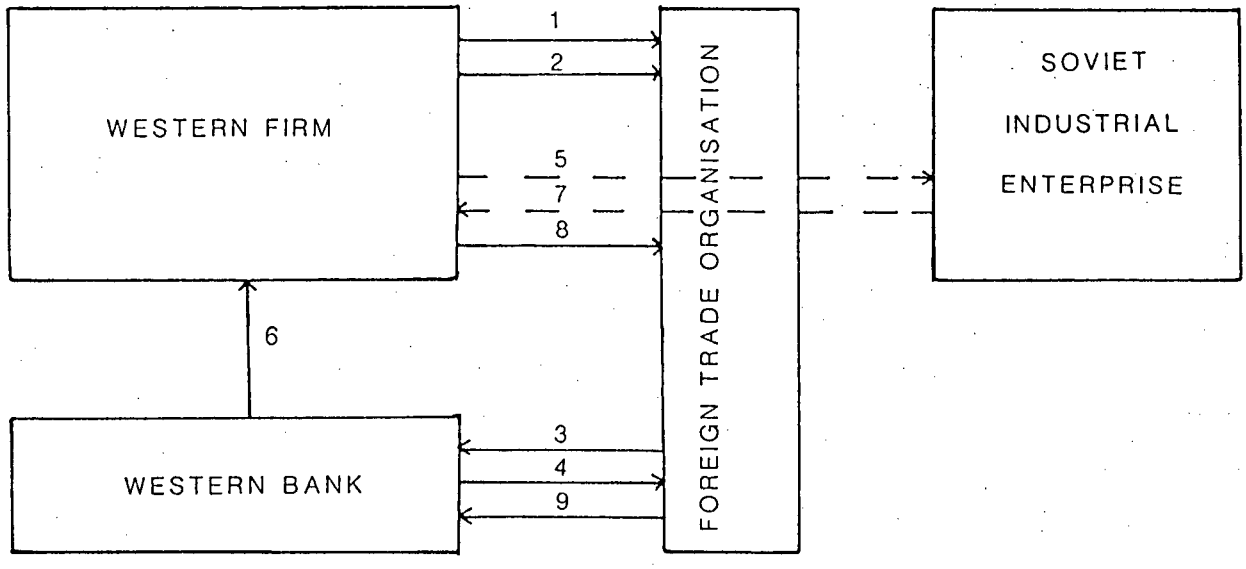
Under a counterpurchase agreement a Western seller provides the eastern buyer with technology, plant and equipment or products and agrees to purchase eastern goods equal to a percentage of the value of the sales contract. The agreement involves two separate contracts, one for the sale of the Western products and a second for the purchase of the eastern product. The eastern partner usually buys the Western goods using Western credits, only part of which is paid off with deliveries of product. An important attribute of counterpurchase agreements is that the eastern goods involved

are not produced using Western equipment purchased under the agreement. Examples of trade under such agreements include Pepsi Cola for vodka, and whale meat for fishing equipment.

Compensation agreements differ from counterpurchase agreements because the product which pays for the plant and equipment is usually produced using that imported equipment. The U.N. Economic Commission for Europe (1982, pp. 172-173) defines a compensation agreement as:

> "A specific kind of long-term economic contract between two or more partners from different countries providing deliveries, as a rule on credit, from one partner of complete equipment, licences and know-how for the construction of industrial installations and, from the other partner, for counter-deliveries over several years of products resulting from these installations (or of related products resulting from other installations) in total or part payment for the previously-imported equipment and technical documentation".

Common characteristics of Soviet-Western compensation agreements are that they are large-scale, capital intensive and predominantly in the primary and basic industrial sectors (Barclay, 1979). Contracts are negotiated on a case-by-case basis and there is no set contractual format. The generalised structure of compensation agreements is presented in Figure 2.2. In the first stage (1) the Western firm agrees to sell plant and equipment to the Soviet Union. It should be noted that while one Western company may sign the contract it often sub-contracts parts of the deal to other Western companies. In the second stage (2) the Western firm agrees to purchase some of the plant's output, for its own use or for sale in Western markets. The third stage (3) involves negotiation between the Soviet Union (for which there is a



----- = The Movement of Contracts, Credits and Money

——— = The Movement of Plant and Product

1. The Western Firm contracts to sell plant and equipment to an Eastern Partner.
2. The Western Firm contracts to purchase some of the plant's output once production has begun.
3. The Eastern Partner negotiates with the Western Bank(s) for credit with which to purchase Western plant and equipment.
4. Western Bank(s) extend purchase credits to the Eastern Partner.
5. The Western Firm delivers plant and equipment.
6. Western Bank(s) pay the Western Firm for plant and equipment.
7. When production begins, the Eastern Partner delivers part of the production to the Western Firm.
8. The Western Firm pays the Eastern Partner for the deliveries of product.
9. The Eastern Partner repays the Bank credit.

Figure 2.2. The Structure of a Compensation Agreement

special department in the Ministry of Foreign Trade) and Western banks for credit with which to buy plant and equipment. Because of the bargaining power of the Soviet Union and the value of these agreements, as well as their political significance, credit is often supplied below market rates. In many cases government-supported credit facilities such as the Japanese Export-Import (EXIM) Bank provide credit. Having secured the necessary credit (4), the Western partner delivers the plant and equipment (5) and is paid by the Western bank (6). Once the plant is in operation (there may be a considerable amount of time between delivery of plant and start-up) part of its production is supplied to the Western firm (7), which then makes payment for the product to the Soviet partner (8), who in turn pays off the Western bank (9).

The supply of Western plant under a compensation agreement provides a number of advantages, not least of which is the fact that the Western partner has a vested interest in the successful installation and operation of the plant. In addition the Western technology is usually supplied in the form of a "Turnkey Plant", which means that the Western partner is responsible for the construction of the production facility and all the Soviet partner need do is "turn the key" to start operation. The purchase of turnkey plants has a number of potential advantages for the Soviet Union. First, they quickly create new production facilities and enable rapid expansion of output. Second, additions of Western technology enhance labour productivity in the recipient industry by improving the efficiency of production. Third, related to the previous

point, turnkey plants can improve the input/output ratio of the recipient industry. Fourth, turnkey plants can act as an example of the benefits of technological innovation, thus stimulating the domestic innovation process. Finally, once compensation agreements have been made, the high-quality products of the plant can be exported to generate further foreign currency. Compensation agreements are not the only means of obtaining turnkey plants, but they do represent the preferred form of turnkey plant acquisition.

By the early 1980s, 65 projects were being built in the Soviet Union on the basis of compensation agreements (Nirsha, 1981, p. 38). One Soviet source estimates that since 1970 more than 10 billion roubles worth of equipment, technical documentation, pipe and materials have been delivered under compensation agreements (Zhebrovskiy and Ponomarov, 1986, p. 18). During 1978 no compensation agreements were signed, and only one agreement was reached in 1979 (Brainard, 1983). This reflects a backlash against Western imports which is discussed later in this chapter, but it also indicates that there must have been a large number of agreements negotiated in the early 1970s. An additional reason for the declining number of compensation agreements is that the depression-struck industries of the West no longer wished to secure further supplies of raw and semi-processed materials. From the Soviet viewpoint compensation agreements have provided an important means of complementing domestic investment and increasing the productive capacities of key industries. For the purposes of this study the popularity of large-scale compensation

agreements as a means of developing Siberian resources is particularly fortuitous because it enables identification of both the sectors and regions that have been recipients of Western technology or producers of exports.

The state monopoly over foreign trade enables the Soviet leadership to maintain control over the level and structure of trade with the West in such a way as to meet the needs of the Soviet economy. It is this central control, more than anything else, that distinguishes foreign trade under socialism from foreign trade in the economies of the industrialised West. While central control enables planners to use foreign trade to solve specific problems in the national economy, such as inadequate grain production, it requires a complex bureaucratic system that may actually reduce the efficiency of trading relations between the Soviet Union and the West.

2.2. The Pattern and Structure of East-West Trade.

Since the Second World War the Soviet Union has become a more active participant in the international trade arena. But the Soviet Union cannot be considered a major trading nation. Despite being the world's second largest economy, in 1980 the Soviet Union ranked eighth in the value of its foreign trade (North, 1983, p. 97). In the immediate post-war years the growth of Soviet foreign trade was associated with the expansion and consolidation of the Eastern Bloc. The "Cold War" blockade severely restricted the potential for East-West trade. During the late 1960s there was a change of attitude on the part of the Soviet leadership towards East-West trade. The signing of a large technology trade agreement with the Italian

automobile firm FIAT in 1965 marked a new era in East-West trade relations (see Holliday, 1979). The Brezhnev-Kosygin leadership perceived increased trade with the West as a means of revitalising a stagnating domestic economy by providing much-needed technological innovation. Western leaders, in particular in the United States, saw increased trade with the Soviet Union as a means of fostering an economic interdependence that would enable the West to influence Soviet policy. The combination of these attitudes contributed to the first Brezhnev-Nixon Summit in May 1972 and the era of detente.

It is the purpose of this section to examine the evolution of East-West trade since the early 1970s. While the emphasis is upon economic aspects, political aspects are not ignored as they exert great influence upon the pattern of trade.

2.2.1. The Geographical Distribution of Soviet Foreign Trade

Since the 1970s there has been a steady increase in the value of Soviet foreign trade (see Figure 2.3). While part of this increase can be ascribed to inflation and manipulation of exchange rates, there can be no doubt that foreign trade is more important to the Soviet economy in the 1980s than it was in the 1960s. Soviet foreign trade accounting practices distort the value of CMEA trade, and manipulations of the rouble/dollar exchange rate may undervalue trade with the West. Nevertheless, during the 1970s trade with the West became more important while the share of trade with the developing nations remained relatively stable (see Table 2.1 and Figure 2.4). In all cases there was a large increase in the total value of trade.

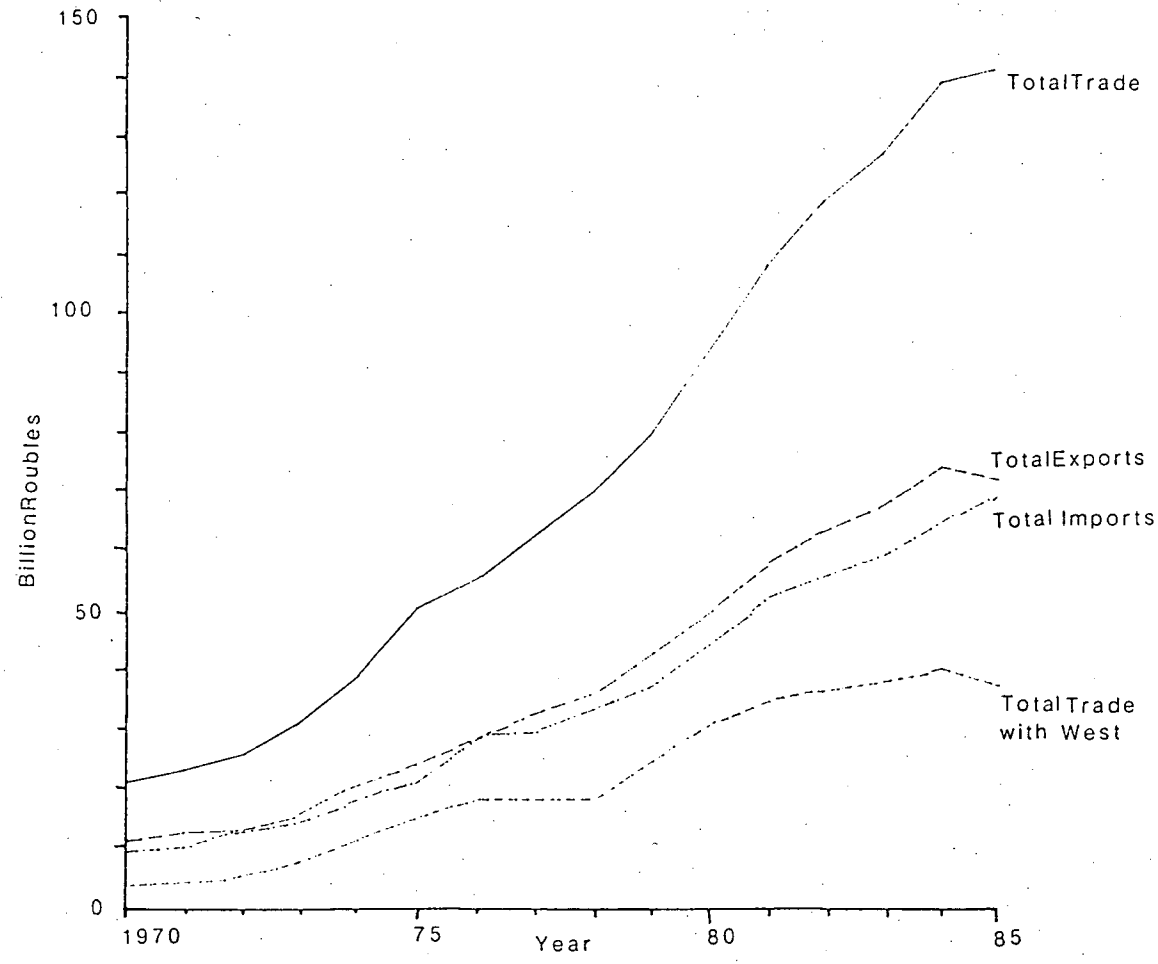


Figure 2.3. The Recent Growth of Soviet Foreign Trade, 1970-1985

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

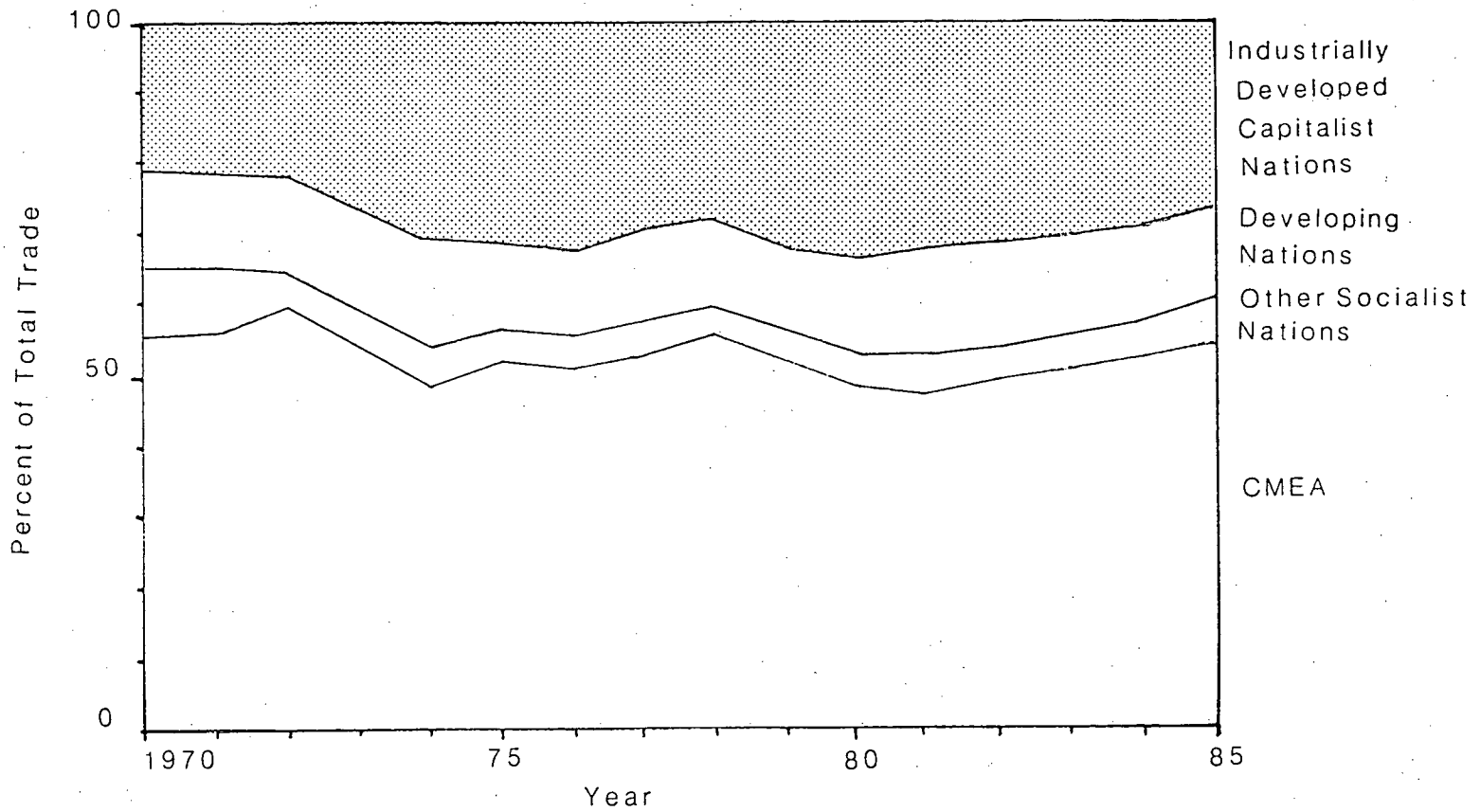


Figure 2.4 The Geographical Distribution of Soviet Foreign Trade, 1970-1985

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

Table 2.1

Soviet Trading Partners, 1970-1985

	1970	1975	1980	1981	1982	1983	1984	1985
(Value of Total Trade Turnover, Billion Foreign Trade Roubles)								
Trading Bloc								
Socialist Countries[a]	14.4	28.5	50.6	57.9	65.0	71.4	80.3	86.5
CMEA Members	12.3	26.2	45.8	52.2	58.7	65.3	72.8	77.7
Other Socialist	2.1	2.4	4.8	5.8	6.3	6.1	7.5	8.8
Industrialised Capitalist Nations	4.7	15.8	31.6	35.3	37.7	38.4	40.9	37.9
Developing Nations	3.0	6.3	11.9	16.5	16.9	17.7	18.5	17.2
Total	22.1	50.6	94.1	109.7	119.6	127.5	139.7	141.6
(Percent of Total Trade Turnover)								
Trading Bloc								
Socialist Countries[a]	65.2	56.3	53.7	52.8	54.3	56.0	57.5	61.1
CMEA Members	55.6	51.8	48.6	47.6	49.1	51.2	52.1	54.8
Other Socialist	9.6	4.5	5.1	5.2	5.2	4.8	5.4	6.3
Industrialised Capitalist Nations	21.3	31.3	33.6	32.2	31.6	30.1	29.3	26.7
Developing Nations	13.5	12.4	12.7	15.0	14.1	13.9	13.2	12.2
Total	100	100	100	100	100	100	100	100

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

a. After 1972 Cuba is included in CMEA figures.

During this period of expanding East-West trade there has been considerable flux among the major Western trading partners. Table 2.2 presents the share of the major Western industrialised nations in total Soviet foreign trade. In the early 1970s the major trading partners were the nations of Western Europe, most notably Great Britain, Italy, West Germany and Finland as well as Japan. In many studies of East-West trade Finland is treated as a special case because Soviet-Finnish trade is based on a bilateral clearing system, annual trade protocols and five-year trade agreements (Ruoho, 1985, pp. 26-28). In addition Finland is not a member of CoCom, the committee responsible for monitoring strategic trade with the East (McIntyre and Cupitt, 1980). However, Finland does observe the re-export restrictions set by a country of origin. This means that while Finland would not abide by a strategic embargo imposed by the United States, she would not re-export United States products subject to that embargo. Thus, Soviet-Finnish technology trade can be affected by Western policy towards technology transfer. While the bilateral trading system with Finland means that the Soviet Union can acquire high-technology Western products without spending foreign currency, the Soviet Union has to provide exports to Finland to pay for those imports. Therefore, in this study Finland is considered together with the other West European nations.

By the mid-1970s the share of the major Western partners in Soviet trade had increased and the United States had joined the ranks of the major trade partners. In 1975 West Germany was the most important trading partner, followed by Japan,

Table 2.2

Distribution of Soviet Foreign Trade Among the Industrialised Capitalist Nations ,1970-1985

(As a Percent of Total Trade Turnover)

	1970	1975	1980	1981	1982	1983	1984	1985
Total	21.3	31.3	33.6	32.2	31.6	30.1	29.3	26.7
Including:								
Austria	0.7	0.9	1.0	1.2	1.0	1.1	1.2	1.2
Belgium	0.7	1.0	1.3	1.1	1.3	1.3	1.2	1.0
Great Britain	2.9	1.9	1.9	1.4	1.3	1.4	1.6	1.3
Italy	2.1	2.8	3.2	3.2	3.4	3.5	3.2	2.7
Canada	0.6	0.9	1.1	1.3	1.2	1.0	1.0	0.7
Netherlands	1.0	0.9	1.5	1.4	1.6	1.3	1.4	0.9
United States	0.7	3.2	1.6	1.7	1.9	1.5	2.2	1.9
West Germany	2.5	5.5	6.1	5.5	5.5	5.5	5.4	5.0
Finland	2.4	3.5	4.1	4.6	4.3	4.1	3.4	3.5
France	1.9	2.6	4.0	3.8	3.0	3.2	3.0	2.7
Sweden	1.1	1.1	0.7	0.6	0.6	0.7	0.6	0.6
Japan	3.0	3.8	2.9	2.8	3.2	2.3	2.1	2.3

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

Finland, the United States and France. But by the beginning of the 1980s the pattern had changed yet again. West Germany remained the most important partner followed by Finland and France, but trade with the United States and Japan had declined. The downward trend in Soviet-American trade was triggered by both political actions in the United States and American response to Soviet foreign policy.

In December 1974 the United States Congress passed the Export-Import Bank Amendments and the Trade Act of 1974. The so-called "Jackson-Vanik" Amendment made the granting of Most-Favoured Nation status to the Soviet Union conditional upon Soviet emigration policy (with particular reference to Jewish emigration), and the "Stevenson" Amendment set an overall ceiling of $ 300 million on Export Import Bank credits to the USSR with even lower limits for energy projects. Following these moves the Soviet Union redirected much of its trade away from the United States towards Western Europe and Japan. The major exception was the import of grain from the United States: the poor Soviet harvests in 1975 and 1979 served to bolster the level of Soviet-American trade. The Soviet invasion of Afghanistan occurred in December 1979, and prompted economic sanctions against the Soviet Union, including a grain embargo, and a boycott of the 1980 Olympic games in Moscow. The United States called upon her Western allies to support sanctions against the Soviet Union. The response was mixed, not because of disagreement over condemnation of Soviet actions in Afghanistan, but because many West European governments did not agree in principle with trade sanctions and also had a much

greater stake in East-West trade. Despite sanctions European trade with the Soviet Union continued to expand. The Japanese Government responded to the United States' sanctions by stopping Soviet access to government credit. This action hampered many Siberian resource projects and led to the downturn in Soviet-Japanese trade in the early 1980s depicted in Table 2.2. Japanese credit facilities were restored in 1985.

In April 1981 the Reagan Administration lifted the grain embargo instigated by the Carter administration, but the declaration of martial law in Poland led to economic sanctions in December 1981. The West European nations and Japan again questioned the effectiveness of sanctions. As a result President Reagan attempted to stop the export of United States licensed energy-related technology to the Soviet Union by West European and Japanese companies. The resulting disagreement has become known as the "Siberian Pipeline Controversy" after the Urengoy export pipeline that was the focus of this debate over East-West trade. The pipeline deal is dealt with in Chapter 6 of this study. At present it is sufficient to note that the controversy served to further polarise the American and European positions on East-West trade. These actions have reduced the role of the United States so that East-West trade now predominantly concerns West European and Japanese business. The United States is no longer able to influence Western trade with the Soviet Union directly. Even in grain trade the Soviet Union has attempted to diversify her sources, thus reducing the level of dependence on the United States. In the context of

this study the focus of East-West trade upon Western Europe and Japan has important geographical implications. Geographically the West European market can be considered an extension of the East European market; while Japan is located in close proximity to the resource riches of the Far East. Both the Western European nations and Japan are major trading economies dependent on imported energy resources and raw materials. Therefore there exists a complementarity that promotes trade. The United States on the other hand is both geographically removed and relatively self-sufficient. The ramifications of the geographical pattern of East-West trade are more apparent when one examines the commodity structure of Soviet foreign trade.

2.2.2. The Structure of Soviet Foreign Trade

The general structure of Soviet foreign trade is presented in Tables 2.3 and 2.4. These data include all trading groups: CMEA members, other socialist nations, the industrialised capitalist nations and the developing nations. Soviet exports are dominated by trade in energy resources and raw materials, which have increased in importance since 1970. The main reason for the increased share of energy exports is the rapid increase in their value on world markets as the result of OPEC price increases. The export of energy and raw materials is particularly important in Soviet trade with Eastern Europe and the industrialised West, while machinery exports are more important in trade with the developing nations. The reason for this is the inability of Soviet manufactured goods to compete successfully in Western markets.

Table 2.3

Structure of Soviet Exports, 1970-1985

(As a Percent of Total Imports)

	1970	1975	1980	1981	1982	1983	1984	1985
Machinery, Equipment & Means of Transport	21.5	18.7	15.8	13.7	12.9	12.5	12.5	13.6
Fuel & Electricity	15.6	31.4	46.9	50.2	52.3	53.7	54.4	52.8
Ores, Concentrates, Metals & Metal Products	19.6	14.3	8.8	8.0	7.4	7.5	7.2	7.5
Chemical Products, Fertilizers and Rubber	3.5	3.5	3.3	3.5	3.1	3.1	3.5	3.9
Forest Products, & Cellulose, Paper Products	6.5	5.7	4.1	3.3	2.8	2.8	2.8	3.0
Textiles Raw Materials & Semi-Manufactures[a]	3.8	3.1	1.9	2.0	1.8	1.4	1.2	1.3
Food & Raw Materials for their production	8.4	4.8	1.9	2.0	1.6	1.5	1.5	1.5
Consumer Manufactures	2.7	3.1	2.5	1.8	1.9	1.8	1.8	2.0

Source: Ministertvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

a. Includes furs and skins.

Table 2.4

Structure of Soviet Imports, 1970-1985

(As a Percent of Total Imports)

	1970	1975	1980	1981	1982	1983	1984	1985
Machinery, Equipment & Means of Transport	35.5	33.9	33.9	30.2	34.4	38.2	36.6	37.2
Fuel & Electricity	2.0	4.0	3.0	3.6	4.6	5.6	6.1	5.3
Ores, Concentrates, Metals & Metal Products	9.6	11.5	10.8	10.0	9.9	8.8	8.3	8.3
Chemical Products, Fertilizers, & Rubber	5.7	4.7	5.3	5.2	4.4	4.6	4.5	5.0
Forest Products, & Cellulose, Paper Products	2.1	2.2	2.0	1.8	1.5	1.3	1.2	1.3
Textiles Raw Materials & Semi-Manufactures	4.8	2.4	2.2	1.7	1.6	2.1	1.6	1.7
Food & Raw Materials for their production	15.8	23.0	24.2	27.7	23.7	20.5	22.5	21.2
Consumer Manufactures	18.3	13.0	12.1	12.9	12.7	11.5	11.7	12.4

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

The structure of Soviet imports is very different with the most important items being machinery and equipment and food products. The majority of Soviet machinery imports come from other CMEA members, with the industrialised West accounting for 25-30 percent. Food products are imported from the major Western grain producers (United States, Canada, Argentina and the European Community) as well as the developing nations.

The commodity composition of Soviet foreign currency trade is shown in Table 2.5. The pattern is similar to that of total trade, with energy and raw materials dominating exports and machinery and agricultural imports making up the majority of imports. The very rapid increase in the value of energy exports is illustrated by the fact that in 1970 petroleum and petroleum products and natural gas earned $ 444 million or 18.3 percent of total foreign currency imports, while by 1983 the value of oil and gas exports had reached $ 18.7 billion or 71.4 percent of total foreign currency exports. Other important foreign currency exports include wood and wood products and diamonds. Also of importance are exports of non-fuel minerals which are not identified separately in Soviet statistics. Finally, foreign currency earned by gold sales and arms sales is not included in Soviet trade statistics.

While the value of foreign currency machinery and equipment imports has risen since 1970, their share of total imports has fluctuated. Agricultural products increased in importance during the 1970s and grain imports are now a major import item. Included in ferrous metals imports (Table 2.5) are imports of steel pipe. Further insight into the importance

Table 2.5

Structure of Soviet Foreign Currency Trade, 1970-1983[a]

(By Value, Million $ U.S., and Percent of Total)

	1970		1975		1980		1983	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent
Exports	2,424	100	8,280	100	23,584	100	26,243	100
Petroleum & Petroleum Products	430	17.7	3,391	40.9	12,295	52.1	15,527	59.2
Natural Gas	14	0.6	220	2.7	2,704	11.5	3,194	12.2
Coal & Coke	106	4.4	402	4.9	366	1.5	177	0.7
Machinery & Equip.	193	7.9	647	7.8	1,468	6.2	1,932	7.4
Ferrous Metals	137	5.7	164	2.0	246	1.0	201	0.8
Wood & Wood Products	389	16.0	739	8.9	1,500	6.4	853	3.2
Chemicals	64	2.6	243	2.9	758	3.2	691	2.6
Agricultural Products	192	7.9	547	6.6	458	2.1	328	1.2
Diamonds	175	7.2	478	5.8	1,304	5.5	na	na
Other	724	30.0	1,449	17.5	2,485	10.5	3,340	12.7
Imports	2,984	100	14,577	100	26,070	100	27,715	100
Grain	101	3.4	2,323	15.9	4,548	17.5	4,859	17.5
Other Ag. Products	657	22.0	1,760	12.1	4,717	18.1	4,242	15.3
Machinery & Equip.	967	32.4	4,593	31.5	6,039	23.2	6,998	25.3
Rolled Ferrous Metal	303	10.2	2,627	18.0	3,606	13.8	3,712	13.4
Chemicals	215	7.2	722	5.0	1,646	6.3	1,431	5.2
Consumer Goods	392	13.1	630	4.3	1,123	4.3	1,171	4.2
Other	349	11.7	1,922	13.2	4,391	16.8	5,302	19.1

Sources: CIA (1983), Handbook of Economic Statistics, 1983. Washington, D.C.: GPO, p. 68.
CIA (1985a), Handbook of Economic Statistics, 1985. Washington, D.C.: GPO, p. 70.

a. These data are based on Soviet statistics and include all countries trading with the Soviet Union on a foreign currency basis as of January 1, 1980.

of East-West trade is gained by examining the share of foreign currency trade in each commodity group (see Table 2.6). The importance of energy resource and raw material exports as a source of convertible currency is emphasised by their high share of total exports. For example, since the mid 1970s foreign currency sales of oil have accounted for over 40 percent of all oil exports. The special role of East-West trade is even more apparent when examining Soviet foreign currency imports. Foreign trade imports account for the vast majority of grain imports and a large part of rolled ferrous metals and chemical imports. The relatively low share of machinery imports reflects the importance of CMEA trade as a source of machinery and equipment.

2.3. Soviet Trade with the Industrialised West

East-West trade is dominated by a relatively small group of countries. According to Soviet foreign trade statistics since 1970 West Germany, Finland, Italy, France, Great Britain, Japan and the United States together have, on average, accounted for 70 percent of Soviet trade with the industrialised West. The commodity structure of that trade is presented in Table 2.7. By removing trade with the developing nations the share of food imports is reduced, while the importance of manufactured good and equipment imports is increased. In the case of Soviet exports, removal of the developing nations serves to further reduce the share of machinery exports, while exports of energy and raw materials assume greater importance. Since the mid-1970s energy resources have replaced raw materials as the most important

Table 2.6

Role of Foreign Currency Trade in Total Soviet Foreign Trade,[a] by Commodity, 1970-1983

(Foreign Currency Trade as a Percent of Total Trade)

	1970	1975	1980	1981	1982	1983
Exports:	19	25	31	30	30	29
Petroleum and Petroleum Products	29	41	43	40	42	41
Natural Gas	27	34	48	52	45	38
Coal & Coke	26	29	22	11	8	10
Machinery & Equipment	7	10	12	14	17	17
Ferrous Metals	10	6	7	5	7	5
Wood & Wood Products	47	39	49	37	30	30
Chemicals	19	26	38	32	30	30
Agricultural Products	14	23	17	19	16	14
Other	18	17	17	21	18	15
Imports:	25	39	36	38	35	34
Grain	75	87	92	88	23	23
Rolled Ferrous Metals	51	79	78	84	88	77
Chemicals	50	54	56	53	37	52
Consumer goods	16	11	10	10	3	11
Other	20	12	48	44	36	42

Sources: CIA (1983), Handbook of Economic Statistics, 1983. Washington, D.C.: GPO, p. 68.
CIA (1985a), Handbook of Economic Statistics, 1985. Washington, D.C.: GPO, p. 70.

a. In Soviet trade statistics the importance of hard currency trade is overstated for exports and understated for imports because of the artificial prices used in trade with the CMEA.

Table 2.7

The Commodity Structure of Soviet Trade with the OECD Nations[a]

(Percentage of Soviet Total Imports and Exports)

SITC SECTIONS	1970-1975 Average	1976-1980 Average	1981-1984 Average
SOVIET IMPORTS FROM OECD			
Food and Live Animals (0)	15.4	17.8	25.3
Beverages and Tobacco (1)	0.6	0.5	0.4
Crude Materials, except fuel (2)	5.9	4.9	4.4
Mineral Fuels and Energy (3)	0.2	0.5	1.0
Animal and Vegetable Oils and Fats (4)	0.1	0.3	0.6
Chemicals (5)	8.6	9.0	8.7
Manufactured Goods, by Material (6)	29.6	28.8	27.3
Machinery & Transportation Equip. (7)	32.2	33.0	26.1
Miscellaneous Manufactures (8)	6.4	4.8	5.2
Non-Classified (9)	1.0	0.7	1.0
TOTAL (0-9)	100.0	100.0	100.0
SOVIET EXPORTS TO OECD			
Food and Live Animals (0)	3.3	1.2	0.9
Beverages and Tobacco (1)	0.2	0.2	0.1
Crude Materials, except Fuel (2)	29.1	16.3	8.2
Mineral Fuels and Energy (3)	39.9	61.8	78.7
Animal and Vegetable Oils and Fats (4)	1.7	0.3	(0.04)
Chemicals (5)	3.4	5.8	4.1
Manufactured Goods, by Material (6)	16.5	9.5	5.2
Machinery and Transportation Equip. (7)	4.5	3.5	1.9
Miscellaneous Manufactures (8)	0.8	0.7	0.3
Non-Classified (9)	0.7	0.7	0.6
TOTAL (0-9)	100.0	100.0	100.0

Source: OECD (various years), Series "C", Trade by Commodity. OECD: Paris.

a. OECD data are organised by the SITC system.

source of foreign currency. In the following discussion the major sources of foreign currency and the structure of Soviet imports are examined.

2.3.1 Soviet Fuel Exports to the Industrialised West

In recent years by far the most important source of foreign currency for the Soviet Union has been the export of petroleum and petroleum products. The major market for Soviet oil exports has been Western Europe (see Table 2.8). In 1979 the Soviet share of West European imports of crude oil was 3.9 percent (245 million tons) and of oil products 16.5 percent (19.1 million tons) (Hannigan and McMillan, 1984, p. 80). The Soviet Union has reaped great benefit from the rapid increase in oil prices brought about by the actions of OPEC. The value of Soviet oil exports has increased at a much faster rate than has volume. Between 1970 and 1983 foreign currency revenue from oil exports (crude oil and oil products) increased from $ 430 million to $ 15.5 billion, while between 1971 and 1983 the volume of exports of crude oil and oil products to non-communist countries increased from 50 million tons to 90.4 million tons (see Table 2.8). These windfall profits have played a very important role in financing the expansion of East-West trade.

During the first half of the 1980s the Soviet Union continued to expand exports of oil to the West. According to OECD figures, Soviet exports of oil and oil products to OECD nations rose from 53.5 million tons in 1981 to 69 million tons in 1982 and 78 million tons in 1983 (Gorst, 1985, p.57). Exports peaked at 81.4 million tons in 1984, and during 1985

Table 2.8

Soviet Oil Exports, 1971-1984

(Million Tons per year)[a]

	1971	1975	1980	1981	1982	1983	1984[b]
Total Exports	105.5	130.0	163.9	161.2	169.5	183.4	188.4
Communist Countries	55.5	77.5	99.6	100.2	91.3	93.0	94.5
Non-Communist Countries	50.0	52.5	64.3	61.2	78.2	90.4	93.9
Western Europe	33.9	33.8	56.6	52.2	67.1	77.6	79.8
Including:							
Finland	8.6	6.9	9.7	9.9	11.4	11.7	10.4
France	3.8	2.9	8.4	8.1	7.0	8.4	7.8
Ttaly	9.1	6.2	6.9	6.7	8.6	9.8	12.1
Netherlands	0.8	2.3	7.3	8.3	12.6	13.5	13.6
Sweden	5.1	4.5	2.4	1.3	2.4	4.2	2.5
West Germany	5.7	7.4	6.9	5.0	8.6	10.6	12.0
Exports to Western Europe as a percent of total exports	32.1	26.0	34.5	32.4	39.8	42.3	42.4

Sources: Scherer, J.L. ed. (1984), USSR Facts and Figures Annual, Vol.8. Gulf Breeze Fl.: Academic International Press, pp. 148-149.
Scherer, J.L. ed. (1986), USSR Facts and Figures Annual, Vol. 10. Gulf Breeze FL.: Academic International Press, p. 108.

a. Converted from barrels per day and rounded up.
b. Preliminary figures.

Soviet oil export revenue declined for the first time since 1958. The total volume of oil exports during 1985 was 165-175 million tons, compared to total exports of 188.4 million tons in 1984. Volume figures are not available for exports to the West, but the value of oil exports to non-communist countries fell from $ 17.6 billion in 1984 to $ 14.1 billion in 1985, a fall of $ 3.5 billion.[1] As this fall occured well ahead of the collapse in oil prices in early 1986 it is probably related to domestic production and transportation problems. Soviet oil production has been in decline since 1983 when it reached 616 million tons a year. In 1984 production fell to 613 million tons a year and in 1985 to 595 million tons, 33 million tons short of the 1985 plan target of 628 million tons.[2] Nevertheless, between 1983 and 1984 the volume of exports to the West increased despite falling production, a clear indication of the vital role of oil exports in Soviet foreign currency trade. Just as the Soviet Union benefited from the 1974 and 1979 oil shocks, it will undoubtedly suffer from the third oil shock and the rapid reduction in price. During the first few months of 1986 the Soviet Union did not sell oil on the World market, but it re-entered the market in April 1986. Faced with production problems and faltering oil prices the Soviet Union decided in the late 1970s to expand foreign currency exports of natural gas.

The natural gas reserves of the Soviet Union, estimated at 35 trillion cubic metres in 1982, represent one-third of the world's proven reserves (Russell, 1983, p. 131). In the space of 15 years the Soviet Union has gone from being a net importer

of natural gas to the world's largest producer and second largest exporter after the Netherlands. The rapid expansion of Soviet natural gas production is examined later in this study. At present we are concerned with its role in foreign currency exports. As with oil exports, Western Europe is the most important market accounting for 44.5 percent of all Soviet gas exports in 1983 (Scherer, 1986, p. 109). According to OECD energy statistics, the volume of exports to the OECD (OECD Europe consumes all Soviet gas exports to the OECD) has increased from 1.0 billion cubic metres in 1970 to 25.3 billion cubic metres in 1983.[3] However, it should be noted that natural gas is not as transportable as oil. Pipelines are the only efficient means of transportation, and this limits the markets to which Soviet gas can be sold. Construction of long-distance gas pipelines is very expensive, and once installed such pipleines are inflexible. Sea transportation requires that the gas be liquified which is costly. During the 1970s there were a number of projects proposed to export liquified natural gas (LNG) from the Soviet Union to the United States, but they never came to fruition. Exports of LNG to Japan from the Sakhalin region may begin in the 1990s. In the meantime Western Europe represents the most important foreign currency market for Soviet natural gas.

Since the mid-1970s the Soviet Union has imported large amounts of large diameter pipe to construct the pipeline networks necessary to transport Siberian oil and gas to domestic and export markets. Much of this pipe was purchased through gas-for-pipe deals, whereby the credit supplied by a

Western source to purchase pipe is paid back by eventual deliveries of natural gas. Now that the pipeline systems are complete the pay-off stage of these deals has been reached, and gas exports to the West are likely to expand in the second half of the 1980s. Since the initial deals were signed West European demand for gas has declined and the Soviet Union now has more gas to export that it can sell. In 1983 one Western analyst (Stern 1983, p. 380) forecast that Western Europe could be importing 65 billion cubic metres of natural gas from the Soviet Union by 1990. However, since then some of the West European nations have reduced their commitments to buy Soviet gas, and by late 1984 the Soviet Union had firm contracts for export of only 21 billion cubic metres a year. Exports are now not expected to exceed 30 billion cubic metres in 1990 (Stern, 1985, pp. 52-53). Obviously the collapse of oil prices will have a negative effect on both the demand for and price of natural gas. Despite the existence of a floor price for Soviet gas exports to Western Europe the future of foreign currency revenues from oil and gas is impossible to predict. In sum, while the rapid increase in energy prices during the 1970s and early 1980s enabled the Soviet Union to increase its foreign currency exports substantially, reliance on the volatile energy market for over 70 percent of foreign currency income incurs a risk, and all indications are that during the second half of the 1980s domestic production problems and reduced prices will severely reduce the value of Soviet foreign currency energy exports.

2.3.2. Soviet Non-Fuel Exports to the Industrialised West

The other major sources of foreign currency are exports of non-fuel minerals, wood and wood products, arms and services. The economics of Soviet non-fuel mineral resources are difficult to fathom because the Soviet Union generally participates in the minerals markets to generate foreign currency to cover balance of payments requirements only when necessary. The reason for this is that exports are not necessarily surplus production and in many cases could readily be consumed in the domestic market (Ballinger, 1985, p. 163). Soviet mineral development policy is based on the goal of maximum self-sufficiency, and cost is a secondary consideration. Mineral deposits are often developed under conditions that would not be considered economic in market economies. Here we are concerned with those minerals that are the more important sources of foreign currency, namely gold, platinum group metals and diamonds.

The Soviet Union does not release official statistics on gold reserves, production and trade, but the CIA produces annual estimates of all these. These estimates are presented in Table 2.9, along with the production estimates suggested by Michael Kaser, a leading Western expert on the Soviet gold industry. For a discussion of the differences between the two sets of estimates and the changes in the CIA estimates see Kaser (1983, pp. 584-587). The Soviet Union is the world's second largest producer of gold after South Africa and has increasingly used gold sales to obtain foreign currency. Over the period 1960-1979 gold sales, on average, accounted for 14

Table 2.9

Soviet Production and Trade in Gold, 1970-1983

	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983
Gold Production (Metric Tons)										
Kaser[a]	264	308	321	325	330	335	344	na	na	na
CIA est.[b c]	218	258	276	285	296	207	317	326	329	333
Reserves (CIA)[c]	1,631	1,899	1,797	1,702	1,527	1,581	1,811	1,889	2,118	2,391
Gold Exports										
Metric Tons[a e]	-	141	341	338	422	223	70	290	203	93
Million $[c d]	-	725	1,379	1,618	2,522	1,490	1,780	2,700	1,100	750
Exports as a percent of output (CIA est.)	-	54.7	123.6	118.6	142.6	107.8	22.1	89.0	na	na

Sources: a. Kaser, M. (1983), "Soviet Gold Mining Industry," in Soviet Natural Resources in the World Economy. Edited by R.G.Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 585-587.
b. CIA (1983), Handbook of Economic Statistics, 1983. Washington, D.C.: GPO, p. 71.
c. CIA (1985a), Handbook of Economic Statistics, 1985. Washington, D.C.: GPO, p. 72-73.
d. East-West (Fortnightly Bulletin) (1984), Number 315, May 10, p.3.
e. Milling-Stanley, G. (1986), "Gold," Mining Annual Review, p.19.

percent of the total value of foreign currency exports (Hewett, 1983, p. 286). However, the level of Soviet gold sales in any one year is very difficult to predict because the Soviet Union uses gold to meet financial requirements as they arise. Despite its large production the Soviet Union is not a price setter on the international gold market.

Gold sales play a special role in balancing Soviet trade with the West, but the pattern of Soviet gold sales is difficult to understand because it is not always the case that gold is sold to meet short-term cash needs, nor that the Soviet Union sells gold to make maximum profit. For example, following the disastrous harvest of 1975 the Soviet Union appears to have chosen commercial credits rather than gold sales to finance imports of grain from the West, the reason being that gold prices were not high enough to warrant large-scale sales (Ericson and Miller, 1979, p. 230). Kaser (1984, p. 167) has suggested that in deficit situations the price of gold influences the choice between gold sales and borrowing. As gold prices peaked in 1980 and Soviet gold exports in 1978 it would seem that maximisation of potential revenue is not as important as meeting short-term cash shortages. However, the data in Table 2.9 do suggest that in the period 1976-1978 the Soviet Union dipped into its gold reserves (assuming of course that the CIA estimates are correct) to benefit from increasing gold prices. The decline in 1980 coincides with increased oil revenues as a result of the 1979 OPEC price increase. When gold prices started to fall in the 1980s the trade gains from gold exports probably declined; Kaser (1984, p. 171) has

suggested that with declining world prices and increasing domestic costs gold exports were probably not viable at 1982 prices. However, domestic cost considerations are far less important than the foreign currency balance of payments. The vital role of gold exports is reflected by the fact than in 1981, when the Soviet Union registered a record net debt to the West of $12.5 billion (CIA, 1983, p. 71), the Soviet Union raised its gold sales to over 80 percent of its output even though the price of gold had fallen over one-third. Thus, the extent to which gold sales are used to balance the books would seem to depend on the size of the debt and the price of gold. More recent data on gold sales are not available, but Consolidated Goldfields Ltd. (1986, p. 27) suggests that after exceptionally low gold sales in 1983, sales returned to around 200 tons in 1984 and 1985. However, in the first few months of 1986 gold sales were running ahead of production, suggesting that reserves were being used to compensate for declining oil and gas revenues.

In 1980 the Soviet Union produced 47.5 percent of the total world production of platinum group metals, the remaining production being accounted for by South Africa (45.3 percent) and Canada (6.0 percent). Data on platinum group metal production are as scarce as information on gold, but there seems to be a single agreed-upon Western estimate of Soviet production (Kaser, 1984, p. 16). These data are presented in Table 2.10. Japan and the United States are the principal markets for Soviet exports of platinum group metals (Shabad, 1983a, p. 266). While the Soviet Union has exported platinum

Table 2.10

Soviet Production and Trade in Platinum Group Metals, 1975-1984
(Metric Tons)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Production										
World	178	186	196	197	202	213	215	211	206	219
South Africa	81	84	89	89	94	96.4	96.7	91.8	83.6	90.2
Soviet Union	82	87	90	95	100	101	104	109	112	115
Exports										
South Africa	58	68	70	81	99	89.5	87.6	79.8	73.9	91
Soviet Union	56	81	79	74	87	46.1	46.5	53.2	53.4	57.6

Sources: Kaser, M. (1984), "The Soviet Impact on World Trade in Gold and Platinum," in The Soviet Impact on Commodity Markets. Edited by M.M. Kostecki. London: McMillan, p. 163.
British Geological Survey (1986), World Mineral Statistics, 1976-1984. NERC, London: HMSO, pp. 200-201.

since the 1950s, only during the 1970s has it become a major actor on the world market. In 1974 platinum exports to the industrialised West were valued at $ 371 million (Adams, 1983, pp. 551). Platinum is more valuable than gold and experienced similar price increases during the 1970s. The spot price of platinum was $ 105-106 per troy ounce in 1972, peaked at $ 905 per ounce in 1979, and has since fallen to $475 (Adams, 1983, p. 583). According to Western sources (Table 2.10) platinum group metal exports peaked in 1979 at 87 tons and then fell in 1980-1982, only to pick up slightly in 1982-1983--a pattern very similar to gold sales. No estimates of Soviet platinum reserves are published in the West, but Kaser (1983, p. 166) has estimated that exports to the West constituted 68 percent of Soviet production in 1975 and 87 percent in 1979. Since then exports have declined and production has increased, so it is likely that reserves have increased, although it is also possible that increasing domestic demand has absorbed much of the increased production (Adams, 1983, p. 553).

Until the 1950s the Soviet Union did not produce diamonds, but in response to the Cold-War strategic trade embargo Stalin started a search for a domestic source of diamonds. In 1955 the Mirny (Peace) Kimberlite Pipe was discovered in Yakutia and by the early 1960s diamonds were produced from Yakutian mines (Epstein, 1982). In 1962 the Soviet Union agreed to sell virtually all its uncut gem diamonds to De Beers, the South African diamond cartel, thus benefiting from the monopoly position of De Beers.

Since it is difficult to distinguish Soviet uncut diamonds

from other diamonds and the Soviet Union does not release information on diamond sales, data on Soviet diamond dealings are scarce and unreliable. Soviet uncut diamonds are marketed through De Beers' operation in London and should figure in British trade returns. In the late 1960s the Soviet Union also began to market cut diamonds known as "Silver Bears" through traders in Antwerp and later the Middle East. According to the data presented in Table 2.5, diamonds earned $ 175 million and accounted for 7.2 percent of foreign currency exports in 1970. By 1975 exports had risen to $ 478 million but only accounted for 5.8 percent of total exports. In 1980, the last year data are available, diamond exports earned $ 1.3 billion, comprising 5.5 percent of total exports. The very rapid increase in the value of diamond exports is also shown in the data in Table 2.11. These data are from the British Geological survey (1985, p. 11), but a more recent publication by them (1986, p. 79), which records exports by carats rather than value, shows the volume of exports in 1980 to be lower than the volume in 1981. Given that the diamond market was depressed at that time the discrepancy between volume and value of exports in 1980 is difficult to explain. The data in Table 2.11 have been converted from pounds sterling and the pound was very strong against the dollar in 1980, but this alone does not explain the sudden increase. To further complicate the situation the CIA value of $ 1.3 billion would seem to agree with the British figure. Either both value figures are incorrect or the volume figure is incorrect. It is probably safe to conclude that in 1980 sales were higher than usual, but

Table 2.11

Soviet Diamond Production and Trade, 1976-1984[a]

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Production (Million Carats)	9.9	10.3	10.5	10.7	10.9	10.6	10.7	10.8	11.0
Exports[b] (Million $)									
Gem	521.9	633.2	380.5	314.8	1,305.5	225.7	na	na	na
Industrial	1.4	1.4	0.8	0.3	0.2	13.9	na	na	na
Total	523.3	634.6	381.3	315.1	1,305.7	239.6	na	na	na

Sources: Institute of Geological Sciences (1982), World Mineral Statistics, 1976-1980. NERC, London: HMSO. p. 11. British Geological Survey (1985), World Mineral Statistics, 1981-1983. NERC, London: HMSO, p. 11. British Geological Survey (1986), World Mineral Statistics, 1980-1984. NERC, London: HMSO, p. 78

a. Does not include synthetic diamonds.
b. See Appendix 1 for exchange rates.

the exact value of those sales is unknown. Andleman (1982, pp. 86-87) has provided a possible explanation for the increase in sales. In the late 1970s the agreement with De Beers was undermined as the Soviet Union started to sell large quantities of diamonds, despite the fact that demand and prices were falling. To protect their position De Beers had to buy up the surplus. More recent data are not available, but a recent report by De Beers suggests that the Soviet Union has reduced sales of certain grades of cut stones, having previously glutted the market.[4] It is perhaps more than a coincidence that the very high diamond sales in 1980 coincided with low sales of gold and platinum. It is possible that the monopoly position of De Beers made the diamond market a more profitable target for "dumping" than other commodity markets as De Beers was likely to have to buy up surplus.

The Soviet Union is one of the World's leading timber producers, but the bulk of its production is consumed domestically, with only 5-8 percent of its roundwood and sawnwood being exported (see Table 2.12). Nevertheless, wood and wood products exports are an important source of foreign currency. In 1970 wood and wood products earned $ 389 million or 16 percent of all foreign currency export income. (In the same year oil and oil products earned $ 430 million). In 1983 wood and wood products earned $ 853 million but only accounted for 3.2 percent of total exports (see Table 2.5). The most important Western markets for wood and wood products are Western Europe and Japan--Soviet trade accounts for one-fifth of Western Europe's imports of sawnwood (Eronen, 1983, p. 205).

Table 2.12

Soviet Output and Trade of Selected Forest Products, 1970-1984

	1970		1975		1980		1984	
	Prod.	Export	Prod.	Export	Prod.	Export	Prod.	Export
Commercial Round Wood (Million Cubic Metres)	199	15.3	313	16.9	278	13.9	na	15.6
Sawnwood (Million Cubic Metres)	116	8.0	116	7.8	98	7.0	97.3	7.2
Woodpulp (Thousand Cubic Metres)	5,110	448	6,815	515	7,123	820	8,153	1,010
Paper (Thousand Cubic Metres)	4,185	475	5,215	617	5,288	647	5,862	674
Paperboard (Thousand Cubic Metres)	2,516	247	3,368	308	3,445	372	3,889	372
Plywood (Thousand Cubic Metres)	2,045	281	2,196	303	2,022	314	2,132	317

Sources: Shabad, T. (1983), "The Soviet Potential in Natural Resources: An Overview," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, T. and A.W Wright. Chicago: University of Chicago Press, p. 262.
Tsentral'noye Statisticheskoye Upravleniye (1985), Narodnoye khozyaystvo SSSR v 1984 g. Moscow: Finansy i Statistika. p. 188-189.
Ministerstvo Vneshney Torgovli (1985), Vneshnyaya torgovlya SSSR, v 1984 g. Moscow: Finansy i Statistika, pp. 69-72.

The data in Table 12.12 include all Soviet exports of wood and wood products. In terms of East-West trade the most important items are roundwood and sawnwood, the least processed wood products. While exports of more processed products, particularly woodpulp, have increased, Eastern Europe is the major market. For example, in 1983 the major West European trading partners accounted for only 28 percent of Soviet exports of sulphate pulp. Among the Western nations Japan accounts for the bulk of roundwood, consuming 42 percent of roundwood exports in 1983. Much of this trade is associated with compensation agreements under which Japan provides machinery and equipment for the exploitation of Soviet timber resources. The other major Western trading partner is Finland, which for example takes 35 percent of Soviet plywood exports (Shabad, 1983, p. 262). While the Soviet Union would like to diversify its wood products trade with the West, a combination of domestic supply problems and competition has served to retain the traditional reliance on low-value-added products. Indeed, for countries such as Japan, the willingness on the part of the Soviet Union to sell relatively unprocessed timber may be a major attraction, as other suppliers, such as Indonesia, have stopped the export of unprocessed timber. In sum, exports of wood and wood products are an important source of foreign currency for the Soviet Union, with the major markets being Western Europe and Japan. The majority of exports are in the form of roundwood and sawntimber, with very little trade in higher-value-added products.

Since the early 1970s the export of chemical products has

become an increasingly valuable source of foreign currency. According to the data in Table 2.5 the foreign currency value has increased from $ 64 million in 1970 to $ 691 million in 1983. Because of the increase in the value of fuel exports, chemicals have not increased their share of total exports. The United States and Western Europe are the most important foreign currency markets for Soviet chemical exports, accounting for about 40 percent of Soviet chemical product exports during the early 1980s. Much of this trade is related to compensation buy-back. According to Borin (1980) in 1979 one-third of Soviet chemical exports were related to compensation payments. The majority of compensation projects are only just starting to make deliveries. The U.N. Economic Commission for Europe (1982) estimated that in 1985 buy-back exports to the West would be worth $ 660 million. Soviet trade data show exports of chemical products to the West to have been worth over $ 800 million in 1985.

The final components of Soviet foreign currency exports considered here are arms sales and the sale of transportation services. While Soviet armament sales are predominantly with the developing nations, they require mention because they are becoming an increasingly important source of foreign currency. During the 1970s there was an increasing commercialisation of Soviet arms sales. Between 1977 and 1981 foreign currency transactions accounted for more than 80 percent of all arms exports. The foreign currency value of arms sales increased from $ 400 million in 1970 to $ 4.2 billion in 1981 (Kanet, 1983, p. 185). In 1979 $ 10.4 billion worth of arms were

exported, $ 6.6 billion of wich were delivered to developing nations, mainly on a foreign currency basis (Kanet, 1983, p. 185). While arms sales may provide a more stable source of foreign currency than commodity exports, they are controlled by political rather than economic reasoning and have a limited market. In addition the gains from trade may be minimal because production of armaments is more costly and may require greater levels of high-quality inputs than raw material export production.

As Soviet participation in the global economic system has increased so has the Soviet merchant fleet, which quadrupled in size between 1961 and 1977 (Carr 1979, p. 666). The Soviet merchant fleet earns foreign currency both from the delivery of Soviet cargoes and from cross trade cargoes (moving goods for other nations). In 1977 the Soviet merchant fleet earned $980 million which accounted for 7 percent of the Soviet Union's foreign currency income, 72 percent of this income came from delivery of Soviet exports and 28 percent from the carriage of cross trade cargoes (Carr, 1979, p. 668). Since then both the level of trade and the size of the Soviet merchant fleet have increased, and by the late 1970s shipping and transportation services are estimated to have earned almost $ 1 billion (Hewett, 1983, p. 288). Included in this figure are earnings from the Trans-Siberian Container Landbridge Service, which was started in 1971 to move containers between Europe and the Far East. Details of the route and its development are presented in Chapter 5. In terms of foreign currency earnings the route is estimated to have earned an average of 57 million foreign

trade roubles per year ($ 78.5 million at 1982 rates) during its first twelve years of full operation, with total earnings during that period of 678.6 million roubles, $ 934.7 million at 1982 rates (Mote, 1984b). With the completion of the BAM railway and improvements in the management of the system, the landbridge may increase its revenues during the second half of the 1980s.

According to OECD data (Table 2.7), Soviet exports of crude materials (including wood and wood products) and mineral fuels and energy on average accounted for 86.9 percent of total exports to the industrialised West during the 1981-1984 period. In the period since 1970 the composition of those exports has changed with oil and oil products becoming the single most important source of foreign currency in trade with the West. Given that the purpose of these exports is to facilitate imports from the West, it is necessary to examine the nature of those imports to appreciate fully the role of trade in the Soviet economy.

2.3.3. Soviet Imports from the Industrialised West

Soviet imports from the industrialised West are predominantly machinery and transportation equipment, manufactured goods (including pipe) and food products. According to OECD data (Table 2.7) these commodity groups have accounted for almost 80 percent of total imports from the West since 1970. This analysis concentrates on imports of machinery and equipment, large diameter pipe and grain. The Soviet Union has been a net importer of machinery and industrial consumer goods since the Second World War, but has only become a net

importer of food products since the early 1960s (Smith, 1985, p. 107). In the following analysis the major Western partners and the pattern of trade are examined, and the sectors that receive the majority of machinery and equipment imports are identified.

2.3.4. Machinery and Equipment Imports

Western analysts such as Holliday (1979) and Hanson (1981) have suggested that there has been a change in Soviet attitudes towards the importation of Western machinery and equipment, both in terms of the scale of trade and the role of Western technology in the Soviet economy since the 1960s. The following discussion outlines the role of Western machinery in total machinery imports, the geographical distribution of the major trading partners, the types of machinery imported and the changing level of imports in the period since 1970.

The data in Table 2.13 illustrate the role of machinery imports from West Germany, Finland, Italy, France, Great Britain, Japan and the United States in total machinery imports. During the period 1970-1984 the industrialised West supplied an average of 30 percent of total imports of machinery, equipment and means of transportation. The fluctuations in the level of machinery trade are discussed later in this section. Among the nations of the industrialised West the most important sources of machinery and equipment are West Germany, France, Finland and Japan. The United States became an important trade partner in the mid-1970s, during the period of detente, but following American attempts to use trade for political ends imports from the United States declined. By

Table 2.13

Role of Machinery and Equipment Imports in Soviet Trade with the Industrialised West, 1970-1985

	1970	1975	1980	1981	1982	1983	1984	1985
Total Machinery Imports (Million Roubles)	813	3,104	4,110	3,790	5,166	5,802	4,954	4,625
Machinery Imports as a percent of total imports from the West[a]	32.1	32.0	26.1	22.0	27.4	31.0	25.3	24.0

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

a. The industrialised West is defined as West Germany, Finland, Italy, France, Great Britain, Japan, and the United States.

the 1980s over 93 percent of Soviet imports of machinery and equipment from non-socialist countries came from Western Europe and Japan (Smith 1985, p. 110). Because of the Soviet-Finnish bilateral trade agreement, Finland is a somewhat different case from the rest of Western Europe. When Finnish trade is omitted, Western Europe accounted for 63.4 percent in 1982 and 84 percent in 1984 (Hanson, 1985, p. 35).

As a result of data problems and the nature of the Soviet price system it is very difficult to assess the role of Western machinery imports in total Soviet machinery investments. Hanson (1981, p. 129 and 1985, p. 38) has attempted to determine the share of Western imports as a percentage of total equipment investment in the following year, though his calculations do not compensate for differences in foreign trade and domestic rouble prices. Hanson calculates that the share of imports (including pipe) peaked at around 8 percent of Soviet investments in 1976 and subsequently fell to 4.3 percent in 1981, only to pick up to an estimated 8.9 percent in 1983. The consensus among Western analysts seems to be that while imports of Western machinery play a relatively minor role in terms of total machinery investments in any given year, the fact that they embody "Western technology" and are concentrated within a few industrial sectors tends to increase their impact. Holliday (1984, p. 57), on the basis of a survey of Western literature, has concluded that the machinery and equipment for the chemical, automotive, oil and gas, metalworking and metallurgical, electronic, shipping, mining and construction sectors were the most important types of equipment imports

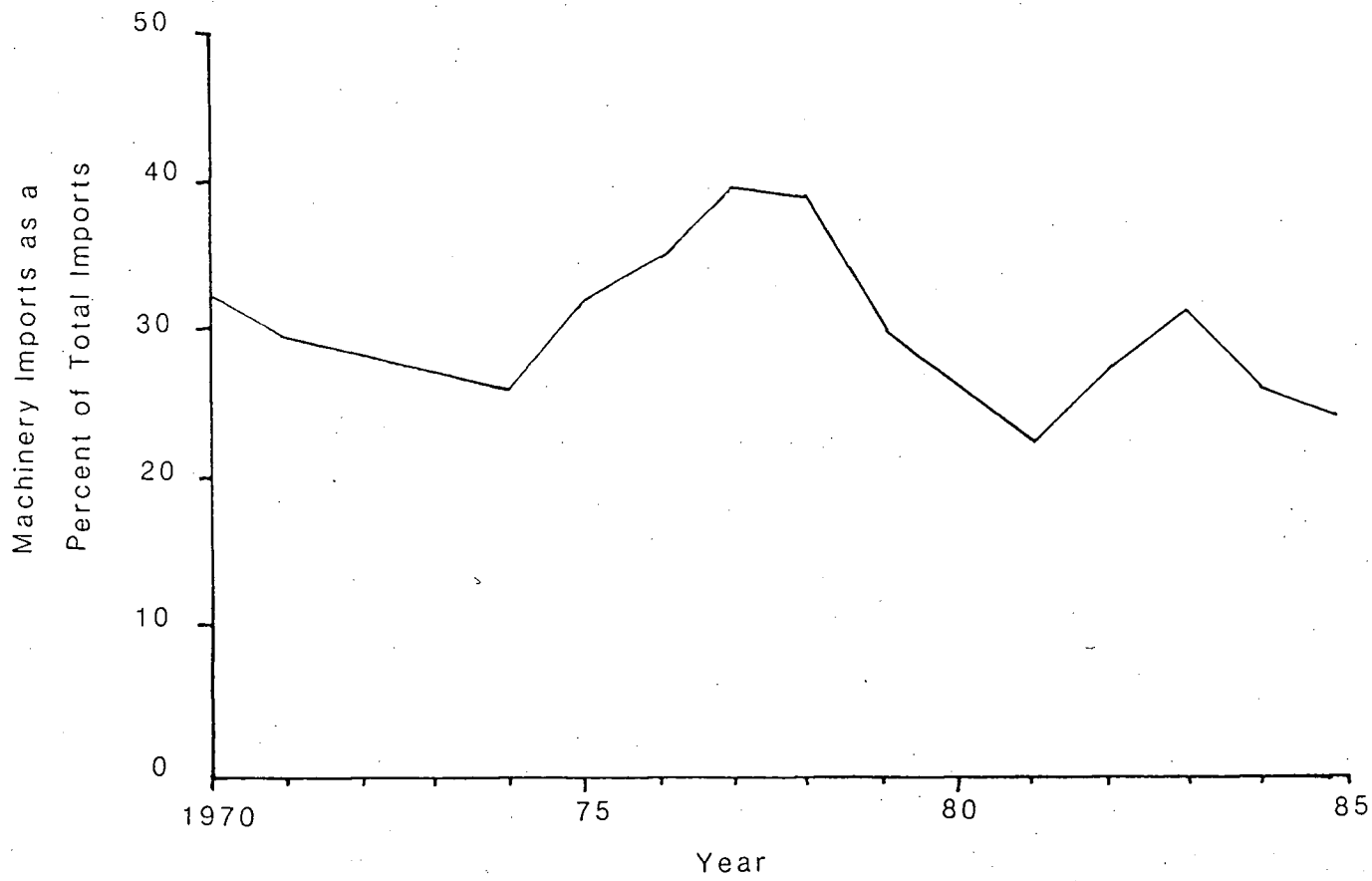


Figure 2.5 Role of Machinery and Equipment Imports in Trade with the Industrialised West.

Source: Calculated from Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

during the late 1970s (see Table 2.14). Hanson (1981, pp. 134-139) has also examined the sectoral distribution of Western technology imports and has suggested that those sectors showing a "high import dependence" are chemicals, forestry, light industry and shipping. The Office of Technology Assessment (OTA) (1982, p. 204) has examined the role of Western technology imports in the Soviet energy industries and concluded that the major recipients in the energy sector are the oil and gas industries. Imports of Western technology have also played an important part in the expansion of the Soviet automotive industry (see Holliday, 1979 and 1985).

The changing role of machinery imports in Soviet trade with the West is illustrated by Figure 2.5. Machinery imports comprised a rising proportion of imports during the early 1970s, peaking at 40 percent of all Western imports in 1977. They then experienced a rapid decline falling to 22 percent in 1981. They recovered through 1982-1983, only to decline again in 1984 and 1985. The fluctuations in the total value of imports, particularly if one allows for inflation, show that there were both absolute and relative declines in the level of machinery imports after 1977. The fact that this decline occurred well in advance of the invasion of Afghanistan and the subsequent economic sanctions suggests that it was the result of a change in Soviet policy towards machinery imports from the West. Western analysts have offered a number of explanations for this change in Soviet attitudes. One suggestion is that increasing debt to the West forced cut-backs in imports. According to the CIA (1983, p. 71) the Soviet Union's net debt

Table 2.14

Machinery Orders Placed with Hard Currency Countries, 1976-1978

(Million US $)

	1976		1977		1978	
	Value	Percent	Value	Percent	Value	Percent
Total Machinery Imports	5,991	100	3,816	100	2,803	100
Of Which:						
Chemical & Petrochemical	1,818	30.3	1,628	42.7	902	32.2
Oil & Natural Gas	1,688	28.2	308	8.1	832	29.7
Metal Working & Metallurgy	1,028	17.2	641	16.8	348	12.4
Timber and Wood	146	2.4	65	1.7	86	3.1
Automotive	355	5.9	183	4.8	115	4.1
Ships and Port Equipment	283	4.7	67	1.8	127	4.5
Food Processing	63	1.0	155	4.1	17	0.6
Minning and Construction	120	2.0	147	3.9	118	4.2
Manufacturing of Consumer Goods	121	2.0	78	2.0	44	1.6
Electronics	55	0.9	193	5.1	179	6.4
Electricity	63	1.0	138	3.6	6	0.2

Source: Adapted from Holliday, G.D. (1984), Transfer of Technology from West to East: A Survey of Sectoral Case Studies. Paris: OECD, p. 58.

to the West reached a high of $11.2 billion in 1977 but was subsequently reduced to $9.2 billion in 1980. Marris (1984, p. 12) suggests that despite improved export revenues, the ever-increasing cost of grain imports forced the Soviet leadership to cut back other imports or increase the level of debt. Machinery imports were therefore reduced. This explanation is questionable because, as we have seen in the discussion of exports, the Soviet Union did not seek to increase revenues from gold sales in 1980 when prices were at a record high. If the cut-back did not result from an inability to pay, the cause was probably a policy decision to reduce machinery imports from the West. Brainard (1983, pp. 671-671) has suggested that the large-scale import of Western technology during the 1970s had caused an "indigestion" problem within the Soviet economy. Imported plant and equipment placed "resource demands" on the domestic economy that could not be met, so other sectors suffered and the imported technology did not perform as well as expected. Hanson initially proposed a balance-of-payments explanation (Hanson 1982a, p. 171), but later concluded that financial grounds alone could not explain the cut-back and therefore deduced a change in Soviet policy (Hanson, 1982b, p. 23). According to Hanson (1982b, p. 35) there was a change in Soviet attitudes towards Western technology imports simply because the "technological fix" did not appear to be reaping the anticipated benefits. Goldman (1982, pp 254-256) supports this position and maintains that Western equipment often only operated at only 40 percent of the capacity achieved in the West. Obviously this poor performance is closely related to

the "indigestion" problem mentioned by Brainard. The real reason for the decline in imports probably lies somewhere between the financial explanation and changing Soviet policy. The upswing in orders during 1981 is related to the Urengoy pipeline and the subsequent decline in orders does not indicate there will be a return to the large scale imports of the 1970s.

2.3.5. Pipe and Pipeline Equipment Imports

Since the early 1970s the Soviet Union has expanded its oil and gas pipeline systems. Domestic production facilities have been unable to supply the required quantities of pipe and equipment, and the Soviet Union has turned to the West to obtain the necessary inputs. Western pipe producers were experiencing recession and were more than willing to supply the necessary products. The actual level of pipe imports is difficult to determine, firstly, because all types of pipe are included under a general heading in Soviet foreign trade statistics, and secondly, because it is not possible to determine what percentage of pipe imports are from the West. A more detailed discussion of pipe imports is presented in Chapter 6. Here it is sufficient to note that the most important sources of pipe imports have been West Germany, Italy, France and Japan. Compressor stations, although based on American technology, have been purchased from West European companies, and pipelaying equipment has been purchased from the United States and Japan.

2.3.6. Grain Imports

The third and final component of Soviet imports under consideration here is grain imports. Figure 2.6 illustrates

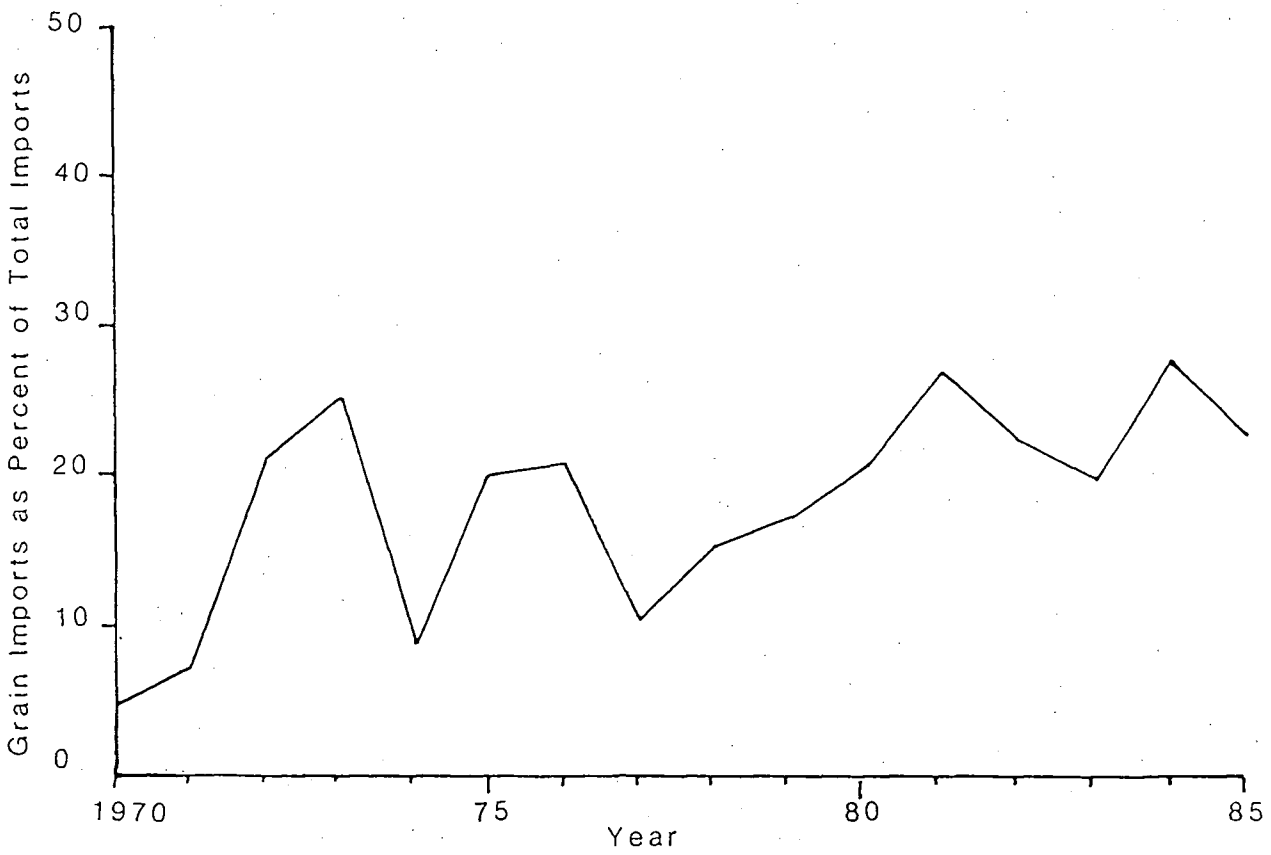


Figure 2.6 The Role of Grain Trade in Imports from the West, 1970-1985

Source: Calculated from Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finanst i Statistika.

the role of grain trade in Soviet imports from the West, while Table 2.15 provides data on the volume of grain imports and the major Western suppliers. Prior to the 1970s the Soviet Union was not a regular buyer on the world grain market. During the 1970s the Soviet Union resorted to imports of grain to compensate for poor domestic harvests, particularly in 1972, 1975 and 1979. Following two disastrous harvests in 1972 and 1975 it would seem that Soviet policy makers realised that they would be unable to improve living standards while having to rely on domestic sources of feedstuffs. Thus, while in the early 1970s Soviet grain imports were direct reactions to short-term requirements brought about by poor harvests, in the late 1970s and early 1980s the Soviet Union, benefiting from increased oil revenues and a global surplus of grain, decided to use regular imports to sustain improvements in standards of living (Bryne, et al., 1982, p.61 and Malish, 1985, p. 210). The increasing role of grain imports is indicated by the fact that in 1975 (the year of a bad harvest) imports of grain accounted for 8.1 percent of total grain available in the Soviet Union, but by 1981 the estimated share of imported grain was 20.4 percent, despite the fact that total domestic production was 20 million tons higher than in 1975 (Vanous, 1982, p. 8). It is clear that since 1977 grain imports have played a more important role in total imports. At the same time the share of machinery imports has been declining. While grain imports did decline in 1983, the level increased in 1984, and the United States Department of Agriculture estimates that grain imports in 1985 were 39 million tons.[5]

Table 2.15

Soviet Imports of Wheat and Coarse Grain, 1972-1983[a]

(Million Tons)

	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1983	1982-1983
Total Imports	22.5	10.9	5.5	25.7	10.1	18.4	15.1	25.9	39.5	39.9	31.8
Imports from:											
	13.7	7.9	2.3	13.9	7.4	12.5	11.2	9.9	8.7	14.7	6.2
United States	0.1	0.3	1.8	1.4	0.3	2.7	1.4	6.3	14.9	9.5	8.6
Argentina	5.1	1.8	0.3	4.5	1.4	1.9	2.1	3.0	7.7	8.7	8.7
Canada	0.9	0.1	0.9	2.0	0.5	0.3	0.1	4.1	2.9	2.4	1.0
Australia	1.9	0.5	0.1	0.5	0.2	0.2	0.2	0.9	1.6	2.4	4.0
EEC	0.8	0.3	0.1	3.0	0.3	0.8	0.1	1.9	3.7	2.2	3.3
Other											
United States as a percent of total	60.8	72.8	41.8	54.1	73.3	68.0	74.2	38.2	22.0	37.0	19.4

Source: Adapted from Scherer, J.L. ed. (1984), USSR Facts and Figures Annual, Vol. 8. Gulf Breeze, Fl.: Acadaemic International Press, p. 189.

a. Prior to 1979-1980 based on July-June data. For 1979-1980 onward wheat based on July-June and coarse grain on October-September.

The major Western suppliers of grain are the United States, Argentina, Canada, Australia and the European Economic Community. During the 1970s the United States was the most important source of grain, accounting for an average of 63.5 percent of total grain imports in the 1972-1979 period. However, following the grain embargo to protest the invasion of Afghanistan, the role of the United States declined, such that between 1980 and 1983 the United States supplied just under 30 percent of all imported grain. Immediately following the grain embargo the Soviet Union negotiated agreements with Argentina (1980), Canada (May 1981) and Brazil (July 1981) to supply at least 10 million tons of grain a year. The Canadian agreement guaranteed sales of 25 million tons over 5 years. In 1984 barley, wheat and other cereals accounted for over 90 percent of Soviet imports from Canada.

On the basis of this brief discussion we can conclude that in the early 1970s the Soviet Union imported grain only when poor domestic production dictated, but after 1977 grain imports became a regular and increasingly important component of imports from the West. Grain imports have become a necessity for the improvement of the Soviet diet. Since the 1980 United States grain embargo the Soviet Union has sought to reduce its reliance on American wheat and has diversified its sources.

2.4 Conclusions

In sum, during the 1970s there seems to have been a change in the structure of Soviet imports from the industrialised West, with machinery imports declining in importance and grain imports increasing. Imports of large diameter pipe have also

increased during this period. Because of the peculiarities of Soviet foreign trade, imports of machinery and equipment require different forms of industrial cooperation from those found in the West.

This chapter has described the nature of Soviet trade with the industrialised West. The information presented above portrays a trading relationship characterised by Soviet exports of natural resources, particularly oil and gas, and imports of machinery, equipment and agricultural products. In terms of the geographical distribution of Soviet trade with the West, most exports are sold to Western Europe. But, while Western Europe is the most important supplier of machinery and equipment, most grain is purchased from the Americas. Thus, in general terms Soviet trade with Western Europe produces a surplus to purchase food imports from elsewhere. In terms of the politics of East-West trade the most noticeable development has been the decline in the position of the United States, both as a supplier of machinery and equipment and also of grain. East-West trade during the 1980s is dominated by Western Europe.

Notes

1. Oil and Gas Journal (1986), Vol. 84, No. 36, p. 49.

2. Shabad, T. (1986), "News Notes", SG:R&T, Vol. 29, No.4, p. 252.

3. See Table 5.3 for the source of the data.

4. Mining Journal (1986), Vol. 306, No. 7856, p. 197.

5. The Economist (1985), Vol. 297, No. 7415, p. 77.

Chapter 3

The Role of Siberia and the Far East in the National Economy

> "The accelerated development of the productive forces of Siberia and the Far East has been and remains a component part of the Party's economic strategy."
>
> The Draft Program of the Communist Party of the Soviet Union (New Version) (CPSU, 1985, p.10)

This chapter examines the structure of Siberian industry and its role in the national economy. Most attention is paid to the resource-producing and resource-processing industries, which are shown to be the most important sectors in the Siberian economy. In conclusion, the national specialisations of Siberia and the Far East are presented.

3.1. The Structure of the Economies of Siberia and the Far East

It has been necessary to use fragmented data sources to piece together a general picture of the industrial structure of the Siberian and Far Eastern economies. Detailed information at the regional level has not been published in the Soviet statistical handbooks since the mid-1970s. In addition production figures for many Siberian products, such as gold, diamonds and non-ferrous metals, are considered State secrets.

The Siberian economies are dominated by energy production and raw material production and processing. Almost 75 percent of the nations's energy resources (coal, oil and gas) are accounted for by the West and East Siberian economic regions; and Siberia and the Far East encompass 75 percent of the nation's hydro-electric potential. Granberg (1981a, p.10) has

characterised the structure of Siberian industry as being concentrated on the production of energy resources, non-ferrous metallurgy, wood products and wood processing industries and a series of energy-intensive chemical products. The relative importance of the extractive industries is illustrated by the fact that their share in the value of industrial production (18.8 percent) is 2.3 times higher than the national average (8.2 percent), while the share of finished product production (47.2 percent)--machine-building, light and food industries--is lower than the national average (62.8 per cent). More recent data (Granberg, 1985, p. 42) show that this trend has continued. In 1983 the extractive industries accounted for 21.0 percent of Siberian industrial output, compared to 7.5 for the Soviet Union as a whole. These data are based on 1967 prices; raw material prices were increased in 1982. If one uses 1982 prices, the share of the extractive industries rises to 28.0 percent in Siberia compared to 9.0 percent for the Soviet Union as a whole. The pattern in the Far East is somewhat different because the role of the food industry is inflated by the fishing sector, and the region has a much more limited energy base. However, the production of non-ferrous and precious metals and gems increases the share of the extractive industries to above the national average.

Table 3.1 illustrates the dominance of the extractive industries, with energy and raw-material producing sectors accounting in 1975 for 48.4 percent of industry in Western Siberia, 58.86 percent in Eastern Siberia and 39.16 percent in the Far East. Table 3.2 presents more recent statistics on the

Table 3.1

The Structure of Siberian Industry, 1960-1975

(Percent of the total value of production)

	West Siberia			East Siberia			Far East		
	1960	1975	change	1960	1975	change	1960	1975	change
Fuels Energy Complex	21.1	23.7	+2.6	15.13	16.86	+1.73	11.0	7.4	-3.26
Electric Power	3.5	3.6	+0.1	4.85	7.69	+2.84	1.5	2.77	+1.27
Fuel Industries	17.6	20.1	+2.5	10.28	9.17	-1.11	9.5	4.97	-4.53
Branches Producing and Processing Raw Materials	26.4	24.7	-1.7	43.47	42.06	-1.41	28.5	34.42	+2.92
Ferrous Metals	8.1	5.2	-2.9	0.85	0.95	+0.1	0.8	0.95	+0.15
Non-ferrous Metals	2.6	1.9	- 0.7	11.4	17.66	+6.26	7.4	10.37	+2.97
Chemicals	4.8	9.4	+4.6	2.76	4.63	+1.87	0.7	1.22	+0.52
Wood Products and Pulp and Paper	7.2	4.7	-2.5	20.73	13.81	-6.92	13.2	11.63	-1.57
Building Materials	3.7	3.5	-0.2	7.73	5.01	-2.72	6.4	7.25	+0.85
Branches Producing Finished Goods	52.5	51.6	-0.9	41.4	41.08	-0.32	60.5	60.84	+0.34
Machine Building	18.3	28.2	+9.9	10.06	16.02	+6.14	16.8	21.88	+5.08
Light Industry	11.7	8.6	-3.1	9.1	11.53	+2.43	5.4	5.29	-0.11
Food Industry (Inc. Fish)	22.5	14.8	-7.7	22.24	13.35	-8.89	38.30	33.67	-4.63

Source: Mozhin, V.P. (1980), Ekonomicheskoye razvitiye Sibiri i Dal'nego Vostoka. Moscow: Mysl', p. 208.

Table 3.2

The Structure of Siberian Industry, 1970-1985[a]

(Percent of the total value of production, at 1975 prices)

	1970	1980	1983	1985 (est.)
Fuels Energy Complex	18.0	22.2	23.5	23.6
Power Industry	5.4	5.2	5.0	5.0
Fuel Industry	12.6	17.0	18.5	18.6
Branches Producing & Processing Raw Materials	25.3	21.7	21.5	21.4
Ferrous Metals	5.0	3.8	3.6	3.4
Chemicals & Petrochemicals	6.6	7.3	7.7	8.2
Timber, Wood Working, Pulp & Paper	9.3	6.9	6.8	6.3
Construction Materials	4.4	3.7	3.4	3.5
Branches Producing Finished Goods	48.0	46.0	44.4	44.4
Machine-Building & Metal Working	19.8	23.4	24.2	23.5
Light Industry	10.8	10.7	9.9	9.7
Food Industry	17.4	11.9	10.3	11.2
Others (includes Non-Ferrous Metals)	8.7	10.1	10.6	10.6

Sources: Granberg, A.G. (1985), "Structural Changes and Intensification in Siberian Industry," from EKO, No. 6, pp. 3-27. Translated in POE, 1986, Vol. 24, No. 3, p. 44.
Granberg, A.G. (1986), "Vzaimosvyaz' strukturnoye i prostranstvennoy politiki ekonomicheskogo razvitiya Sibiri," ISOAN SSSR, No. 1, p. 25.

a. Siberia defined as West and East Siberia.

structure of the Siberian economy and shows the continued growth of the fuels industry. Outside the energy sector Siberian industry has tended to stagnate. In Eastern Siberia the growth in electricity generation can be attributed to the construction of large hydro-electric schemes, which has continued into the 1980s. Likewise non-ferrous metallurgy, based on the Noril'sk metallurgical combine and the various aluminum smelters, has continued to expand. In the Far East the relatively minor role of the energy sector reflects the fact that energy supply in this region has been and remains a limiting factor. Expansion of non-ferrous metallurgy is related to the various mining and processing operations in the region. The very high percentage assigned to the food industry reflects the importance of the Far Eastern fishery.

Table 3.3 examines Siberian production from the point of view of the national economy. In the final column a simple location quotient has been calculated for 1975 to illustrate the role of individual sectors relative to Siberia's share of total industry. It can be seen that within the Siberian economy the electricity and fuels-energy production and wood-products and pulp and paper sectors are over-represented. The more labour-intensive sectors of the light and food industries are under-represented.

Table 3.4 provides data on the share of Siberian production in the growth of national industrial output for key sectors during the period 1960-1980. The most dramatic change is the increasing role of Siberia in the the production of fuel oils. In the period since 1980 Siberia has accounted for 100

Table 3.3

The Share of Siberian Industrial Production[a] in the National Economy

(Percent of total national production)

Branch	1960	1965	1970	1975	1975 LQ.[b]
All Industry	8.1	8.2	8.5	8.8	
Electricity	11.3	13.6	15.5	16.2	1.84
Fuel-Energy	12.8	14.6	17.0	22.1	2.51
Chemical & Petrochemical	6.2	12.0	9.5	9.7	1.1
Machine Buidling & Metal Working	9.7	7.5	8.1	7.5	0.85
Wood Products & Pulp and Paper	12.6	14.9	14.9	15.4	1.75
Construction	8.7	9.0	9.1	8.6	0.98
Light Industry	4.2	4.2	5.0	5.8	0.66
Food Industry	6.4	6.9	6.7	6.6	0.75

Source: Baranova, T.B. (1979), "Osnovnyye pokazateli razvitiya promyshlennosti Sibiri v sed'moy-devyatoy pyatiletkakh," ISOAN SSSR, No. 1, p. 30.

a. Siberia defined as West and East Siberia

b. The location quotient is a simple ratio of the share of production in a particular industry over the share of production in all sectors. A value greater than 1 implies specialisation.

Table 3.4

Siberia's Share in the Growth of Industrial Output[a] by Five-Year Plan Period

(As percentage of national growth)

Branch	1960-65	1966-70	1971-75	1976-80
All industry	8.2	9.2	9.6	10.4
Electricity	16.1	19.0	18.0	13.9
Fuel Oils	23.6	24.1	38.4	59.3
Chemicals & Petrochemicals	16.4	6.4	10.0	8.6
Machine Buidling & Metal Working	5.6	8.8	6.7	6.6
Forestry	35.5	14.9	17.9	15.3
Construction Materials	9.7	9.2	7.5	15.9
Light Industry	4.3	6.5	8.6	8.7
Food Industry	8.6	6.2	6.0	1.9

Sources: Baranova, T.B. (1979), "Osnovnyye pokazateli promyshlennosti Sibiri v sed'moy-devyatoy pyatiletkakh," ISOAN SSSR, No.1, p. 32, and Baranova, T.B. (1982),"Osnovnyye pokazateli razvitiya promyshlennosti Sibiri v desyatoy pyatiletke," ISOAN SSSR, No. 11, p. 73.

a. Siberia defined as West and East Siberia.

percent of the growth in oil production and the bulk of the growth in natural gas production. Sectors which account for a relatively high share of national growth include forestry (although at a declining level), electricity and construction. Table 3.5 takes this analysis one step further and examines Siberia's role in the production of certain industrial products in 1975. The per capita level of production in Siberia relative to the national per capita production is also presented. While it should be noted that the relatively small size of the Siberian population distorts this indicator (in 1985 Siberia and the Far East accounted for 11 percent of national population, 30.5 million people), there can be no doubt of the national importance of Siberian production of coal, oil, electricity, timber cut and sawn timber. Since 1975 the pattern has remained similar, save for an increase in the importance of natural gas production.

3.2. The Fuels-Energy Complex

Oil and gas production, coal mining and thermal and hydro-electric power generation comprise the activities discussed below. Figure 3.1 illustrates the concentration of oil and gas production within the West Siberian oil and gas region which, occupying an area of more than 3 million square kilometers, is the largest structural sedimentary basin in the world (CIA, 1985b, p.16). The only other region producing oil is Sakhalin Island in the Far East. Natural gas production, while predominantly in Western Siberia, also takes place in the Far north of Krasnoyarsk Kray, the Vilyuy region of central Yakutia and Sakhalin Island. Large deposits of both coking coal and

Table 3.5

The Role of Siberia in the National Economy at the End of the Ninth Five-Year Plan (1975)[a]

Industrial Products	Share of Siberian Production in National Production (Percent)	Production of Product Per Capita, percent of USSR Value
Cast Iron	9.2	116
Steel	8.5	111
Rolled Metal	8.7	109
Coal	29.2	364
Oil	30.0	378
Natural Gas	13.1	167
Electricity	16.0	201
Tractors	7.5	93
Machine Tools	1.9	24
Mineral Fertilizer	3.0	39
Timber Cut	25.9	324
Sawnwood	22.5	282
Paper	2.6	32
Furniture	6.5	82
Cement	9.7	121
Prefabricated & Reinforced Structures	8.8	110
Fabrics	3.1	39
Knitted Goods	6.2	78
Footwear	4.3	54
Meat	7.7	96
Animal Oils	9.6	120

Source: Granberg, A.G. (1981), "Mesto Sibiri v narodnom khozyaystve strany na sovremennom etape," in Sibiri v Yedinom narodno-khozyaystvennom komplekse. Edited by M.K. Bandman, V.A. Kalmyk, V.P. Orlov, and Ye. P. Tsimdina. Novosibirsk: Nauka SO., pp. 10-11.

a. Siberia defined as West and East Siberia.

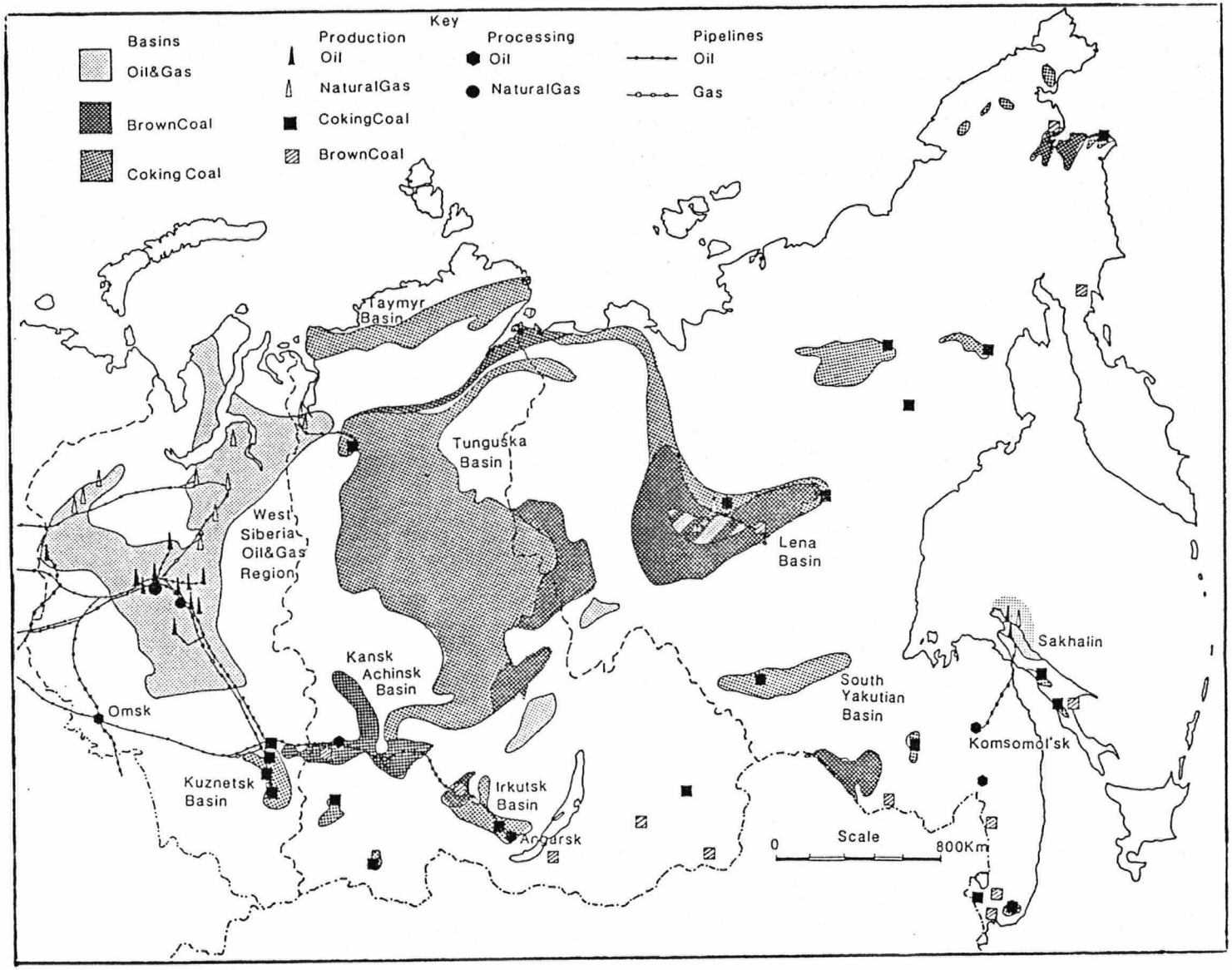


Figure 3.1 Energy Resources in Siberia and the Far East

brown (thermal) coal are found in the region. The most important coal producing area by far is the Kuznetsk basin (Kuzbass) in the south of West Siberia.

3.2.1. The Oil Industry

Siberia's rise to national prominence in energy fuels production is amply demonstrated by the data in Table 3.6 and Figure 3.2. Oil production on Sakhalin Island began in 1921, under Japanese occupation. The Sakhalin fields peaked in 1968 with an annual production of 2.65 million tons and only accounted for 40 percent of Far Eastern consumption during the 1960s (Dienes and Shabad, 1979, p. 61). It was not until the early 1960s that commercial oil fields were discovered in the West Siberian region and the supergiant Samotlor field was discovered in 1969. Prior to 1970 oil was transported from the Volga-Urals field to supply the refineries at Omsk and Angarsk. During 1970 West Siberian production rose to 31.4 million tons, 28.5 million tons from Tyumen' Oblast' and 2.9 million from Tomsk Oblast'. As a result the flow in the pipeline to Omsk was reversed and the first surplus Siberian crude oil began to move to refineries in European Russia (Shabad, 1977, p. 36). West Siberia's share of national production rose from 9.6 percent of national production in 1970 to 63 percent in 1985. By 1990 it will account for 70 percent. The rate of growth is even more impressive when one realizes that the Nizhnevartovsk Oil Association in Tyumen' Oblast', which contains the Samotlor field, supplied 86.6 million tons of the total 116.6 million tons (77 percent) of net increase in West Siberian production between 1971 and 1975 (Gustafson, 1985, p. 120). By 1985 the

Table 3.6

The Geographical Shift in Soviet Oil and Gas Production

	1970	1975	1980	1981	1982	1983	1984	1985 Plan	1985 Actual	1990 Plan
Oil Production (Million Tons a Year)[a]										
USSR Total[b]	353	491	603	609	613	616	613	628	595	630-40
European USSR[c]	289	299	259	243	229	217	204		190	
Central Asia[d]	30	42	28	28	28	27	28		30.3	
Siberia and Far East[e]	34	150	316	338	356	372	381	405	375	450-60
West Siberia	31	148	312	335	353	369	378	402	372	445-60
Natural Gas Production (Billion Cubic Metres)										
	1970	1975	1980	1981	1982	1983	1984	1985 Plan	1985 Actual	1990 Plan
USSR Total	198	289	435	465	501	536	587	632	643	835-50
European USSR	139	155	159	156	153	146	139	135	137	
Central Asia	47	94	114	114	114	113	117	126	125	
Siberia and Far East[f]	11	39	161	196	234	277	331	371	380	565-70
Tyumen' Oblast'	10	38	156	190	228	270	324	365	372	540-50

Sources: 1970-75: "News Notes," (1976), SG:R&T, Vol. 17, No. 5, p. 349 & p. 351
1979-80: "News Notes," (1981), SG:R&T, Vol. 22, No. 4, p. 273 & p. 276
1981-82: "News Notes," (1983), SG:R&T, Vol. 24, No. 4, p. 312 & p. 317
1983:84: "News Notes," (1985), SG:R&T, Vol. 26, No. 4, p. 289 & p. 295
1985-90: "News Notes," (1986), SG:R&T, Vol. 27, No. 4, p. 252 & p. 258

a. 1 million tons a year equals 20,000 barrels per day.
b. In some cases, due to rounding up, regional values do not equal USSR total.
c. The European USSR is the European RSFSR including the Urals, Belorussia, Ukraine, Azerbaijan and Georgia.
d. Central Asia is Kazakhstan, Turkmenia, Uzbekistan, Kirgizia and Tadzhikistan.
e. Siberia and Far East includes Western Siberia and Sakhalin.
f. Siberia and Far East includes West Siberia, East Siberia and the Far East.

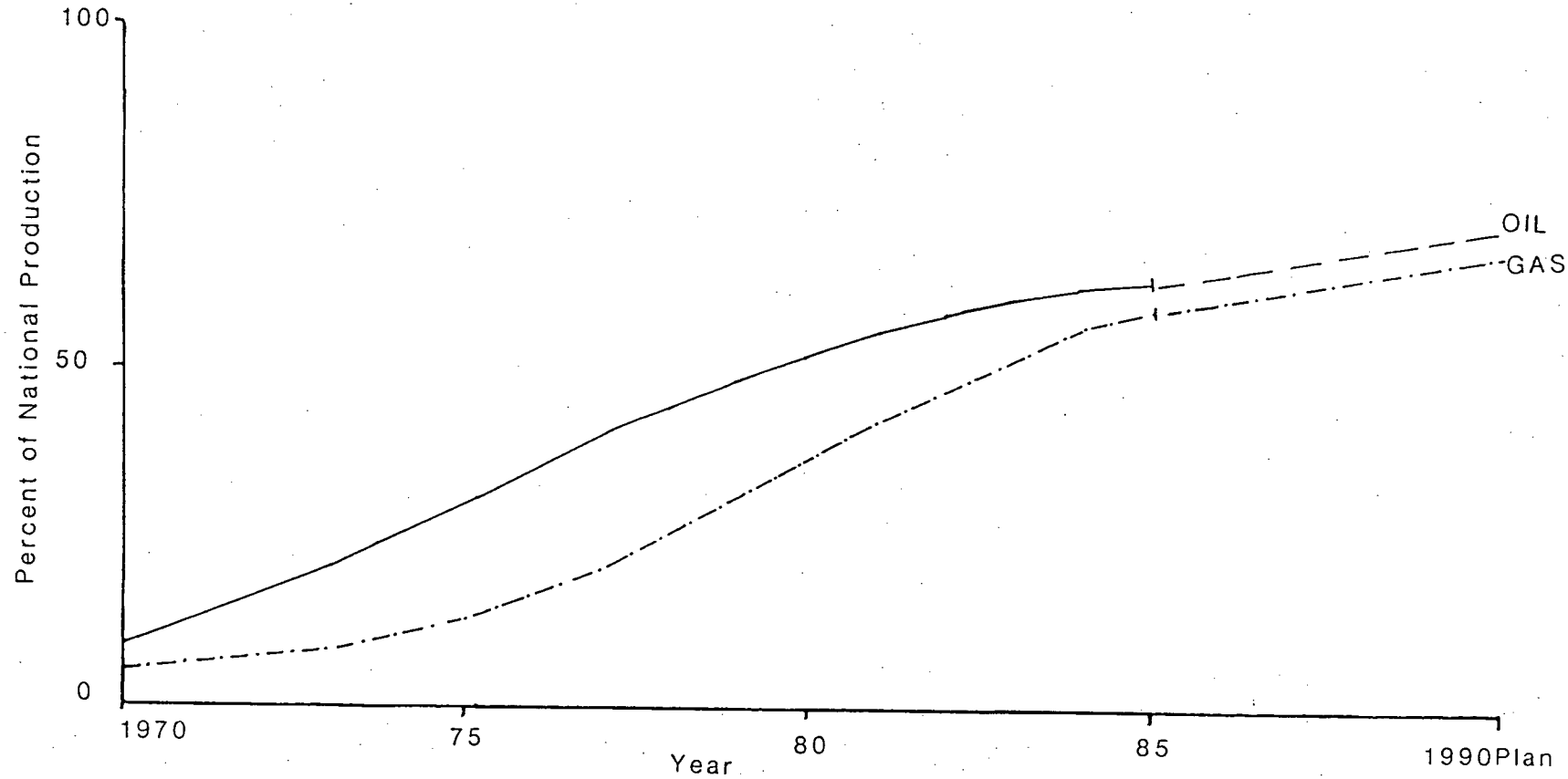


Figure 3.2 The Changing Role of Siberia and the Far East in Soviet Oil and Gas Production

Source: see Table 3.6

Samotlor field supplied 25 percent of national and 50 percent of Siberian oil production (CIA, 1985, p. 17) Production at Samotlor peaked during 1980 at 155 million tons, with 1985 production estimated at 145 million tons (Wilson, 1986, p.18).

West Siberia's role in national oil production is even more significant when the following factors are considered. First, increased production in West Siberia has taken place during a period of decline in the traditional European oilfields. Thus, West Siberian production has not only enabled rapid production increases but it has also compensated for declines elsewhere. West Siberia's share of Soviet oil production will continue to increase, even though increments to Siberian production will be relatively small during the 1980s, because the European fields will continue to decline. Second, rapid increases in oil and gas production have enabled the Soviet economy to switch from solid to liquid fuels. Oil accounted for 24 percent of Soviet energy requirements in 1960, rising to 37 percent in 1982. Natural gas consumption increased from 8 percent in 1960 to 29 percent in 1982. At the same time, reliance on coal has declined from over 50 percent in 1960 to 26 percent in 1982 (CIA, 1985b, p.6). Third, as Chapter 2 revealed, oil exports have been a major source of foreign currency and a key component in economic integration within CMEA. The rapid development of Siberian oil production has made the region the focus of Soviet energy policy since the early 1970s.

3.2.2. The Natural Gas Industry

Development of natural gas production has been equally impressive. Natural gas was first produced from the Medvezh'ye fields in northern Tyumen' in 1972, and the first Siberian natural gas reached Moscow in October 1974. As with oil development, fields in Tyumen' Oblast' have dominated West Siberian production: first the Medvezh'ye field, and then Urengoy in 1978. In 1980 Urengoy produced 50 billion cubic metres and in 1985 production peaked, a year ahead of schedule, at 250 billion cubic metres.[1] During the period 1981-1985 Urengoy accounted for almost all of the Soviet Union's natural gas production increases. To date Siberian natural gas has lagged behind oil in its share of national production, partly because of the maintenance of production in other regions such as Central Asia. However, as oil production is likely to be difficult and costly to maintain in the latter half of the 1980s, gas will become more important, as reflected by the 60 percent increase in Siberian natural gas production called for in the 12th FYP. The additional production will come from the exploitation of the Yamburg field on the Taz Penisula, north of Urengoy. The 12th FYP calls for increased substitution of gas for oil in the national economy, particularly in electricity generation.

The rapid development of the Siberian oil and gas region has been at great cost. During the 9th FYP investment in the West Siberian Fuels Energy Complex was 11.4 billion roubles, in the 10th FYP 25 billion rubles (Bud'kov, 1983, p. 114), and in the 11th FYP over 50 billion roubles (Kazanskiy and Singur,

1984, p. 100). The increasing cost of developing the West Siberian Fuels Energy Complex is even more evident when expressed as a percentage of total investment in industry. The complex accounted for almost 6 percent of total investment in industry during the 9th FYP, 10 percent during the 10th FYP and almost 20 percent during the 11th FYP.[2] In addition to the cost of development of the oil and gas region itself, the transportation of ever-increasing volumes of oil and gas to the European USSR has necessitated the construction of extensive oil and gas pipeline networks. Dienes, (1985b, p. 352), quoting Aganbegyan, reports that during the early 1980s 80 percent of the investment in the gas industry has been devoted to pipeline construction. The volumes involved are enormous. Soviet sources report that nearly 90 percent of the oil and gas produced in the region is exported out of the region (Sobolev, 1980, p. 17). Figure 3.3 illustrates the expansion of the Soviet oil and gas pipeline network. At present 5 oil pipelines and 12 gas pipelines transport oil and gas from the West Siberian region to the European USSR. The relative slowing of the construction of oil pipelines in the 1980s, and the rapid expansion of the gas pipeline network depicted on Figure 3.3., reflect the slackening of Siberian oil production and the rapid expansion of natural gas production. As a result of the eastward shift of oil and gas production the average length of haul of oil and oil products increased from 629 km in 1965 to 1,981 km in 1981; and of natural gas from 680 km in 1965 to 1,625 km in 1981 (Cadieux, 1984, p. 84). The demand for large diameter pipe has been so great that the Soviet Union

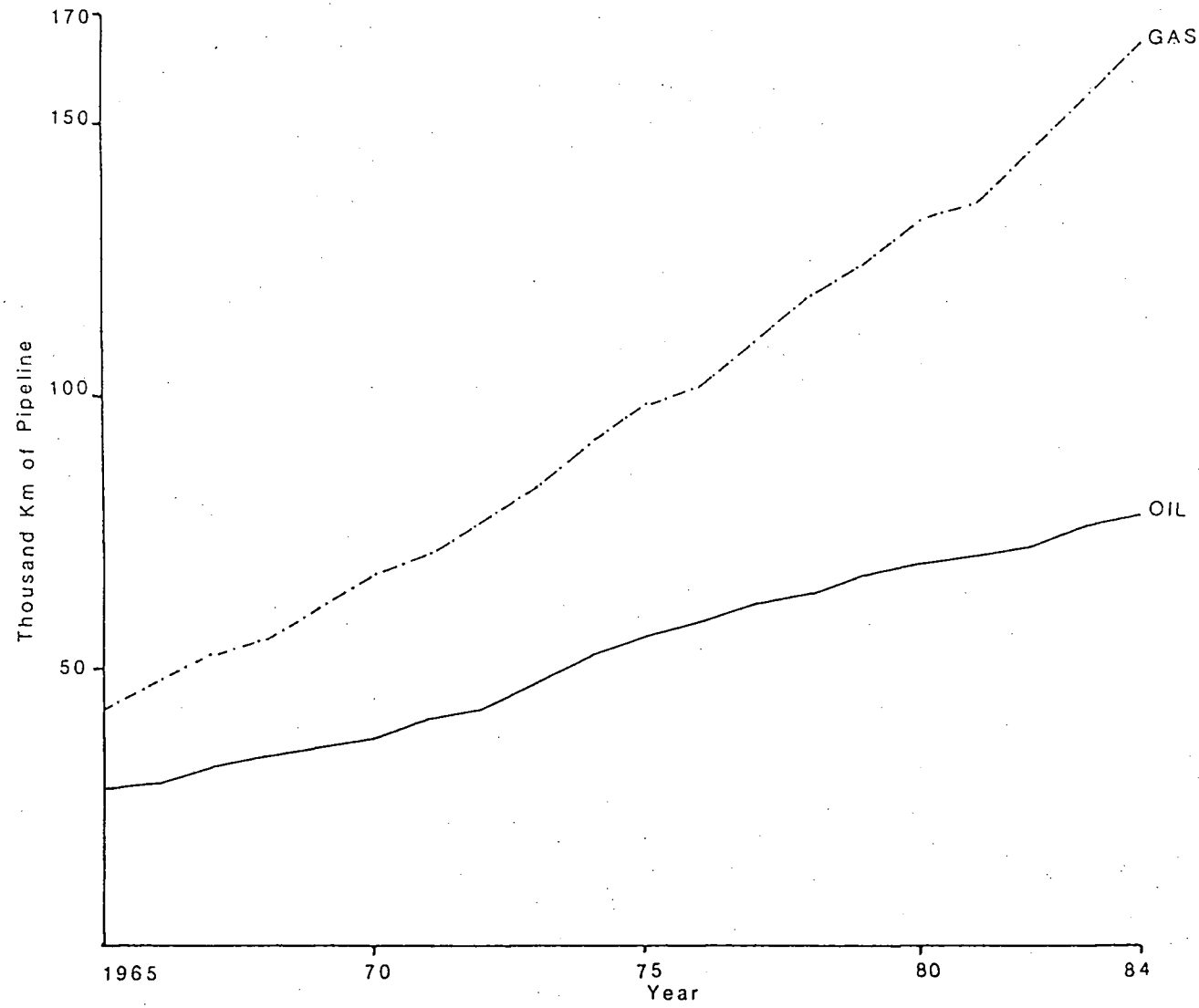


Figure 3.3 The Development of the Soviet Oil and Gas Pipeline Networks

Source: Tsentral'noye Statisticheskoye Upravleniye (various years), Narodnoye khozyaystvo SSSR. Moscow: Finansy i Statistika.

has had to import large amounts of pipe to meet its transportation needs.

The other smaller natural gas fields in Siberia and the Far East serve local demands. The Messoyakha field, discovered 250 km from Noril'sk, supplies the Noril'sk metallurgical combine. The switch from coal to gas has resulted in the reduction the labour force by 6,000 workers in a region where labour is very costly and the environment extreme (Dienes and Shabad, 1979, pp. 92-93). Likewise the gas fields near Yakutsk have been used to generate power and heat for the city of Yakutsk. While there are considerable reserves in the Yakutsk region local demand is limited, and distance restricts production for European markets. Various attempts have been made to attract foreign investors to develop the fields for export (these are discussed in Chapter 6) but so far no projects have reached the production stage.

3.2.3. The Coal Industry

The development of oil and gas as the major components of the Soviet energy mix has been at the cost of the coal industry which has gone into relative decline. According to a Soviet source, 77.2 percent of the coal reserves suitable for exploitation are located in Siberia and the Far East (Zvyagitseva, 1984, p. 23) and yet, as Table 3.7 documents, the region has only accounted for 25 percent of national production. The coal basins of Siberia and the Far East that are of national importance are: the Kuznetsk basin, the Kansk-Achinsk basin and the South Yakutian basin. The other smaller basins produce coal for local consumption and generation of

Table 3.7

The Geographical Distribution of Soviet Coal Production, 1965-85

(Million Metric Tons)

	1965	1970	1975	1980	1981	1982	1983	1985 Plan
USSR Total	578	624	701	716	704	718	716	775
Western USSR	351	335	366	338	326	330	324	341
Donets	206	217	223	204	198	200	196	210
Moscow	41	36	34	25	22	23	21	20
Pechora	18	21	24	28	28	28	28	28
Urals	62	54	45	44	43	44	44	45
Other	24	27	40	37	35	35	35	38
Eastern USSR	227	269	335	378	378	338	392	434
Ekibastuz	14	23	46	67	68	70	72	84
Karaganda	31	38	46	48	49	49	49	50
Kuznetsk	96	113	138	144	144	148	147	154
Kansk-Achinsk	14	18	28	35	35	37	40	48
South Yakutia	-	-	0	3	3	4	4	12
Other	72	77	77	81	79	80	80	86
Siberia as Percent of National Total[a]	19	21	23.7	25.4	25.9	26.3	26.7	27.6

Source: CIA (1985b), USSR Energy Atlas. Washington, D.C.:GPO, p. 36.

a. Siberia calculated as the production from the Kuznetsk, Kansk-Achinsk and South Yakutian basins. The smaller Siberian basins are included in "other" eastern producers, therefore the role of Siberian production is slightly underestimated.

electricity. Since the mid-1970s the coal industry as a whole has been in decline. Production reached 724 million tons in 1978, but fell to 716 million tons in 1983. The 1985 plan target of 775 million tons was not met, although coal production did reach a record 726 million tons that year. Inspection of the geographical distribution of coal production (Table 3.7) reveals that production in the Eastern regions of the USSR (Central Asia and Siberia) has increased, while production in the European USSR, most notably the Donets basin, has declined. Production declines in the European USSR reflect the greater age of the mines and the depletion of their most economical seams. Production in the Eastern regions is predominantly opencast, which results in lower production costs. In 1985 opencast mining accounted for 42 percent of Soviet coal production, compared to 32 percent in 1975.[3] In terms of national importance the Kuznetsk basin is the most important Siberian producer, with production increases being used to compensate for the decline of the Donbass. However, production in the Kuzbass has now stagnated and considerable new investment is required if production is to increase. Kuznetsk coal is transported westward to the European USSR as well as eastward to Japan (until South Yakutia reaches full production). Kansk-Achinsk coal is unstable brown coal and cannot be transported safely over long distances; therefore, it is to be used to generate electricity for transmission through the power grid to other regions. The scale of development at Kansk-Achinsk is dependent on advances in high-voltage transmission and also the production of synthetic fuels. The

only other coal-producing region of national importance is the South Yakutian Coal Complex. The Neryungri opencast mine started operation in 1978 when the Little-BAM railway reached the complex. By 1983 the complex was producing 5 million tons of coal. The final annual production capacity will be 12 million tons a year, 5 million tons of which will be exported to Japan under the compensation agreement that funded development of the complex.

3.2.4. Electricity Generation

Electricity in Siberia and the Far East is produced primarily by coal-fired thermal and hydro-electric stations. The region contains a single nuclear reactor at Bilibino in the far north of Magadan Oblast'. In the last decade there have been attempts to increase the amount of casing-head gas used to generate power in West Siberia. Figure 3.4 shows the power production and transmission system in Siberia and the Far East. The more developed and accessible southern regions are part of the national unified power system, whilst other regions are served by local power systems. It is one of the ironies of Siberian development that despite the vast energy resources of the region electricity supply has been unable to keep up with demand and power shortage is a serious problem. The power problem reflects lack of coordination between the power producing and power consuming industrial ministries, in particular the failure to synchronise the start up of power plants and industrial capacity.

Hydro-electric power generation is concentrated in the Angara-Yenisey river system which contains over 25 percent of

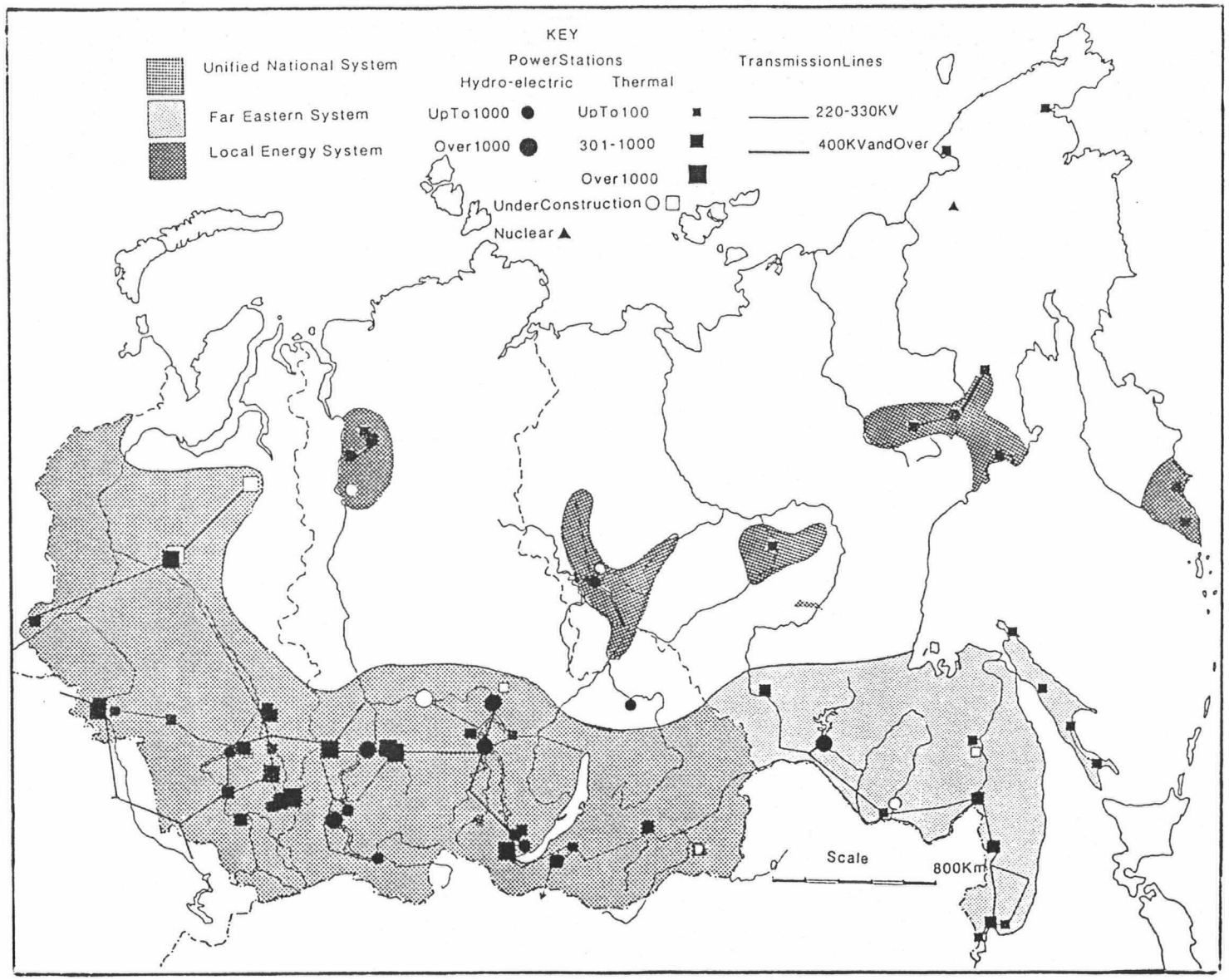


Figure 3.4 Siberian Power Generation and Transmission System

the country's total HEP potential, capable of producing 300 billion KWh of electricity annually (CIA 1985, p. 51), The first station in the Angara-Yenisey system was a small one at Irkutsk, but the first large project was Bratsk which reached full capacity of 4,500 MW in 1966. At that time it was the largest HEP station in the world. In 1971 the Krasnoyarsk station with a capacity of 6,000 MW claimed first place. A second station was completed downstream of Bratsk at Ust'-Ilimsk, in 1977. When the Sayan-Shushenskoye station is completed it will have a capacity of 6400 MW, making it the largest in the region. The 12th FYP calls for the completion of the Boguchany station on the Angara, which will have an installed capacity of 4,100 MW. When the smaller Irkutsk station is included, the total installed capacity of the Angara-Yenisey system (including Boguchany) is 25,980 MW. Feasibility studies have now been completed on the last of the chain of hydro-electric stations to be built on the lower reaches of the Angara and the middle reseaches of the Yenisey. The station is to have a capacity of 6,000 MW and is to be built on the Yenisey river, downstream from the Angara-Yenisey confluence.[4] Despite these large complexes the hydro-electric potential of Siberia and the Far East is relatively undeveloped when compared to the European USSR. Only in Eastern Siberia has the resource been extensively developed. Hydro-electric stations have been constructed in the Far East at Kolyma, Vilyuy, Zeya and Bureya but they use less than 4 percent of the potential of the region. In the Noril'sk region hydro-stations have been constructed to supply local demands. The hydro

capacity of the Angara-Yenisey is of national importance because it represents a source of cheap energy for the production of energy intensive products, such as aluminum. Thus, Siberian energy is embodied in products that are exported to other regions of the country and to export markets.

In conclusion, it is clear that the energy industries have a different role to play in the various regions of Siberia and the Far East. In the northern part of the West Siberian region the rapid growth of the oil and gas industries has made the West Siberian Fuels Energy Complex the centre of the Soviet energy system. In the south the Kuzbass remains an essential component of the coal industry, but as a result of inadequate investment it has not been able to meet the demands placed upon it. In the southern part of Eastern Siberia the emphasis has been upon the generation of hydro-electricity to provide energy for power-intensive industries. In the north energy developments in the Noril'sk region are aimed at supplying the needs of the metallurgical combine. Likewise in the Far East the majority of the energy industry is oriented to local needs, and it is only with the recent development of the South Yakutian coal complex that sizeable energy exports have started. The Far East still has to import the majority of its petroleum needs, although in the future Sakhalin offshore production may increase local petroleum production. Thus, in terms of export potential, the West Siberian fuels energy complex and the Kuzbass and South Yakutian coal mines are most likely to contribute to energy exports to the West.

3.3. Raw Material Production and Processing

In this section the following industrial activities are examined: ferrous metals, non-ferrous metals, chemicals, and forestry and forest products. In each case the nature and location of production in Siberia and the Far East is presented, and the role of regional production in the national economy is evaluated.

3.3.1. Ferrous Metallurgy

Iron ore is one of the few raw materials that the European USSR contains in greater abundance than Siberia and the Far East. During the 1980s Siberia and the Far East have, on average, produced 16 million tons of marketable iron ore, or 6 percent of national production.[5] Iron and steel production is confined to the Kuznetsk basin in West Siberia, where two large integrated iron and steel mills are located at Novokuznetsk, and Komsomol'sk in the Far East. One of the Kuzbass mills dates back to the 1930s and creation of the Urals-Kuznetsk Combine, while the second plant was constructed during the 1960s. Although the Kuzbass plant orginally received iron ore from Magnitogorsk in the Urals, it now receives its iron ore from the Siberian region--60 percent from local mines in the Gornaya Shoriya district and the Khakass Autonomous Oblast'. The other 40 percent comes from Zheleznogorsk, east of Bratsk in Irkutsk Oblast', and also from Kazakhstan (Lydolph, 1979, p. 323). Coking coal comes from the Kuzbass, the smaller East Siberian basins and more recently the South Yakutian basin. Steel mills are located at Novokuznetsk and Novosibirsk in West Siberia, at Krasnoyarsk and Petrovsk-

Zabaykal'skiy (east of Lake Baykal) in East Siberia, and at Komsomol'sk in the Far East. The steel plant at Komsomol'sk began operation in 1942 and formed the basis for the city named after the Young Communist League. Annual production of 1 million tons of steel is based on scrap iron and pig iron from the Kuzbass. The plant provides 30-40 percent of local needs, specialising in tin plate for fish canning and ship plating for local shipyards (Lydolph, 1979, p. 325). However, steel production is so specialised that the Komosomol'sk plant has to export a large amount of its output to other regions. At the end of 1985 a new mini-mill started production at Komosomol'sk, and it will help to reduce long-haul shipment of steel. But Siberia and the Far East remain importers of iron and steel, and the lack of an adequate iron and steel industry continues to be a limiting factor in the development of metal consuming industries, such as machine-building. The 12th FYP envisages the possibility of a Far Eastern iron and steel complex, probably at Tommot in the South Yakutian complex, utilising local coal and iron ore. However, this plan is unlikely to be realised in this century.

3.3.2. Non-Ferrous Metallurgy

Siberia and the Far East play a much more substantial role in non-ferrous metallurgy. The region not only has an abundance of mineral wealth, but the availability of hydro-power has made it a centre of aluminum production. National and regional production figures are State secrets, and therefore one has to rely on Western sources. A recent Western study of Siberian natural resources (Kirby, 1984, p. 36)

concluded that Siberia and the Far East were the Soviet Union's leading sources of diamonds, gold, platinum, uranium (probably), wolfram, cobalt and nickel; and a significant producer of copper, mercury, silver, and other non-ferrous metals such as selenium and tellerium. Figure 3.5 shows the location of the major mineral deposits and ore bodies in Siberia and the Far East. As Chapter 2 showed, exports of non-fuel minerals are an important source of foreign currency. The contribution of Siberian and Far Eastern mineral production to both national production and exports is assessed in Chapter 5. Because of their role in regional development, the East Siberian aluminum industry and the Noril'sk metallurgical combine are examined here.

Because of its high degree of dependence upon imported raw material, the aluminum industry is a special case among Soviet industries. The Soviet Union has limited resources of high-grade bauxite and initially developed its aluminum industry on nepheline and alunite. The more recent expansion of the industry has been based on imported bauxite from Greece, Guinea, Yugoslavia, Hungary, India, and Jamaica. Reliance on imported bauxite rose from 12 percent in 1965 to 50 percent in 1980 (Shabad, 1983b, p. 89). The Siberian industry is concentrated within the southern regions of Eastern Siberia and is based on local nepheline ores and imported bauxite. An alumina plant based on nepheline deposits at Belogorsk has been constructed at Achinsk. It has encountered many production problems and as of 1980 was only operating at 75 percent of capacity. As a consequence the aluminium plant at Krasnoyarsk

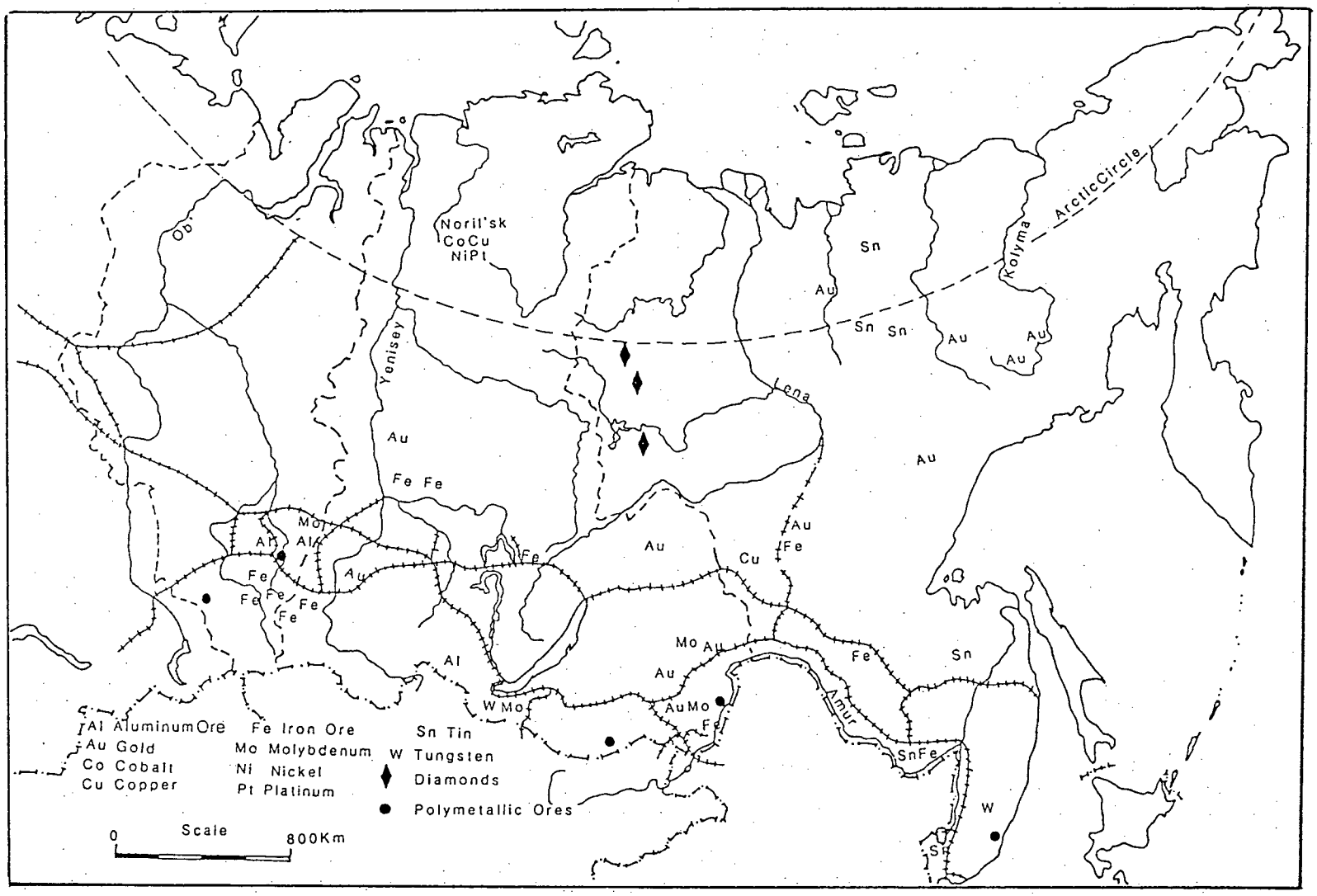


Figure 3.5 Major Mineral Deposits and Ore Bodies in Siberia and the Far East

has also only reached 75 percent of its planned capacity. Both plants were scheduled to be at capacity by 1985. The remaining plants utilise bauxite that is transported into the region from domestic deposits in the Urals and from the Nikolayev alumina plant on the Black Sea, which processes imported bauxite.

Aluminum smelting capacity in Siberia has developed with the expansion of the region's hydro-electric power system. There have been problems of coordination resulting from the fact that it takes longer to build a smelter than it does a HEP station. At Bratsk power from the dam was used by other industries, so that a second station at Ust'-Ilimsk had to built to satisfy the power needs of the Bratsk smelter when it came on stream. Siberian aluminum production was limited to a single complex at Novokuznetsk until the 1960s when a rapid expansion of the industry began. The first plant, the Irkutsk plant at Shelekhov, started production in 1962 and was followed by the Krasnoyarsk plant in 1964 and the Bratsk plant in 1966. Between 1960 and 1980 these plants contributed to a four-fold increase in the production of aluminum, from 620,000 tons to 2,460,000 tons. Since the mid-1970s the rate of increase has slowed, with production increases coming from the completion of additional capacity at Krasnoyarsk and the construction of the Sayanogorsk plant (Shabad, 1983b, p. 91). The Sayanogorsk plant has been under construction at the Sayan TPC since the mid 1970s; after considerable delay its first potline started production in April 1985.[6] By 1990 Siberian aluminum production is expected to be more than 3 million tons, accounting for 60 percent of national production. With the

possibility of future plants at the Boguchany HEP project in Eastern Siberia, and on the Pacific coast (using Australian bauxite), Siberia is likely to maintain its national importance in aluminum production.

The other non-ferrous metallurgical complex within Eastern Siberia is at Noril'sk. Construction of the Noril'sk mining and metallurgical combine started in the early 1930s and continued through the War. In 1947 about 3,000 tons of finished nickel were produced at Noril'sk (Bond, 1984, p.356). During the 1970s the Noril'sk combine underwent considerable expansion, and production of nickel, copper and platinum group metals has increased. In addition ore is shipped via the Northern Sea Route to smelters on the Kola Penisula where the local ore is depleted. The role of Noril'sk in East-West trade is examined in Chapters 5 and 6; since the late 1960s two-thirds of Soviet nickel production has come from plants at Noril'sk and the Kola Penisula. The Noril'sk combine also accounts for 75 percent of national production of platinum group metals. Thus, Noril'sk is one of the most important non-ferrous metallurgical combines in the Soviet Union.

3.3.3. The Chemical Industry

Given the existence of large amounts of oil and gas, minerals resources and electricity, Siberia has the potential to be an important component of the Soviet chemical and petrochemical industries. But, as Table 3.8 shows, Siberia has to date played a relatively minor role in chemical and petrochemical production. This discrepancy is explained by the fact that the limited infrastructure and high cost of

Table 3.8

Regional Distribution of Chemical and Petrochemical Production

(As Percent of National Production)

Region	1970	1975	1980
North European USSR	56.6	56.4	57.2
South European USSR	30.2	29.3	28.7
Central Asia and Kazakhstan	4.1	4.7	4.7
Siberia and the Far East	9.1	9.6	9.4
West Siberia	6.5	7.1	7.1
East Siberia	2.2	2.0	1.8
Far East	0.4	0.5	0.5
Total	100	100	100

Source: Fridman, Yu. A. (1984) Khimicheskaya promyshlennost' v khozyaystvennom komplekse Sibiri. Novosibirsk: Nauka SO., pp. 71-72.

construction in Siberia have led the chemical industry to avoid Siberian locations when at all possible. The potential for expansion of the petrochemical industry is small because of the limited amount of refinery capacity in the region (Figure 3.6). In 1980 the combined throughput of the refineries at Omsk, Angarsk, Khabarovsk and Komsomol'sk was 54 million tons, which represented 12.2 percent of Soviet refinery capacity (Sagers, 1984, p. 29). Natural gas processing capacity in Siberia was nearly 20 billion cubic metres in 1982 (CIA, 1985b, p. 31). In addition the predominance of crude oil over product pipelines and the crowded railways have resulted in the movement of unprocessed crude oil out of the region to the European USSR. The existence of a developed infrastructure, stable labour force, and proximity to domestic and export markets has led to a concentration of the chemical industries in the European regions. During the 9th FYP Siberia received only 7 percent of total national investment in the petrochemicals industry (Rumer, 1984, p. 85). It has been a persistent complaint of the pro-Siberian school that the chemical industry should be expanded in Siberia (see Kalashnikova, 1980, pp.26-31 and Granberg, 1985, pp. 48-49).

The components of the industry located within the region tend to be concentrated within large industrial complexes, at Omsk (benzene), Tomsk (methanol and polypropylene), Tobol'sk (butadiene), Kemerovo (urea) and Zima (PVC)(See Figure 3.6). The plants within these complexes often make an important contribution to national production of certain products. The Siberian chemical industry has been a major

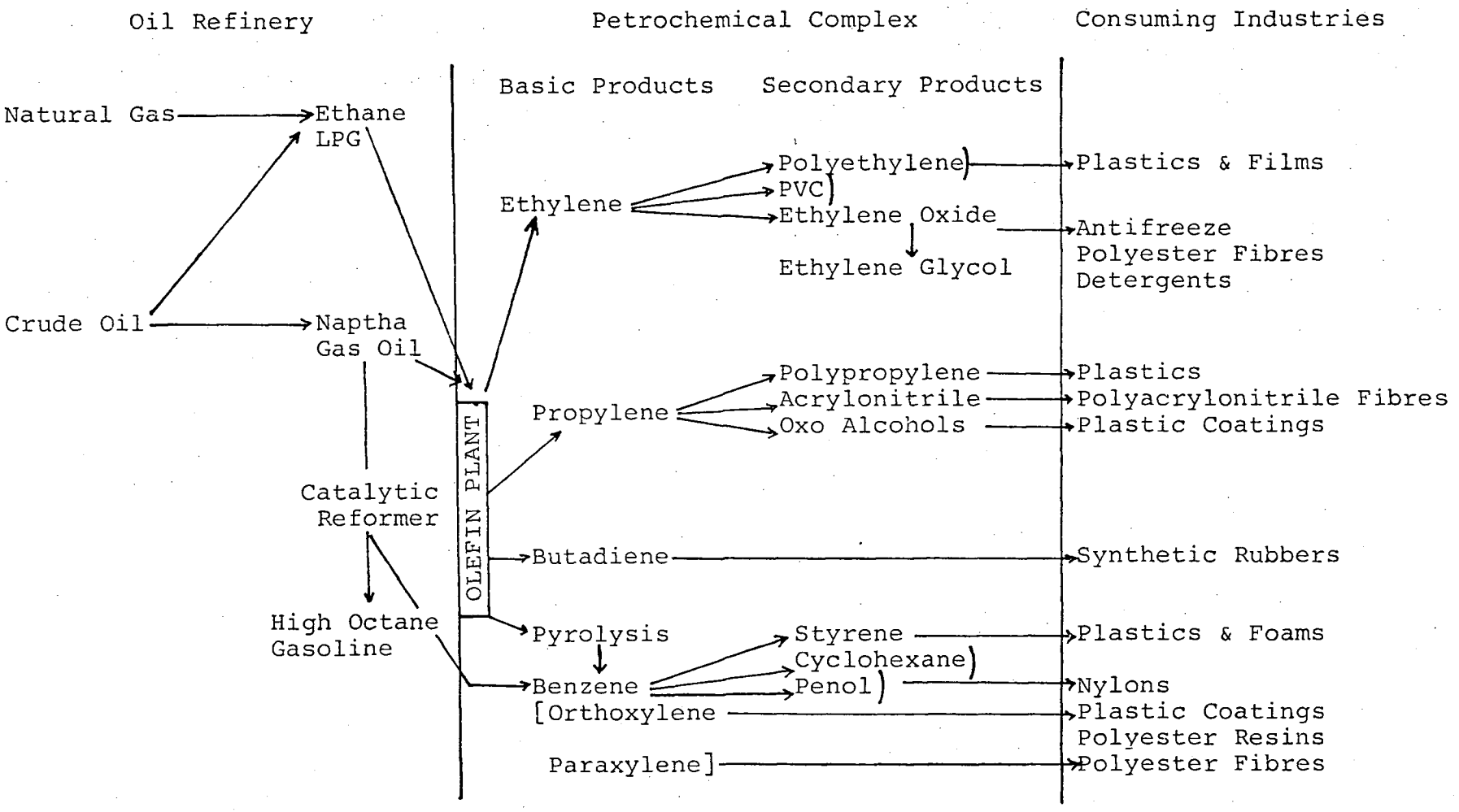


Figure 3.6 The Petrochemicals Industry

Source: OECD (1980), East-West Trade in Chemicals. Paris: OECD, p. xv.

recipient of Western technology. As such it is the subject of a more detailed analysis in Chapter 6. For the moment it is sufficient to note that while at a regional scale the chemical and petrochemical complexes are of considerable importance, in general the region plays a rather modest role in the Soviet chemical industry.

3.3.4. The Forest Industry

The final industry examined in this section, the forest and forest products sector, has been the subject of many studies by Western scholars (see for example, Barr, 1983, 1984, Blandon, 1983, Eronen 1985a, 1985b, and North and Solecki, 1977). For the purposes of this study it is sufficient to examine Siberia and the Far East's share of the forestry resource and role in the forest products industry.

The RSFSR contains 95 percent of Goslesfond, the land under the jurisdiction of the State Forestry Service. Seventy six percent of Goslesfond is forested area (933.3 million hectares), of which 21.1 percent is located in the European region and 79.9 percent in the Asiatic region. About 83 percent of the forested area is actually forest covered. The forested area of Goslesfond is on average 75.1 percent conifer, but there is a higher than average conifer content in the Asiatic region. In 1970 385 million cubic metres of timber were logged. Of this, 61 percent (236 million metres) were felled in the European USSR (Blandon, 1983, pp 27-31). Thus, in simple terms, the forest resource of the Asiatic region was under utilised, while the European resource was over utilised.

Within Siberia and the Far East the forest is dominated

by stands of mature or overmature conifers. As one moves eastwards the amount of larch increases (see Table 3.9). In the West Siberian region 60 percent of the land is forested. Pine and birch are the most common species and 75 percent of the stands are mature or overmature. Only one-third of the allowable cut is harvested and the region accounts for 8.5 percent of the total volume of timber felled in the Soviet Union (Blandon, 1983, pp.35-36). The East Siberian region is 70 percent forest covered. Seventy four percent of the stand is mature or overmature and 85 percent of the trees are conifers, with larch being the most common species. The major problem limiting the timber cut is accessibility. This leads to overcutting in the more accessible regions and a shortage of timber around industrial centres. The Far Eastern region is 45.9 percent forest covered and 84 percent of the trees are conifers, with larch the most common species.[7] About 5 percent of the timber cut in the Soviet Union comes from the Soviet Far East, and only 40 percent of the allowable cut is harvested.

On the face of it, it would seem that the forest resource of Siberia and the Far East is very much underdeveloped. However, the nature of the forest resource reduces its economic attractiveness. First, the predominance of overmature stands means that the region's annual timber growth is low. Second, the nature of the environment reduces the regenerative capacity of the forest. The mean annual increment is three times greater in the accessible regions of the European USSR than in Siberia (Barr 1984, pp. 246). The slow rates of forest regrowth premit soil erosion, which compounds the problem.

Table 3.9

Geographical Distribution of Major Coniferous Species[a]

(Thousand Hectares)

Region	Pine	Spruce	Fir	Larch	Total
USSR Total	141,611	72,105	23,100	274,261	511,077
West Siberia	33,349	4,750	4,234	4,807	47,140
Percent USSR	23.5	6.6	18.3	1.8	9.2
East Siberia	61,776	4,462	16,576	215,432	298,246
Percent USSR	43.6	6.2	71.8	78.5	58.3
Far East	4,801	14,201	923	53,274	73,199
Percent USSR	3.4	19.7	4.0	19.4	14.3
Siberia & the Far East as a Percentage of USSR Total	70.5	32.5	94.1	99.7	81.8

Source: Blandon, P. (1983), Soviet Forest Industries. Boulder, Colorado: Westview Press, p. 41.

a. Refers to forests where a particular tree predominates or characterises the area.

Third, the forest stands are not very dense, and the steep terrain often makes harvesting difficult and environmentally disastrous. The large amount of larch in the region's forests is also a negative factor, on the one hand, because it does not float very well and is therefore difficult to transport, and on the other hand, because it is difficult to process and requires special machinery. When one also considers that the major destinations for Soviet forest products are the European USSR and European export markets, the relatively limited use of the forest resource is understandable.

Faced with the depletion of the forests of the European region and the existence of an extensive forest reserve in the Eastern regions, the forest products sector has adopted a dual investment policy. Pressure on the European resource has required investment in forest management and improvements in the capital stock of the processing sector, in an attempt to move to a more intensive mode of activity. At the same time, exploitation of the forests of the eastern regions has required considerable investment in labour, infrastructure and processing capacity. During the 10th FYP the Ust'-Ilimsk complex absorbed one quarter of all the investment allocated to the forest products sector (Shabad, 1979, p.250). Barr (1983, p. 434) has suggested that a shortage of capital and labour has led the forestry industry to concentrate on the European regions, rather than Siberia and the Far East. Within Siberia the forest products sector has tended to become concentrated within large integrated complexes, such as Bratsk and Ust'-Ilimsk. In the Far East the industry is dispersed throughout

the southern areas of the region and, because of its distance from national markets, serves local markets and the Pacific export market. The forest industry has been both a recipient of Western technology and a producer of exports, and this is examined in more detail in later chapters. Table 3.10 details the role of Siberian and Far Eastern forest products industries in the national economy. The greater role assigned to sawnwood, rather than processed products, suggests that timber is shipped out to be further processed in European regions. The regional pattern of sawnwood production mirrors the pattern of timber cut, since saw mills tend to locate at the raw material source. Far Eastern export production is not adequately reflected in these figures because the majority of exports to Japan are in the form of round wood. Within the regions the most dramatic gains in forest product output have been in Eastern Siberia. The large increases in production are associated with the creation of large complexes at Bratsk and Ust'-Ilimsk in Irkutsk Oblast', and Seleginsk and Baykal'sk on the south-eastern shores of Lake Baykal. The paper and cardboard industry in the Far East is mainly a legacy of the Japanese occupation of Sakhalin Island.

The forest sector as a whole is plagued with problems of poor coordination, lack of capital and waste. Only 51 percent of the forest resource harvested reaches the consumer, and only 8 percent of the remaining scrap is utilized. A major cause of waste is the fact that timber is harvested by over 10,000 enterprises, under the jurisdiction of 34 ministries and departments (Barr, 1984, p. 250). In East Siberia much of the

Table 3.10

The Role of Siberia and the Far East in the Soviet Forest Products Industry

	Sawnwood (,000 Cubic Metres)				Plywood (,000 Cubic Metres)			
	1970	1975	1980	1984	1970	1975	1980	1984
USSR	116,391	116,219	98,199	97,322	2,045	2,196	2,032	2,132
RSFSR	91,829	93,513	80,310	78,650	1,421	1,559	1,460	1,523
West Siberia	8,248	8,790	8,639	8,728	65.9	68.3	49.2	48.8
East Siberia	14,965	17,339	16,422	16,137	38.8	50.2	107.7	160.3
Far East	6,663	6,580	6,254	6,195	50.7	46.6	36	38.9
Siberia & Far East	29,867	32,709	31,315	31,060	155.4	165.1	192.9	280
As a Percent: of USSR	25.7	28.1	31.9	32	7.6	7.5	9.5	11.6
of RSFSR	32.5	35	39	39.5	10.9	10.6	13.2	16

	Paper (,000 Tons)				Cardboard (,000 Tons)			
	1970	1975	1980	1984	1970	1975	1980	1984
USSR	4,185	5,215	5,288	5,862	2,516	3,368	3,445	3,965
RSFSR	3,476	4,318	4,462	4.917	1,973	2,514	2,536	2,814
West Siberia	25	1.8	2.7	2.2	16.4	56.3	60.3	61.8
East Siberia	128.8	133.3	113.9	119.3	252.2	393.9	436.6	469.1
Far East	195.3	229	231.6	208.7	121.1	133.7	169.7	168.7
Siberia & Far East	318.6	364.1	348.2	330.2	389.7	583.9	666.6	699.6
As a percent: of USSR	7.6	7	6.6	5.6	15.5	17.3	19.3	17.6
of RSFSR	9.1	8.4	7.8	6.7	19.6	23.2	26.3	24.9

Source: Tsentral'noye Statisticheskoye Upravleniye RSFSR (various years), Narodnoye khozyaystvo RSFSR. Moscow: Finansy i Statistika.

timber targeted for utilisation by the large forest complexes has been removed by other agencies. Eronen (1985a, 1985b) has examined the locational strategies of the Soviet forest products sector. He suggests that the large Siberian complexes were developed because of the availability of extensive softwood reserves and hydro-power, which are thought to offset the additional transport cost incurred in moving products to market. However, Eronen (1985a, p. 606) maintains that these complexes are simply too big--Bratsk has a capacity to consume 7 million metres of wood annually and Ust'-Ilimsk 6.9 million metres- -and are unable to work at planned capacity because of problems with timber supply.

A number of concluding statements can be made concerning the role of Siberia and the Far East in the Soviet forestry industry. First, while the region contains nearly 80 percent of the forested area of Goslesfond, the forest is dominated by mature and overmature stands, the productivity of the forests is reduced by both its age and the harshness of the environment, and the stands are dominated by larch. Second, much of the timber felled in the region leaves as unprocessed round wood or semi-processed timber products. Third, the regional forest-product sector plays a minor role in the national economy. However, despite the problems with the large forest complexes at Bratsk and Ust'-Ilimsk, the region continues to receive investment. The final hydro-station being built on the Yenisey is planned to provide the energy base for another pulp and paper plant.

3.4. Production of Finished Goods

The regional economies of Siberia and the Far East are dominated by resource and raw material production and processing. Therefore, one would not expect the machine-building enterprises of Siberia and the Far East to be of national significance. However, the Siberian machine-building industry is oriented towards national needs rather than regional needs which has led to an unusual pattern of machine-building. In the case of the food industry a distinction is made between provision of agricultural products for local needs and the Far Eastern fishing industry which provides for the national market.

3.4.1. The Machine-Building Industry

The role and structure of the Siberian and Far Eastern machine-building industries reflect both the impact of the Second World War on the region, and the problems of planning the Soviet economy by sector rather than region. Much of the Siberian machine-building industry is a legacy from the evacuation of industry eastwards during the Second World War. While this acted as an impetus to Siberian development it led to a machine-building industry that reflected the needs of the nation. Therefore, after the war the machine-building industry in Siberia and the Far East did not suit the needs of the Eastern regions. This pattern of specialisation has been allowed to persist because the various industrial ministries involved have been concerned with their own needs, and not those of the region.

The poor match between regional consumption and regional

production is reflected in the data in Table 3.11. While one would expect to see a high share of machine-building for the mining industry, even that fails to meet regional demand. The iron and coal output of Western Siberia accounts for 16 percent of Soviet output, yet the region produces only 10.7 percent of the national output of the equipment for those sectors (Kurbatova, 1980a, p.279). The West Siberian fuels energy complex is estimated to consume 35 to 40 percent of national production of petrochemical equipment, yet the region accounts for only 4 percent of national petrochemical equipment production (Kurbatov, 1980b, p. 36). In the late 1960s the northern and eastern regions of the RSFSR accounted for 28 percent of the all-wheeled tractors, 40 percent of the caterpillar tractors, 30 percent of the road-building equipment, 26 percent of the steam-shovels, 20 percent of the cranes and 32 percent of the motor vehicles used in the Republic (Loginov, 1970, p. 52). The majority of this equipment was produced in the western regions of the country, which account for 90 percent of machine-building output (Rumer, 1984, p.104).

Given the poor agricultural base of the region, it is hard to justify the large share of regional industry occupied with the production of agricultural machinery. In addition, because the agricultural machine-building enterprises are specialised they have to export a large part of their production to other regions, and Siberia has to import more than 50 percent of its agricultural machinery from western regions. The irrational structure of the machine-building

Table 3.11

The Branch Structure of Machine-Building in the USSR and West Siberia

(Percentage of Total Production)

	Branch Structure		West Siberia's share of USSR production
	USSR	West Siberia	
Machine-Building (Excluding metalworking and repair)	100	100	5.1
Energy and Power	1.9	5.47	14.7
Electrical	12.0	13.3	5.7
Mining	1.77	3.71	10.7
Machine Tools	4.29	5.35	6.45
Automobile Industry	11.54	3.8	1.64
Tractors & Agricultural	11.0	17.5	8.2
Metallurgical	1.4	-	-
Oil & Gas Equipment	0.95	0.78	4.2
Construction Equipment	2.06	0.68	1.7
Logging and Paper	0.39	0.12	1.55
Construction Materials	0.7	0.34	2.52
Chemical Industry	0.95	0.78	4.2
Hoisting-transporting	1.6	0.1	3.1
Total for 13 Branches	51.4	52.0	5.17
Other Branches	49.6	48.0	-

Source: Kurbatova, G. Ya. (1980), "Mashinostroyeniye," in Ocherki ekonomiki Sibiri. Edited by V.V.Alekseev. Novosibirsk: Nauka SO., p. 278.

sector has been a source of concern among Soviet planners and academics. Loginov (1970, p. 50) talked of a "transport shuttle" system, whereby Siberian machine-building enterprises obtained steel and parts from western regions and then shipped the finished product back to the western regions. Granberg (1985, p. 46) suggests that about 70 percent of the production of the Siberian machine-building industry is shipped out of the region. This not only leads to increased transportation costs and added burden on the transportation system, but is also a waste of Siberia's scarcest resource--labour.

3.4.2. The Food Industries

The agricultural resource base of Siberia and the Far East is severely limited by the harsh climate of the region, as well as extensive areas of swamp and permafrost. Consequently the region is not even self-sufficient in basic products. On average local producers provide 25 percent of locally consumed staples such as potatoes, eggs and milk. In the more remote areas greenhouses are the only practical means of cultivation, and in the Far North artificial light is required to maintain plant growth. Production costs are much higher than the national average. The average cost of milk in the region is 58 percent above the national average (Wien, 1984, p. 596). Obviously it is far more expensive to operate a dairy operation in Noril'sk, above the Arctic Circle, than in the south. Only the southern areas of the Siberian region can be considered good general farming land.

The industrialisation of Siberia has tended to reduce agricultural potential in the region by taking up land (for

example as a result of hydro projects) and by attracting the rural population to work in industry. But at the same time it has increased the demand for local production of staple goods--meat, eggs, potatoes, cabbages, and milk. As part of the national "Food Programme", Siberia and the Far East are expected to increase local production to supply 65 percent of local needs of staple goods by 1990 (Wien, 1984, p. 595). Increased agricultural output is to result from the addition of 500,000 hectares of land from reclamation and the opening up of new regions. In the Far East the programme is concentrating on four areas: the construction of livestock complexes, the modernisation of agricultural equipment, the creation of "agro-belts" around cities, and the concentrated cultivation of relatively rich soils in the Maritime Kray and the Amur Oblast' (Chichkanov amd Minakir, 1986, p. 104). The programme for the development of the BAM service zone also envisages intensive production of agricultural products for local consumption. It is too early to assess the success of these initatives. However, one must question whether the necessary labour can be made available to expand the limited agricultural base of the region.

In the Soviet Far East the role of the food industry is inflated by the inclusion of the fishing industry. The Far Eastern fishing industry is administered by "Dalryba" and operates mainly in the Pacific and seas adjoining it (Solecki, 1979. p. 105). Prior to the Second World War the Far Eastern fishing fleet accounted for 10 percent of the national catch, but since the war it has come to national prominence and now

accounts for 40 percent of the national catch. (Chichkanov and Orlov, 1983, p. 67). In 1940 the total catch was 300,000 tons, in 1970 2,190,000 tons and in 1980 3,500,000 tons (Solecki, 1979, p. 109; Chichkanov and Orlov, 1983, p. 67). Expansion of the Far Eastern fleet has resulted in part from the depletion of stocks in other fishing grounds, both inland water and open sea. There has been considerable investment in the fishing industry in the maritime regions of the Far East. Krivoruchko (1976, p. 158) estimated that during the early 1970s 45 percent of all investment in Maritime Kray was used to expand maritime-related activites and 20 percent of the population was occupied in them. In the mid 1970s the Far Eastern region accounted for 36 percent of the nation's fish processing capacity and during the 10th FYP it produced 30 percent of the commercial fish products, 40 percent of the canned fish preserves and 45 percent of the fish meal for fodder (Chichkanov and Orlov, 1983, p. 67). During the 1960s the Far Eastern fishing fleet operated in nearby waters, but during the 1970s it moved into the North and South Pacific. Now the North Pacific provides 90 percent of the catch. The institution of the 200 mile limit, acknowledged by the Soviet Union, has necessitated negotiation and compensation for fishing in waters under the jurisdiction of other states, for example the tuna fishery in the South Pacific and the Alaskan fishing grounds in the North Pacific. At the same time foreign fishermen, particularly the Japanese, have had to compensate the Soviet Union for fishing in Far Eastern waters under Soviet control (Toda, 1985). Since over 60 percent of the production of the Far Eastern fishing

industry goes to other regions of the Soviet Union and to export, the industry is of national significance.

3.5. Conclusions

This chapter has described the industrial structure and identified the national specialisations of Siberia and the Far East. Findings of this analysis are presented in Table 3.12. In the wider context of this study the specialisations represent those sectors which are most likely to participate in East-West trade, both as a producer of exports and a consumer of imports. Table 3.12 makes a distinction between regional production that is of national significance and production within particular complexes that is of national importance. In West Siberia the West Siberian Fuels Energy Complex dominates the north of the region, and has become the centre of the Soviet energy system. Within the Fuels Energy Complex there are also large petrochemical complexes that are of national importance. In the south the Kuzbass is an important producer of both coal and of iron and steel. In Eastern Siberia the regional specialisations are hydro-electricity and non-ferrous metals, and there are large complexes specialising in chemicals, forestry and forest products. In the Far East the regional specialisations are fishing the mining of non-ferrous metals. The Far Eastern forest and coal-mining industries are also of national importance but are oriented more toward the Pacific export market than the domestic economy. These sectoral specialisations reflect a distinct economic geography. It is the task of the next chapter to describe the spatial structure of Siberian industry and to create a regionalisation

Table 3.12

The Role of Siberia and the Far East in the National Economy

Branch	West Siberia	East Siberia	Far East
Oil Production	* * * *		* *
Gas Production	* * * *	* *	* *
Coal Production	* * * *	* *	* * *
Hydro-power	*	* * * *	* *
Ferrous Metals	* * *	*	* *
Nonferrous Metals	*	* * * *	* * * *
Petrochemicals	* * *	*	*
Chemicals	* * *	* * *	*
Forestry	* *	* * *	* * *
Forest Products	*	* * *	* * *
Machine-Building	* *	* *	* *
Agriculture	*	*	*
Fishing	*	*	* * * *

KEY

* * * *= Regional production that is of national significance.

* * * = Industrial Complexes within a region that are of national significance.

* * = Production of importance to the regional economy.

* = Production of limited local importance.

scheme that is used to evaluate the spatial impact of Siberian trade participation.

Notes

1. The 1980 figure is from Shabad, T. (1985), "News Notes,"SG:R&T, Vol. 26, No. 4, p. 295. The 1985 figure is from the Oil and Gas Journal, (1985), Vol. 83, No. 44, November, 4, p. 54.

2. Calculated from Narodnoye khozyaystvo SSSR v 1984 g. (1985), p. 381. Total industrial investment in the 9th FYP was 196 billon roubles, in the 10th FYP 251 billion roubles and in the first four years of the 11th FYP 234.4 billion roubles.

3. Calculated from, Shabad, T. (1986),"News Notes," SG:R&T, Vol. 27, No. 4, p.266.

4. Soviet News & Views (1986), No. 21, p. 5.

5. Shabad, T. (1984),"New Notes," SG:R&T, Vol. 25, No. 4, p. 292.

6. Shabad, T. (1985), "News Notes,"SG:R&T, Vol. 26, No.9, pp. 579-578.

7. Blandon does not provide a figure for percent forest covered. It has been calculated using his total of 285,123.4 thousand hectares and a total area of 6,215,900 sq. km (100 hectares = 1 sq. km).

Chapter 4

The Spatial Structure of the Siberian Economy

Previous chapters, on the commodity structure of Soviet trade with the West and the industrial structure of the Siberian economy, were sectoral in approach and have provided sufficient information to estimate Siberia's role in East-West trade. This chapter adopts a spatial approach and provides the information necessary to identify the impact of trade participation on the various sub-regions and industrial complexes that comprises the Siberian economy. Assessment of this spatial impact requires an understanding of the conceptual basis and practice of Siberian development strategy.

Contemporary Siberian development strategy is dominated by the creation and operation of a number of Territorial-Production Complexes. It is therefore likely that these complexes play an important part in export production and are the recipients of Western technology. The first section of this chapter examines the concept of the TPC, while the second section describes the various Siberian TPCs.

Transport was not considered in the preceeding sectoral analysis of Siberian industry; but, because of the peripheral location of Siberia and the Far East and the nodal pattern of industrial activity within the region the transportation system plays an important part is shaping the industrial geography of Siberia and the Far East. In the third section of this chapter transport is considered as an industrial activity in its own

right that might be affected by foreign trade participation, and as an important component in the regional differentiation of the Siberian economy.

The final section of this chapter combines the national specialisations identified in the previous chapter with information on Siberian TPCs and the transportation system to produce an economic regionalisation of Siberia and the Far East. This regionalisation scheme is then used in Chapter 6 and Chapter 7 to evaluate the spatial impact of East-West trade at the regional and sub-regional scale.

4.1 The Concept of the Territorial-Production Complex

Both Soviet and Western authors recognise the work of N.N. Kolosovskiy as the origin of the contemporary concept of the TPC. Kolosovskiy (1947) was concerned with identifying the essential industrial cycles and processes that comprise the core of industrial complexes and economic regions. Kolosovskiy (1947, p.7) called these industrial cycles "energy-production cycles" (EPCs), and defined them as the: "constantly existing aggregate of production processes arising in a mutually conditioned manner around a basic process, for a given kind of power or raw material." The EPC comprises the technological structure of a TPC, and as such forms the basis for economic classification and regionalisation. At the same time the TPC provides a means by which economic regions can be planned and developed. Referring to the planning role of the concept, Kolosovskiy (1961, p.1) offered the following definition of a

TPC:

> "The name of production complex is given to an economic (mutually conditioned) combination of enterprises at one industrial site or in a whole region, whereby a definite economic effect is achieved through a successful (planned) choice of enterprises in accord with the natural and economic condition of the region, and with its transportation and economic-geographic situation.

Thus, the main characteristics of the TPC as defined by Kolosovskiy can be summarised as: 1. the presence of industrial linkages, 2. a defined territorial location, 3. the planned coordination of industries, and 4. the existence of an economic effect or cost saving (Huzinec, 1983, p 129). Simple geographical juxtaposition of industries without linkages does not constitute a TPC. Kolosovskiy was primarily concerned with the use of EPCs and TPCs in regionalisation schemes. The concept has been further developed in a planning context by both academic and planning institutions. In the process of evolution a number of different terms have been used to describe the spatial concentration and combination of industries including Sectoral-Production Complex (Maslov, 1970) and Regional-Production Complex (Nikol'skiy, 1973). In addition the use of the TPC as a regionalisation methodology has resulted in a profusion of TPC classifications in the Soviet literature. This study confines itself to the 11 TPCs officially sanctioned by Gosplan USSR and included in national economic plans (see Appendix 2) and concentrates on their role in the process of industrial planning and development.

The major reason for combining industries within industrial complexes is to reduce the cost of production and increase the efficiency of investment. Probst (1977, pp. 198-

199) identified a number of cost savings that can be made by creating TPCs. First, if all of the industrial processes that comprise an entire production chain are located within a single complex, transportation costs can be reduced. Second, the location of a number of related industrial enterprises within a single complex may enable a higher degree of specialisation and subcontracting. For example, the entire complex can be served by a single machine-tool plant. Third, it may possible for one plant to use by-products or waste of another, thus increasing the level of resource utilisation. An example of this is provided by the Achinsk alumina plant that produces by-products used in the local cement industry. Fourth, a mixture of enterprises with different labour demands enables a more complete utilisation of the local labour pool, in particular female labour. Fifth, the various industrial enterprises within a complex will differ in their rate of use (over time) of energy resources and transportation facilities, making it possible to maintain steady use of available capacity. It may also be possible for one plant to reduce its transport costs by using another plant's back haul. Finally, the compact design of the TPC makes it possible to save on land requirements (saving agricultural land), site preparation costs and intra-complex transportation costs. Probst (1977, p.201) estimated that the widespread adoption of the TPC concept in the 10th FYP may have yielded tens of billions of roubles in savings. Gladyshev and Mozhin (1982, p. 42) have suggested that the spatial concentration of investment within TPCs could result in a 10-15 percent saving on land and up to a 30 percent saving on

transport costs.

Since the late 1960s the TPC has been the subject of a great deal of attention in the Soviet literature on industrial location and planning (Kibal'chich and Stepanov, 1979 and Bradshaw and North, 1984). Among the various research institutes concerned with industrial planning two have been of particular importance in the evolution of the TPC, namely the Council for the Study of Productive Forces (Russian acronym SOPS) attached to Gosplan USSR (represented by the work of such authors as Probst and Nekrasov), and the Institute for the Organisation of Industrial Production (Russian acronym IEOPP) of the Siberian Branch of the Academy of Sciences in Novosibirsk. The Novosibirsk Institute, under the direction of Academician Aganbegyan (who is now one of Gorbachev's economic advisers), has developed a series of mathematical models of the national economy and TPCs and has been involved in the planning of many of the Siberian TPCs and the BAM service area (De Souza, 1982 and Soule and Taaffe, 1985). In examining the evolution of the TPC one confronts the problem of having to separate the aspirations of the pro-Siberian academics from the actual role assigned the TPC by official organs such as Gosplan.

The following definition of the TPC, offered by Bandman (1980, p. 20), provides a basis for more detailed examination of the structure of the TPC. A TPC is:

> "a planned, proportionately developing aggregate of stably interconnected units of the sectors of the economy which have been built for the joint solution of one or more major economic problems, and are concentrated in a relatively limited, compact

> (undivided) area, possessing resources of a composition and scale adequate for the complex to be involved in solving these major problems, and which ensure efficient use of local and outside resources, conservation of the environment, and reproduction of natural resources, and served by a single infrastructure."

The researchers at Novosibirsk have been concerned with modelling the various components of the complex to ensure the balanced and efficient combination of resources, manpower, infrastructure and industrial capacity. Other models examine systems of TPCs and their role in the national economy. The core of the TPC is its specialisation industries; Figure 4.1 illustrates the major components of the TPC as well as the pivotal role of the specialisation industries. The nature and importance of the specialisation industries in a complex define the role of the individual TPC within the national economic system. In many cases the specialisation sectors are composed of a power-generating branch, such as coal or hydro-electricity, and a power-consuming branch, such as aluminum or pulp and paper. The auxiliary industries are those operations needed to ensure the operation of the specialisation industries. They may provide inputs or utilise outputs. Service industries are enterprises that provide for the population of the complex, such as agricultural enterprises. The TPC's infrastructure is divided into three sub-groups (Bandman, 1980, p. 28): production, social and institutional. Production infrastructure includes railways, power transmission lines, pipelines, watermains, municipal engineering works, and supply bases and warehouses. Social infrastucture includes passenger transport, trade, public catering, child care, schools,

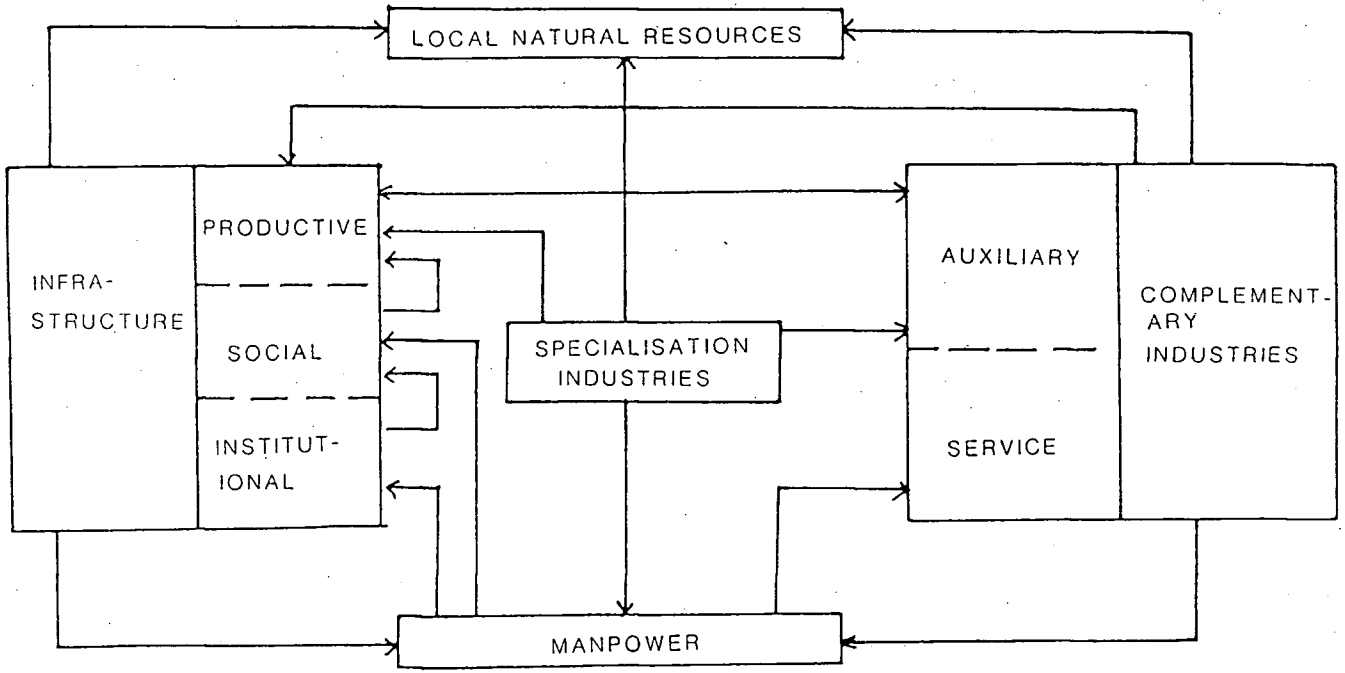


Figure 4.1 The Linkages within a Territorial-Production Complex

Source: Bandman, M.K. (1980), "The Significance, Sequence and Instrument of Optimising the Formation of Territorial Production Complexes," in Territorial Industrial Complexes: Optimisation Models and General Aspects. Moscow: Progress Publishers, p. 34.

housing, medical and communal facilities. The institutional infrastructure includes Party and administrative bodies and agencies, scientific institution and specialised higher schools.

At present the central planners seem to view the TPC as a large industrial complex that is oriented towards the solution of a national economic problem. Both Gosplan (Nekrasov and Adamesku, 1981, p. 7) and IEOPP (Aganbegyan and Bandman, 1984, p. 28) envisage three possible situations where TPCs may be created to solve economic problems. The first is for the intensive large-scale development of natural resources in newly opened up regions, for example in the oil and gas fields in the Middle Ob' region. The second is for the intensive development of existing older industrial regions, changing the role of these regions in the national economy. An example is the Kursk Magnetic Anomaly. And the third is for the intensive development of the resources and other economic opportunities (such as labour) of less developed regions, for example the TPCs in Central Asia and at Sayan in Eastern Siberia.

The major advantage of the TPC for Soviet planners is that it provides a means not only of concentrating investment upon specific national problems, but also of combining the efforts of the various sectoral ministries. Thus the TPC aims to provide a degree of horizontal integration in an economy dominated by vertical sectoral planning. In reality the TPC has evolved as just another territorial planning system with no more power to influence central ministries than local oblast' level officials. Because the TPC has no legal status, no

overall planning body and no planning authority the benefits of regional integration are not fully recognised. In addition, because the TPC boundaries are delimited by the extent of a particular resource, they often contain or cross the boundaries of other territoral systems, most notably oblast' boundaries. As a result of a 1979 planning decree, in 1980 Gosplan created a set of guidelines that requires each TPC to have a plan for the development of all aspects of the complex, productive and non-productive. In the absence of radical economic reform the TPC has acted as a band aid for the existing planning system, a tool for assigning priority and concentrating investment on industrial projects of national importance. But without radical reform the full potential of the TPC will not be realised.

4.2 Territorial-Production Complexes and Siberian Development

Of the eleven TPCs that have been officially recognised by Gosplan (see Table 4.1) five are located within Siberia and the Far East: West Siberia, Bratsk-Ust'-Ilimsk, Kansk-Achinsk, Sayan, and South Yakutia.

It is clearly neither desirable nor economic to develop all of Siberia and the Far East. In the planning system the TPC provides a means of modelling various development strategies and combinations of industries to determine the most effective path for Siberian development. Obviously planners in Moscow evaluate the various strategies in terms of national goals, while the economists at Novosibirsk are more concerned with regional goals. In the regional development forum the TPC has become an instrument of compromise between the pro-

Table 4.1

Officially Recognised Territorial Production-Complexes, 1970-1990

Project/ Primary Resource and Specialisation	Five-Year Plans 9TH	10TH	11TH	12TH
Timan-Pechora/ Oil, Natural Gas, Forest Products			TPC	TPC
Kursk Magnetic Anomaly/ Iron Ore, Steel		TPC	TPC	TPC
West Siberia/ Oil, Natural Gas, Petrochemicals		TPC	TPC	TPC
Kansk-Achinsk/ Coal, Electric Power			TPC	TPC
Sayan/ HEP, Aluminum	TPC	TPC	TPC	TPC
South Yakutia/ Coal, Apatite, Iron Ore		TPC	TPC	TPC
Bratsk-Ust'-Ilimsk/HEP, Aluminum, Forest Products	TPC	TPC	*	**
Orenburg/ Natural Gas, Petrochemicals			*	**
Mangyshlak/ Oil, Natural Gas		TPC	*	**
Karatau-Dzhambul/ Phosphates, Chemical Fertilizers		TPC	*	**
Pavlodar-Ekibastuz/ Coal, Electric Power		TPC	TPC	TPC
South Tadjik/ HEP, Aluminum	TPC	TPC	TPC	TPC

* Identified as a TPC in the Atlas of the 11th Five-Year Plan.
** Identified as a TPC in the Atlas SSSR, 1984.

Source: Adapted from Kamerling, D. (1982),"The Role of Territorial Production Complexes in Soviet Economic Policy," in Soviet Economy in the 1980's Part 1. U.S. Congress, Joint Economic Committee. Washington D.C.: GPO, p. 249.

Siberians and the central planners. The pro-Siberians, both in Moscow and Novosibirsk, have stressed the cost saving advantages of the TPC to promote more in-situ processing of Siberian resources (Orlov, 1971, p. 31). As the latter half of this section documents, the pro-Siberians have been relatively successful, but the reluctance of the central planners and ministries to relinquish power has reduced the effectiveness of the Siberian TPCs. The importance of the TPC in resource production is illustrated by the fact that in 1985 TPCs accounted for 65 percent of national oil production, 62 percent of natural gas, 23 percent of coal production and 20 percent of iron ore.[1] Despite the creation of five Siberian TPCs, the Siberian lobby is still pressing for more downstream activity within those complexes. While plans for the economic assimilation of the BAM service zones call for the creation of a series of TPCs the only complex constructed so far is the South Yakutian Complex. The 12th FYP does not envisage further complexes (see Appendix 2). It would seem that the stagnation of the national economy has suspended the immediate construction of any further Siberian TPCs.

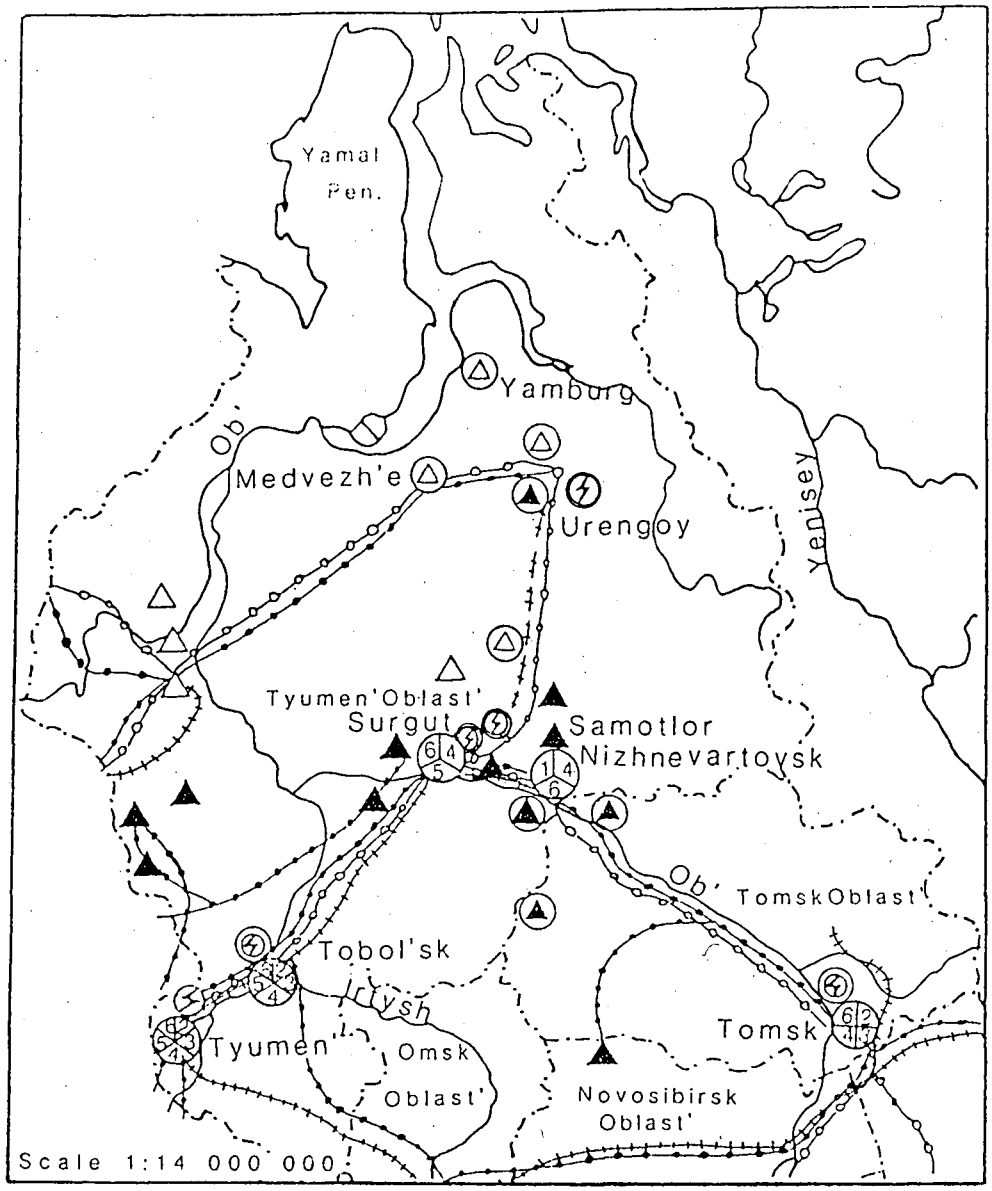
It is possible to identify four stages in the regional development of Siberia and the Far East during the Soviet period (Shniper, 1977, pp. 65-66). The first stage involved the development of the Urals-Kuznetsk Combine and the creation of an industrial base in the Kuzbas in the 1930s and 1940s. The second stage involved the creation of the Angara-Yenisey system, containing the Bratsk-Ust'-Ilimsk, Kansk-Achinsk and Sayan TPCs. The entire southern region of Eastern Siberia is

considered part of this system which is still in the process of development. The Boguchany complex represents the next component in the system (Bandman, 1984, p. 9). The third stage involves the exploitation of the West Siberian oil and gas deposits and the creation of the West Siberian TPC. The fourth stage is the development of the BAM service area.

Given the central role of the TPC in Siberian development it is likely that the impact of trade participation will be felt through the TPC system. The following section presents a brief description of the Siberian TPCs, providing the information necessary to evaluate the role of East-West trade in their creation and operation.

4.2.1. The West Siberian TPC

The West Siberian TPC is without doubt the most important complex in the Eastern regions and probably the entire country. The vital role of West Siberian oil and gas production was clearly demonstrated in Chapter 3. According to Aganbegyan (1979) the development of the West Siberian complex is oriented towards solving five major tasks. These tasks are also reflected in the various FYP statements concerning the development of the complex. The first task is the formation of the country's major fuels-energy base. Oil and gas production is concentrated in the more northerly regions of the complex (see Figure 4.2). The second task is the creation of large petrochemical complexes at Tomsk and Tobol'sk, using casing-head gas as a feed stock. Gas processing facilities have been constructed in the Surgut-Nizhnevartovsk region. For every ton of West Siberian oil produced, 60-70 cubic metres of casing-



KEY

Administrative Boundary
Railway
Oil Pipeline
Gas Pipeline

Oil
Gas
Under Development
Thermal Power Station
Under Construction

Industry
1. Gas Processing
2. Petrochemicals
3. Machine-Building
4. Forest Industry
5. Construction Materials
6. Food Industry

Figure 4.2 The West Siberian TPC During the 12th Five-Year Plan

head gas is produced. During the 1970s much of this associated gas was wasted. The third is to make greater use of casing-head gas to generate power, the first stage in this process having been the construction of the Surgut power station. The 12th FYP calls for expansion of capacity at Surgut and the construction of facilities at Nizhnevartovsk and Urengoy. The fourth task is to replace coal and oil with natural gas for both power generation and industrial processes. The use of natural gas in the Kuzbass could save as much as 2 million tons of coke annually, coke that could be shipped westwards to compensate for the decline of the Donbass. Utilisation of natural gas in thermal power stations in cities such as Novosibirsk could not only reduce consumption of coal and oil but would also do much to reduce air pollution. The fifth task is to provide oil and gas for export. As Chapter 2 revealed, the export of oil and gas is both an important source of foreign currency and a major part of Soviet economic relations with CMEA members.

In more general terms the development of the West Siberian TPC can be divided into two stages. Stage one involves the exploitation of the region's oil and gas deposits and the construction of pipeline systems to move energy resources westwards to the European regions. Stage two involves the "downstream" development of the industrial structure of the complex, the utilisation of casing-head gas and the construction of large petrochemical complexes. So far development efforts have concentrated on stage one. As a result stage two developments have suffered as reflected by the

poor construction record at the Tomsk petrochemical complex.

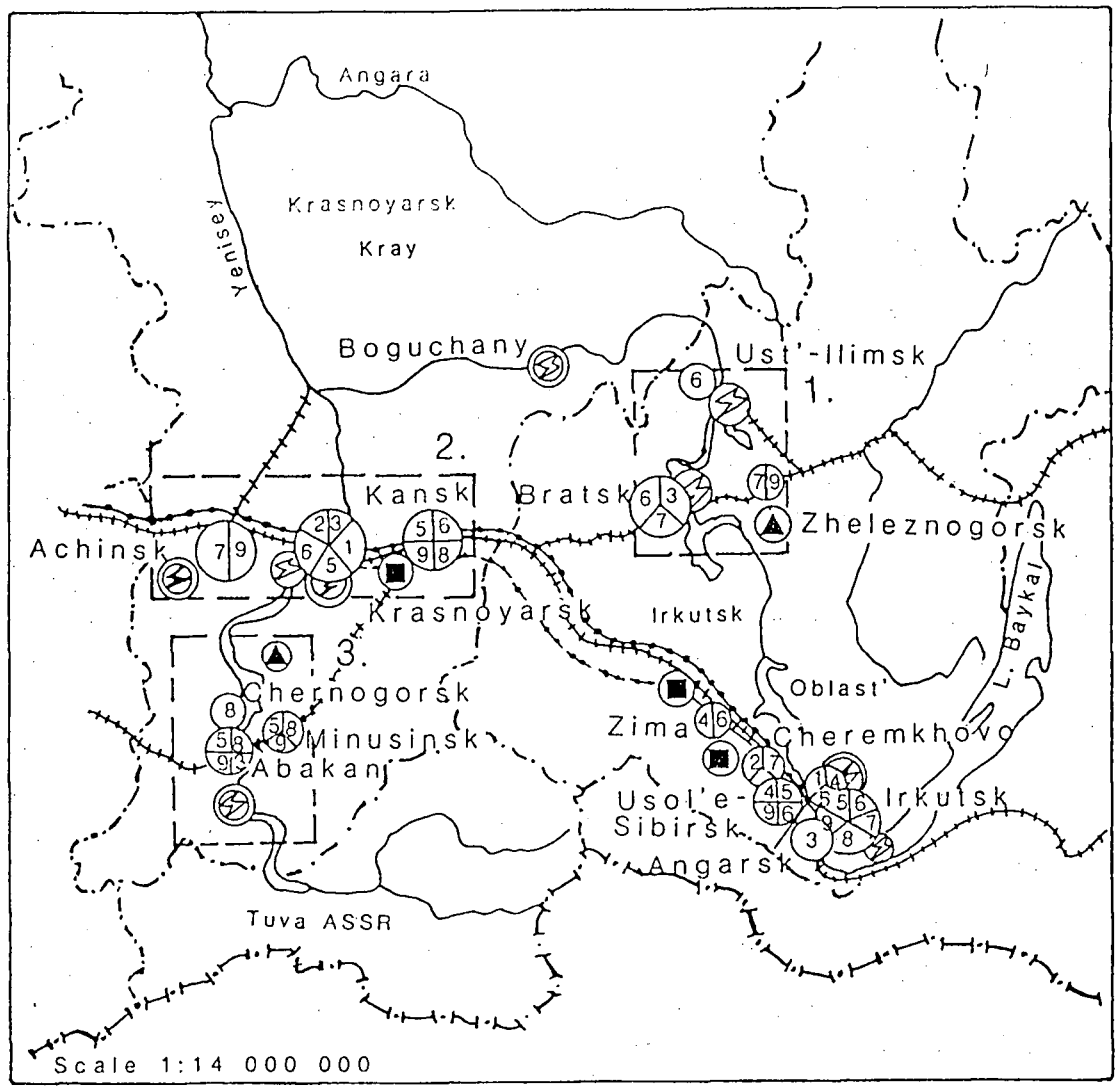
During the 1970s the development of the West Siberian TPC was dominated by a number of large industrial ministries, such as the Oil Ministry and the Geology Ministry. While the Ministry of Oil and Gas Construction was given the task of coordinating infrastructure developments, it was unable to exert any influence over the other ministries. Consequently each ministry developed its own economic and social infrastructure, leading to fragmentation and duplication of facilities. No single unified plan was developed for provision of housing or transportation, and power generating facilities were ignored to such an extent that the country's major energy-producing region suffered from power shortages. In recognition of the these problems Leonid Brezhnev, at the 26th Congress of the CPSU in 1981, created two commissions to oversee the West Sibherian oil and gas complex: the USSR/Gosplan Interdepartmental/Interagency Regional Commission on Questions of the Development of the West Siberian Oil and Gas Complex, and the Commission of the USSR Council of Ministers Presidium on Questions of Developing the West Siberian Oil and Gas Complex. It is not clear what the exact role of these commissions is since their actions are clouded in secrecy, but it is likely that they are concerned with reducing friction between the Oil and Gas Ministries and the Geology Ministry, rather than overseeing the integrated development of the entire complex. The focus of the commissions upon oil and gas production reflects Moscow's concern to maintain Siberian oil and gas production at all costs.

4.2.2. The Angara-Yenisey System

The development of the Angara-Yenisey system started with the construction of the Irkutsk HEP station and the development of the Irkutsk-Cheremkhovo region (see Figure 4.3). The experience gained at Irkutsk provided the basis for the construction of the series of large HEP projects--at Bratsk, Ust'-Ilimsk, Krasnoyarsk and Sayan--that form the energy base of the three TPCs within the region. The Angara-Yenisey TPCs incorporate 3.34 million sq km or 77 percent of the total area of Eastern Siberia and have a total population of over 6 million (Nekrasov and Adamesku, 1981, p. 97).

The Bratsk complex was started in 1955 with the construction of the Bratsk HEP station and was one of the first TPCs designated by Gosplan in the 9th FYP (see Appendix 2). In the 10th FYP the complex was expanded to include Ust'-Ilimsk, and the Bratsk-Ust'-Ilimsk complex now covers 11.5 percent of the territory of Irkutsk Oblast'. The national economic tasks assigned to the complex comprise the generation of hydro-electric power and energy-intensive industrial activity--namely aluminum production and forest products. An aluminum smelter and pulp and paper plant have been built at Bratsk and a large pulp and paper plant has been built at Ust'-Ilimsk with assistance from other CMEA members. In addition to these two hydro-power centres the other important industrial activity within the complex is the production of iron ore at Zheleznogorsk.

The Kansk-Achinsk TPC or KATEK (Kansk-Achinsk Fuel and Power Complex) was officially designated a TPC in the 10th FYP,



KEY

Administrative Boundary
Railway
Oil Pipeline
Territorial-Production Complexes
TPC

1. Bratsk-Ust'-Ilimsk
2. Kansk-Achinsk
3. Sayan

Under Construction
Hydro-electric Power Station
Thermal Power Station
Coal Mine
Iron Ore

Industry

1. Oil Refinery
2. Ferrous Metals
3. Non-Ferrous Metals
4. Chemicals & Petrochemicals
5. Machine-Buidling
6. Forest Industry
7. Construction Materials
8. Light Industry
9. Food Industry

Figure 4.3. The Angara-Yenisey System During the 11th Five-Year Plan

but its development started with the construction of the Krasnoyarsk HEP station. The complex consists of three industrial centres: Achinsk, Kansk and Krasnoyarsk. Krasnoyarsk is by far the biggest of the centres and acts as the administrative core of the entire region (as well as for Noril'sk in the far north). The hydro-energy base of the complex is being supplemented by thermal power generation using the brown coal deposits of the Kansk-Achinsk basin. The development of KATEK was assigned national priority in 1979, but progress has been slow and KATEK is unlikely to make a major contribution to the national economy until the 1990s. One of the reasons for this delay is the technological barriers facing increased utilisation of Kansk-Achinsk coal. Although the Soviet Union has made great advances in high voltage transmission, it is still not feasible to transport KATEK power a sufficient distance to benefit major Soviet deficit regions. As is shown in Chapter 6, foreign assistance is being sought for the development of synthetic fuel production facilities, but as yet no agreements have been made. At present the industrial core of the complex is the city of Krasnoyarsk which has become a centre of energy-intensive industrial production--aluminum smelting and oil refining--and machine-building, including heavy excavators for opencast mining. Alumina for the Krasnoyarsk smelter is produced at Achinsk.

The third TPC in the Angara-Yenisey system is at Sayan based on the Sayan-Shushenskoye HEP station. The major consumer of power in the complex is the aluminum plant at Sayanogorsk. The industrial centres of Abakan and Minusinsk

specialise in machine-building and heavy electrical equipment. The more favourable climatic conditions of the Sayan region have permitted the development of more labour-intensive industries, such as textiles. The southerly location of the complex also favours agricultural activity, and the complex is an important source of food for more northerly industrial centres. Located on the railway link between the Kuzbass and the central East Siberian region the Sayan TPC is in an ideal location to produce goods for the Siberian economy.

The development of the various TPCs with the Angara-Yenisey region has been fraught with problems of delay and poor coordination. In many cases the various sectoral ministries involved in the complex have ignored the provision of social infrastructure. In the productive sphere there has been a lack of integration between the power-producing and power-consuming sectors, and simple mismanagement has reduced the efficiency of the equipment installed in the complexes. Unauthorized utilisation of the forest resource has reduced the efficiency of the forestry complexes in the Bratsk-Ust'-Ilimsk TPC. Inadequate investment in the construction industry has resulted in long delays in the construction of major projects and even the cancellation of some, such as the Abakan railway car plant which has been converted to house a container production factory. Soviet authors are well aware of these problems and have long called for the creation of a single TPC authority at each complex to coordinate the creation of the necessary infrastructure (Gukov and Dyatlov, 1981, pp. 127-128). At Sayan the Krasnoyarsk Kray Executive Committee and the Krasnoyarsk

Kray Gosplan have tried to coordinate activity, but without reform at the national level such initiatives have little effect (Kamerling, 1982, p. 265). In June 1985 Mikhail Gorbachev attacked the poor performance of Soviet industry and singled out the Sayan TPC and Krasnoyarsk Kray as particularly poor performers. While recognising the need for Siberian development Gorbachev demanded a better return on investment:

> "The state will continue to give unstintingly for the development of Siberia. But, we have the right to demand the resources be used to full effect rather than frozen."
>
> (Gorbachev, 1985, p. 13)

4.2.3. BAM and the South Yakutian TPC

The South Yakutian TPC is the only TPC in the Far Eastern economic region and represents the first stage in the economic development of the BAM service area. Of the eleven TPCs and industrial centres envisaged by the Siberian planners in the BAM area, the South Yakutian complex is the biggest, occupying 38 percent of the region. The complex has been developed under a compensation deal with the Japanese signed in 1974, which is examined in greater detail in Chapter 6. The resource base for the complex is the South Yakutian coal basin with estimated reserves of 44 billion tons of coking coal, and 22 billion tons of iron ore.[2] In addition the complex has deposits of apatite and other minerals. At present coal-mining activity is concentrated at Neryungri, the railhead of the Little-BAM, where production started in 1978 and reached 5 million tons in 1983. Eventually production will be over 12 million tons a year, with 5 millions tons a year being shipped to Japan over a 20 year period. Neryungri is also the site of coal-processing

facilities and a rail terminal for the loading of coal. Power for the complex is generated by a thermal power station at Neryungri using local coal. The first stage in the development of the complex, the creation of a coal and energy base, has been achieved. The second stage will be initiated during the 12th FYP with the extension of the railway north to Tommot and the development of the Denisovskoye and Chulmakan coal fields and the Seligdarsk apatite deposits. Eventually South Yakutian apatite production could satisfy 80 to 90 percent of Siberian and Far Eastern demands. Local production could save as much as 200 million roubles a year over the cost of transporting fertilizers from European regions (Sobolev and Stratula, 1983, p.32). The 12th FYP also calls for preparatory work on the development of a Far Eastern ferrous metallurgy complex in the South Yakutian region using local ore. However, it is unlikely that the metallurgical complex will be built in the next decade or so.

Not suprisingly, the development of the South Yakutian Complex has suffered from infrastructure problems. The Ministries responsible for the creation of the coal and energy base of the complex have concentrated on the productive sphere of the complex to the detriment of infrastructure provisions (Borovukov and Krivoruchko, 1984, p. 55). Because an adequate construction industry has not been developed within the complex, much of the construction has had to be carried out by coal miners. The population of the complex has risen from 1,000 in 1970 to 63,000 in 1985, placing severe pressures on the socio-economic infrastructure. In the productive sphere

poor management and operation of the coal terminal have led to problems with coal deliveries (Mote, 1985, pp. 703-704). Neverthless, the development of the South Yakutian Complex is a remarkable feat and illustrates the benefits of the TPC strategy in remote-area development.

4.2.4. Summary: The Role of TPCs in Siberia

To evaluate the success of the TPC strategy in Siberian development it is necessary to return to the essential features of the TPC concept presented at the beginning of this chapter. In most of the Siberian TPCs there is a clear set of linkages between the power-generating and power-consuming components of the specialisation industries. However, in some cases these linkages have not been well coordinated. While the Siberian TPCs have distinct territorial locations, in many instances their geographical boundaries cross existing administrative boundaries creating problems of jurisdiction and complicating the planning process. In the majority of the complexes development efforts have concentrated upon one or two sectoral specialisations that are oriented towards the national economy. Consequently the development of each complex has been dominated by a few large industrial ministries (usually responsible for the specialisation industries) which have concentrated on fulfillment of their own sectoral plans, rather than the balanced and coordinated development of the entire complex.

With the exception of the Sayan TPC, the Siberian complexes exhibit a truncated economic structure, concentrating upon power generation, resource production and harvesting and primary processing, with relatively little downsteam processing

and manufacturing. Thus, the transportation cost savings that might have been gained by incorporating an entire production chain within a single complex are rarely realised. In addition the TPCs produce few products that can be consumed in the local economy. In sum, the TPC has provided a means by which to graft the sectoral specialisations identified in Chapter 3 upon the economic landscape of Siberia and the Far East. While they have enabled the concentration of investment upon key tasks, institutional problems have reduced the cost-saving benefits of the TPC strategy. However, the five TPCs discussed above do not represent the entire Siberian economy. Therefore it is necessary to integrate the TPCs into a regionalisation scheme to provide a complete picture of the spatial structure of the Siberian economy.

4.3 The Siberian Transportation System

> "In the vast expanse of Siberia, transport plays an exceptionally important part in economic development, and in maintaining both a normal cycle of production and consumption within the region, as well as regular ties between Siberia and other parts of the nation."
>
> (Granberg, 1981b, p. 51)

In this brief examination of the Siberian transportation system the basic tasks of the system are identified and the nature of the transportation system in the various sub-regions described. This information will enable one to assess the impact of foreign trade on the development of the transport system as well as aid the creation of a regionalisation scheme.

It is possible to identify four basic tasks for the Siberian transportation system: 1. the movement of goods and equipment into the region to facilitate economic development

and meet the needs of the population, 2. the movement of fuels, raw materials and semi-processed products out of the region to the major markets in the European USSR and also to export markets, 3. the movement of fuel, materials and equipment within the region, and 4. the movement of goods through the region in transit between the Pacific basin and European markets via the Trans-Siberian Landbridge.

The nature of the Siberian transportation system is depicted on Figure 4.4 which illustrates the railway network, the navigable sections of rivers, major shipping routes, and roads. Roads are shown only when there is no river or rail route running parallel. The pipeline network is not shown on Figure 4.4 since it was discussed in Chapter 3. From Figure 4.4 it is possible to discern that the various sub-regions of Siberia and the Far East are served by different types of transport. For example in the southern industrial belt railways dominate the system, while in the more northerly regions river transport predominates. In the Soviet Union transportation is rarely used to promote development. To a large degree the level of economic activity within a particular region determines the level of transportation services available, and it is not until a region is assimilated into the industrial fabric of the national economy that railway connections are constructed. Consequently, much of the remote-area development in the northern regions started on the basis of river and winter road systems, only later to be supplemented by a railway. A good example of this pattern is the evolution of the transportation system in the West Siberian TPC.

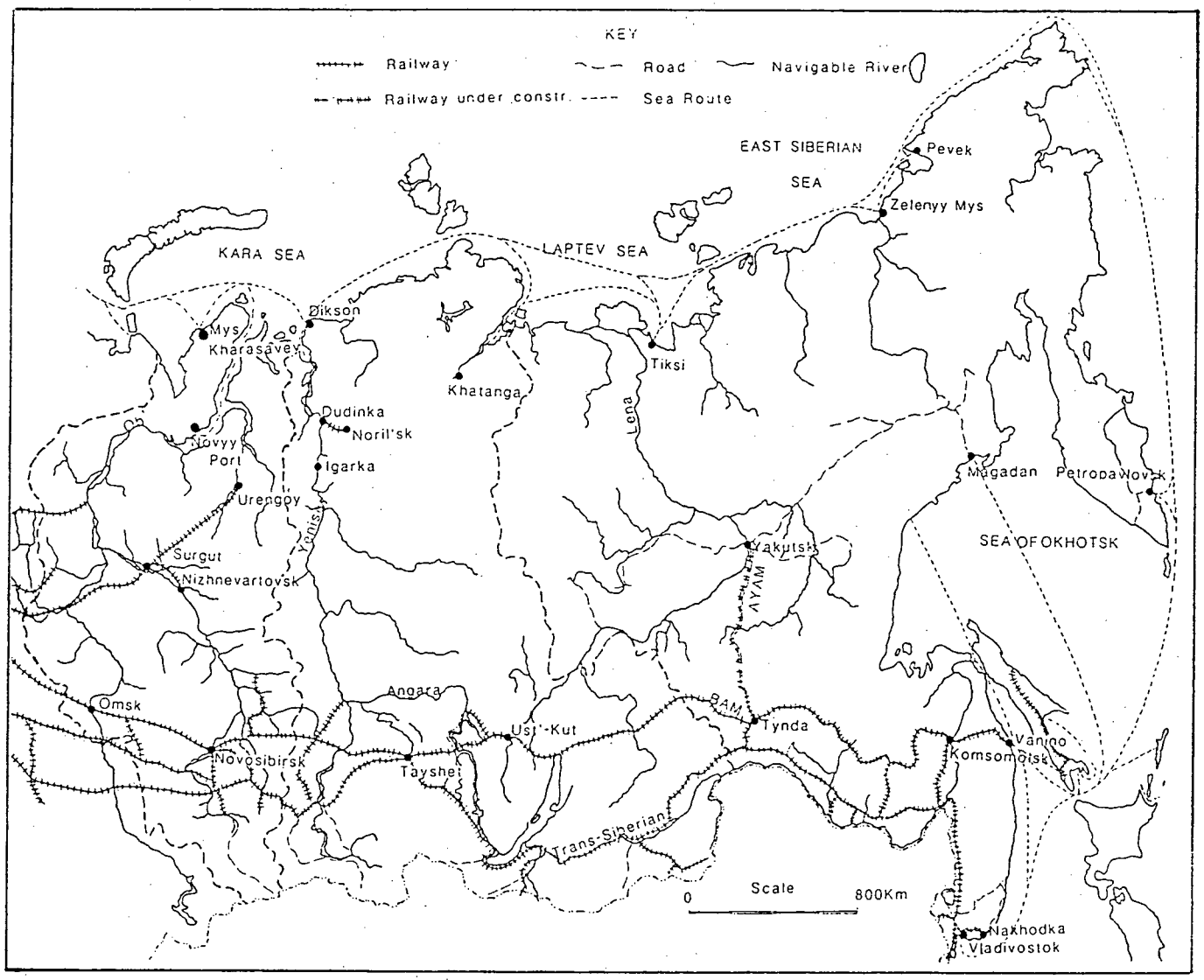


Figure 4.4 The Siberian Transportation System

Given the fact that most general freight movements (as opposed to bulk fuel and raw material movements) are likely to involve two or three different modes of transportation and a number of transhipments, the degree of coordination between modes is an important consideration. Unfortunately, the "Unified Transportation System" in the USSR is unified in name only. In fact the various components of the system are organised into sectoral ministries (Shaw, 1985). To further complicate the situation many industrial ministries (that is other than the transportation ministries themselves) have their own transportation facilities. As a result each mode is planned in an uncoordinated fashion. The net result of vertical planning and a lack of horizontal, inter-modal, planning is that the transportation system is inefficient, both in terms of cost of movement and the time taken to move goods.

In general terms it is possible to identify two transportation zones within Siberia and the Far East (North, 1987) Zone 1 is the southern industrial belt served by an east-west transportation system the axis of which is the Trans-Siberian railway; Zone 2 includes the regions to the north of the industrial belt. It is possible to further divide the southern belt into two sub-zones, one to the west of Lake Baykal that encapsulates the Kuzbass and the Angara-Yenisey regions, and a second zone to the east of Lake Baykal which includes the BAM service zone, the frontier regions and the Pacific coast. In the Southwestern sub-zone a number of parallel east-west railways dominate freight movements. The Trans-Siberian and its associated parallel lines are some of

the busiest in the Soviet Union and in the future may be unable to handle increased demands (North, 1984). The major tasks of the rail system in this region involve the westward movement of energy resources (coal) and raw materials to the European regions. Eastward flows involve the movement of machinery and equipment, some semi-processed materials (alumina), and food and manufactured goods for the Siberian workforce. Within the region the rail network links the various TPCs and industrial centres, moving raw materials such as iron ore, timber and alumina between the various industrial complexes. Westward traffic flows (which are much higher than eastward flows) reflect the national specialisations and the truncated nature of the regional economies, being dominated by Kuzbass coal, timber and forest products and ferrous and non-ferrous metals.

The second sub-zone to the east of Lake Baykal is somewhat different because its remoteness from the major markets in the European region restricts the level of economic activity and volume of westward freight movements. As a result the dominant flow of freight is of equipment and materials into the region, and in recent years much of this movement has been related to the construction of the BAM railway. Until the completion of the BAM the Trans-Siberian railway was the only east-west route through the region and poor accessibility limited economic development. Althought the BAM will not be fully operational until the 1990s, it is hoped that it will stimulate resource development. At present coal from South Yakutia moves westward into the southern industrial belt of Siberia and eastward to the port of Vostochnyy and then to Japan. Timber and forest

products also move eastward out of the region again to Japan, and, to a lesser extent, eastwards to domestic markets. Petroleum amd petroleum products are moved into the region by rail, because the pipeline from West Siberia stops at Angarsk. The east-west axis also acts as an important link between the Pacific coast and the European core, providing for increased interaction with the Pacific basin and maintenance of strategic interests.

The second zone, to the north of the east-west belt, can be further divided into three sub-zones based on the major river basins in the north: Zone 1 is the Ob'-Irtysh basin, Zone 2 the Yenisey basin, and Zone 3 the Lena basin and the northeast (North, 1987). In each of these three zones the transportation mix is different, reflecting their different levels of economic development and their role in the national economy. The Ob'-Irtysh basin is dominated by oil and gas production, and West Siberian oil and gas is now moved out of the region by systems of large diameter pipelines. To facilitate this rapid development large amounts of equipment and material have had to be moved into the region. Initially the river systems were used to move freight from the east-west railway system. Then the railway network was extended northwards first to Surgut and Nizhnevartovsk and then to Urengoy and most recently to Yamburg. However, these northern lines are under severe pressure because the volume of traffic has been consistently underestimated and the unloading facilities have been unable to handle the large amount of freight.

In the last decade an alternative to the southern rail and river link has been provided by the Northern Sea Route. Starting in 1979, freight for the oil and gas industry has been delivered to the west coast of the Yamal peninsula. In 1979 several thousand tons were delivered to Novyy Port on the Gulf of Ob', and in 1984 265,000 tons were delivered. A total of 700,000 tons of pipe (enough for 1,000 km) were delivered to Novyy Port during the first five years of operation.[3] An added advantage of this route is that the ships take delivery of the pipe in Western Europe and transport it directly to the West Siberian oil and gas fields. Since 1984 a limited amount of pipe has also travelled through the Northern Sea Route from Japan. The next stage in the development of the West Siberian gas industry will concentrate on the Yamburg field on the Taz Peninsula and it is planned to supply this development partly from the north.

The second zone, the Yenisey basin, is also supplied by a southern rail-river link and the Northern Sea Route link. However, the volumes involved are much lower because the only industrial centre in the far north is Noril'sk. The Noril'sk metallurgical combine is linked by rail to the port of Dudinka. The annual turnover at Dundinka is 5.0-5.5 million tons, of which 3.0-3.5 million tons consists of ores and concentrates from Noril'sk bound for the European USSR and the Kola Penisula. Equipment and supplies for the complex are supplied from the south via the Yenisey River. The other major sea port on the Yenisey is Igarka, to the south of Dudinka, which is open 135-140 days a year and exports timber direct to export

markets. In recent years efforts have been made to operate the sea route to Dudinka on a year-round basis. Since 1979 the route has been kept open except for a six week period in May-June when spring floods bring high water and destructive river ice to Dudinka, so that port equipment has to be moved to high ground. Extension of the season has been made possible by the addition of shallow-draught icebreakers and improvements to port facilities. The northern route has also been used to supply the southern regions. For example turbines for the Sayan-Shushenskoye HEP station travelled up the Yenisey to Krasnoyarsk.

The third sub-zone, the Lena basin and the northeast, is also served by a northern and southern route, but at present the southern route dominates. The Northern Sea Route is open in the eastern sector of the Arctic for about 3 months of the year. The most important ports in the eastern sector are at Tiksi, at the mouth of the Lena, and Pevek. The Northern Sea Route is used to supply remote mining settlements in the far north as well as the various scientific and military installations in the high Arctic. In addition coastal routes distribute freight that has travelled north along the Lena. There are indications that the amount of traffic in the eastern sector of the northern sea route will increase with the development of diamond placer mining in the Anabar river basin and tin lode mining at Deputatskiy on the lower Yana River. Port facilities are also being improved and, following the disasters of 1983 when difficult ice conditions trapped ships and sank one freighter, the northern fleet is being modernized

with further additions of ice-strengthened freighters and nuclear and diesel-powered ice-breakers. Much of this specialised shipping is built in Finland and is discussed in Chapter 6.

The most important route into the Lena basin is from the south by railway to Ust'-Kut and the river port of Osetrovo on the Lena. The port at Osetrovo is a major bottleneck in the Far Eastern transport system. In 1980 it handled 3.2 million tons and the 1985 plan called for 4.3 million tons (North, 1984, p. 274). Railway access to the port has been congested, in part due to BAM-related traffic, and the railyards and river port have suffered from poor coordination between river and port authorities. In addition dredging has exacerbated problems of low water levels. The river route itself is hazardous, and freight moving all the way to the high Arctic may be delayed by ice conditions in the mouth of the Lena. The Lena is also the major transportation route within the region. According to Armstrong (1985, p. 527) the planned total freight movement by the Lena fleet in 1985 was 13 million tons, the bulk of which was internal traffic. The majority of the refined minerals produced in the region are probably flown out of the region. A second route into the Lena basin is provided by the highway that travels north from Tynda to Berkakit, Aldan and Yakutsk. The northward extension of the Little-BAM, the AYAM, will follow this route when completed during the 1990s, greatly improving accessibility to the central regions of Yakutia. The port of Magadan is now kept open year-round and is supplied from Vladivostok. In the hinterland of the port of Magadan

access to the interior is gained by winter roads. The highways into Yakutia are of limited importance, never carrying more than 0.1 million tons a year (North, 1984, p. 274), but for many mining activities in the region they are the major source of supply. It does seem possible that the railway to Yakutsk may continue to Magadan 10-15 years from now, greatly increasing access to the northeast.

Obviously transportation plays a vital role in enabling East-West trade and it is likely that export production has placed an additional burden upon the transportation system. It is also possible that Western imports have been used to expand Siberia's transport system.

4.4. The Spatial Structure of Siberian Development

This concluding section presents a regionalisation scheme that is the spatial expression of the sectoral specialisations identified in Chapter 3 and combines the TPCs and transportation system discussed above. The regionalisation scheme provides the framework for evaluating the spatial impact of East-West trade on Siberian development. The geographical boundaries of the scheme are based on the work of Krotov (1969 and 1976) and reflect the roles assigned to the various sub-regions of Siberia and the Far East in the 9th FYP and the long-term plans to 1990 and the year 2000. Krotov's scheme did not accommodate the building of the BAM railway. However, as the railway is not yet fully operational it has had a limited impact of the economic geography of its service area.

The seven sub-regions that constitute the regionalisation scheme are shown in Figure 4.5, while the administrative units,

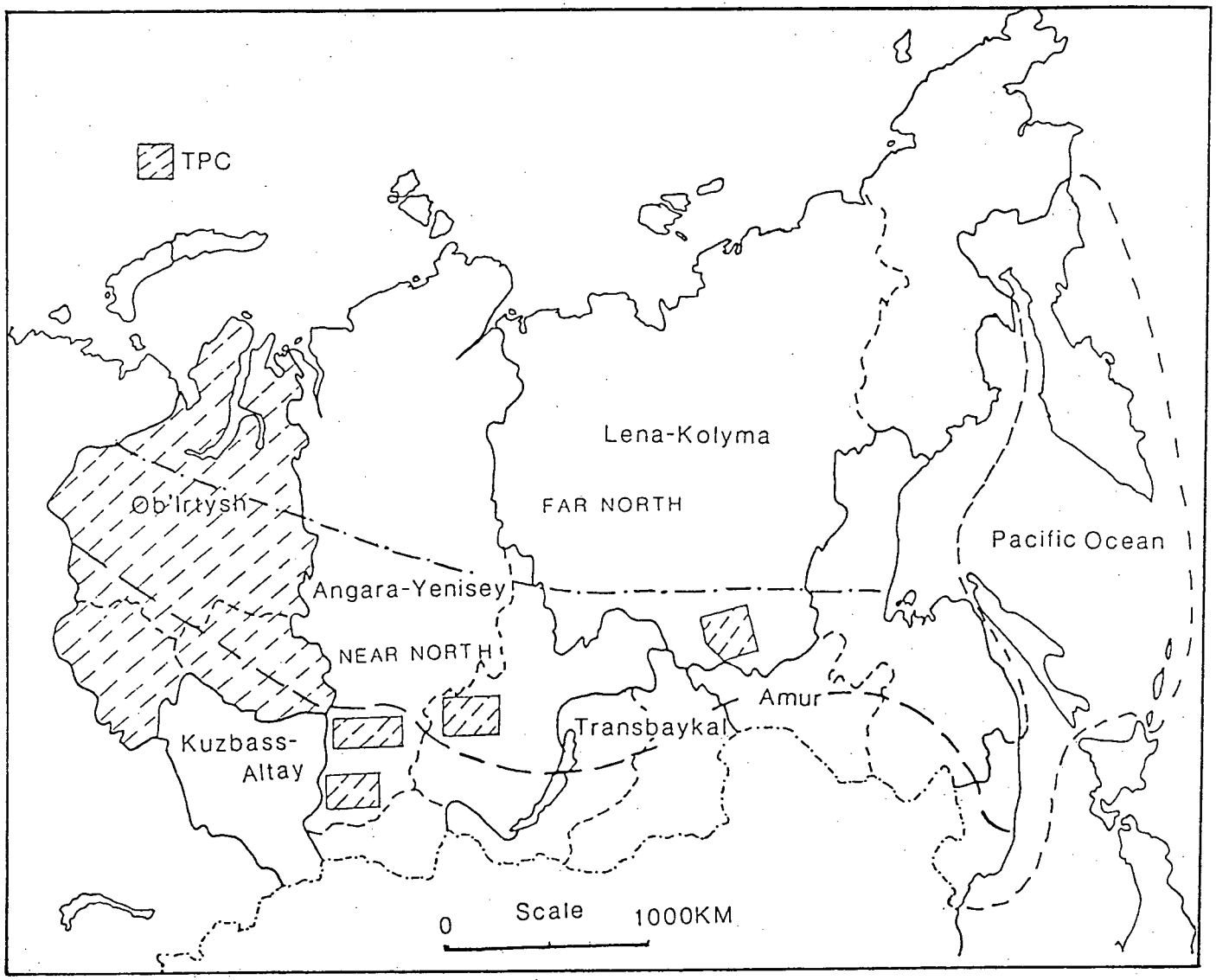


Figure 4.5 An Economic Regionalisation of Siberia and the Far East

Table 4.2

Regionalisation Scheme for Siberia and the Far East

Sub-Region		National Specialisations
I	**Ob'-Irtysh**	
	Tyumen' Oblast'	Oil and Gas Production and Petrochemcals.
	Tomsk Oblast'	
	Omsk Oblast'	
	West Siberian TPC	
II	**Kuzbass-Altay**	
	Kemerovo Oblast'	Coal Production, Ferrous-Metallurgy, Chemicals and Machine-Building.
	Novosibirsk Oblast'	
	Altay Kray	
III	**Angara-Yenisey**	
	Krasnoyarsk Kray	Hydro and thermal electricity production, energy intensive industries (aluminum and chemicals), forestry and forest products and mining.
	Tuva ASSR	
	Irkutsk Oblast'	
	Bratsk-Ust-Ilimsk TPC	
	Kansk-Achinsk TPC	
	Sayan TPC	
	(Noril'sk)	
IV	**Transbaykal**	
	Buryat ASSR	Mining and machine-building.
	Chita Oblast'	
V	**Amur**	
	Khabarovsk Kray	Ferrous metallurgy, mining (non-ferrous) and forestry.
	Amur Oblast'	
VI	**Pacific Ocean**	
	Maritime Kray	Pacific fishery, fish and sea products, forestry and forest products (offshore oil and gas).
	Sakhalin Oblast'	
	Kamchatka Oblast'	
VII	**Lena-Kolyma**	
	Yakut ASSR	Mining (non-ferrous), precious metals and gems and coal production.
	Magadan Oblast'	
	South Yakutian TPC	

Table 4.3

Population Characteristics of Siberia and the Far East, 1970-1985

Sub-Region	Total Population (,000)			Percent Urban	Growth Rates (Percent)		Population Density
	1970	1980	1985	1985	1965-1975	1975-1985	(sq/km.)
Ob'-Irtysh	4,016	4,891	5,723	69.9	+ 13.4	+31.0	3.0
Kuzbass-Altay	8,070	8,334	8,635	73.2	- 2.0	+ 6.2	28.7
Angara-Yenisey	5,535	6,150	6,513	75.1	+ 8.1	+ 11.8	2.0
Transbaykal	1,969	2,184	2,362	62.3	+ 11.5	+ 13.6	3.0
Amur	2,177	2,579	2,801	75.2	+ 16.1	+ 16.0	2.4
Pacific Ocean	2,672	3,074	3,299	79.7	+ 16.1	+ 13.3	4.5
Lena-Kolyma	1,040	1,373	1,551	72.7	+ 27.7	+ 28.0	0.4
Total	25,479	28,585	30,884	73.1	+ 12.2	+ 14.6	2.5

Source: Tsentral'noye Statisticheskoye Upravleniye RSFSR (various years), Narodnoye khozyaystvo RSFSR. Moscow: Finansy i Statistika.

TPCs and national specialisations contained within each sub-region are presented in Table 4.2. Data on the demographic characteristics of each sub-region are presented in Table 4.3.

Sub-region I, the Ob'-Irtysh, follows the boundaries of the West Siberian TPC which has been the focus of the Siberian development strategy since the early 1970s. The rapid population growth rates shown in Table 4.3 attest to the increased economic activity. Much of the activity within this area has been concentrated on the northern oil and gas producing regions. Further evidence of this northern orientation is provided by the dramatic growth of the northern cities. The population of Surgut increased from 37,000 in 1970 to 215,000 in 1985, and of Nizhnevartovsk grew from 20,000 in 1970 to 200,000 in 1985. The industrial centres in the southern areas, such as Tomsk and Tobol'sk, have also experienced growth though to a much lesser degree. These southern centres have acted as support bases and transhipment points for northern development and have also become petrochemical centres. Thus, this sub-region is oriented to the production, transportation and primary processing of oil and gas.

Sub-region II, the Kuzbass-Altay, represents the old industrial base of Siberia. It developed as part of the Urals-Kuznetsk Combine and was the recipient of evacuated industry during the Second World War; as such it can be considered the most easterly extension of the Soviet industrial heartland. The region is characterised by heavy industry--chemicals, ferrous and non-ferrous metallurgy and machine-building--and

coal mining. Production is oriented towards the national economy rather than the needs of Siberia. Contemporary Siberian development strategy has tended to neglect this region. It registered a net population decline between 1965 and 1975, but more recently national programmes for renovation have provided investment. The most southerly area of the sub-region, Altay Kray, is an important agricultural region.

Sub-region III, the Angara-Yenisey, contains the TPCs and industrial centres of the Angara-Yenisey system, as well as the Noril'sk metallurgical combine. The population statistics for the major industrial cities show a rapid rate of growth. Between 1970 and 1985 the population of Krasnoyarsk grew by 33 percent, Bratsk by 52 percent and Noril'sk by 29 percent. Noril'sk is included within this sub-region because it is linked to the southern industrial area by the Yenisey river and falls within the administrative jurisdiction of Krasnoyarsk Kray. The Angara-Yenisey sub-region specialises in the generation of thermal and hydro-electricity, and the production of energy intensive products--pulp and paper, aluminum, and chemical products--for the national economy. Noril'sk specialises in the mining of polymetallic ores and the smelting of nickel, copper and platinum group metals.

Sub-region IV, the Transbaykal, is the watershed between European and Pacific influences and the region fails to benefit from either. The southern border areas are of strategic importance and the northern areas are part of the BAM service area. While the industrial centres of Ulan-Ude and Chita have experienced growth, the sub-region contains no TPCs and has a

relatively low level of urbanisation. Despite considerable mineral wealth including the Udokan copper deposits, this sub-region is unlikely to play a major role in Siberian development until the BAM improves accessibility.

Sub-region V, the Amur, includes the border areas along the Amur river and the coastal areas of Khabarovsk Kray. While it includes the eastern terminus of the BAM railway, at present the majority of freight travels through the ports of Vladivostok and Nakhodka/Vostochnyy in the Maritime Kray. The border areas are heavily fortified. Remoteness from the European core has served to limit economic activity to mining and forestry. Much of the forest industry is oriented to the Japanese export market. At present there are no TPCs in the sub-region, but future plans for the development of the BAM service area envisage the creation of TPCs at Komsomol'sk and the port area of Vanino-Sovetskaya Gavan'.

Sub-region VI, the Pacific Ocean, consists of the Maritime Kray and Sakhalin Island in the South and the Kamchatka peninsula in the North. The ports of this sub-region are of national importance, from both an economic and military viewpoint. The southern ports of Vladivostok and Nahodka/Vostochnyy are the major gateways to the Pacific. The Trans-Siberian and BAM railways link the resource-rich hinterland of East Siberia and the Far East with Pacific basin export markets. Vladivostok is also an important support base for the northern regions which are supplied by coastal shipping. In addition Vladivostok and Petropavlovsk are important bases for the Soviet navy and the Far Eastern fishing

fleet. The petroleum and forest industries of Sakhalin Island are a relic of Japanese occupation and serve local markets. On the mainland the forest and fishing industries are the most important activities, supplying local, national and international markets. In the future the Sakhalin Continental Shelf Project may strengthen the energy base of the region, enabling heavy industry to develop.

Sub-region VII, the Lena-Kolyma, incorporates the Yakut ASSR and the Northeast. The very low population densities of this sub-region reflect both its vast size and remoteness. Because of the extreme environmental conditions and distance from major markets, vast areas of this sub-region remain undeveloped. At present industrial activity concentrates on the producton of mineral resources, such as gold and diamonds, and more recently coal mining in the South Yakutian TPC. The level of mining activity with the sub-region is sustained by a desire on the part of the Soviet leadership to remain as self-sufficient as possible in mineral production. While the future extension of the railway to Yakutsk (and possibly Magadan) will increase access to the region, extreme environmental conditions will remain a barrier to economic development.

When one examines the sectoral and spatial structure of the Siberian economy it is possible to identify a number of large developments that are the focus of Siberian development. These projects have influenced the geographical distribution of Siberian investment, which is shown in Table 4.4. In West Siberia efforts have focussed on the development of the oil and gas industries and this is reflected in the increasing share of

Table 4.4

Geographical Distribution of Siberian Investment, 1966-1980

Economic Region	Share of North and South[a] (Percent)			Share of Total Soviet Investment (Percent)		
	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80
West Siberia	100	100	100	6.2	7.1	9.5
Near & Far North	19.1	29.8[b]	41.7	1.2	2.1	4.0
South	80.1	70.2	48.3	5.0	5.0	5.5
East Siberia	100	100	100	4.7	4.5	na
Near & Far North	20.3	22.3	29.0	1.0	1.0	na
South	79.3	77.7	71.0	3.7	3.5	na
Far East	100	100	100	4.3	4.5	na
Near & Far North	16.9	21.7	29.5	0.7	1.0	na
South	83.1	78.3	70.5	3.6	3.5	na
Siberia & Far East	100	100	100	15.2	16.1	18.0
Near & Far North	18.8[c]	20.2[b]	35-36	2.9	4.1	6.4
South	81.2	78.8	64	12.3	12.0	11.6

Source: Dienes, L. (1984), "The Development of Siberia, Regional Priorities and Economic Development," in Changing Geographical Perspectives on the Soviet Union; Essays in Honour of Chauncy D. Harris. Department of Geography, Research Paper No. 211. Chicago: University of Chicago Press, pp. 189-213.

a. See Figure 4.5 for boundaries of Near and Far North.
b. Error in the original
c. Weighted averages.

capital investment being consumed in the northern areas of the economic region. In East Siberia emphasis has been upon the development of the Angara-Yenisey system and its TPCs. During the 1970s investment has also been used to expand the Noril'sk Metallurgical Combine. In the Far East the construction of the BAM railway and the South Yakutian TPC have increased the share of investment in the North and near North, but the bulk of the population and industry remains in the South, particularly on the Pacific coast. The question then remains, how important has East-West trade been in the shaping of the Siberian economy. The next two chapters focus upon Siberian participation in East-West trade.

Notes

1. Narodnoye Khozyaystvo SSSR v 1986g, p. 95.

2. Soviet News and Views (1986), No. 28, p. 5.

3. Shabad, T. (1984), "News Notes," Polar Geography and Geology, Vol. 8, No.2, pp. 166-171.

Chapter 5

Siberia and the Far East and Exports to the West

> "..., a considerable percentage of foreign currency earnings will be produced by oil and petroleum products, gas, coal, non-ferrous metals, and lumber, i.e. specifically by products that Siberia will produce a large share of. The dynamics of world market prices promote the increased economic efficiency of Siberian exports."
>
> Granberg, 1981b, p. 62.

This chapter answers two interrelated questions: first, what is the role of Siberia and the Far East in the production of exports to the West; and second, how important are such exports to the regional development of Siberia and the Far East.

To estimate the role of Siberian industry in providing exports to the West it must be shown first that there is sufficient productive capacity to facilitate exports, and secondly that the transportation system is capable of delivering Siberian commodities to foreign currency markets. Therefore in each case the productive capacity and transportation requirements are assessed prior to the calculation of export production. In the absence of detailed information on the regional distribution of Soviet export production one must make a number of assumptions to estimate the level of Siberian trade participation. In most cases it is assumed that the Siberian share of export production is equal to its share of national production, so that if Siberia produced 62 percent of the Soviet Union's crude oil in 1984 the

region is assumed to contribute 62 percent of export production. Clearly this may not be the case as far as the direct contribution is concerned, but Siberian production may also contribute indirectly by providing for domestic needs, thus freeing other fields for export production. In the case of Soviet exports to Japan it is assumed that the production of bulky raw materials such as coking coal and forest products is confined to Siberia and the Far East. This assumption is supported by the fact that much of Soviet-Japanese trade is related to compensation agreements that identify particular regions and resource deposits as the source of export production. Other large-scale compensation agreements also enable one to identify the extent and location of associated export production. Combining the various estimates enables one to determine both the role of Siberia and the Far East in export production and the extent to which that role has changed since the early 1970s. Those same estimates can then be used to assess the role of export production in the sub-regions of Siberia and the Far East.

5.1 The Role of Siberia and the Far East in Exports to the West

Chapter 2 revealed Soviet exports to the industrialised West to be dominated by natural resources, in particular fuel and non-fuel minerals and forest products. Chapter 3 demonstrated that Siberian industry specialises in the production of fuel minerals, non-fuel minerals and forest products. Therefore, one would expect Siberia and the Far East to play an important role as the source for exports of these commodities. Those commodities that are both an important

source of foreign currency and a specialisation of Siberia and the Far East are presented in Table 5.1. The data are from the OECD and represent the U.S. dollar value of exports from the Soviet Union to all the OECD nations. Six commodity groups are identified: cork and wood (SITC 24) which consists of unprocessed forest products, coal (SITC 32) which includes both coking and thermal coal, oil and oil products (SITC 33), natural gas (SITC 34), non-metallic mineral manufactures (SITC 66) which in the case of Soviet trade is almost entirely diamond exports (see Kravalis et al. 1979, p. 432), and non-ferrous metals (SITC 66). These six commodity groups accounted for 64.2 percent of total exports to the OECD in 1970, 82.9 percent in 1980 and 87 percent in 1984. While all these groups have experienced growth in the value of exports, oil and gas exports have expanded more rapidly, reducing the relative importance of other commodities. In addition to the commodity groups listed above, gold, fish, furs, chemicals and transportation services also figure in both foreign currency exports to the West and the regional economies of Siberia and the Far East. The following analysis of export production is sub-divided into four sections: fuel minerals, non-fuel minerals, forest products and others (which includes fish, furs, chemicals and transportation services).

5.2. Siberian Fuel Mineral Exports to the West

The rapid expansion of West Siberian oil production has paralleled both the increase in oil prices brought about by the actions of OPEC, and the expansion of Soviet trade with the industrialised West. There can be little doubt that the

Table 5.1

Key Soviet Exports to the OECD

(Million $ and Percent of Total Exports)[a]

Commodity	1970	1975	1980	1981	1982	1983	1984
Cork and Wood (SITC 24)							
Value	474	930	1,653	1,116	1,016	1,004	963
Percent Total	18.5	11.0	7.0	4.7	4.0	4.1	3.7
Coal (SITC 32)							
Value	177	534	555	352	301	300	325
Percent Total	7.0	6.2	2.3	1.5	1.2	1.2	1.2
Oil and Oil Prod. (SITC 33)							
Value	659	3,782	13,450	13,903	15,549	15,891	16,140
Percent	25.8	44.5	56.5	58.5	62.0	64.2	62.3
Natural Gas (SITC 34)							
Value	15	266	2,778	4,072	3,912	3,327	3,943
Percent	0.6	3.1	11.7	17.1	15.6	13.4	15.2
Diamonds (SITC 66)							
Value	24	113	470	254	350	275	397
Percent	0.9	1.3	2.0	1.1	1.4	1.1	1.5
Non-Ferrous Metals (SITC 68)							
Value	292	465	816	564	610	722	805
Percent	11.4	5.5	3.4	2.4	2.4	2.9	3.1
Total Value ($ million)	2,555	8,494	23,789	23,767	25,060	24,749	25,893
Above as a percent of total exports to the OECD	64.2	71.6	82.9	85.3	86.6	86.9	87.0

Source: OECD (various years), Series "C", Foreign Trade by Commodity. Paris:OECD.

a. The value of exports has been rounded up to the nearest million dollars, while the percentages have been calculated from the values in the OECD trade statistics.

windfall profits gained from Soviet oil exports have played an important role in financing the expansion of East-West trade during the past decade. More recently domestic production problems and the collapse in oil prices have led to a sharp reduction in Soviet foreign currency purchasing power.

The expansion of the oil and gas pipeline networks has enabled Siberian resources to reach domestic and foreign markets despite the remote location of the producing regions. However, these pipeline systems were not operational until the mid-1970s. Therefore, because of inadequate transportation, Siberia is not considered an export supplier until after 1975 (see Sagers and Green, 1985, pp 371-372 and Cadieux, 1984, pp. 72-82). From 1975 to 1985 Siberia's share of Soviet oil production rose from 30.5 to 63 percent, and of natural gas production from 13.5 percent to 59.1 percent. During the same period the share of oil and oil products in exports to the OECD rose from 44.5 to 62.3 percent, and natural gas from 3.1 to 15.2 percent.

5.2.1. Siberian Oil Exports

The role of Siberian oil production in oil exports to the West is estimated in Table 5.2. According to these calculations the value of Siberian oil exports to the West has risen from $ 1 billion in 1975 to over $ 10 billion in 1984. As one would expect, the volume of exports has risen at a much slower rate, from 12.6 million tons in 1975 to 43.7 million tons in 1984. It should be noted that the OECD figures are for oil and oil products while the Siberian production figures are just for crude oil. As it takes more than one ton of crude oil

Table 5.2

The Role of Siberia in Soviet Oil Exports to the West

	1975	1980	1981	1982	1983	1984
Siberia's Share of Soviet Oil production (percent)[a]	30.5	52.4	55.5	58.1	60.4	62.2
Value of oil exports to the OECD ($ million)[b]	3,782	13,449	13,903	15,549	15,891	16,140
Volume of oil exports to the OECD (,000 tons)[c]	41,445	52,811	52,034	64,147	72,419	na
Value of exports from Siberia if export share equals national share ($ million)	1,153	7,048	7,716	9,034	9,598	10,039
Volume of exports from Siberia if export share equals national share (,000 tons)	12,641	27,673	28,879	37,269	43,741	na
Exports as a percent of Siberian production	8.4	8.7	8.5	10.5	11.8	na
Siberian oil exports as a percent of total exports to the OECD	13.6	29.6	32.5	36.0	38.8	38.8

Sources: a. Calculated from Table 5.1
b. Includes oil and oil products, from Table 5.1
C. Includes oil and oil products, from OECD (various years), Annual Oil and Gas Statistics. Paris: OECD.

to produce one ton of oil products, the volume of Siberian oil exports is understated. The extent of that underestimation is difficult to determine, but the Soviet refining industry is not renowned for its efficiency (see Sagers and Tretyakova, 1985). While the Soviet Union would like to increase the share of oil products in sales to the West, exports of crude oil have grown quicker than product exports. This is probably because the refining sector has been unable to meet the needs of the domestic economy, let alone foreign markets. On the other hand the Soviet practice of re-exporting oil which has been obtained in barter trade may serve to overstate the role of domestic production in exports. When all the factors are considered, once adequate transmission facilities had been installed, the assumption that Siberia's share of exports is equal to its share of national production provides a realistic estimation of foreign trade participation.

Because Siberian production continued to increase in parallel with increasing exports the role of export production in Siberian production remained fairly stable. Only recently with the stagnation of oil production has the share of total exports increased. Exports to the West represent about 45 percent of all oil exports (see Table 2.9) with most of the remainder going to Eastern Europe. Thus, the total amount of oil exported is probably twice the amount estimated above, about 20-25 percent of Siberian production. While these figures are estimates, it seems certain that the rapid increase in Siberian oil production has played a vital part in enabling the expansion of oil exports to the West. Further support for

this conclusion is provided by the fact that since the mid-1970s oil production in other regions in the Soviet Union has been in decline. Without the expansion of Siberian production the Soviet oil industry would have been unable to meet domestic needs, let alone generate a surplus for export. In the early 1980s, as the oil price declined, the volume of Soviet exports to the West was increased despite faltering production; as a result exports to Eastern Europe were cut back (Hewett, 1986, p. 185). But during 1985 oil exports to the OECD were cut back 10 million tons, and the total volume of Soviet oil exports fell by 25 million tons compared to 1984 exports.[1] It would seem that the luxury of simply increasing the volume of oil exported to the West is no longer available. The final set of figures in Table 5.2 shows the role of Siberian oil exports in total exports to the West. Because of the nature of the assumptions made about the distribution of export production it is not suprising to find a rapid increase in the role of Siberian oil exports, from 13.6 percent af all exports in 1975 to 38.8 percent in 1984. In the period to 1982 this increase reflected both the rapid increase of oil prices and the expansion of Siberian oil production, but since then both oil prices and the volume of exports have declined and the value of exports will probably decline in the 1985-1986 period.

5.2.2. Siberian Natural Gas Exports

All Soviet natural gas exports to OECD nations are consumed in Western Europe, mainly by Austria, West Germany, France, Italy and Finland. By the early 1980s almost 90 percent of those gas deliveries were related to gas-for-pipe

compensation agreements (Arbatov and Shakay, 1981, p. 149). The first such compensation deal was signed with Austria in 1968, and since then they have become an essential part of Soviet trade with Western Europe. The role of Siberia in Soviet natural gas exports to the West is shown on Table 5.3. Natural gas has lagged behind oil in production and trade and has only recently become an important source of foreign currency. Table 5.3 shows that natural gas exports have stabilized at approximately $ 4 billion per year. As a result of the expansion of the export pipeline system the Soviet Union can now deliver more gas to Western Europe than it can sell. Under the associated gas-for-pipe deals the Soviet Union now has contracts for about 26 billion cubic metres of gas, but it could deliver over 40 billion cubic metres by the end of the century.[2] However, the latest International Energy Agency study on European gas supplies suggests that there is likely to be a glut of gas in the European market for some time to come.[3] Therefore the Soviet Union is unlikely to be able to increase exports much beyond their present level. In fact some West European nations are now trying to renegotiate existing agreements to reduce both the volume and price of Soviet gas exports.

In the Far East the Sakhalin Continental Shelf Project could result in deliveries of liquified natural gas to Japan during the 1990s (Hough, 1985). In Yakutia reserves of over 650 billion cubic metres of natural gas have been discovered, as a result of a U.S.-Japanese-Soviet venture, but the construction of an export pipeline is unlikely under present

Table 5.3

The Role of Siberia in Soviet Gas Exports to the West

	1975	1980	1981	1982	1983	1984
Siberia's share of Soviet gas production (percent)[a]	13.5	37.0	42.1	46.7	51.7	56.4
Value of gas exports to the OECD ($ million)[b]	266	2,777	4,072	3,912	3,327	3,943
Volume of gas exports to the OECD (billion cubic metres)[c]	4.8	25.6	27.8	26.8	25.3	na
Value of exports from Siberia if export share equals national share ($ million)	35.9	1,028	1,714	1,826	1,720	2,224
Volume of exports from Siberia if export share equals national share (billion cubic metres)	0.7	9.5	11.7	12.5	13.1	na
Exports as a percent of Siberian production	1.7	5.9	5.9	5.3	4.7	na
Siberian gas exports as a percent of total exports to the OECD	0.1	4.3	7.2	7.3	7.0	8.6

sources: a. Calculated from Table 3.7
b. From Table 5.1
c. OECD (various years), Annual Oil and Gas Statistics. Paris:OECD.

conditions. Thus, natural gas exports to Western Europe represent the only foreign currency market for Siberian natural gas.

As with oil production Siberia has played an increasingly important role in the Soviet natural gas industry and is estimated to have exported 13 billion cubic metres of gas to Western Europe in 1983, valued at $ 1.7 billion. At present estimated exports of Siberian gas to Western Europe represent about 5 percent of Siberian production, but if production continues to expand (the 12th FYP calls for a 60 percent increase in natural gas production) and further West European contracts are not secured, then export production will obviously decline in importance. At the same time if the value of oil exports declines, as it is bound to do, then the relative importance of foreign currency earnings from natural gas will increase. As with oil, exports to Eastern Europe are roughly the same, in terms of volume, as exports to the West, thus approximately 10 percent of Siberian gas production may be destined for foreign markets. It is possible that gas deliveries to Eastern Europe may be increased to compensate for shortfalls in oil production and the lack of foreign currency markets (see Kramer, 1985).

5.2.3. Siberian Coal Exports

The third and final fuel mineral considered is coal. Because of the bulky nature of coal it is assumed that the only foreign currency market that Siberian mines could directly supply is Japan. While it is recognised that Kuznetsk coal could contribute indirectly to European export production, it

is assumed that Siberian mines supplied all exports to Japan and non-Siberian mines the remainder. (In actual fact Japan's share of coal exports to the West is very close to Siberia's share of national production). According to Mathieson (1979, p. 74) the Soviet Union has sold coal to Japan under various agreements since 1958. The bulk of these exports have come from the Kuzbass, but mines on Sakhalin Island have also contributed. Japan has been involved in the development of the South Yakutian coal basin and is known to have received both Kuznetsk and South Yakutian coal in compensation deliveries.

Under the terms of the South Yakutian Coal Development Project Japan has supplied nearly half a billion dollars of credit to purchase machinery and equipment to develop the coal basin. In return the Japanese companies involved will receive 104 million tons of coking coal over a 20 year period, 84.4 million from South Yakutia starting in 1983 and 20 million from the Kuznetsk basin starting in 1979 (Spandaryan, 1975, p.27). Production in South Yakutia was delayed, but it started during 1984 when 800,000 tons of coal were delivered (Mote, 1985. p. 705). In August 1985 a ceremony was held at Neryungri to mark the delivery of the first million tons of South Yakutian coal (Agafonov, 1985). During 1985 the Japanese contracted to accept 3.15 million tons of South Yakutian Coal, and starting in 1986 the project calls for 5 million tons per year until 1998. If one examines the coal export data in Table 5.4 it is clear that the South Yakutian project could represent a substantial expansion in coal trade with Japan. Prior to 1984

Table 5.4

Soviet Coal Exports to the West

	1970	1975	1980	1981	1982	1983	1984
Total Coal Exports to the OECD (Million $)[a]	177.6	533.6	555.5	351.6	301.4	300.2	324.8
Exports to Japan (Million $)[b]	43.6	164.0	120.7	91.1	94.4	145.2	na[a]
Exports to Japan (Million tons)[c]	2.9	3.1	2.1	1.4	1.3	1.9	na
Coal Exports to Japan as a percent of total exports to the OECD	1.7	1.9	0.5	0.4	0.4	0.4	0.5

Sources:
a. OECD (various years), Series "C", Foreign Trade by Commodity. Paris:OECD.
b. JETRO (various years), White Paper on Foreign Trade, Japan. Tokyo:JETRO.
c. Ministerstvo Vneshney Torgovli (1970), Vneshnyaya torgovlya SSSR v 1970 g. Moscow: Finansy i Statistika.

coal exports were actually declining, probably reflecting competion from other Pacific basin suppliers such as Australia, the United States and Canada, as much as the poor economic and political climate between Moscow and Tokyo. Prior to the development of the South Yakutian basin the Kuznetsk basin was the primary source of high-quality coking coal exports to Japan. As the volume and value of coal exports have declined and oil and gas exports have increased, coal has become a relatively minor source of foreign currency. Given the present glut of coking coal in the Pacific basin it is unlikely that Japan will take delivery of 5 million tons of South Yakutian coal a year. If exports remain around the 3 million ton level South Yakutia would do little more than replace exports from the Kuzbass, which would not help the balance of payments situation. In 1985 Japan recorded a $ 1.3 billion trade surplus in trade with the Soviet Union.[4]

In conclusion, the total contribution of Siberian fuel mineral exports is estimated to have risen from 1.7 percent ($ 43.6 million) of all exports to the OECD in 1970 to 47.9 percent ($ 12.4 billion) in 1984. This rapid increase is the result of the development of the West Siberian TPC which has become the most important source of fuel minerals in the Soviet Union and thus a major source of foreign currency.

5.3. Siberian Non-Fuel Mineral Exports to the West

Soviet exports of non-fuel minerals to foreign currency markets are far less significant than mineral exports to other CMEA nations. In 1981, according to the U.S. Bureau of Mines, 73 percent of aluminum exports, 95 percent of copper exports

and 98 percent of iron ore exports were delivered to Eastern Europe (Levine, 1984, p.4). However, there are a small number of minerals that play a more important role in trade with the West than in CMEA trade, namely: nickel, platinum group metals, diamonds and gold. In total exports of copper, chromite, asbestos and aluminum combined are important sources of foreign currency. Siberia and the Far East have the productive capacity to play an important part in the export of nickel, platinum group metals, aluminum, gold and diamonds. Transportation is not a major consideration because most of these commodities are high value-to-weight products that can be flown out of remote areas such as Mirnyy and Magadan. The Noril'sk metallurgical combine is now supplied year-round by the Northern Sea Route, and the aluminum plants in the Angara-Yenisey region are well served by railways. The first step in evaluating Siberian export production is to determine the share of Siberian mines in the production of the minerals identified above. In the following analysis gold is treated separately from other minerals because gold sales are not included in OECD commodity trade statistics. It should be noted that this discussion concentrates on processed minerals (SITC 66) and does not include unprocessed mineral ores (SITC 283). Mineral ore exports play a part in East-West trade, but the minerals identified above tend to be exported as processed metals, rather than ores.

5.3.1. Nickel, Platinum Group Metals and Aluminum Exports

The first minerals considered are those in the non-ferrous metals group (SITC 68) that are mined in Siberia and the Far

East and are an important source of foreign currency, namely platinum group metals, nickel and aluminum. The value of these metal exports is shown in Table 5.5. It can be seen that they have accounted for an increasingly large share of all non-ferrous metal exports to the West. Nickel and platinum group metals are considered together because in Siberia platinum group metals are produced entirely as a by-product of copper and nickel smelters at Noril'sk. Noril'sk and the Kola penisula account for over 95 percent of Soviet platinum group metal and 80 percent of nickel reserves (Ballinger, 1985, p. 163). Noril'sk is the most important production centre, accounting for 75 percent of Soviet platinum group metal production and 65 percent of Soviet nickel production. Noril'sk's indirect contribution may be even higher as polymetallic ores are transported from Noril'sk via the Northern Sea Route to smelters on the Kola peninsula. Platinum group metal bearing residues from Noril'sk are refined at Krasnoyarsk.

Since 1965 the Noril'sk metallurgical combine has undergone considerable expansion. Adams (1983, p. 541) has suggested that mining capacity may have increased from 20,000 tons of nickel metal content in 1965 to possibly as much as 200,000 tons in 1980. Western plant and equipment have played an important part in the development of Noril'sk and are discussed in Chapter 6. Expansion of productive capacity and rising world prices have made platinum and nickel exports an attractive source of foreign currency, but the recent recession in the West has reduced demand and the volume of sales has

Table 5.5

Siberian Non-Ferrous Metal Exports to the OECD

($ million)

	1970	1975	1980
Non-Ferrous Metals (SITC 68)	292	465	816
Including:			
Silver, Platinum and other Platinum group metals (SITC 681)	111	204	437
Siberian production (75 percent)	83	153	328
Nickel (SITC 683)	19	53	163
Siberian production (65 percent)	12	34	106
Aluminum (SITC 684)	33	75	155
Siberian production (60 percent)	20	45	93
Total value of non-ferrous exports to the OECD	163	332	755
Total value of Siberian non-ferrous exports to the OECD	115	232	527
Siberian exports as a percent of total non-ferrous exports to the OECD	40	50	65
Siberian non-ferrous exports as percent of total exports to the OECD	4.5	2.7	2.2

Source: OECD (various years), Series "C", Foreign Trade by Commodity. Paris:OECD.

declined. The most important foreign currency markets for Soviet platinum are the United States and Japan. According to OECD figures exports of platinum group metals increased from $ 111 million in 1970 to $ 437 million in 1980. Unfortunately disaggregated OECD data are not readily available after 1980, but according to the volume data in Table 2.11 exports have declined during the early 1980s. Consequently as production has continued to increase, the percentage of total production exported has decreased from 68 percent in 1970 to 47 percent in 1983. During the late 1970s, when platinum prices were very high, over 80 percent of annual production was exported. This suggests that the generation of foreign currency is a primary objective at the Noril'sk combine and is one of the main reasons for its continued development despite its remote location.

Nickel exports, although less valuable then platinum, have also increased, from $ 19 million in 1970 to $ 163 million in 1980. The most important foreign currency markets for Soviet nickel are the United States, West Germany, Japan and France. In recent years Soviet nickel exports have encountered problems in Western markets. During 1983 the EEC imposed an anti-dumping duty on Soviet nickel, though the duty was later lifted and the funds collected reimbursed. In late 1983 the United States banned Soviet nickel imports because the Soviet Union was importing Cuban polymetallic ores to produce nickel. The Soviet Union is now required to prove that its nickel is free from Cuban content (Levine, 1984, p. 25). Japan has remained an important market and in 1985 increased its imports

to between 4,000 and 5,000 tons.[5] Given the expansion of smelter capacity at Noril'sk the Soviet Union now has the productive capacity to increase the volume of exports substantially should it wish to do so. For the purposes of estimating Siberia's share of foreign currency exports the region is assumed to contribute 75 percent of platinum group metal exports and 65 percent of nickel exports. Copper and cobalt are also produced at Noril'sk but neither plays a major role in exports to the West. In the case of copper the majority of Soviet production comes from Kazakhstan, the Urals and Uzbekistan. Since 1960 the Soviet Union has been trying to enlist Western help in the development of the Udokan copper deposits in the BAM service area. A number of Western companies have studied the deposit but so far no contracts have been signed.

The expansion of the aluminum industry has been shown to play an important part in the development of the Siberian non-ferrous metals industry, and in particular the Angara-Yenisey system. Soviet aluminum production capacity has rapidly increased during the 1970s. Shabad (1983, p. 90), using CIA estimates, shows Soviet primary aluminum production increasing from 1.49 million tons in 1970 to 2.46 million tons in 1980. The U.S. Bureau of Mines estimated 1970 primary aluminum production to be 1.1 million tons, 1980 production 1.76 million tons and 1983 production 2.0 million tons.[6] According to the Soviet foreign trade handbooks in 1970 the Soviet Union exported 368 thousand tons of aluminum (33 percent of production), and in 1975, the last year Soviet figures were

published, 500 thousand tons were exported (33 percent of production). The U.S. Bureau of Mines estimated 1983 exports to be 600 thousand tons (30 percent of production). About 70 percent of Soviet aluminum exports are sent to Eastern Europe, with Japan being the most important foreign currency purchaser. Japanese trade statistics report that Japan imported $ 96 million worth of Soviet aluminum in 1980 (62 percent of OECD imports).[7]

In 1984 Siberian smelters accounted for 60 percent of Soviet aluminum ingot production capacity.[8] The majority of Siberia's aluminum plants started operation in the 1960s but did not reach capacity until the late 1970s. Siberia's share of Soviet aluminum production averaged about 60 percent during the 1970s. Table 5.6 shows estimated capacity and production in the late 1970s. In 1985 the Sayan plant began production and should serve to maintain Siberia's share of national aluminum production at around 60 percent. The Sayan project may lead to an increase in the value of foreign currency exports as it has been constructed under a compensation agreement by a consortium of Western companies led by the French firm Pechiney Ugine Kuhlman. The plant capacity is reported to be 500,000 tons per annum and the Western partners are to receive 500,000 tons of aluminum bars as part payment for the plant. In the future an aluminum smelter may be built on the Far Eastern seaboard to process bauxite imported from Australia. For the purposes of estimating Siberia's present share of aluminum export production the region is assumed to contribute 60 percent of exports.

Table 5.6

Estimated Capacity and Production of Aluminum Plants in Siberia

(Thousand Tons)

Plant	Began operation	Probable Annual Capacity 1979 (January)	Probable Annual Capacity 1981 (January)	Probable Output 1978	Probable Output 1980
Bratsk	1966	540	540	460	480
Irkutsk	1962	240	240	200	200
Krasnoyarsk	1964	390	390	275	300
Novokuznetsk	1943	160	160	135	135
Total Siberian Production		1,330	1,330	1,070	1,115
Total Soviet Production		2,085	2,185	1,670	1,790
Siberian Production as a Percent of total Soviet Production		64.0	61.0	64.0	62.0

Sources: Strishkov, V.V. (1979), "Mineral Industry of the U.S.S.R." reprint from Mining Annual Review, U.S. Bureau of Mines. Pittsburg, PA.: U.S. Bureau of Mines, p. 11.
Special Contributor, (1981) , "The Soviet Union," Mining Annual Review, p. 579.

It is now possible to estimate the total share of Siberan production in non-ferrous metal exports to the West. Table 5.5 shows the value of exports and also the estimated value of Siberian production. According to these estimates the value of Siberian exports increased from $ 115 million in 1970 to $ 527 million in 1980. At the same time the role of Siberian production in non-ferrous metal exports increased from 40 percent in 1970 to 65 percent in 1980. Increased sales of platinum group metals were the most important source of growth, and the Noril'sk metallurgical combine was by far the most important source of non-ferrous metal exports. Since 1980 Siberia has probably retained it 65 percent share of exports as platinum, nickel and aluminum remain the most important exports in the non-ferrous metals commodity group. The overall share of non-ferrous metal exports in trade with West has declined simply because of the rapid growth of oil and gas exports.

5.3.2. Diamond Exports

Estimation of Siberia's role in diamond exports is a relatively simple task, as the Far East is the only producer of natural diamonds in the Soviet Union. Although the Soviet Union does produce synthetic diamonds these do not figure in trade data and are not considered here. At present the Far Eastern diamond industry is based on three production centres: Mirnyy in the Upper Vilyuy basin; the Aykal-Udachny district on the upper reaches of the Markha river; and the Anabar on the Ebelyakh river, a tributary of the Anabar river. During the 1970s production was concentrated on the Mirnyy openpit operation, the Aykhal operation and placer mine operations at

Udachny and Ebelyakh. The Anabar deposits have been known since the 1960s, but the Anabar placer mine did not begin operation until 1983. All these mining operations are in very remote locations, and provision of adequate power and socio-economic infrastructure has been a persistent problem. However, because the region is presently the only source of diamonds cost is not the most important consideration.

The role of diamonds in Soviet exports to the West was discussed in Chapter 2. OECD trade data do not report diamond exports, but in Soviet trade with the OECD SITC 66 is almost entirely diamonds. The value of SITC 66 exports increased from $ 24.3 million in 1970 to $ 113 million in 1975, $ 470 million in 1980 and $ 397 million in 1984. Clearly the OECD figures are not reporting the total value of Soviet diamond exports. As Soviet uncut diamonds are marketed through DeBeers in London and cut diamonds through Antwerp, Great Britain and Belgium are the most important markets in the OECD data. In 1984 Belgium accounted for 72 percent of Soviet exports in SITC 66 but Britain less than 1 percent. The discrepancy between the OECD data and the other sources may lie with the fact that DeBeers purchases of Soviet uncut diamonds are not reported in SITC 66; otherwise the share of Britain would be much higher. Alternatively it may be that in 1980 the Soviet Union dumped diamonds via markets in non-OECD countries, probably in the Middle East. For the purposes of this study Siberia is assumed to contribute the entire value of exports in SITC 66. However, it should be understood that this probably underestimates the foreign currency value of Soviet diamond exports.

5.3.3. Gold Exports

Siberia has traditionally been the centre of the Soviet gold mining industry. However, in recent years Siberia's share of Soviet gold production has been declining, primarily because of increased production in Central Asia. The spatial distribution of Soviet gold production is shown in Table 5.7. Siberian production has fallen from just over 68 percent of total production in 1970 to just over 60 percent in 1980. Kaser (1983) estimates that Siberia's share will further decline to about 50 percent by 1990. The most important producing region in Siberia is Magadan Oblast', which contains that Severovostokzoloto district, but because of poor economic infrastructure, poor management and harsh environmental conditions gold production is this region is difficult to maintain. For the purposes of estimating Siberia's contribution to Soviet gold exports Kaser's estimates of regional production shown in Table 5.7 are used. In addition a Consolidated Goldfields report estimated Siberia's share of Soviet gold production in 1975 to be about 65 percent (Dowie, 1976, p. xii); while a more recent estimate by Kaser (1984, p. 160) assigns 59.5 percent of 1981 production to Siberian fields. When one combines the gold sales data on Table 2.10 with the Siberian production estimates presented above it is possible to estimate the value of Siberia's gold exports to the West. No gold sales are reported for 1970-72, but in 1973 gold sales were valued at $ 900 million. If one assumes that Siberia contributed 68 percent of those exports they would be worth $ 612 million. In 1975 the Soviet Union sold $ 725

Table 5.7

The Spatial Distribution of Soviet Gold Production

	1970		1980		1990[a]	
	Volume	Percent	Volume	Percent	Volume	Percent
Siberian Fields						
Severvostokzoloto (Northeast)	82	31.1	85	24.7	72	15.7
Primorzoloto (Maritime Kray)	14	5.3	17	4.9	22	4.8
Yakutzoloto (Yakutia)	40	15.2	49	14.2	68	14.8
Zaibaykalzoloto (Transbaykal)	17	6.4	28	8.1	43	9.4
Lenazoloto (Lena)	15	5.7	16	4.7	18	3.9
Other Siberian producers	13	4.9	14	4.1	10	2.2
Total Siberian production	181	68.56	209	60.76	233	50.76
Other regions[b] (C.Asia)	35 (16)	13.26 (6.1)	74 (44)	21.51 (16.7)	133 (94)	29.00 (20.5)
Byproduct gold	48	18.18	61	17.73	91	19.80
Other	-	-	-	-	2	0.44
Total production	264	100	344	100	459	100

Source: Kaser, M. (1983), "The Soviet Gold Mining Industry," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, p. 559.

a. The projections are based on a detailed analysis of production trends and potential for each gold field.
b. Includes Kazakhstan, Central Asia, the Urals and Armenia.

million worth of gold and Siberia contributed an estimated 66 percent or $ 478.5 million. In 1980 gold sales were $ 1.78 billion with Siberia's estimated share of 60 percent valued at $ 1.07 billion, and in 1981 gold sales were worth $ 2.7 billion with Siberia's share estimated at $ 1.6 billion. Because gold sales are not included in OECD commodity statistics the value of gold exports cannot be incorporated in calculations of the total vale of exports to OECD . However, an examination of the value of Siberian gold sales as a percent of total commodity transactions provides an indication of the relative importance of gold in Soviet exports to the industrialised West. In 1975 Siberian gold sales to the West were the equivalent of 5.6 percent of total commodity exports to the OECD, and in 1980 4.5 percent of exports to the OECD. Thus in terms of value Siberian gold exports are far more important than all the other non-ferrous metals combined.

5.4. Siberian Forest Products Exports

Unlike most Soviet exports, forest products have not shown rapid increase since the early 1970s. According to OECD statistics the value of exports of Cork and Wood (SITC 24) was $ 963 million in 1984, having declined from $ 1.6 million in 1980. While the various sources of information on Soviet forest products exports do not agree in terms of specific amounts and volumes they show a similar set of trends; first, that Soviet exports are dominated by low-value-added products and second, that in recent years exports have experienced stagnation and decline. The Soviet Union only exports about 5-8 percent of its roundwood and sawnwood production, but these

exports have been a steady source of foreign currency. Exports of roundwood and sawnwood accounted for 74 percent of all forest product exports (by value) in 1970, though in 1984 that figure had declined to 63 percent. This was mainly on the strength of increased sulphate pulp exports, whose share increased from 2.0 percent of forest products exports in 1970 to 11.9 percent in 1984. However, most pulp exports are delivered to Eastern Europe, and exports to the West remain dominated by roundwood and sawnwood. In general terms Europe (both East and West) is the most important export market for sawnwood, while Japan accounts for most of the roundwood exports and Eastern Europe most of the pulp exports (Volkov, 1985, p. 47).

While Siberia and the Far East account for the larger part of Soviet timber reserves they play a relatively modest role in the forest industry. This is because of their distance from market and the dominance of less desirable larch. Siberia's share of Soviet sawnwood production has increased from 25.7 percent in 1970 to 32 percent in 1984 (see Table 3.11), but in the more intensive sectors of the industry the region's performance has been less spectacular. The exception is the production of pulp, which has benefited from the construction of large complexes at Bratsk and Ust'-Ilimsk. Unfortunately detailed regional data are not available.

For the purposes of the present discussion one can divide Siberia into two halves along the eastern boundary of Krasnoyarsk Kray. To the west of this boundary forest products are of sufficiently high quality and accessible enough that it

is possible to transport wood to domestic and export markets in Europe. East of the boundary the quality of the forest resource declines (the amount of larch increases) and inaccessibility inhibits the transport of wood to Western markets. The satisfaction of local demand and export to the Pacific basin are therefore the only markets for Far Eastern timber. Savin et al. (1974, p. 30) refered to this boundary as the "Siberian Barrier". They suggested that it could be overcome only if a greater amount of processing took place in the Far East. However, the Far East's share of Soviet timber production actually declined from 4.7 percent in 1970 to 3.6 percent in 1980 (see Table 3.11).

Soviet forest products exports to the OECD are divided between OECD Europe and Japan. On average exports to Japan have accounted for 45 percent of exports of SITC 24 and OECD Europe the remaining 55 percent. Exports to Japan are predominantly in the form of unprocessed logs. According to OECD data, in 1984 79 percent of Japanese wood products imports from the Soviet Union were in SITC 247.1: Saw-Veneer Logs Conifer. It is difficult to determine what proportion of these exports are logged in the Far East. Most western sources assume that the bulk of timber comes from the immediate hinterlands of the Far Eastern ports. Rodgers (1983, p. 209), quoting a Soviet source, has suggested that in 1972 the Soviet Far East accounted for 45.6 percent of all Soviet roundwood exports or 7.7 million cubic metres. In 1972 the Soviet Union exported 7.8 million cubic metres of roundwood to Japan, thus it is likely that East Siberia also contributed to exports to Japan.

The reason for hauling logs all the way from East Siberia lies with the structure of the forest in the Far East. The Japanese are reluctant to accept more than 25-30 percent larch in log imports and the stands in the Far East are dominated by larch. Therefore, to obtain a satisfactory mix of species in log exports, species other than larch are transported from Eastern Siberia, where larch is less prevalent. East Siberian enterprises have benefited from equipment imports under agreements with Japan. Included in SITC 24 are wood chips (FTN 50004). Their role in exports has increased from 5.7 percent of timber exports (FTN 500) by value in 1970 to 13.6 percent in 1984. Both timber and woodchips have been linked to long-term compensation agreements which are discussed below. For the present we can conclude that Siberia contributes all SITC 24 exports to Japan and that more specifically the Far East and to a lesser extent East Siberia are the sources of those timber exports.

Siberia's role in forest product exports to OECD Europe is harder to determine. Finland is the most important market and in 1984 accounted for nearly 25 percent of Soviet roundwood exports. Trade with Finland is conducted under long-term agreements that exchange Soviet logs and lumber for high-quality imports such as paper. The majority of Soviet exports to Western Europe are harvested in the European regions of the USSR, but much of this forest is over exploited and the forests of West and East Siberia probably play an increasing role in supplying export markets. The only component of Siberian production that can be positively identified as being for

export is the lumber that is exported via the port of Igarka on the Yenisey river. During the 1970s an average of 1.2 million cubic metres of sawnwood was shipped to export markets through the port of Igarka. Eronen (1983, p. 208) estimates that 0.35 million cubic metres are sawn at mills at Igarka and the remainder transported down the Yenisey from mills at Lesosibirsk. According to Kolesov (1982, p. 167) wood exports from Igarka represent 14 percent of Soviet sawnwood exports or 6 percent of all forest product exports. Given the fact that exports to OECD Europe are predominantly sawnwood, Igarka is assumed to contribute 14 percent of Soviet exports to Western Europe. This probably overstates the role of Igarka but allows for export of sawnwood from mills in West and East Siberia by rail. Exports of pulp are not included in SITC 24, since they form part of SITC 25. The value of these exports has increased from $ 16.6 million in 1970 to $ 103. 4 million in 1984. During the same period Soviet sulphate pulp production increased from 161,000 tons to 805,859 tons. The construction of large pulp mills at Bratsk (1 million ton capacity) and Ust'-Ilimsk (0.5 million tons) certainly played a major role in the expansion of Soviet pulp exports. Under the terms of the various agreements for the Ust'-Ilimsk complex the East European partners will receive 40 percent of the output over a 12 year period, and Parsons Whittemore (France) will receive 85,000 tons of the annual production to finance the purchase of a pulp plant (Hannigan and McMillan, 1981, pp. 272-273). In terms of the present discussion pulp exports are not of great importance, representing about 0.4 percent of all exports to

the OECD, but they are a sector where Siberia has played a role in expanding production to meet domestic and foreign markets.

In an attempt to summarise Soviet forest products exports to the West and estimate the role of Siberia in that trade Table 5.8 combines the available data on Soviet forest products trade. Three sources of data have been used: OECD foreign trade data for SITC 24, Japanese trade data on imports of lumber; and Soviet foreign trade data on roundwood (FTN 500) exports to Japan. In addition Soviet exports to OECD Europe are included to enable one to estimate the role of Igarka. There is a fair degree of agreement between the Soviet and Japanese data on the volume of exports, but less so between Japanese and OECD data on the value of exports to Japan. This discrepancy probably results from different accounting periods and exhange rates as well as the fact that the Japanese category does not include woodchips. In estimating the share of Siberia, East Siberia and the Far East are assumed to contribute all SITC 24 exports to Japan. In estimating the value of sawnwood exports through Igarka it is assumed that this trade accounted for 14 percent of Soviet exports in SITC 24 to OECD Europe. Both the Japanese value and the Igarka value are added to provide an estimate of Siberia's share in exports of SITC 24. We can see that exports reached $ 864 million in 1980 but have since leveled off at about $ 500 million. As with all other non-fuel exports the relative importance of forest products exports in trade with the west has declined since the early 1970s.

Prior to concluding this section on forest products it is

Table 5.8

Siberian Forest Product Exports to the West

	1970	1975	1980	1981	1982	1983	1984
Soviet Exports to OECD							
Cork and Wood (SITC 24) Value (Million US $) [a]	474	938	1,653	1,116	1,016	1,004	963
Lumber Exports to Japan [b]							
Volume (Million cubic metres)	na	7.9	6.3	5.7	6.1	6.5	na
Value (Million US $)	198	246	375	264	397	408	na
Roundwood Exports to Japan [c]							
Volume (Million cubic metres)	7.0	8.0	6.1	5.7	6.1	6.5	5.8
Value (Million Roubles)	129	246	375	264	214	230	214
Exports of SITC 24 to Japan (Million US $)	198	417	736	488	418	424	373
Exports of SITC 24 to OECD Europe (Million US $)	276	521	917	628	598	580	590
Estimated Exports of timber via Igarka (14 percent of OECD Europe)	38.7	72.9	128.3	87.9	83.7	81.2	82.6
Estimated share of Siberia (Japan plus Igarka) *	236.4	490.5	864.1	575.6	501.7	505.6	455.7
Siberian wood exports as a percent of all wood exports to the OECD	9.2	5.7	3.6	2.4	2.0	2.0	1.8

Sources:
a. OECD data from: OECD (various years), Series "C", Foreign Trade by Commodity. OECD: Paris.
b. Japanese data from: JETRO (various years), White Paper on Foreign Trade, Japan. Tokyo: JETRO.
c. Soviet data from: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

* Total share has been calculated from orginal OECD data. The other OECD figures have been rounded up.

necessary to discuss the role of compensation agreements in Soviet-Japanese forest products trade. Since the late 1960s a large part of Soviet forest products exports to Japan has been components of large-scale compensation agreements. The first such agreement was signed in July 1968 and subsequent agreements were reached in July 1974 and March 1981. Under the terms of the first Far East Forest Resource Development Project the Soviet Union received a bank loan of $ 163 million with which to purchase machinery, equipment and consumers goods. In return the Soviet Union delivered 7.6 million cubic metres of timber and pulp and 320,000 cubic metres of sawnwood between 1969 and 1973 (Edmonds, 1983, p. 216 and Nobuhara and Akao, 1983, p. 199). The second agreement, signed in July 1974, provided a loan of $ 550 million, $ 435 million for timber exploitation facilities, $ 65 million for ships and $ 50 million for local costs; in return the Japanese received 18.4 million cubic metres of timber and sawnwood between 1975 and 1979. In the first agreement the price remained constant throughout the entire delivery period, but in subsequent agreements the value was adjusted annually (Edmonds 1983, pp. 216-217). A third agreement was delayed by Soviet actions in Afghanistan, but was signed in March 1981. The third agreement, which ran from 1981 to 1986, provided for a bank loan of $ 910 million and the delivery of 13.2 million cubic metres of timber between 1981 and 1986. While the value of the loans has almost doubled since the first agreement, the value of timber shipped has declined by about 30 percent. The total value of loans provided under the three agreements is about $

1.6 billion, with timber deliveries of nearly 40 million cubic metres. When one compares the volume of forest products trade under these agreements with total exports to Japan it is possible to estimate the importance of these compensation deals. Under the second agreement 18.4 million cubic metres of lumber were delivered to Japan, while total Soviet exports of lumber to Japan during this period amounted to 41.4 million cubic metres; thus the agreement accounted for 44 percent of forest products trade.

In addition to the Far Eastern forestry development agreements a wood chip and pulp development agreement was signed in December 1971. Under this agreement Japanese companies exported $ 45 million worth of chip and pulp facilities, machinery and equipment and ships, plus $ 5.5 million worth of consumer goods. In return the Soviet Union was to deliver 4.7 million cubic metres of pulp and 8 million cubic metres of chips between 1971 and 1981. The project did not work as smoothly as the timber agreements and by 1981 only 71 percent of the pulp and 59 percent of the chips had been delivered. The reason for the late delivery was a combination of delays on the Soviet side and a reluctance on the part of the Japanese to take delivery because domestic demand was low. When deliveries were completed in the mid 1980s a second agreements was not signed; but in December 1985 a ten-year agreement was signed between the Japan Chip Trading Company and Exportles for 11.2 million cubic metres of woodchips worth about $ 500 million. This agreement is not a compensation deal but at the same time a separate contract for $ 100 million

worth of chip production equipment was signed (Roscoe, 1985, p. 51). The next chapter examines the equipment deliveries that have been made under the various forest development agreement, but for the moment it sufficient to note that a large portion of Soviet-Japanese forest products trade is linked to specific equipment deliveries and to developing the forest resource of Siberia and the Far East.

5.5. Other Siberian Exports

The final part of this review of Siberian export production examines a number of sectors to which Siberian industry contributes but which are of limited importance in exports to the West. Included in the following discussion are fish and fur exports, compensation deliveries of chemicals and the Trans-Siberian Container Landbridge.

5.5.1. Fish Exports

In Chapter 3 the Far Eastern fishing industry was estimated to contribute 40 percent of the Soviet catch. According to Chichkanov and Orlov (1983, p. 67) more than 60 percent of the production of the Far Eastern fishing industry goes to other regions of the country and to export. However, these figures provide only a very general indication of the role of the Far East in fish exports to the West. Other factors to be considered are that the region is the only Soviet producer of salmon and crab, and that the instigation of the 200 mile limit has affected foreign access to Soviet fisheries and enabled the Soviet Union to control the activities of Japanese fisherman and also obtain compensation payments. In terms of total fish exports the eastern bloc and the developing

nations are the most important markets. But exports of canned fish do generate foreign currency earnings from the West. Earnings from the export of canned fish (FTN 813) to the West have increased from 19 million roubles ($ 21 million) in 1970 to 38.8 million ($ 59.8 million) in 1980 and 45.7 million ($ 54.3 million) in 1984. The most important Western markets are Great Britain, France and Belgium. To obtain an aggregate figure for fish exports to the West it is necessary to turn to OECD data. According to OECD commodity trade statistics Soviet exports of fish, crustaceans, molluscs and preparations (SITC 03) were worth $ 33.4 million or 1.3 percent of total exports in 1970. By 1975 the value of exports had risen to $ 72.6 million, but their share of total exports had fallen to 0.8 percent. In 1984 exports were worth $ 175.4 million but only accounted for 0.7 percent of total exports. In estimating the role of the Far Eastern fishing industry in exports to the West the region is assumed to contribute the same share as its share of national production, that is 40 percent. Given the region's proximity to Japan and the dominance of the region in the salmon and crab fisheries the Far East may actually play a more important part in foreign currency exports.

Before leaving the fishing industry it is necessary to mention the impact that the 200 mile limit and the Law of the Sea have had on the Far Eastern fishery. In short the Soviet Union has gained control over the Sea of Okhotsk and the continental shelf off the Kurile Islands and the Kamchatka Peninsula. In the context of the present study the most important development is the fact that the Soviet Union now

receives compensation from Japan for Japanese landings of salmon and sea trout which orginate in Soviet inland waters. The money is used for building fish management facilities such as hatcheries in order to maintain salmon stocks. The Japanese are thus sharing in the cost of maintaining the salmon fishery; payment is mainly in the form of machinery and materials, but a small portion is also paid in foreign currency (Toda, 1985, p. 8). In 1978 compensation payments for salmon and sea-trout catches amounted to $ 8 million; since 1983 the sum has been $ 19 million per annum. Between 1978 and 1985 a total of $ 133 million was paid. There also exists a quota arrangement that controls the amount of fishing in Japanese waters by Soviet fishermen and Japanese fishermen in Soviet waters. In terms of their share of total exports the Far Eastern fishery is of limited importance. However export production does play an important role in the Far Eastern fishing industry and in the economic development of the seaboard regions of the Far East.

5.5.2. Fur Exports

Historically the fur trade played a vital part in the Russian development of Siberia and the Far East. In the Soviet period hunting and trapping have fallen under state control and fur farms have replaced the traditional hunter. Conolly (1975, p. 148), quoting a Soviet source, has suggested that 70 percent of the fur produced in northern Siberia is from fur farms. The most important fur-bearing animals are squirrel, fox, hare, ermine, mink and sable. Muskrat have also been successfully introduced from Canada. The most important producing regions are East Siberia and Yakutia. The area around Lake Baykal is

the habitat of the most valuable fur-bearing animals including the famed Barguzin sable. The West is by far the most important market for fur exports. In 1970 OECD trade statistics recorded Soviet exports of hides, skins and fur skins (SITC 21) to be worth $ 43.6 million; Soviet trade statistics for the same year report total fur exports (FTN 52) to have been worth $ 49.7 million. While SITC 21 and FTN 52 are not strictly comparable it is quite clear that the West is the most important market for Soviet fur exports. Among the Western nations Great Britain, the United States and West Germany are the most important markets for Soviet furs. In 1975 fur exports to OECD were worth $ 60 million or 0.7 percent of total trade, in 1980 $ 119 million or 0.5 percent and in 1984 $ 104.4 million or 0.4 percent. Thus, despite the fact that the general public in the West may perceive fur to be a major export from the Soviet Union it cannot be considered an important source of foreign currency. For the purposes of estimating the role of Siberia in exports to the West, in the absence of detailed data, the region is assumed to contribute the total value of SITC 21. This probably is not the case but the values involved are so small that the overall role of the region is hardly affected.

5.5.3. Chemical Exports

Foreign trade data show exports of chemical products to be an increasingly important source of foreign currency. During the 1970s a large number of compensation agreements were signed with Western companies. Under the terms of these agreements plant and equipment will be paid off with deliveries of

product. It has been estimated that between 1968 and 1980 $ 10.1 billion worth of chemical products were contracted under compensation agreements; the majority of these agreements (69 percent) were for deliveries over a period of 10 years or more (U.N. Economic Commission for Europe, 1982, p.189). Most of the facilities purchased under these agreements have only recently started to enter into production and pay-back deliveries are only just starting, so that one can expect the value of chemical exports to the West to continue to increase. A number of large chemical complexes have been built in Siberia, but the region's share of Soviet chemical production is relatively small. In fact the Siberian share of the Soviet chemical and petrochemical industry declined from 13 percent in 1965 to 9.2 percent in 1982 (Granberg 1986, p. 48). The chemical complexes at Kemerovo, Omsk, Tomsk, Zima and Tobol'sk have all received Western plant and equipment, and many of these purchases have been made on a compensation basis. However, it is very difficult to determine if production from Siberian plants has actually been delivered to export markets. As Savin (1980, p. 23) has noted, it makes more sense to make pay-back deliveries for Siberian plants using existing production capacity in the European USSR, thus reducing transport costs and reducing the burden on the transportation system. Indeed many of the Siberian projects have twin facilities further west. For example, the aromatics complex at Omsk and the methanol plant at Tomsk are twinned with plants at Ufa and Gubakha respectively. The plastics complex at Zima has been constructed on a compensation basis and pay-back deliveries of

vinyl chloride and PVC worth nearly $ 100 million have been made, but there is no guarantee that pay-back deliveries actually came from Zima. When one combines the declining national share of the Siberian chemical industry with the tendency to make pay-back deliveries from facilities in the European USSR, Siberia's contribution to exports to the West is probably very small. Thus, for the purposes of the present discussion Siberia is not considered a major source of chemical exports. However, this does not mean that imports of technology have not played their part in the development of industrial complexes in Siberia. The major turnkey and compensation deals are discussed in the next chapter.

5.5.4. The Trans-Siberian Landbridge

The final source of foreign currency considered in this section is the Trans-Siberian Container Landbridge. It is questionable whether a service such as the Landbridge should be considered at all, but the fact that the service is a source of foreign currency, relying on port service and railway lines in Siberia and the Far East, and that it has stimulated imports of Western technology warrant its examination in this study. Commercial operations began in 1970, since when there has been a considerable increase in the volume and value of cargo shipped by the route (Miller, 1978, Mote, 1984a, 1984b). The fact that sea routes between Japan and Europe via the Suez or Panama canals or around the Cape of Good Hope are 20,000 to 27,000 km long, whereas the Trans-Siberian route is only 13,000km; and that labour, shipping and handling costs are much lower in the Soviet Union have enabled the Soviet operators

consistently to undercut the rates offered by their rivals. Depending on the origin and destination the trip from east to west takes between 25 and 45 days, the record for the journey between Yokohama and London being 16 days (Khryaschev, 1982, p. 25). During its first six years of operation the route managed to capture 25 percent of the Japan-to-Europe container traffic. Despite the advantages of speed and cost the Landbridge has encountered a number of problems that have reduced its effectiveness. Imbalance between east- and west-bound freight movements has often resulted in shortage of containers at the Far Eastern terminal; the severe cold and constant vibration of containers have damaged goods, poor management has resulted in delays; and until recently the Soviet operators were unable to monitor the progress of individual containers. To overcome these problems modern container handling equipment has been imported, container production facilities have been purchased, special container trains have been created, special container ships now operate on feeder routes and a computerised monitoring system has been installed. On the Far Eastern coast special container ports have been built at Nakhodka and Vostochnyy. Since 1977 all east-bound traffic has been handled by Vostochnyy and west-bound traffic by Nakhodka (Zhinkin, 1978, p. 27). As of 1982 the container terminal at Nakhodka was capable of handling 200 20-ton containers a day and Vostochnyy 600 to 800 a day. The container handling equipment, imported from Japan, is discussed in the next chapter.

There exists no complete set of data on Landbridge traffic and earnings, but Mote (1984b) has combined the existing

fragmentary data to provide estimates of the volumes of freight movements and foreign-currency earnings (see Table 5.9). From these data it can be seen that there has been considerable fluctuation in the volume of movements. In view of the improvements made on the route it is likely that these fluctuations reflect problems in the international economy rather than the route itself. Total foreign currency earnings have been converted from foreign trade roubles to U.S. dollars using the conversion rate for the corresponding years. This provides a total value of $ 957.73 million. Thus, the Landbridge cannot be considered a major source of foreign currency. Earnings in 1980 ($ 134 million) were equivalent to less than 0.5 percent of total commodity exports to the OECD. In reality the fact that the Landbridge has provided experience with containerisation and access to advanced technology is probably more important than foreign revenue generation. In the Soviet Far East the Landbridge has stimulated the development of modern container facilities that have benefited the region.

5.6. The Role of Siberia and the Far East in Exports to the West: A Summary

All the sectors that are likely to contribute to Siberia's share of exports to the West having been examined, it is now possible to summarise Siberia's role in exports to the West. Table 5.10 shows the contribution of Siberia and the Far East to the OECD. It is clear that the role of Siberia and the Far East has increased dramatically in the period since the early 1970s. In 1970 the region contributed 18.5 percent of commodity exports to the OECD, valued at $ 472.7 million, but

Table 5.9

Estimated Foreign Currency Earnings from the Trans-Siberian Landbridge[a]

Year	Europe/Japan TEU's	Iran/Japan TEU's	Empty Containers TEU's	Value (Million) Roubles	Value (Million) U.S $[b]
1971	1,767	547	296	1.9	2.11
1972	9,578	2,880	1,582	10.5	11.67
1973	22,601	5,688	3,593	23.9	32.34
1974	41,180	10,320	6,540	43.4	57.41
1975	47,570	15,030	8,000	52.6	73.10
1976	62,556	17,305	24,000	74.1	98.28
1977	72,600	17,400	21,150	80.9 est	109.92
1978	71,791	18,209	21,150	80.7 est	118.50
1979	64,804	16,865	19,192	73.2	111.93
1980	74,947	22,209	22,832	86.9	133.99
1981	64,462	35,027	24,095	88.1	122.53
1982	64,261	16,756	18,580	62.4	85.95
			Total	678.6	957.73

Source: Mote, V.L. (1984b), "Transport Aspects of Pacific Basin Prospects for the USSR," in Pacific Basin Transportation Prospects, by A.S.Whiting, and V.L. Mote, Soviet Transportation Research Project, Working Paper # 8. Washington, D.C.: Wharton Econometric Forecasting Associates, p. 9.

a. See source p. 30 for explanation of estimates.
b. Based on conversion rates in Appendix 1.

Table 5.10

Siberia's Share of Exports to the OECD

(As percent of total exports to OECD)

	1970	1975	1980	1981	1982	1983	1984
Oil Exports	-	13.6	29.6	32.5	36.0	38.8	38.8
Gas Exports	-	0.1	4.3	7.2	7.3	7.0	8.6
Coal Exports	1.7	1.9	0.5	0.4	0.4	0.4	0.5
Non-Ferrous Metals	4.5	2.7	2.7	1.5[a]	1.6[a]	1.9[a]	2.0[a]
Forest Products	9.2	5.7	3.6	2.4	2.0	2.0	1.8
Diamonds	0.9	1.3	2.0	1.1	1.4	1.1	1.5
Others[b]	2.2	1.1	0.7	0.7	0.6	0.6	0.7
(Gold)	na	(5.6)	(4.5)	(4.5)	na	na	na
Total (not including Gold)	18.5	26.4	43.4	45.8	49.3	51.8	53.9
Total Value of OECD Exports ($ million)	2,555	8,494	23,789	23,767	25,060	24,749	25,893
Value of Exports from Siberia ($ million)	472.7	2,242	10,324	10,885	12,355	12,820	13,956

a. Estimates assume that Siberia's share remains at the 1980 level of 62 percent.

b. 'Others' comprises exports of fish and furs.

by 1984 the region's share had increased to 53.9 percent of exports, valued at 25.9 billion. The major reason for this rapid increase has been the development of the West Siberian fuels energy complex. In 1984 oil and gas exports accounted for 77.5 percent of exports to the West. Exports of Siberian oil and gas are estimated to have accounted for 46.6 percent or just over $ 12 billion. However, since then Siberian oil production has stagnated and world oil prices have fallen. Undoubtedly the foreign currency value of oil exports provided a major incentive for Siberian development in the late 1970s and early 1980s, but with the recent decline in oil revenues it is possible that Siberia may be perceived as a burden.

As the value of oil and gas exports increased during the 1970s the relative importance of other Siberian exports, such as non-ferrous metals, declined despite the fact that their actual value continued to increase. Obviously as the value of oil and gas exports declines the share of other commodities will increase. This is particularly true of non-ferrous metals as the price of platinum and gold has been increasing. The value of gold exports is not included in the OECD data, but if gold is included the value of Siberian exports in 1980 is increased by about 10 percent to $ 11.4 billion.

In a similar study of Siberian resource industries, Kirby (1984, p. 45) concluded that Siberia and the Far East contributed 75-80 percent of Soviet foreign currency exports in 1983, valued at $ 25-30 billion. Unfortunately Kirby provided no details on how this estimate was arrived at, but it probably includes trade with developing nations and assigns all oil and

gas exports to Siberia. As a result both the relative share and value of exports are higher than those estimated in the present study. If one were to ascribe all exports of oil and gas to Siberia, then in 1980, according to OECD data, the region would have accounted for 79.7 precent of all exports to the OECD, valued at $ 20 billion, and in 1983 83.6 percent, valued at $ 20.7 billion. Kirby's estimate represents a maximum possible share including both direct and indirect contributions, while the figures presented in this study represent only the direct contribution of Siberia and the Far East. Both estimates suggest that by the mid-1980s Siberia and the Far East contributed more than half of the value of exports to the West. Therefore, policies that rely upon the purchase of Western technology (and grain) to stimulate Soviet economic development are to a large degree dependent upon the successful exploitation of Siberian resources.

5.7. The Spatial Distribution of Siberian Export Production

This section describes the spatial distribution of export production in Siberia and the Far East and evaluates the importance of foreign currency exports in promoting the development of particular sub-regions and industrial complexes. The regionalisation scheme presented in Chapter 4 provides the framework for this discussion. Later this will enable comparison of the distribution of export production, the ultilisation of Western technology, and the pattern of industrial development.

The Ob'-Irtysh sub-region, better known as the West Siberian TPC, is presently the sole Siberian producer of oil

and gas for export to foreign currency markets. According to the estimates in Table 5.2, in the early 1980s 8 to 12 percent of West Siberia°s oil production was exported to the West. In addition a further 12 to 13 percent of production was exported to Communist nations. In other words, as much as 20 to 25 percent of West Siberian oil production may be destined for foreign markets. Exports play a less significant role in the West Siberian gas industry: in the early 1980s exports to the West accounted for about 5 percent of production. The problem limiting the level of Siberian gas exports to Western Europe is neither a lack of production nor pipeline capacity, but a lack of Western buyers. Apart from oil and gas exports the only other possible exports from the West Siberian TPC are compensation deliveries of chemicals in association with the development of petrochemical complexes; and the export of logs and timber. However, given the fact that in 1984 Siberian oil and gas exports accounted for an estimated 47.4 percent of exports to the OECD, worth more than $ 12 billion, there can be little doubt that export production is an important task for the region. While the West Siberian TPC was primarily created to meet domestic needs, foreign exports have promoted a more rapid and larger-scale development.

The role of the West Siberian TPC is in sharp contrast to that of the southern area of the West Siberian economic region. The only possible sources of foreign currency exports in the Kuzbass-Altay are coal from the Kuzbass and compensation deliveries of chemicals from the Western-built plants at Kemerovo. Because of the minor role of coal exports in trade

with the OECD and the even smaller contribution made by the Kuzbass, it is possible to conclude that foreign currency export production has not been an important factor in promoting the economic development of the region.

When discussing the role of export production in the Angara-Yenisey sub-region it is necessary to divide the region into two parts, namely the Noril'sk metallurgical combine in the north and the Angara-Yenisey system of TPCs in the south. As the Soviet Union°s most important producer of nickel and platinum group metals the Noril'sk metallurgical combine is an important source of foreign currency. The foreign currency value of Noril'sk mineral production is a primary motivation behind the continued expansion of the complex under very harsh environmental conditions. Not only has mine production and smelter capacity been increased, but the Northern Sea Route now supplies the complex year-round. In the south the TPCs of the Angara-Yenisey system contribute to non-ferrous metal and forest products exports to the West, while chemical complexes in the Irkutsk region have been involved in compensation deliveries of chemicals. Given that about 30 percent of Soviet aluminum production is exported and that the smelters of the Angara-Yenisey system comprise more than half of the Soviet aluminum production capacity, export production is likely to have been an important consideration in the development of the region. However, most Soviet aluminum exports are destined for Eastern Europe.

The other sector that contributes to exports to the West is the forest industry. The Angara-Yenisey region lies on the

boundary between the European and Pacific export production hinterlands. Krasnoyarsk Kray and Irkutsk Oblast' have contributed over 90 percent of the forest products exports from Siberia (Tishina, 1978, p. 52). Because forest product exports to the West are dominated by unprocessed logs and timber and the large forest complexes at Bratsk and Ust'-Ilimsk are dedicated to the production of higher value-added products their contribution to exports is limited. The region does contribute to the export of logs and sawnwood via Igarka and by rail to Western Europe and Japan. In conclusion, because of the relatively minor role of forest products exports in the region and the fact that the majority of aluminum exports are delivered to Eastern Europe, one must conclude that foreign currency export production has not been an important factor in the development of the Angara-Yenisey system. Rather the region has been developed to cater to needs of the domestic economy and Eastern Europe.

The two sub-regions that comprise the BAM service area, the Transbaykal and Amur, are considered together because they share a common problem. Inaccessibility has reduced the level of economic development. In terms of foreign trade, forestry and furs as well as a limited amount of mineral production (including gold) are the most important exports to the OECD. Forest products are in the form of unprocessed logs and sawnwood moving to Japan, but poor accessibility and the predominance of larch limit the commercial value of the forest. Until the BAM is fully operational there is little potential for increased exports, and even then considerable investment

will be required to exploit the natural resources of the region. The lack of BAM-related projects in the 12th FYP is an indication that in the short term the region will remain undeveloped.

The Far East is perhaps the only region in the Soviet Union where the expansion of the export base is seen as an acceptable means of promoting economic development (see Mayergoyz, 1975, p. 434). The Pacific Ocean sub-region is the area that has benefited the most from interaction with the Pacific basin, in particular Japan. According to Shlyk (1981, p. 35) 70-80 percent of the Far Eastern exports are forest products and fish. (Note that the Amur sub-region is also part of the Far Eastern Economic Region). The ports of the region are the centre of the Far Eastern fishing fleet and the forests of the hinterland have been the major source of logs and timber for export to Japan. Further indication of the importance of foreign trade is provided by the existence of Dal'intorg, a regional trade association, which manages coastal trade between enterprises in the Far East and neighbouring countries (Miller, 1981). Surplus production from enterprises in the region is traded for industrial equipment and consumer goods. Such coastal trade accounts for about 2-3 percent of Soviet trade with Japan (Edmonds, 1983, p. 225).

Foreign currency exports from the Lena-Kolyma sub-region include gold, diamonds, coal and furs. The importance of gold sales as a means of balancing trading accounts with the West has been important in promoting the development of gold fields in some of the harshest environmental conditions in the world.

The same is true for the diamond industry. Although the initial impetus was provided by the Cold War embargo, diamond sales have become an essential part of trade with the West. The extension of operations along the Northern Sea Route has enabled the exploitation of gold and diamond deposits in locations that are virtually inaccessible from the south. When the 1980 export earnings of the Northeast and Yakutia gold mining districts are added to Soviet diamond exports, the two minerals contributed $ 1.162 billion worth of trade with the OECD (nearly 5 percent of total exports). Thus, one can conclude that the desire to earn foreign currency has promoted a level of economic development greater than that required to meet domestic gold and diamond demand. The South Yakutian TPC falls within the boundaries of the Lena-Kolyma sub-region. While compensation deliveries have only just started, the complex could export as much as 5 million tons of coal a year to Japan. Without foreign participation and the provision of Western technology it is questionable whether the South Yakutian TPC would have been developed. In sum, the industrialised West is by far the most important market for Soviet gold and diamond exports and Japan is presently the sole export market for South Yakutian coal. Foreign trade is a key factor in the region without which there would be little incentive for battling the inhospitable environment.

5.8. Conclusions

In concluding this chapter we return to the two questions posed at the beginning. Firstly, what is the role of Siberia and the Far East in the production of exports to the West? It

is clear from the analysis of export production presented above that since the mid-1970s the region has become the most important producer of commodities for export to the West. Since the early 1980s the region is estimated to have contributed more than half of Soviet exports to the West. By far the most important source of foreign currency is the export of oil and gas, and the West Siberian TPC is the most important producer of these fuels.

Secondly, how important is export production to the regional economies of Siberia and the Far East? The regional review of export production presented above suggests that export production is most important in the northern regions: the West Siberian TPC, the Noril'sk metallurgical complex and the gold and diamond mines of the Lena-Kolyma. Table 5.11 calculates the value of exports from these regions in 1980. The three regions accounted for an estimated 37.8 percent of all exports to the OECD (including gold) and 84.4 percent of Siberian exports to the OECD. After the northern regions the Pacific coast is the next centre of export production, with the southern interior being of minor importance. This northern and Pacific orientation duplicates the pattern of domestic investment described in the previous chapter, and suggests that export production has been an important factor in the economic development of the Siberian north and the Pacific region.

Table 5.11

The Spatial Distribution of Siberian Export Production in 1980

Industrial Region	Value of Exports ($ Million)
West Siberian TPC	
Oil Exports to OECD	7,048
Gas Exports to OECD	1,048
Noril'sk Metallurgical Combine	
Platinum Exports to OECD	328
Nickel Exports to OECD	106
Lena-Kolyma	
Diamond Exports to OECD	470
Gold Exports	692
Total Value of Exports	9,672
Total value of commodity exports to OECD plus gold sales.	25,569
Total Value of all Siberian exports to OECD (includes gold).	11,406
Exports from the Siberian north as a percent of:	
Total Exports to OECD	37.8
Siberian Exports to OECD	84.8

Notes

1. The Economist (1986), Vol. 300, No. 7453, p. 63.

2. The Oil and Gas Journal (1984), Vol. 82, No. 40, p. 77.

3. The Economist (1986), Vol. 299, No. 7448, pp. 68-70.

4. International Monetary Fund (1986), Direction of Trade Statistics, April, p. 72.

5. Mining Journal (1985), Vol. 304, No. 7798, p. 81.

6. 1970 figures from Strishkov, V.V. (1972), "The Soviet Union", Mining Annual Review, p. 427. 1980 and 1983 data from Levine, R.M. (1984), "The Mineral Industry of the USSR", Reprint from U.S. Bureau of Mines Minerals Yearbook. Pittsburg, PA.: U.S. Bureau of Mines, p. 3.

7. Japan External Trade Organisation (1981), White Paper on International Trade, Japan. Tokyo: JETRO, p. 413.

8. American Bureau of Metal Statistics Inc. (1985), Non-Ferrous Metal Data, 1984 Secaucus, New Jersey: AMBS, p. 96.

Chapter 6

Soviet Imports of Western Technology and Siberian Development

> "The expansion of economic cooperation between the USSR and the Capitalist States proceeds from the possibility of a more rational utilization of the natural resources of the Soviet State, by attracting the financial means and the material technical expertise of Western partners. This permits a more rapid assimilation of a series of new regions - above all, Siberia and the Far East - which will enhance many fields of production and transportation."
>
> Rozanov, 1977, p. 147 [1]

This chapter describes and evaluates the role of imports from the industrialised West in the industrial development of Siberia and the Far East. For the most part the discussion is organised by industry, focusing upon those sectors of the Siberian economy that have been the major recipients of Western technology. As with export production, a brief summary of the spatial distribution of Western technology is also presented to enable the evaluation of the role of imports in the development of the various sub-regions and industrial complexes.

6.1 The Role of Western Technology in the Industrial Development of Siberia and the Far East

In the following analysis five major sectors are examined: fuel minerals, non-fuel minerals, forestry, chemicals and transportation. In each case the aim is to describe the nature of technology imports, the Western partners, the value of imports and the location of their use. Within each industrial sector discussion is organised temporally and, when appropriate, by stage in the production cycle, starting with exploration and production and proceeding, through to primary

processing and transportation. In addition to discussion of the transportation of particular products, a separate section on the development of the Siberian transportation system is included.

6.2. Western Technology Imports to the Siberian Fuel Minerals Industries

It is clear that the development of energy resources has been and continues to be the focus of Siberian development strategy. In the arena of East-West trade the transfer of technology to aid in that development has been controversial to say the least. There have been numerous Western studies on the topic. The most thorough is the study conducted by the United States Office of Technology Assessment (OTA, 1981) which examined the impact of imported Western technology on Soviet energy availability. It concluded that imported technology has been most important in the Soviet oil and gas industries, with limited import reliance in the coal industry, while the electricity generation industry has actually exported technology to the West. (In Canada, for example, British Columbia Hydro has purchased Soviet turbines.) The OTA study supported its findings by using 1979 foreign trade data, which showed that energy-related technology and equipment accounted for $ 3.4 billion, or 22 percent of all Soviet imports from its major Western trading partners. The majority of those imports ($ 2.7 billion, or 79 percent) were delivered to the oil and gas industry. As was pointed out in Chapter 2, much consisted of relatively "low-tech" items such as large-diameter pipe. More recently Gustafson (1985a, pp. 164-169) has examined trends in Soviet imports of oil and gas equipment. He

concludes that "in global terms, the Soviet oil and gas industries have clearly been importing more over time, both in absolute terms and as a percentage of their total investments." He takes his analysis a step further than the OTA and examines the share of imported equipment in total oil and gas investments. He acknowledges that he has not allowed for pricing problems, and he calculates the share of imported equipment in total investment to have risen from 11.5 percent in the 1970-1975 period, to 13.6 percent in 1976-1980, 12.5 percent in 1981, 18.1 percent in 1982 and 19.4 percent in 1983. On the other hand, Gustafson (1985a, p.168) finds a suprisingly small share of total imports destined for the oil and gas industries. In 1970-1975 the average was 4.2 percent of total imports, in 1976-1980, 6.3 percent and in 1981-1984, 6.2 percent.

At first sight these findings may seem at variance with the OTA study, but Gustafson's calculations are based on all imports of equipment, including those from other CMEA countries. The CMEA is an important supplier of equipment for the oil and gas industry. In fact in the period since 1970 there has only been one year, 1978, when the value of Western oil and gas equipment imports was greater than imports from the CMEA. Romania has become an increasingly important source of oil and gas equipment, supplying heavy rigs for the oil industry. CMEA suppliers, particularly Czechoslovakia, have tended to dominate the supply of refinery equipment, while the West dominates oil and gas equipment and pipeline supplies. There seems to be general agreement among Western experts that

while in global terms the Soviet oil and gas industries are not heavily dependent upon Western technology, there are certain areas with a high degree of import dependence, namely: seismic equipment, submersible pumps, enhanced recovery technology, compressors, pipelayers and pipe. The task here is to determine the extent to which these types of equipment have been imported to meet the needs of Siberia and the Far East.

The other energy industry considered in this section is the coal industry. While the Soviet coal industry is not generally dependent upon Western equipment, the South Yakutian Complex is an exception, relying heavily on imports. In the following examination of the Siberian oil and gas and coal industries two types of import are identified; first, general imports of equipment which could be used in Siberia and the Far East; and second, imports related to specific projects such as the South Yakutian Coal Complex or the Urengoy export gas pipeline, often through compensation agreements.

6.2.1 Oil and Gas Exploration

The Soviet oil industry has relied quite heavily upon imports of seismic exploration equipment, in particular computer hardware and software for data analysis. The OTA study (1981, p. 187) concluded that most exploration equipment imported from the West consisted of computers and geophysical equipment, with the most important suppliers being the United States, West Germany and France. The largest American supplier, Geosource Inc., sold $ 30 million worth of equipment to the USSR between 1975 and 1979, some of it related to the Yakutia Natural Gas Project which is discussed below. OTA data

showed a decline in imports of exploration equipment in the late 1970s, due to tightened Western export controls or improved Soviet equipment. However, Gustafson (1985a, p. 170) maintains that in the early 1980s nearly two-thirds of the field computers for data processing were imported. The fact that such equipment was imported does not necessarily mean that it was used in Siberia. Indeed Gustafson (1985b, p. 119) has reported that geologists in West Siberia have complained that they have not been receiving modern seismic equipment. The only instances in which we can be sure imported exploration equipment has been used in the region are when it is tied to specific projects. During the 1970s the Japanese, and to a lesser degree the Americans, were involved in two oil and gas exploration projects in the Far East, namely the Yakutia Natural Gas Project and the Sakhalin Continental Shelf Project.

The Yakutia Natural Gas Project was a tripartite scheme involving the Soviet Union with American and Japanese interests, to develop the Vilyuy gas deposits in the Yakut ASSR and to deliver liquefied natural gas (LNG) to Japanese and west coast U.S. markets. The Yakutia project was initially proposed by the Soviet Union at a meeting of the Soviet-Japanese Economic Cooperation Committee in 1968. At first the Japanese showed little interest, but during the early 1970s with the prospect of American involvement in the project and the impact of the energy crisis Japanese companies decided to participate. El Paso Natural Gas started negotiations with the Soviet Ministry of Foreign Trade in 1972 and a protocol of intent was signed in June 1973. The American companies involved in the

project were El Paso Natural Gas (75 percent of the U.S. interest) and Occidental Petroleum Corporation (25 percent) Becthel Inc. were also involved in a consultative capacity. By July 1974 the Japanese had joined the project. A consortium of 21 Japanese Companies, "Siberian Natural Gas" was created and headed by the Chairman of Tokyo Gas Ltd.. The initial exploration phase of the project was required to prove reserves of 1 trillion cubic metres of gas. This amount was necessary to guarantee compensation deliveries of 20 billion cubic metres (1.5 million tons of LNG) a year for 20 years, half of which would go to Japan and half to the U.S.. In return Japan and the U.S. would provide the Soviet Union with bank loans of $ 3.4 billion for development of the project. The project immediately fell foul of the actions of the U.S. Congress to control EXIM Bank credits to the USSR (see Egyed, 1983, pp. 74-82). As a result of the U.S. measures (which were discussed in Chapter 2) the U.S. partners were unable to secure government-backed credits and had to seek a commercial loan, at a higher rate, from the Bank of America. The Japanese were adamant that the project could only proceed with U.S. involvement. In March 1976 an agreement was reached on a financial package for the exploration phase of the project. In total $ 100 million was provided for the purchase of Western equipment, $ 50 million from the Soviet Union, $ 20 million from the Japanese EXIM Bank, $ 5 million from a consortium of 23 Japanese Banks and $ 25 million from the Bank of America.

The Soviet Union quickly used up its credit with the U.S. buying "high-tech" exploration equipment. Geosource Inc. was

contracted to outfit five geological exploration crews on tracked vehicles,[2] the contract being worth over $ 13 million. The vehicles were supplied by Canadian Foremost Industries Ltd. of Calgary and included 24 two-track carriers of 200 horse power each equipped with vibrators, and 25 two-track carriers for use as geophone buggies, service and maintenance vehicles and recorder carriers. The carriers were equipped with geophysical equipment manufactured by Geosource. In addition to this contract Geosource provided a further $ 11 million worth of seismic instrumentation and data processing systems. The Soviet Union also purchased two self-propelled seismic sounding stations, including computers to interpret the data, worth $ 10 million, but delivery was delayed 18 months by the Carter administration (Egyed, 1983, p. 86). By late 1979 the exploration phase was nearing completion, with 890 billion cubic metres discovered, when the Soviet invasion of Afghanistan dramatically changed the situation. A meeting scheduled for July 1980 was cancelled and the exploration phase remains uncompleted. The Japanese are now concentrating on the Sakhalin project while Soviet gas development has concentrated on Northwestern Siberia. As a result there has been very limited development of the Vilyuy field, which now serves local needs. In the absence of a foreign partner it is unlikely that any large-scale development will take place. Nevertheless, the project provided the Soviet Union access to "high-tech" exploration equipment and enabled them to delineate the reserves of the Vilyuy basin.

A joint Soviet-Japanese venture to develop oil and gas

production on Sakhalin Island was first proposed in 1965, but political problems over the "Northern Territories" reduced Japanese enthusiasm towards the proposal. In the early 1970s proposals shifted to the development of oil and gas potential off the Sakhalin coast. In October 1974, after protracted negotiations, the "Sakhalin Oil Development Company" (SODECO) was created. It consists of 18 shareholders of which the largest is the Japan National Oil Corporation. In the early stages of the project the U.S. Gulf Oil Company had a small share, but it withdrew in the late 1970s. On January 28 1975 a general agreement was signed on "Sakhalin Oil and Gas Development", under the terms of which $ 100 million of credit was advanced by the Japanese for the exploration of oil and gas bearing regions off the coast of Sakhalin. In return the Japanese would receive half of the production from the project at a discount of 8.4 percent as payment for the loan (Stern, 1985, p. 198). When the loan had been paid off, oil and gas would be offered at the world price. Once the development phase was reached it was understood that the Japanese side would contribute half the required investment, at that time $ 600-800 million (Egyed, 1983, pp. 48-49). Conditions off Sakhalin are very difficult with severe cold and ice. Each year drilling activities can only take place between July 1 and October 15. Such conditions required specialised equipment beyond the abilities of the Soviet Union and, at the time the project was initiated, Japan.

During the first exploration season in 1976 geophysical surveys were conducted by two Japanese vessels, the semi-

submersible "White Dragon II" and the jack-up "Okha I" built by Mitsui to a U.S. design. (For an explanation of the different types of rig see CIA 1985b, pp. 24-25.) A third vessel, the "Orion Arctique", was leased from CIE Generale Geophysique of France. The six-month lease included the crew, and data collected by the vessel were analysed in France. During 1976-1977 SODECO purchased equipment to enable them to continue exploration. The Mitsubishi Corporation was contracted to construct two geophysical ships worth $ 2.5 million, while CIE Generale Geophysique was contracted to provide $ 14 million worth of geophysical equipment, including digital seismographic recorders, magnetometers, gravity meters, cables and hydrophones for the two ships. During the first exploration season there had been arguments with the Soviet partner over the presence of foreign advisors on the survey vessels. To overcome this problem CIE Generale Geophysique trained Soviet crews to use the new vessels. At the same time contracts worth $ 5 million were signed to create an operations base on the southwest coast of Sakhalin at Khlomsk. Nippon Kokan KK and Kyoho Tsusho Kaisha Ltd. provided prefabricated building elements for the construction of 6 warehouses, a workmens dormitory, a canteen, offices and garages. Fukushima and Niigata Iron Works provided cranes and sea-bed construction equipment for development of Kholmsk harbour.[3] In addition the U.S. company Control Data supplied a Cyber-172 computer for use in the Sakhalin project.[4]

The results of the first season of exploration were encouraging, and in October 1977 the first major strike was

made at the "Odoptu" deposit off the northeast coast of Sakhalin. During 1978 a floating drilling-rig, the "Borgsten Dolphin", was leased from the U.S. company Dolphin International, but according to Egyed (1983, p. 54) the rig was damaged and had to be removed from the area, a graphic indication of the harsh operating conditions. In February 1978 SODECO announced its intention to extend the $ 100 million credit, since inflation and the strengthening of the yen had increased costs, but it was not until June 1979 that agreement was reached on the terms of the extension (see Egyed, 1983, pp. 52-53). A further $ 70 million was provided and a large share, $ 35-36 million, was used to purchase from Mitsui Ocean Development and Engineering Co. Ltd. a drilling rig especially designed for arctic conditions. The rig was built to a U.S. design and Armco Inc. was contracted to provide equipment for the rig. In October 1979 the "Chayvo" field off the northern coast was discovered. It marked the fifth successful drilling site out of the ten drilled since the project had begun. The economic sanctions following the Soviet invasion of Afghanistan had an immediate effect upon equipment and service contracts for the Sakhalin project. Although the project was a joint Soviet-Japanese venture much of the technology was U.S.. For example, a division of Armco Inc., National Supply Co., was prohibited from supplying $ 6 million worth of equipment for the Mitsui rig under construction for SODECO. However, in April 1980 the Sakhalin project was exempted from sanctions. While the 1980 exploration schedule was unaffected, the construction of equipment for the project was delayed.

Despite equipment problems and severe conditions the exploration efforts were proving successful but the fact that far more gas than oil was being discovered complicated the development phase, oil being easier to transport than gas. In the summer of 1981 agreement was reached on the development phase of the project. SODECO was to participate in the construction of a natural gas liquefication plant on Sakhalin from which LNG would be sent overland by pipeline to Japanese markets. In December 1981 the Reagan administration enforced economic sanctions to protest martial law in Poland. The Japanese government protested the sanctions and with the West Europeans continued supplying equipment for the Siberian Export pipeline. Unfortunately for SODECO, the Sakhalin project was heavily dependent on U.S. technology and the sanctions on the project were not lifted until January 1983. As a result drilling activites were severely reduced during the 1982 season. The initial intention had been for two rigs, the Japanese-built and now Soviet-owned "Okha I" and the "Hakuryu II" (the jack-up built for SODECO by Mitsui). However, because the "Hakuryu II" contained U.S. technology it was prohibited from participating and two instead of five wells were drilled during the season.[5] In early 1983 the Finnish-built drill ship "Mikhail Mirchinsk" was transfered from operations in the Barents Sea to work on the Sakhalin project (Gorst, 1984, p. 146). This drill ship is one of three such vessels built by Rauma Repola between 1981 and 1983. The ships are ice-strengthened and are equipped with systems for dynamic positioning, automatic mud treatment and drill pipe laying,

blowout control and underwater operations (Nemchinov, 1983, p. 18).

By the end of 1983 15 wells had been drilled and the project had confirmed reserves of 140.5 billion cubic metres of gas, 86.3 million tons (630 million barrels) of crude oil and 19.5 million tons (142 million barrels) of oil condensate. During 1984 basic technical plans were agreed upon for the development phase, but the LNG was now to be moved by tanker rather than pipeline. It is possible that the shooting-down of a Korean Boeing 747 aircraft in September 1983 heightened awareness of the strategic importance of the region and reduced Japan's enthusiasm for a pipeline that would make the northern region of Hokkaido reliant on Soviet gas. Under the new agreement the project was to begin production in 1993. The cost of the development phase will be $ 3.8 billion and Japan is expected to provide half the capital. In return the Japanese partners will receive 1.25 million tons (25,000 barrels a day) of crude oil and 3 million tons a year of LNG over a 20 year period. The development plan includes 4 production platforms each with 49 production/injection wells and accommodation for about 100 workers, and a 229 km (143 mile) six-pipeline transportation system linking the platforms with De Kastri on the Soviet mainland. The pipeline system will include a 16 inch (406.4 mm) crude oil pipeline, three 28 inch (711.2 mm) pipelines for gas, associated gas and condensate and two back-up pipelines. A pump station and support facilities will be built at Chayvo on the coast of Sakhalin. Two gas liquification plants will be built at De

Kastri, each with a capacity of 1.5 million tons of LNG per year.[6] Exploration is continuing off the northern and southern coasts and the drilling fleet has been augmented by the Soviet-built semi-submersible "Shelf-5" and the Finnish-built jack-up "Sakhalinskaya". The "Sakhalinskaya" is one of two jack-ups (the other is called the "Kol'skaya") built by Rauma Repola between 1982 and 1983.[7] Rauma Repola is presently building six 140 metre legs (worth $ 44 million) for two arctic jack-ups under construction in the Vyborg yard in the Soviet Union.

Despite the success of the exploration phase and the addition of further exploration vessels the future of the Sakhalin project remains in doubt. A recent report suggests that gas may not be delivered until 1995, instead of 1993, and that because of the low price of oil and the strength of the yen the Soviet side is concerned about the economics of the project.[8] Thus, while the development phase would represent a considerable transfer of Western technology we cannot be sure that the project will proceed. In the context of the present study the Sakhalin project has provided the Soviet Union with access to offshore oil and gas technology which it will need to explore and develop the offshore arctic regions. It may yet provide LNG technology which the Soviet Union has not itself developed. In addition it has proved exploitable reserves of hydrocarbons which can be used to meet the needs of the Far East, though development of those resources clearly will require Western technology.

6.2.2. Oil and Gas Production

Examination of Western technology in Siberian oil and gas production is divided into three sections: drilling, recovery and processing. Assessment of the role of imported equipment is complicated by the fact that the Soviet oil and gas industry has tended to use techniques and equipment, such as the turbodrill and waterflooding, that are not commonly used in the West. Many of these techniques were developed to suit conditions in the oilfields of the European regions, as well as to compensate for the poor quality of Soviet equipment. As the centre of the Soviet oil and gas industry shifted to Siberia so the type of equipment required changed. As a result the Soviet Union has imported specialised equipment from the West to meet its short-term needs, while Soviet industry struggles to produce new types of equipment.

The turbodrill is used in more than 80 percent of oil and gas drilling in the Soviet Union (CIA, 1985b, p. 27). In a turbodrill drilling mud is forced down the drill shaft to drive a turbine which rotates the drill bit, whereas in a rotary drill the rotation of the drill shaft turns the drill bit. The advantage of the turbodrill is that it does not place a great amount of stress on the drill shaft and therefore low-quality drill pipe can be used. This is a considerable advantage in the Soviet Union, where high-quality drill pipe is in short supply. The disadvantages of the turbodrill stem from the fact that there is little direct pressure upon the drill bit, and it is therefore difficult to gauge the wear on the drill bit. As a result the drill has to be reguarly lifted and checked, which

makes deep drilling a very slow process. There is some disagreement among Western experts as to the effectiveness of the turbodrill in Siberian conditions (compare Meyerhoff, 1983, pp. 317-318 and Wilson, 1982, pp. 76-84). Despite its drawbacks the turbodill accommodates the abilities of Soviet industry and reduces the need to import large amounts of Western drilling equipment. Nevertheless, small amounts of rotary drilling rigs, drill pipe and drill bits have been purchased from Eastern Europe and the West. The Finnish Company Tamrock Oy sold the Soviet Union 15 portable drilling rigs, and Canadian Foremost Ltd. has also sold portable rigs. The Soviet Union has imported drill pipe and casing on a regular basis from Japan, West Germany, France and Italy (OTA 1981, p. 188). Gustafson (1985a, p. 188) estimates that Western drill pipe imports account for less than 8 percent of total Soviet consumption. The Soviet Union has also purchased drill bits from the West, mainly from the U.S.; and has also sought to develop domestic production facilities by purchasing a drill bit plant from Dresser Industries. The technology for the plant, worth $ 147 million, was delivered but the Carter administration later revoked the export license and Dresser was unable to provide technical data and on-site assistance with the start up phase. However, Dresser later signed a cooperation agreement with the Soviet Union on oil and gas exploration which was renewed for another 5 years in July 1986. Thus, while the Soviet Union has imported limited amounts of drilling equipment, the vast majority of oil and gas drilling is performed using domestic equipment.

As with drilling techniques, Soviet oil recovery techniques are different from those used in the West. In the Soviet Union the preferred method of secondary recovery is waterflooding. In 1980, 89 percent of Soviet oil output was recovered by waterflooding and in Western Siberia 99 percent. (Wilson, 1982, p. 101). Waterflooding involves pumping water beneath the oil deposit to maintain pressure and thus enhance recovery. It also scours oil from the reservoir. As the deposit is depleted, more and more water has to be pumped into the deposit and more water is lifted along with the oil recovered. One consequence of the ageing of Soviet oilfields is the need to pump ever-increasing volumes of water. In 1980 water accounted for 55 percent of fluids recovered in oil production (CIA, 1985b, p. 16). According to Campbell (1985, p. 154) the most productive technology for lifting large volumes of fluid is a downhole centrifugal pump powered by electric motors. Soviet pumps of this type are based on an old American design and have a limited capacity and a short operating life. As a consequence the Soviet Union has purchased submersible pumps from the U.S. Companies that dominate this market, namely: TRW-Reda, Hughes-Centrilift, Baker-Kobe and Oil Dynamics Inc.. Between 1974 and 1978 the Soviet Union is estimated to have purchased 1,500 pumps from the U.S. (OTA, 1981, P. 195). In 1984 Hughes-Centrilift signed a contract for $40 million worth of U.S. pumps. The deal had been made earlier but the export license was delayed. In 1985 KSB of West Germany sold the Soviet Union about 1 million roubles ($ 1.3 million) worth of centrifugal pumps for the oil

industry (Gustafson, 1985a, p. 188). Given the importance of West Siberian production and the preponderance of waterflooding in Siberian fields it is likely that many imported pumps are used in the region. Reda pumps with a capacity of 800-1,000 cubic metres a day have been used at Samotlor because Soviet pumps were unsuitable (Wilson, 1982, p. 90). Campbell (1980, pp. 223-224) has concluded that imported U.S. pumps were "crucial in achieving output goals during the seventies."

The major advantage of waterflooding is its low cost and relative simplicity, but while it achieves rapid increases in production during the early stages of an oilfield's life, it also results in early peaking and then a rapid decline in production. Gas lift, on the other hand, is more expensive and complex but has the considerable advantage of regulating flow and sustaining production over a greater period of time. Gas lift is particularly suited to West Siberia, where there are deposits of heavy oil and also a problem of salinity. According to Wilson (1982, p. 90) gas lift has been used in Western Siberia since 1970, when a gas lift system was purchased from Camco of Canada, and by 1975 200 gas lift wells were operating. In 1978 the decision was made to convert the two most productive Siberian oil deposits, Samotlor and Fedorovsk, to gas lift, because salt was rapidly destroying the pumps used in waterflooding. The French firm Technip was awarded a $ 190 million contract to provide gas lift equipment to improve oil production levels at Samotlor and Fedorovsk, but work at Samotlor has been hampered by a lack of labour and equipment. The programme at the Fedorovsk field was complete

by mid-1985, and 1,000 wells had been placed on gas lift. In 1984 the production at Fedorovsk was 726,000 barrels a day (36.2 million tons a year). There are conflicting reports as to the effectiveness of the programme. The Oil and Gas Journal reports a 50 percent increase in production, while the Petroleum Economist[9] reports a 15 percent increase. The Petroleum Economist figure seems more likely and would represent 5.43 million tons of oil at the 1984 production level. Under the terms of the contract Technip was responsible for design, construction and start-up of 11 compression stations, 306 gas-injection manifolds, downhole equipment for 2,400 wells and a three-level automation system for each field. As with drilling equipment, the total impact of Western equipment on oil recovery is rather limited. However, specialised imports have been used to maintain and enhance production, particularly in Siberian fields.

The very rapid growth of oil production in Western Siberia during the 1970s produced large amounts of associated gas which at first was simply burnt off. The CIA (1985b, p. 31) estimates that flaring of associated gas reached its peak in West Siberia in 1975, when about 20 billion cubic metres was burnt off. Since then steps have been taken to process associated gas for use in power stations and as a feed-stock for the chemical industry. In large part this change has been brought about by the purchase of Western processing technology. In 1976 Nippon Seiko KK (Japan) was awarded a $ 240 million contract to construct three gas liquefaction plants near Surgut and Nizhnevartovsk (see Nakayasu 1981 for details). The

project consisted of 5 processing lines for separating associated gas into methane, ethane, propane, and butane and for producing liquifed petroleum, gas and an LPG storage facility. The plants were constructed by Nichimen and Japan Steel Works, and the basic design and the turbo-expander process were supplied by the Flour Co. (U.S.). The total capacity of the project is 10 billion cubic metres a year. The project was 82.5 percent financed by a long-term Japanese bank credit, with the balance being paid in cash. The Japanese Mitsubishi Corporation was subcontracted to provide 46 centrifugal and 15 small compressors for the project. The actual construction of the project was carried out by Soviet engineers[10] under Japanese supervision. The project was initially scheduled for completion in 1980, but was actually completed in 1982. The CIA (1985b, p. 31) estimates that the construction of these plants raised associated gas processing capacity to nearly 20 billion cubic metres in 1982. Given that the project has a capacity of 10 billion cubic metres it doubled processing capacity in the region.

In West Siberia it would seem that imports have played a role in maintaining and enhancing oil production and also in improving the efficiency of resource utilisation. However, the importance of this contribution is impossible to measure. In general, one can conclude that imports have helped upgrade production of a region basically served by domestic techniques and equipment.

6.2.3. Oil and Gas Transportation

Because of the geographical separation of producing and consuming areas the Soviet Union has had to embark upon a massive pipeline construction programme. Between 1965 and 1983 an average of 6,000 km of natural gas pipeline and 2,600 km of oil pipeline were constructed every year (CIAb, 1985, p. 32). In 1960 oil, oil product and natural gas pipelines accounted for 3.4 percent of domestic freight, but by 1983 their share had risen to 29.8 percent (Khrushchev and Nikol'skiy, 1985, p. 242). Here we are concerned with identifying the contribution of Western plant and equipment to the expansion of oil and gas pipeline networks necessary to deliver Siberian fuels to both domestic and export markets. The following discussion is divided into two sections; part one examines general imports of equipment, and part two the Urengoy export pipeline.

While the Soviet Union is the world's largest producer of steel pipe, Soviet industry has been unable to meet the demands placed upon it by the expansion of the pipeline network. During the Cold War large-diameter pipeline exports to the Soviet Union were prohibited by CoCom. It was not until the mid-1960s that imports from the West became an alternative to domestic production. During the 1970s and 1980s the Soviet Union has relied upon imports from the West to supplement domestic production and thus enable the transportation of Siberian oil and gas. Campbell (1980, p. 209) has estimated that between 1961 and 1975 17 million tons of large diameter (1020mm and above) oil and gas pipelines were laid, of which about 10 million tons or 58 percent were imported. Cadieux

(1984, p. 107) has carried out a similar analysis and his figures agree with those of Campbell. In his analysis he makes the distinction between all pipe imports and large-diameter imports. According to his figures, during the 1971-1975 period imports accounted for 50-75 percent of all diameters, and 71-100 percent of large-diameter pipe. During this period a number of large interregional lines were laid to move Siberian oil and gas westwards. In the second half of the 1970s, as gas production became more important, the pipeline programme expanded and imports increased. During the 11th FYP six large-diameter gas trunklines were laid from Urengoy westwards. Gustafson (1985a, p. 178) calculates that the 21,000 km of trunkline that were constructed during the 11th FYP required 12-13 million tons of large-diameter pipe. He calculates imports between 1980 and 1984 to have been 11.5 million tons. Therefore over 90 percent of the trunklines were constructed with imported pipe.

The Soviet Union has imported pipe production facilities from the West. In 1979 a seamless pipe production plant worth $ 230 million and capable of producing 170,000 tons of pipe a year was purchased from a consortium of French and German companies including Creusot-Loire and Mannesmann (OTA, 1981, p. 211). In general the Soviet Union has relied on Western producers to supply ready-made large-diameter pipe. The major sources of pipe have been Mannesmann and Klockner of West Germany, Finsider of Italy, and Mitsui, Sumitomo, Nippon Seiko, Nippon Kokan, Kawasaki and Itoh of Japan. Both Cadieux (1984, pp. 174-177) and Gustafson (1985a, p. 193-197) have pieced

together fragmentary reports from the Western business press on pipeline contracts to provide an overall picture of the major suppliers of large-diameter pipe, which can be compared with Soviet foreign trade statistics. The data in Table 6.1 show Soviet imports of pipe since 1975. While all types of pipe are included, large-diameter is by far the most important item in this category. From these figures it can be seen that Japan, West Germany and Italy are the most important suppliers. Between 1970 and 1982 the West German company Mannesmann sold 7 million tons of large-diameter pipe to the Soviet Union. In the case of Japanese exports, Ogawa (1980, p. 23) has reported that prior to 1975 large-diameter pipes were not very important (only 63, 031 tons in 1975). But when Soviet demand outstripped West European production capacity the Japanese became an important supplier. For example, during 1980 Japanese steelmakers signed contracts for delivery of 750,000 tons of large-diameter pipe, 200,000 tons of seamless pipe and 220,000 tons of steel plates for large-diameter pipe. The increasing importance of Japan as a supplier of pipe is shown in Table 6.1.. Six gas trunklines were completed ahead of schedule in 1985, and the 12th FYP calls for a further six pipelines to serve the Yamburg field, each pipeline needing 2.5-3.0 million tons of pipe.[11] Early indications are that Western companies will continue to supply most of this pipe. For example, in February 1986 "Promsyrioimport" contracted Finsider of Italy to supply 150,000 tons of large-diameter pipe, and Mannesmann was awarded a contract for 30,000 tons of pipe.[12] In the case of large-diameter pipelines it seems clear that Western imports

Table 6.1

Soviet Pipe Imports, 1975-1985

(Million Roubles)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Total Value	1,324	1,120	809	1,103	1,374	1,238	1,576	2,174	1,934	1,851	1,890
Of which:											
Japan	207.8	240.9	207.4	309.1	480.8	340.5	640.2	921.7	550.0	531.5	555.9
Belgium	20.6	5.0	0.8	8.1	6.5	-	-	57.7	169.5	129.7	127.5
Italy	270.9	205.3	108.5	152.9	152.3	145.3	201.4	321	284.7	286.8	191.8
Romania	84.5	84.6	67.6	82.2	62.6	71.9	78.9	63.6	59.5	51.5	71.7
West Germany	425.5	300.7	171.6	313.1	362.0	359.9	327.3	456.5	502.7	408.7	490.2
France	113.9	110.3	71.7	60.0	98.1	102.9	88.3	107.9	68.2	120.3	108.6

Source: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Finansy i Statistika.

have played a significant role. Without such imports it is questionable whether the Soviet Union would have been able to deliver Siberian oil and gas to consumers at the levels and in the time frame that it has.

With the expansion of the pipeline system came an increased demand for pumps and compressors. While the majority of pipelines use Soviet equipment, the large Siberian gas trunklines have required large-capacity 25 megawatt (MW) gas-turbines which the Soviet Union has been unable to produce (see Gustafson, 1984). It has therefore imported compressors from Western companies such as AEG-Kanis (West Germany), Nuovo Pignone (Italy) and John Brown Engineering (U.K.). While the compressors are built by West European companies they are based on General Electric (U.S.) technology. Cadieux (1984, p. 111) calculates imported compressors to have accounted for 27.3 percent of capacity installed between 1972 and 1980, and 44 percent for the period 1975 to 1980. Imports play a more important role in gas turbine compressor capacity, where they accounted for 38.4 percent in the 1972-1980 period and 61.9 percent in the period 1976 to 1980. By 1980 imports accounted for 20.5 percent of total compressor power installed in the Soviet Union.

The Soviet oil pipeline system has tended to rely on domestic pumping equipment. However, in Siberia imported pumps have been installed in crude oil pipelines (Cadieux, 1984, p. 113). In the 1974-1980 period the Italian subsidary of the U.S. manufacturer Worthington Pumps supplied 92 pump units worth about $ 46.2 million. In 1976 a subsidiary of Cooper

Industries (U.S.), Coberrow Ltd. (U.K.) was awarded a $ 165 million contract for a pump-drive system for a Siberian pipeline, and in 1983 Ingersoll Rand (U.K.) sold 12 pumps worth $ 5.1 million.[13] While these imports play a minor role in the total oil pipeline system, they have been important in Siberia.

In addition to pipe and compressors the Soviet Union has imported Western earthmovers, cranes and pipelayers for construction of the pipeline system. The major suppliers of this equipment have been Fiat-Allis Construction Machinery Inc. (U.S.-Italy), Caterpillar-Mitsubishi (U.S.-Japan), Kato and Komatsu (Japan), Bunsar (a Polish licensee of International Harvester), International Harvester and Caterpillar (U.S.). Canadian Foremost Ltd. has also supplied pipe-carriers designed for swampy terrain. Since the mid-1970s Canadian Foremost has delivered over 400 "Husky" caterpillar vehicles with a payload of 36 tons. At present they are cooperating with the Soviet Union to produce a 70-ton swamp vehicle (Mirolevich, 1986). Since the late 1970s the Soviet Union has shifted away from Caterpillar to Komatsu as its major supplier of pipelayers. From 1970 to mid-1978 Caterpillar supplied 1,943 heavy vehicles and Komatsu 341, but during the period mid-1978 to 1981 Caterpillar supplied 336 and estimated Komatsu to have supplied 1,998.[14]

As a consequence of U.S. sanctions the Soviet Union has tried to develop its own pipelayer. During 1980 the decision was made to develop the TG-502 pipelayer, based on an existing tractor body, for work on gas pipeline construction. Campbell, (1985, pp. 153-154) has traced the development of

this machine and concluded that domestic production would not provide self-sufficiency by 1985. This conclusion seems to be supported by the fact that in late 1985 Caterpillar was awarded a contract for delivery of 200 tractors and 39 pipelayers worth up to $ 80 million,[15] to be delivered in early 1986. The OTA study(1981, p. 1979) speculated that imports of pipelaying and earthmoving machinery were most likely needed to compensate for shortfalls in domestic production, but that it was also possible that they were better suited to working in harsh environmental conditions.

Much of the large-diameter pipe sold to the Soviet Union by West European companies during the 1970s was related to gas-for-pipe deals. In the case of Japanese pipe exports, loans were often provided by Japanese banks. In addition to compensation deals and commercial purchases the Soviet Union has tried to involve Western companies in large-scale pipeline construction projects. During the late 1960s and early 1970s the Soviet Union tried to interest the Japanese in a project to move Tyumen' oil to Japanese markets (Egyed, 1983, pp. 5-26). The project was finally dropped when the Soviet Union linked the pipeline to Japanese help with the construction of the BAM railway. During the early 1970s an American consortium, consisting of Tenneco, Texas Eastern Transmission, and Brown and Root, were involved in negotiations to deliver LNG from Urengoy to the East coast of the U.S. (see Kosnik, 1975). This project, known as "North Star" fell victim to the changing economic and political climate of the mid-1970s, and the U.S. partners withdrew their support. More recently the Soviet

Union has been successful in attracting Western partners to build a pipeline to export natural gas to Western Europe.

6.2.4. The Urengoy Export Pipeline

The Urengoy export pipeline, known in the Soviet Union as the Urengoy-Pomary-Uzhgorod line and in the West as the Yamal pipeline, is one of six gas trunklines built by the Soviet Union during the 11th FYP. Here we are concerned more with the consequences of the pipeline agreement for Siberian development than with its impact upon East-West and intra-alliance relations. For a discussion of the benefits and costs of the project see Stern, 1982, Crovitz, 1983, Lebahn, 1983 and Stein, 1983. Described as "the deal of the century" the export pipeline is essentially a very large gas-for-pipe deal focusing on a single pipeline. When the project was first proposed in 1978 the Yamburg field was to supply the natural gas. Then the development of Yamburg was postponed and Urengoy became the supplier. The pipeline from Urengoy to Uzhgorod on the Czech border is 4,451 km long, has a design capacity of 32 billion cubic metres per year and required 2.7 million tons of 1420mm pipe to build (CIAb, 1985, p.11). There is considerable confusion surrounding the exact role of Western equipment. Soviet sources suggest, in retrospect, that the original plan called for 40 compressor stations, of which 33 would use Western equipment and 7 Soviet equipment.[16] However, Western sources suggest that contracts were signed to provide Western equipment for 41 compressor stations (Stein, 1983, p. 63). The major equipment orders associated with the project are shown in Table 6.2 and include 125 turbines for 41 compressor stations.

Each station is designed to house three 25 MW gas-turbines, one for daily operation, one for reserve and one for maintenance. To further confuse the matter the head station (at Urengoy) consists of five 10 MW compressors. This may explain why the Soviet sources report only 40 25 MW stations. Given the confusion over the exact nature of Western involvement it is not suprising that Western estimates of the cost of the pipeline show great variation. The CIA estimate of $ 22 billion total cost including $ 7 billion in hard currency, seems realistic. The Soviet Union negotiated a number of low-interest (7-8 percent) loans with West European banks to pay for the equipment (Lebahn, 1983, p. 276). As discussed previously, long-term gas contracts were also signed and included a "floor price" and a "take or pay" clause (covering 80 percent of the contract volume) to ensure sufficient sales to service the loans (Crovitz, 1983, p. 24). In light of recent events these terms seem to favour the Soviet Union. However, when the contracts were negotiated oil prices were not expected to collapse.

Because pipe and pipeline equipment imports have become such a regular feature of East-West trade it is difficult to separate pipe deliveries for the export pipeline from other pipe orders. However, the Urengoy pipeline warrants separate discussion because it brought the question of East-West trade and Siberian development to the fore. It would seem that Mannesmann received a contract for 1.2 million tons of pipe, worth $ 2 billion, and Nippon Steel supplied a further 800,000 tons, leaving 700,000 tons to be provided by other Western

companies such as Finsider (Italy) and Voest-Alpine (Austria). The contracts for compressor stations were split betwen a joint venture of Mannesmann and Creusot-Loire and Nuovo Pignone (part of the Italian state company ENI). As can be seen from Table 6.2, Mannesmann/Creusot-Loire subcontracted other European companies to produce compressor equipment. They also received a management fee worth 6-7 percent of the contract value to coordinate equipment deliveries.[17] Prior to the enforcement of sanctions General Electric had shipped enought rotor sets for 23 turbines. The U.S. Government then prohibited G.E. from shipping $ 175 million worth of rotor kits to the West European companies involved in the project. Alsthom-Atlantique (a GE licensee) had already been contracted to supply the Soviet Union with 40 spare rotor kits, begining in 1984, and could not produce more kits to enable completion of 102 turbines on order (Stein, 1983, pp. 62-65). Despite U.S. sanctions some European governments, Britain and France for example, ordered companies to fulfil their contracts with the Soviet Union.

Because the sanctions were delaying delivery of the compressors, and to show that the Soviet Union was not to be influenced by sanctions, a crash programme was ordered to produce Soviet-built 25 MW compressors (see Gustafson, 1984). As a result of the sanctions 22 stations have been equipped with Soviet turbines built in Leningrad. In August 1983 the Soviet Union announced that the export pipeline has been completed six months ahead of schedule. At that time the link between the Soviet border and Western Europe was not complete and the installation of compressor stations was incomplete.[18]

Table 6.2

Major Equipment Orders for the Urengoy Export Pipeline

Equipment	Western Company	Value ($million)
Equipment for 22 gas compressor stations including:	Mannesnmann (FRG) Creusot-Loire (F)	906
47 turbines	AEG-Kanis (FRG)	(288)
21 turbines	John Brown (UK)	(112)
turbine parts & equipment	John Brown (UK)	(79)
compressors	Demag (FRG)	
compressors	Dresser (F)	
Equipment for 19 gas compressor stations, including:	Nuovo-Pignone (I)	
57 turbines		
Materials and installation of 292 buildings for 41 pumping stations	Metex (FIN)	66
Computerized video information system and terminals	Rediffusion (UK)	16
Four channel radio telephone system, including 2,000 radio telephones	Nokia (FIN)	11
Computerised pipeline surveillance equipment	Thomson-CSF (F)	600
480 excavators	Kato (J)	22
500 pipelayers	Komatsu (J)	209.8

Sources: Lavigne, M. (1985), Economie Internationale Des Pays Socialistes. Paris: Armand Colin, p. 168, and Business Eastern Europe.

Thus, the pipeline was complete but not fully operational. On July 1 1984 Siberian gas started to arrive in Austria via the export pipeline.[19] Late in 1982 the Reagan administration lifted the sanctions against the project and the outstanding compressor stations were delivered. It is not clear where they were installed but it was probably on one of the six Siberian gas pipelines. One casualty of the sanctions was Caterpillar (U.S.), which had been awarded a contract to supply 200 pipelayers worth $ 80 million for use on the export pipeline. The U.S. Government revoked Caterpillar's export license and the Soviet Union awarded a contract to Komatsu (Japan) to supply 120 pipelayers. The order was subsequently increased to 500 pipelayers worth over $ 200 million.[20] Following pressure from American business interests, Caterpillar was granted an export license to sell the Soviet Union 100 pipelayers worth $ 40 million on the understanding that they would not be used on the export pipeline.

In terms of technology transfer the Urengoy pipeline project was really an extension of earlier small scale gas-for-pipe deals and offered equipment that had been sold on a regular basis during the 1970s. In the context of the Siberian gas industry the pipeline was just one of six, all relying on imported pipe, constructed during the 11th FYP. Given these facts it is hard to understand how the project became the source of public disagreement between the United States and her allies in Japan and Western Europe.

While measurement is impossible, it is almost certain that Western technology has played a greater role in Siberia than in

the oil and gas industry as a whole. In the case of the oil and gas exploration projects in Yakutia and off Sakhalin Island there was clearly a reliance upon Western technology.

6.2.5. The Siberian Coal Industry

In general the Soviet coal industry is not a major consumer of Western technology. That is not to say that Soviet coal mining technology is of the same standard as Western, or that it is available in sufficient quantities. The OTA study (1981, pp. 88-89) concluded that Soviet equipment was sturdy and well-designed, but seldom as reliable as Western counterparts. In addition the machine-building industry has been unable to supply sufficient coal-mining equipment. The growth of the production of mining equipment (not just for coal mining) has been much slower than that of the machine-building sector as a whole[21] As a result there is a shortage of equipment such as drag-lines and large-capacity trucks for opencast mining and thin seam excavators for underground mining. Measures have been taken to improve Soviet heavy trucks such as the BelAZ-549 75-ton truck, and heavier 120 and 180 ton trucks are now being produced, but in the mid-1970s the largest Soviet-built truck available for the mining industry was 40 tons (Campbell, 1980, p.129). Thus, as the amount of opencast mining increased, particularly in Siberia and the Far East, equipment had to be imported. The majority of Western imports are associated with the South Yakutian Coal Complex, which is discussed below. The Kuzbass has received a small amount of Western equipment. For example in 1982 Kobe Steel (Japan) supplied $ 10 million worth of electric shovels.[22]

West European companies have supplied pumps and cutting-machines for Siberian mines--presumably underground mines.

Because the characteristics of Kansk-Achinsk coal prohibit long-distance rail transportation, plans to exploit the vast deposits have focused upon mine-mouth power generation and the production of synthetic fuels. The Soviet Union's synfuel programme has been based upon technologies obtained from Germany after the Second World War (see Campbell, 1980, pp. 175-180). In 1976 construction began at Krasnoyarsk on a demonstration plant to convert Kansk-Achinsk coal to coke, synthetic oil and hydrocarbon gases. However, completion of the demonstration plant has been delayed and the Soviet Union has sought Western assistance. Negotiations have been held with Japanese and West European companies. The West German firms Salzgitter and Mannesmann have both shown interest in a compensation deal that would deliver synthetic fuel to pay for the processing plant and technology. The value of the Western contract has been put at $ 16.5 billion.[23] An agreement was to have been signed in July of 1983 at a meeting between Chancellor Kohl and Yuri Andropov in Moscow. No agreement was signed. Since then Kansk-Achinsk has fallen from favour in the Soviet Union as a priority project, and the collapse of oil prices has further undermined its economics.

In an attempt to ease the burden of coal transport on the rail system, the Soviet Union has been experimenting with coal slurry pipelines. Since 1966 two short (10-11 km) pipelines have been operating in the Kuzbass, but they have not been very successful (Pustopalov, 1984. p.9). In 1982 construction was

scheduled to begin on a 250-km line linking the Belovo mine in the Kuzbass with a thermal power station at Novosibirsk. The pipeline was to be operational by 1984 and would be capable of moving 4.3 million tons of coal a year (Biryukov, 1981, p. 25). This pipeline was to act as a prototype for 2,000-3,000 km pipelines to link the Kuzbass with the European regions of the Soviet Union. Things clearly have not gone as planned. According to Pustopalov (1984) work on the pipeline was progressing and pipe-laying was scheduled for completion by the end of 1984. But the pipeline would not be operational until the Uralmash combine had adapted and installed pumping units. Clearly a suitable pumping unit could not be developed, because in 1985 the Soviet Union awarded a $ 277 million contract to the Italian company Snamprogetti to build a 260 km slurry pipeline to deliver 3 million tons of Kuzbass coal to a power station at Novosibirsk. Snamprogetti will supply the technology, basic engineering, equipment and combustion system. The pipeline will be the first commercial development of Snamprogetti's reocarb process that permits transportation at very low temperatures and burning of the mixture without treatment. The process is believed to be the most advanced system for the transport of coal by pipeline. The project will be completed in 1987.[24]

The Kansk-Achinsk synfuel project and the Kuzbass slurry pipeline represent cases where domestic research programmes seem to have failed and Western assistance has been sought to provide an immediate solution. The majority of Soviet imports for the coal industry have been "low-tech" items such as trucks

and shovels, but the slurry pipeline, clearly an advanced transportation system, may represent a change in Soviet attitudes. If the system is successful it could lead to further cooperation on long-distance slurry pipelines. Soviet authors (Styrikovich and Popov, 1983, p. 11) have already noted that increased deliveries of Kuzbass coal to thermal power stations in the European regions could make more oil and gas available for export. Thus the importation of Western slurry technology could be paid for by additional oil exports.

6.2.6. The South Yakutian Coal Complex

On June 4 1974 a general agreement was signed covering the joint Soviet-Japanese development of the South Yakutian coal basin in the Soviet Far East. On June 24, 1974 a credit agreement was signed between the Foreign Trade Bank of the USSR and the EXIM Bank of Japan. The agreement provided $ 390 million for the purchase of equipment to develop the coalfields and $ 60 million for the purchase of consumer goods for local needs. In return the Japanese consortium "the South Yakutian Coal Development Cooperation Company" would receive 104 million tons of coking coal between 1979 and 1998. The role of South Yakutian coal exports was discussed in the previous chapter. Here we are concerned with the nature of the Western equipment supplied to the project.

The creation of the South Yakutian TPC has involved the preparation of an opencast mine and construction of a coal processing plant, a thermal power station, a new town at Neryungri, a railway, and a coal port at Vostochnyy. The half-billion dollars worth of equipment supplied under the

compensation agreement (Table 6.3) has provided mining machinery for the removal of overburden and the excavation and transportation of coal, machinery for the construction of the necessary infrastructure, and equipment for the construction of a coal treatment plant. The cost of constructing a coal terminal at Vostochnyy has been financed under a separate agreement for port expansion, and is discussed later in this chapter. In 1981 an additional $ 90 million worth of credit was provided to compensate for the inflation of equipment prices. The total value of the equipment orders listed in Table 6.3 is $ 385 million. Given that some of the large orders are of an unknown value, the list provides a good indication of how the $ 480 million of credit was actually spent. A recent Soviet study of Soviet-Japanese trade (Stolyarov and Pevzner, eds., 1984, pp. 77) lists equipment purchases for the project to include 403 bulldozers and front-end loaders, 692 cranes of various types and 176 excavators. While $ 490 million worth of equipment represents a substantial investment, Soviet authors are quick to point out that the total cost of developing the South Yakutian Complex is much higher (Alexandrov, 1982, pp. 24-25). Agafonov (1985) notes that the book value of the Neryungri truck fleet alone is 500 million roubles (nearly $ 600 million at 1985 rates). In other words a large amount of Soviet-built equipment works side-by-side with imported machinery.

The extreme environmental conditions of the South Yakutian region have severely hindered development of the coal field. Of course the infrastructure problems mentioned in Chapter 4

Table 6.3

Equipment for the South Yakutian Coal Complex

Equipment	Companies	Value ($ million)
Construction and Mining Equipment		
170-190 Bulldozers	Komatsu	40
600 crane carriers	Mitsubishi Auto Co.	na
12 100-ton capacity mobile cranes	Sumitomo Heavy Ind.	na
164 truck-mounted cranes with 16-, 20- and 30-ton capacities 166 excavators with 1.5m buckets	Nichiman (manufactured by Kato)	80
Unknown number of 20 cubic metre bucket mining shovels	Sumitomo Heavy Ind.	na
10 heavy-duty tracked Marion Power Shovels, with 12.5 cubic metre and 20 cubic metre scoops	Sumitomo Heavy Ind. (license from Marion US)	30
30 120-ton dump trucks	Komatsu	30
30 180-ton dump trucks 29 120-ton dump trucks	Unit Rig (US) (manufactured by the Canadian subsidiary)	92
7 front-end loaders	Mitsui (manufactured by Dart a division of Paccar international US)	2.86
3 front-end loaders	Clark Equipment Ltd.(US)	1
Tyres for large dump trucks, (Each tyre weighs 3.3 tons and has a diameter of 360 cm and width of 110 cm)	Bridgestone Tire Co. Yokohama Rubber Co. and Toyo Rubber Ind.	17
24 63-ton drag-lines 15 41-ton drag-lines 65 20-ton and 30-ton pile drivers	Sumitomo Heavy Ind.	18
10 mobile transformer stations	Hitachi Heavy Ind.	4
Complete truck-crane repair plant	Kato	3.3

Table 6.3 continued

Company	Company	Value ($ million)
75 repair vans, including 5 lubricating vans, half with cranes, half with trailers	Nissho-Iwai	9.4
14 augers for pile driving	Sanwa Kizai	na
30 drilling rigs (for drilling foundations) and mining tools	Nichimen	14
Equipment for the Coal Preparation plant		
Coal crushing station	Marubeni	5.7
Coal dressing plant, flotation dressing machines and accessories, capacity 9 million tons of coal per year	Sumitomo Jukikai Envirotech Inc. (joint Japan/US)	14
Coal drying plant-1,800 tons per hr.-four flo-dryers together with belt conveyors and related electrical equip	Sumitomo Heavy Ind. (license from McNally US)	24
	Total Value	385.26
Vostochnyy Coal Port (separate development agreement)		
Electric Locomotives for shunting coal wagons at coal port	Toshiba	na
Rotary wagon dumpers used to empty coal wagons at coal port	Heyl and Patterson (US) (supplied by Australian subsidiary)	na
Coal handling facility capacity: 3,000 tons per hr., 6.2 million tons per year	Mitsui	27

Sources: Mathieson, R.S. (1979), Japan's Role in Soviet Economic Growth. Praeger: New York, pp. 76-78, OTA (1981), Technology and Soviet Energy Availability. Boulder, Col.: Westview, p. 217, and information obtained from East European Report, EastWest Markets and the Mining Journal.

have had their part to play in delaying the project, but in many cases the technology has been unable to withstand the extreme temperatures of the region. Both Soviet-built and Japanese-built equipment have experienced problems. For example, the hydraulic-lift systems on the Marion and Sumitomo power shovels froze and shattered in winter (Mote, 1985, p. 707). The tyres of the Soviet-built BelAZ 180-ton trucks still split in extreme temperatures. In many cases equipment has been modified to operate in the extreme conditions and Western companies have benefited from this opportunity to test their equipment. One indication of the severity of the problems encountered by Soviet-built equipment is the fact that the Ministry of Heavy and Transport Machine Building has created a special servicing unit at Neryungri (Dyker, 1982, p. 2). In the early stages of the project imported equipment played a more important role as Soviet equipment such as the Uralmash 20 cubic metre bucket excavators and the 180-ton BelAZ trucks were still on the drawing boards. The French company Poclain cooperated in the production of the bucket excavator. Further indication of the crucial role of imported machinery is provided by the fact that the one-year late delivery of Marion power shovels was cited as one of the reasons for the delay in coal production (Hymans, 1981, p. 45).

Because Western equipment purchases have been financed by Japanese credit the majority of the equipment has been supplied by Japanese companies. In some cases the Japanese have been unable to produce equipment and have used U.S. licenses and know-how. For example Sumitomo built Marion power shovels

under license and most of the equipment for the coal preparation plant is built to U.S. design. In the case of the 180-ton dump trucks supplied by Unit Rig the Japanese could not, at that time, produce an equivalent vehicle. Prior to placing its order Avtoexport tested the Unit Rig equipment and a similar 180-ton truck supplied by Terex (a divsion of General Motors Corp.) in Siberia and the Kola Peninsula. Unit Rig was subsequently awarded a contract to supply 30 180-ton dump trucks, and later 29 120-ton dump trucks were added to the order bringing its total value to $ 90 million. Unit Rig ordered its Canadian subsidiary to produce the trucks for delivery during 1977 and 1978.[25]

The South Yakutian TPC is clearly a resource development project that has benefited from Western equipment imports. The half-billion dollars of credit provided by the Japanese partners not only represents a substantial amount of equipment, it is also an investment in the regional development of the Far East. In the absence of such foreign investment and an external market for South Yakutian coal it is questionable whether the TPC would have come to fruition. The type of equipment purchased is a clear indication of the weaknesses of the Soviet machine-building industry. It is somewhat suprising that in the 1970s the Soviet Union was incapable of producing heavy equipment for the development of the South Yakutian coalfield. No doubt Soviet engineers have learnt much from operating Western equipment in some of the harshest conditions in the world and have incorporated these lessons in their own equipment. Now Soviet-built excavators and dump trucks are

being introduced, but much of this equipment is produced in Belorussia and the Urals, not in Siberia. The final irony of the South Yakutian project is that having braved the elements the Japanese no longer require the coal.

6.3 Western Technology Imports and Mining

In previous chapters non-fuel mineral production was shown to be both an important source of foreign currency earnings and a key sector in the Siberian economy. Equipment needs for the mining of non-fuel minerals, such as the polymetallic ores, gold and diamonds are similar to those in the coal mining industry, so that one might expect to find a similar pattern of reliance upon imports. Unfortunately information on non-ferrous mining activities is scarce. Only in the case of very large complexes such as Noril'sk and Sayan is there a reasonable amount of information on Western equipment supplies. Western mining and trade publications do identify equipment orders for Siberian mines, but without information on the nature of mining activities it is difficult to assess the importance of Western equipment.

Conditions in Siberian mines require large-capacity trucks and earthmovers capable of operation in extreme temperatures. During the 1970s, as one can see from Table 6.4, the Soviet Union regularly purchased heavy mining equipment from Western producers. In many cases Siberian mines are identified as the specific destination, and in other instances equipment has been ordered for operation in extremely cold temperatures, suggesting mines in Siberia though possibly the European North. The equipment orders listed in Table 6.4 are representative of

Table 6.4

Heavy Equipment Imports for Non-Fuel Minerals Mining

Equipment/Destination	Company	Year of delivery	Value $ million
Earthmovers	International Harvester (US)	1972	40
25 385-hp. bulldozers for Siberian quarries	Caterpillar Tractor Inc. (US)	1974	NA
39 pay-loaders and spare parts	International Harvester (US)	1974	8.5
Hydraulic truck-cranes, 25 metre beam, 28-ton capacity and spare parts	Poclain SA (F)	1974	0.8
50 bulldozers, 524-hp. for non-ferrous metal projects in East Siberia and Yakutia	Fiat-Allis Construction Machinery Inc. (US-I)	1974-1975	NA
Bulldozers and spare parts	Caterpillar Tractor (US)	1976	20
Heavy earthmoving equipment	Poclain SA (F)	1976	4.8
300 large bulldozers, 425-hp for strip mining in northern Siberia	Fiat-Allis Construction Machinery Inc. (US-I)	1981	90
3 45-ton trucks	Kiruna Truck (Swed)	1983	4
Specialised arctic equipment for opencast mining	Fiat (I)	1985	11

Sources: Reports in: East European Report, Business Eastern Europe, Mining Annual Review, and the Mining Journal.

types of equipment ordered but are far from complete and provide no indication of the scale and importance of Western equipment deliveries. The importance of U.S. producers reflects their dominant position in heavy equipment production during the 1970s. As with opencast coal mining operations, Soviet industry was unable to supply large-capacity excavators and earthmovers during the 1970s. Equipment orders have continued throught the 1980s, suggesting that imports are still required despite the production of Soviet 75, 120 amd 180 ton trucks. For example, early in 1986 a 154-ton giant dump-truck built by Euclid (U.S.) was delivered by plane to a diamond mine in Yakutia.[26] Without more information on the nature of mining operations it is difficult to know how important such equipment imports are for Siberian mines. Reports in the U.S. Bureau of Mines Minerals Yearbooks suggest that imported trucks and scrapers have played an important part in sustaining gold production in the Soviet Far East.[27] It does seem likely that in the more important Siberian mining operations, such as gold and diamond mining, specialised imported equipment has been used to compensate for the inadequacies of the Soviet machine-building industry.

Western equipment has also been used in the Siberian minerals-processing industries. The diamond industry in Yakutia has benefited from imported crushing and sorting equipment. During the early 1970s 30 diamond-sorting tables were supplied by Jeffery Manufacturing Co. (S.A.).[28] Between 1972 and 1975 Kobe Steel (Japan) supplied four diamond sorting mills for diamond mines in Yakutia, and in 1978 Kobe Steel was

awarded a contract to supply three crushing mills.[29] Cement production has also benefited from purchases of Western plant. During the early 1970s the French company Fives-Lille-Cail sold Tekhnopromimport equipment for drying and milling the raw material used in cement manufacturing.[30] There has been no systematic reliance upon imports in the minerals processing industries. There are however two instances where large-scale processing plants have been imported from the West, namely the Noril'sk copper and nickel smelter and the Sayan aluminum smelter. The remainder of this section focuses upon these two projects.

6.3.1. The Noril'sk Metallurgical Combine

Since the early 1960s there has been a concerted effort to expand production at the Noril'sk metallurgical combine. The focus of this development programme has been the construction of a number of underground mines in the Talnakh area. Since 1966 four new underground mines have come into operation: the Mayak mine (75 metres deep), which started operation in 1965; the Komsomol' mine (470 metres: 1971); the Oktyabr' mine (900-1200 metres: 1974); and most recently the Taymyr mine (1500 metres) which began operation in 1982-1983 and is the deepest mine in the Soviet Union (Bond, 1984, p. 357). These new mines have led to a rapid increase in ore production. During the 9th FYP output of non-ferrous metals at Noril'sk increased by 60 percent, and during the 10th FYP output was planned to increase a further 75 percent (Utkin, 1978, p.8). It is doubtful whether this target was met, due to delays in the expansion of smelter capacity, but from the data presented in the previous

chapter it is clear that the volume of nickel and platinum-group metal exports increased rapidly during the 1970s. By the end of the 1960s mine production at Noril'sk had outstripped the smelter capacity at the metallurgical combine, and since that time two strategies have been pursued to process polymetallic ores. First, since the summer of 1969 Noril'sk ore has been transported to smelters on the Kola Peninsula via the Northern Sea Route. Second, smelter capacity at Noril'sk has been increased by the renovation and enlargement of existing facilities, and in 1971 construction began on a new smelter to work tailings from the Talnakh mines. Western imports have played a part in the extension of operations on the Northern Sea Route (discussed later in this chapter), and in the construction of the Nadezhda nickel-copper smelter.

In 1974 Tekhmashimport signed an agreement with Outokumpu Oy (Finland) to deliver a flash-smelting plant for copper and nickel production. At the time it represented the largest contract signed in the history of Soviet-Finnish trade (Kulev, 1983, p. 133). The contract, worth about $ 300 million, was divided among three major suppliers: Outokumpu Oy, Rauma Repola and A. Ahlstrom Oy. Outokumpu Oy was responsible for the engineering and design of the automation system for the smelters, Rauma Repola delivered the flash-smelting furnace, concentrate drying equipment, sulphur recovery systems and other related equipment, and A. Ahlstrom Oy supplied all the boilers and gas purification equipment for the plant. Additional contracts were placed with other Finnish companies that brought the total cost of equipment and assembly work to

$ 540 million.[31] The smelter is sited 10 miles west of the city on the Nadezhda plateau, and ore concentrate is moved from the Talnakh mines via a 20 mile (32 km) slurry pipeline. Ingersoll-Rand (U.S.) supplied large slurry pumps for use on this pipeline. In 1977 a contract for 10 slurry pumps worth $ 14 million was awarded and in 1976 a similar order was completed.[32] The construction of the Nadezhda smelter was due to have been completed by 1977 and at that time would have tripled the aggregate output of finished metals at the combine. The smelter is designed to process iron sulphide tailings from Talnakh concentrators to recover nickel, copper and associated metals, including platinum group metals, and also by-product sulphur. The smelter has a design capacity of 550,00 tons of nickel concentrate (100,000 tons of nickel metal content) 650,000 tons of copper concentrate (150,000 tons of copper metal) and 100,000 tons of sulphur (Os'movoy, 1983, p. 140). Initial operations began in 1979, but the nickel-copper smelter was not completed until 1981 (ten years after construction had started) with the first nickel being produced in February and copper in May of 1981.[33]

Despite the fact that expansion of smelter capacity was identified as a priority project in the 9th FYP (Appendix 2) and represented an investment of over 2 billion roubles, it has been plagued by many of the problems symptomatic of large industrial projects in the Soviet Union. A lack of planning and preparation meant that the construction industry at Noril'sk was unable to fulfill its targets, and a lack of attention to social infrastructure, in particular housing, led

to a shortage of labour (Utkin, 1978 p. 9). Delays were further compounded by the combine's remote location and the harsh climate: the temperature at Noril'sk is below freezing 288 days a year.[34] In addition to providing equipment for the Nadezhda smelter, Western companies have supplied drilling equipment for underground mines, and insulated wall and roof panels. Most recently Finn-Stroi (Finland) has constructed a dairy at Noril'sk.[35] In conclusion, it is clear that Western technology and equipment have played a central role in expanding smelter capacity at Noril'sk. It is also apparent that Western involvement is no guarantee of timely completion of industrial projects. Despite the delays, the increased productive capacity at Noril'sk has placed the Soviet Union in a strong position to expand platinum-group metal and nickel exports, should it wish to use them to compensate for declining oil revenues.

6.3.2. The Sayan Aluminum Complex

In the early 1970s a number of Western companies, in particular Kaiser Aluminum (U.S.) and Pechiney Ugine Kuhlman (PUK) (F), showed interest in the construction of an aluminum smelter in Eastern Siberia. Initially Kaiser was thought to have an edge because of its willingness to incorporate Soviet technology to make alumina from nepheline.[36] However, during 1974 an agreement-in-principle was signed with PUK to provide a 1-million-ton-per-annum alumina plant at Nikolayev on the Black Sea and an aluminum smelter complex at Sayanogorsk. The value of the alumina plant was placed at over $ 20 million (at 1974 exchange rates) and the smelter and associated plants at $ 1.4

billion.[37] The delivery of plant was to be part-financed by compensation deliveries of 500,000 tons of aluminum at a rate of 50,000 tons a year for 10 years once production started. It is not clear why PUK was awarded the contract, but one can speculate that problems with the Soviet nepheline-based plant at Kansk tipped the scales in favour of a bauxite based project. Also U.S. political actions may have acted against American involvement in the project. A Soviet source (Sushkov, 1977, p. 18) provides a clearer picture of what the final agreement covered. PUK have supplied an aluminum complex that includes an alumina works and a factory for the production of semi-finished products, including an anode plant with an annual capacity of 100,000 tons. The smelter, which will eventually have five potlines, was provided by PUK, while the contract for the anode plant, worth over $ 300 million, was awarded to a consortium formed by the West German Company Klockner. The contract included $ 100 million worth of orders for Klockner's French subsidary.[38] During 1980 production at the Nikolayev alumina works began, using imported bauxite. The plant is producing alumina with an aluminum content in excess of 90 percent.[39] The Sayanogorsk aluminum reduction plant started its first potline in April 1985, and the hydro-electric station reached its design capacity of 6,400 MW in December of 1985.[40] There is no clear indication when the aluminum plant will be completed, but the directives of the 12th FYP (Appendix 2) call for "accelerated construction at the Sayan aluminum plant". Completion of the Sayan TPC has fallen behind schedule with many projects being postponed, but it is clear that the

completion of the aluminum production complex remains a priority project. When the Sayanogorsk plant reaches its design capacity of 550,000 tons, probably in the 1990s, it will be the largest of the five aluminum plants in Siberia and will increase Siberian smelter capacity by nearly 30 percent (Table 5.6). While it is not possible to come to any clear conclusions as to the role of Western technology in Siberian non-fuel minerals production in general, it is clear that in the case of Noril'sk and Sayan, Western involvement has played a key role in increasing production capacity.

6.4. The Forest Industry

It is possible to identify two patterns of technology imports to the Siberian forest industry: first, that associated with the large forestry complexes that have been constructed in Eastern Siberia; and second, that related to the large-scale compensation deals between the Soviet Union and Japan for the development of the Far Eastern forestry industry. The type of equipment imported and its role in the forestry sector is somewhat different in the two cases.

The bulk of recent investment in the Siberian forest industry has been concentrated in large industrial complexes such as Bratsk and Ust'-Ilimsk. Both Bratsk and Ust'-Ilimsk have benefited from the importation of Western technology. At Bratsk in the late 1960s and early 1970s Swedish and Finnish companies supplied equipment for pulp and paper production, and more recently, in 1982, Karhula (Finland) was awarded a contract to modernize facilities at the complex.

The situation at Ust'-Ilimsk is rather different because

the complex is a CMEA joint development project, as well as the location of a compensation agreement with Parsons and Whittemore. Under this compensation agreement, signed in 1974, a group of French banks led by Banque de Paris provided $ 60 million worth of credit to purchase equipment for a sulphate pulp plant, sawmills and a wood panel plant (Savin, 1980, p. 21). The loan is supposed to be repaid with deliveries of pulp at a rate of 85,000 tons a year, but Soviet foreign trade statistics show average exports of pulp to France to be 65,500 tons between 1980 and 1984. Deliveries were scheduled to start in 1978 but completion of the project was delayed until 1979. Parsons and Whittemore, a French subsidiary of a U.S. company, were responsible for engineering, design and management of the pulp plant.[41] In addition to French involvement, U.S., Finnish and Japanese companies sold equipment to the complex. Presumably the other CMEA partners were responsible for covering some of the foreign currency costs of equipment for the complex, as they provided 40 percent (328 million roubles) of the capital investment (Shabad, 1979, p. 250). United States involvement included International Harvester, which sold $ 22.5 million worth of front-end loaders, 70 with 15-ton capacity and 14 with 25-ton capacity, designed to operate in - 50 °C temperatures; J.I. Case, which sold 11 timber recovery machines worth $ 1.5 million; and the Measurex Corp., which supplied computerised control systems for two bleach plants and two recovery boilers.[42] The Finnish company Valmet Oy supplied the complex with equipment for sawmills, a hardboard factory worth $ 172.4 million, and an automated system for sorting and drying

lumber worth $ 40 million.[43] Rauma Repola (Finland) sold the complex a giant log merchandiser worth $ 43.5 million, to produce sawlogs, pulpwood, particle board raw material and raw materials for a hydrolysis plant.[44] Japanese involvement included a 110-ton-a-day sludge treatment plant worth $ 13.5 million, supplied by Tsukishima Kikai Co., and a soda recovery unit delivered by Marubeni and manufactured by Hitachi.[45] The orders presented above are not comprehensive and the value of all the contracts is not available, but the known value of the contracts listed above is over $ 350 million, including the $ 60 million compensation deal. If the CMEA's 40 percent share of investment for the project was $ 328 million, the total amount of Soviet and East European investment was about 820 million roubles (over $ 1 billion), so that imported equipment can be estimated to represent one third of the total investment in the complex. Imports have been used in all stages of the production process at Ust'-Ilimsk, from the harvesting of timber to the production of pulp and the burning and treatment of waste products. In many cases equipment has been designed to withstand low temperatures, and a high degree of automation has been incorporated to reduce the size of the labour force. In a number of instances the installation of equipment represented the first use of such equipment in the Soviet forest industry.

In addition to the delivery of equipment to Bratsk and Ust'-Ilimsk, imported equipment has been used at forestry enterprises at Krasnoyarsk, Lesosibirsk, and Baykal'sk (Braden, 1983, p. 463). At Lesosibirsk 90 percent of the wood

production lines installed there in recent years are the result of a cooperative effort between the Soviet Union and the Finnish company Valmet.[46] In 1975 Plan-Sell Oy (Finland) was contracted to supply a sawmill project worth $ 75 million, also for the Lesosibirsk complex (Braden, 1983, p. 451.) The Western commercial press has reported a number of contracts with Western companies to supply equipment for Siberian forestry enterprises. For example, in 1975 Nicholson Manufacturing (U.S.) was contracted to supply 8 log debarkers worth $ 1.5 million for Siberian sawmills.[47] More recently the Finnish firm Raute has been contracted to provide a particle-board plant with a capacity of 240,000 square metres. The equipment will be installed during 1987.[48] Imports of such processing equipment are playing an important part in intensifying the Siberian forest industry. However, as the production data in Chapter 3 illustrated, the region still plays a relatively minor role in the wood products industry, and the majority of imported processing and production equipment has been destined for enterprises in the European USSR which have the benefit of a market location.

6.4.1. Soviet-Japanese Forestry Agreements

In the previous chapter exports related to compensation agreements signed between Japan and the Soviet Union were discussed. Here we are concerned with the equipment delivered under these agreements. Since July 1968 there have been three general agreements on the development of Far Eastern forestry resources and one agreement on wood chip and pulp development. The intention of the Far Eastern foresty development projects

has been to provide plant and equipment to increase the exploitation of the forestry resource in East Siberia and the Far East. In return Japan has received wood exports. A selection of equipment deliveries associated with these agreements is presented in Table 6.5. Details for the first agreement, signed in 1968, and the second agreement, signed in 1974, are reasonably complete. In each case a portion of the credit was used to purchase consumer goods for the Soviet workforce. However, there is a distinct lack of information about the third agreement, signed in March 1981. The reasons for this lie with the fact that signing of the agreement was delayed by the Soviet invasion of Afghanistan, and subsequent deliveries took place during a period of East-West tension and disagreement among the Western alliance as to the wisdom of East-West trade. Thus, it was not a good time to publicise the sale of almost $ 1 billion worth of equipment and merchandise to the Soviet Union. If one examines the types of equipment supplied under the first two agreements it is clear that the intention of these projects was to renovate existing facitities and extend the area of forest harvesting as well as create new forestry enterprises. Japanese companies supplied equipment for building logging roads, moving timber to sawmills and improving river transportation. None of these imports can be considered "high tech" and one might reasonably expect the Far Eastern machine-building industry to be capable of supplying timber carriers, excavators and bulldozers. But this was clearly not the case, and a familiar pattern of reliance on suppliers such as Caterpillar-Mitsubishi and Komatsu is evident

Table 6.5

Japanese Equipment Deliveries under the Far Eastern Forestry Development Agreements

Equipment	Company	Value $ Million
First Forestry Agreement: $ 133 million credit		
2,300 trailer trucks for hauling logs	Komatsu	43
250 trailer trucks	Komatsu	7
85 truck-mounted cranes to load trucks	Tadano	3
1,000 bulldozers for building logging roads	Caterpillar-Mitsubishi	24
90 bucket excavators	Kobe Steel	13.4
250 bulldozers 100 motor graders	Komatsu	10
Bucket dredge to deepen the Amur River	Mitsubishi-manufactured by Hitachi	8
Steel haulage ropes	unknown	4
Electric cable	unknown	4
Second Forestry Agreement: $ 550 million credit		
1,400 12-ton timber carriers	Marubeni-manufactured by Komatsu & Nissan	55
1,250 dump trucks	Isuzu	25
1,100 trailer trucks	Komatsu	50
800 bulldozers	Mitsubishi-Caterpillar	54
800 crane carriers	Mitsubishi Auto Co.	na
180 hydraulic cranes	Tadano & Kato	11.8
100 12-ton auto-graders	Komatsu	3.4

Table 6.5 Continued

Equipment	Company	Value $ Million
18 140-hp. bulldozers	Mitsubishi Corp.	1.1
4 75-ton track-mounted cranes 12 30-ton cranes 10 16-ton cranes	Nichimen-manufactured by Kato	na
4 floating cranes	Kyoto Trading Co.-built by Fukushima Shipbuilding & Eng.	10.1
2 pile-driving ships	Niigata Iron Works	8.8
2,200-ton suction dredger	Ishikawajima-Harima Heavy Ind. & Kyoho Tsusho Kaisha	11.6
4 sets of pusher tugs 2 sets of timber barges	Hakodata Dock	na
3 woodchip Carriers	Unknown	20
Equipment to modernise paper mills	Mitsubishi Heavy Ind. & Mitsubishi Corp.	10
Third Forestry Agreement: $ 910 million credit		
800 trucks for timber hauling	Komatsu & Nissan	36.3
400 bulldozers	Caterpillar-Mitsubishi	31.8
250 large tractors	Mitsubishi Corp.	12.8

Sources: Mathieson, R.S. (1979), Japan's Role in Soviet Economic Growth. Praeger: New York, pp. 53-64, and information obtained from East European Report, Business Eastern Europe and EastWest Markets.

on Table 6.5. In 1984 a Soviet source (Stolyarov and Pevzner, 1984, p. 173) reported that 70 percent of the timber carriers in "Dal'lesprom" (the Far Eastern Forestry Industry) were Japanese-built.

At the same time as the area of harvesting was being expanded, the technological level and production capacity of the forest enterprises in the region was increased with imports of Japanese equipment. In 1968 the Amursk combine near Komsomol'sk received Japanese equipment that doubled its pulp production capacity to 150,000 tons per year. During the 9th FYP a saw-milling and timber-processing complex capable of processing 1 million tons of timber per year was developed with Japanese assistance at Novomikhailovka in Primorskiy Kray. During the same period Japanese help was provided to build a large timber complex at Poronyask on Sakhalin Island (Matheison, 1979, p. 60). Braden (1983, p. 455) reported equipment deliveries under the first agreement to include ten Japanese planers for use at Krasnoyarsk and other at sawmills near Lake Baykal in Eastern Siberia, as well as two plywood lines for Irkutsk and Lake Baykal and sawmill machinery for a mill at Sovetskaya Gavan.

During the second agreement equipment was supplied to expand logging units in Primorskiy Kray and Amur Oblast' (Alexandrov, 1982, p. 24). To accommodate increased log harvesting the second agreement also provided for the expansion of processing facilities. According to Mathieson (1979, pp. 62-63) Japan supplied two complete pulp-making plants, which were located at Amursk in the Far East and Novoyeniseysk in

East Siberia. Another mill using Japanese plant and machinery was set up at Khabarovsk. Braden (1983, p. 463) includes pulp and paper equipment deliveries to Amursk as part of the wood chip and pulp development project signed in 1971. This project ran concurrently with the general agreements and delivered wood-chips and pulp in return for wood-processing equipment. It is difficult to separate pulp and chip project equipment from the general agreements, but it would seem that plant and equipment were supplied to construct a 250,000 ton-a- year pulp and paper mill at Lesosibirsk in East Siberia. This mill was probably supplied by Marubeni Iida and Sanyo-Kokusaku Pulp Industry and was worth $ 113 million.[49] A large mill worth $ 600-700 million and capable of producing 500,000 tons of newspaper and 50,000 tons of wrapping paper was built at Khabarovsk. In addition a pulpmill at Amursk was expanded (this is probably the mill mentioned by Mathieson as part of the first general agreement) and pulp and paper facilities on Sakhalin were modernised (Braden, 1983, p. 463). Whichever agreement provided credit for the supply of equipment, it is clear that during the 1970s these deliveries allowed a substantial expansion of the forest sector in Eastern Siberia and the Far East. It is likely that a similar pattern of imports continued through the third agreement with equipment for timber harvesting as well as processing. Braden (1983, p. 455) mentioned problems during the third agreement because the Soviet Union wanted to purchase equipment beyond the scope of Japanese expertise. This suggests a growing desire to use these agreements to create large-scale forest enterprises.

6.4.2. Conclusions

In many cases the effectiveness of Western imports to the forest industry has been reduced by delays in installation and problems with operation. The Bratsk-Ust'-Ilimsk TPC has suffered from all the problems habitually associated with such large projects, such as a lack of coordination between the various ministries and foreign trade organisations as well as the neglect of socio-economic infrastructure (Gukov and Dyatlov, 1981, pp. 125-126). Finnish machinery manufacturers interviewed by Braden (1983, p. 445) reported that equipment was delivered to Bratsk more than two years before buildings to house the equipment were completed. In Chapter 3 it was reported that once operational these very large complexes had had problems securing timber supplies and as a result were unable to operate at design capacity. There are also instances reported in the Soviet press where imported equipment was found to be unsuitable for Siberian conditions. For example, drying, sorting and bundling equipment for sawmills in "Krasnoyarskleseksport" (Lesosibirsk and Igarka) was eventually dismantled and sent to warmer climes.[50] Given these problems with assimilation it is not suprising that the forestry industry in Eastern Siberia and the Far East has shown very slow growth. If one examines the data presented in Table 3.11 it can be seen that between 1970 and 1984 sawnwood production in East Siberia only grew by 7.8 percent and in the Far East actually declined by 7.0 percent. Other parts of the forest industry have shown growth, particularly plywood production in East Siberia. Cardboard production has grown in both regions.

During the same period exports of forest products to the West were relatively stable, and they have actually declined in recent years (Table 5.8). One notable exception has been pulp exports which have shown a substantial increase. Without doubt the pulp mills at Bratsk and Ust'-Ilimsk have made a major contribution. However, during the late 1970s Bratsk was only operating at about 75 percent of capacity. Those complexes aside, it would seem that the forestry agreements with Japan have not produced rapid production increases in the forest products sector as a whole. There are a number of possible reasons for this: firstly, the agreements stressed the replacement and renovation of existing facilities; secondly, much of the equipment was used to gain access to new regions because the older more accessible regions were depleted; and thirdly, if much of the timber felled was removed from the region in the form of roundwood, whether for domestic or export markets, this increased timber production would not be reflected in regional forest products production statistics. In reality it is likely that a combination of all these factors has contributed to the seemingly poor performance of the Far Eastern forest industry.

In her study of technology transfer to the Soviet forest products sector, Braden (1981, pp. 114-115) concluded that:

> "Foreign machinery and equipment has contributed to intensifying wood products use, rebuilding older facilities, and the creation of new Siberian complexes."

In general the findings of this study support her statement. However, one could suggest that Western imports have been more effective in intensifying production in the modern and highly

concentrated forest industry of East Siberia, in such centres as Bratsk, Ust'-Ilimsk and Lesosibirsk, than in the older and more dispersed industry of the Far East. By concentrating on imports of processing equipment and ignoring imports of harvesting equipment, such as log carriers and bulldozers, one is bound to conclude that imports intensify production; but in the Far East imports have been used to extend the area of harvesting as much as to intensify production.

6.5 Western Technology in the Siberian Chemical Industry

Since Khrushchev's "chemicalisation drive" started in the late 1950s the Soviet chemical industry has been a major recipient of Western technology imports. A CIA analysis (CIA, 1978, pp. 6-9) of Soviet purchases of Western chemical equipment concluded that during the 1961-1970 period Western equipment purchases averaged $ 140 million per year and from 1971 to 1975, $ 700 million per year. The CIA analysis then compared the value of imports with the value of domestic investment in the chemical industry and concluded that between 1971 and 1975 the $ 3.6 billion spent on purchases of Western equipment represented 25 percent of total Soviet investment in the chemical industry. Hanson (1981, pp. 138-141) has suggested that because of the pricing system used in the CIA analysis the 25 percent share may be too low. During the 1976-1980 period the value of imports continued to grow, and purchases of Western equipment averaged $ 1.6 billion.[51] Hanson (1981, pp. 136-137), in an examination of the sectoral and branch distribution of Soviet technology imports, identified the chemical industry as one with a high degree of dependence

upon Western imports. This conclusion was based on a comparison of the industry's share of Western equipment imports and its share of "productive investment". Hanson's analysis showed the chemical industry's share of imports to be consistently higher than its share of productive investment, though the share of imports was seen to decline in the early 1970s. But chemical equipment imports showed a substantial increase during 1976-1980 period and then declined in 1981-1982, to recover again in 1983-1984 (Table 6.6). Although not strictly comparable, an analysis similar to Hanson's can be conducted for the period since 1975.[52] During the 10th FYP, the period 1976-1980, the chemical industry's average share of Western equipment imports was 24.7 percent, while its share of total capital investment in industry was 9.9 percent. In other words the industry maintained its high degree of reliance upon Western imports. During 1981-1984 the industry's share of Western equipment imports was 8.9 percent and its share of industrial investment was 7.7 percent. These figures suggest that during the 11th FYP the role of Western equipment imports declined as did the industry's share of total capital investment. These figures relate to new investment but say little of the overall role of Western equipment in Soviet chemical production. Despite recent declines it is clear that Western imports have played a substantial role in the recent development of the Soviet chemical industry (see Sobeslavsky and Beazely, 1980). The task here is to acertain how important such imports have been in the development of the Siberian chemical industry.

Table 6.6

Soviet Chemical Equipment Imports from the West, 1970 - 1984

(Million Roubles)

	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total Imports	193	638	1,132	1,722	1,743	1,754	1,244	852	853	1,042	1,176
Imports from West as a percent of all Chemical equipment imports	38.3	56.8	71.9	79.1	750	73.8	65.0	55.1	50.4	46.5	50.1
Chemical Imports as a percent of all western imports	8.3	10.0	18.9	30.9	27.4	28.7	17.4	10.8	7.3	7.2	10.2
Britain	13.7	37.1	78.4	38.4	47.7	165.7	161.7	71.6	26.0	19.1	28.1
Italy	14.0	52.0	69.1	268.2	267.4	179.6	99.1	65.4	69.0	76.1	38.4
United States	15.0	29.8	143.8	112.8	42.7	12.1	5.2	3.1	2.9	6.3	4.5
West Germany[a]	9.7	142.0	194.7	273.9	238.3	214.9	184.6	149.1	81.5	158.8	321.2
France	6.1	45.5	192.7	350.7	406.1	360.9	219.0	86.2	81.3	71.0	72.0
Japan	16.4	30.9	114.8	286.1	232.8	337.0	90.1	51.6	83.6	87.5	76.0
Above as a percent of total chemical equipment imports	31.8	52.9	70.1	77.3	70.8	72.4	61.1	50.1	4.04	40.2	46.0

Sources: Ministerstvo Vneshney Torgovli (various years), Vneshnyaya torgovlya SSSR. Moscow: Financy i Statistika.
Cooper, J. (1985), "Western Technology and Soviet Economic Power," in Technology Transfer and East-West Relations. Edited by M.E. Schaffer. New York: St. Martin's Press, pp. 94-95.

a. Does not include West Berlin.

As was explained in Chapter 3, despite obvious locational advantages the Siberian chemical industry has not grown as rapidly as might be expected. During the 1966-1980 period, when the Soviet Union's refining and petrochemical industries tripled their output, Siberia's share of Soviet chemical and petrochemical production actually declined.[53] This does not mean that the volume of production in Siberia declined, but rather production grew faster in other regions than in Siberia. In fact the period since the late 1960s has seen the development of a number of large chemical complexes in West and East Siberia, at Omsk, Tobol'sk, Tomsk, and Irkutsk. As was discussed in Chapter 4, these complexes have played an important part in the diversification of the Siberian economy and the in-situ processing of West Siberian hydrocarbon resources. In every case these large complexes have benefited from the importation of Western plant and equipment.

The data in Table 6.7 have been collected from reports in the journal Hydrocarbon Processing, which provides listing of major chemical construction project and their status. The date of first appearance represents the year when a contract was signed, not the date when negotiations first started. Western involvement in the Soviet chemical industry is complicated by the fact that the processes embodied in the chemical plant often belong to a different company from that constructing the plant. When possible, therefore, both the licensor and the engineer/contractor are identified. The major chemical product from each plant is identified in Table 6.7.

Since the 9th FYP the development of the West Siberian

Table 6.7

Western Equipment Imports to the Siberian Chemical Industry

Location	Project	Capacity	Estimated Cost $ million	First Appear-ance	Estimated Completion	Actual Completion	Licensor	Engineer	Contractor
West Siberia									
Kemerovo									
	Caprolactam	150 t/d	na	1966	1968	1972	Stamicarbon	Continental Eng.	Continental Eng.
	Ammonia (2 units)	2.7 mmt/yr	100	1975	1978	1981	Kellog	Kellog	Toyo Eng. & Mitsui Corp.
	Urea	5.0 mmt/yr	na	1973	1979	?	Montedison	Montedison	
Omsk									
	Petroleum Sulphates additives, lubes	na	na	1968	1971	1977	Castrol	Petrocarbon	Petrocarbon
	Grease Plant	5.0 mmt/yr	2	1969	na	1978	Tarmac	Tarmac	Tarmac
	Acid Sludge	40 t/d	0.3	1970	1971	1974	Witco Chem.	Petrocarbon	Sim-Chem
	Surface Active Agents	na	na	1971	1972	1977	Castrol	Petrocarbon	Petrocarbon
	Polystyrene	100 mt/yr	53	1975	1977	1982	Cosden	Litwin	Litwin
	Paraxylene	165 mt/yr		1976	1980	1984	UOP	Technip	Litwin
(comp)	Orthoxylene	165 mt/yr	250	1976	1980	1984	UOP	Technip	Litwin
	Benzene	125 mt/yr		1976	1980	1984	UOP	Technip	Litwin
	Catalytic Reformer	1.0 mmt/yr	40	1977	1981	1984	UOP	Litwin	Litwin
	Offsite utilities	----	na	1979	1981	?	----	----	Technip
Tobol'sk									
	Butadiene	180 mt/yr	na	1982	1985	?	Houdry	Toya	Toya
Tomsk									
(comp)	Polypropylene	100 mt/yr	na	1976	1978	1983	Montedison	Techimont	----
(comp)	Methanol	750 mt/yr	150	1977	1981	1984	ICI	Davy Powergas	Davy Powergas
	Waste Disposal	na	na	1984	1985	1986	Degremont	Kanematsu	----

Table 6.7 continued

Location	Project	Capacity	Estimated Cost $ million	First Appear.	Estimated Completion	Actual Completion	Licensor	Engineer	Contractor
East Siberia									
Krasnoyarsk									
	DMT	60 mt/yr	13	196?	1968	?	Witten	Simon-Carves	Simon-Carves
	Acetic Acid	35 mt/yr	14	196?	1968	?	Distillers	Davy Powergas	Davy Powergas
Angarsk									
	Urea	1.1 mt/yr	na	1977	1981	?	Stamicarbon	Chemoprojekt	Chemoprojekt
	Ammonia	1.4 mt/d	82	1978	1980	1984	ICI/Kellog	Toya/Mitsui	Toya/Mitsui
	Carbon Dioxide remover	39.9 mmcf/d	50	1978	1980	?	Benfield	Toya	Toya
	Benzene	120 mt/yr	na	1983	1984	?	Houdry	Eurotechnia	Eurotechnia
	Alcohols	30 mt/yr	10	?	?	1986	Intech	Intech	----
Irkutsk									
	Paraxylene	8 mt/yr	na	196?	?	?	Krupp	Krupp	Krupp
	Alcohols	20 mt/yr	10	?	?	1986	Intech	Intech	----
Zima									
	Treatment of effluent	4.0 mt/yr *	na	1974	1978	1983	Hoechst	Uhde	Uhde
	Carbon tetra-Chloride	36 mt/yr *	na	1974	1978	1985	Hoechst	Uhde	Uhde
(comp)	PVC	250 mt/yr *	71	1974	1978	1983	Huls	KHD/Prichard	Klockner
(comp)	Vinyl Cholride	270 mt/yr *	47	1974	1979	1983	Goodrich/ Hoechst	Badger/Uhde	Badger/Uhde
	Epichlorhydin	30 mt/yr	79	1976	?	?	Solvay	CMP	CMP
Ust-Ilimsk									
	Sodium chlorate	na	na	1975	?	?	Krebs	----	----

Table 6.7 continued

Sources: OECD (1980), East-West Trade in Chemicals. Paris:OECD, Annex 1, Sobeslavsky, V and Beazley, P. (1980), The Transfer of Technology To Socialist Countries: The Case of the Soviet Chemical Industry. Cambridge, Mass: OG&H, pp. 123-132., and Hydrocarbon Processing.

Abbreviations:

DMT = Dimethylterephthalate
PVC = Polyvinylchloride

(comp) = compensation agreement

t/d = tons per day
mt/d = thousand tons per day
mt/yr = thousand tons per year
mmt/yr = million tons per year
mmcf/d = million cubic feet per day

* = measure in long tons

chemicals industry has been directed towards processing West Siberian oil and gas resources. Prior to that the industry was concentrated in the southern regions of the Kuzbass and Altay Kray at centres such as Kemerovo and Barnaul. Initially the chemical industry was coal-based, but during the 1970s natural gas became the major feedstock and the Kemerovo complex received Western plant to produce urea and ammonia. Recently most Western imports have been delivered to the petrochemcials industry within the West Siberian TPC. The centre of the Omsk petrochemical complex is a large oil refinery which opened in 1955 and has since undergone numerous expansions (Sagers, 1984, p. 62). During the early 1970s imported plant and equipment were installed to produce lubricants for automobiles. In 1974 Litwin (a French subsidiary of Amtel, U.S.) sold the Soviet Union a polystyrene complex worth $ 33 million for the Omsk petrochemical coplex. The deal was a strict cash purchase rather than a compensation deal.[54] At the beginning of the 10th FYP, in 1976, the Soviet Union signed a $ 500 million compensation deal with the French company Technip to provide two aromatics complexes, one at Ufa and one at Omsk. These complexes use feedstock provided by local refineries and produce aromatics for use in making polyester fibres. Responsibility for engineering, procurement and construction was shared between the Italian company Eurotechnica, Litwin and Proco-France (a French subsidiary of UOP, U.S.). Technip managed the project and agreed to compensation deliveries worth $ 500 million between 1981 and 1989. Personnel training was also supplied by Technip and the licensor UOP.[55] Although

scheduled for completion in 1980 the Omsk complex did not come on stream until 1984.[56]

Large petrochemical complexes at Tobol'sk and Tomsk were identified as priority construction projects in the 9th FYP (Appendix 2). Of the two complexes Tomsk has received more Western technology. Tobol'sk is to become a major synthetic rubber centre and is relying upon Soviet technology and expertise for the majority of its production units. The Western contribution to Tobol'sk has so far been limited to the construction of a butadiene complex. The Japanese companies Toya Engineering and Mitsui were awarded a contract to construct two butadiene units with a combined capacity of 180 thousand tons a year. Financing was provided by the Japanese EXIM Bank and construction was scheduled to be completed in 1986.

The development of the Tomsk petrochemical complex has been divided into a number of stages. The first stage of the complex consisted of the construction of a polypropylene plant. In 1975 the Italian company Montedison was contracted to provide a 100,000-ton a year plant, which was part of a much larger compensation deal in 1973 to provide $ 800 million worth of chemical equipment (Sobeslavsky and Beazely, 1980, p. 90). Montedison's engineering construction subsidiary Techimont was responsible for construction of the plant, which was scheduled for completion in 1980. The plant actually started production in 1981 and once at its design capacity will more than triple Soviet polypropylene production.[57]

The second stage of the Tomsk complex has involved the

construction of a large methanol plant. In 1977 a British consortium consisting of Davy Powergas, ICI and the West German company Klockner signed a compensation deal worth over $ 250 million to provide two 750 million ton a year methanol plants, one at Gubakha (in the Perm' region) and one at Tomsk. In return the Western partners will receive about 300,000 tons of methanol a year for a 10-year period once production starts. The plants were engineered and supplied by Davy Powergas and use an ICI process to produce methanol from natural gas. West German involvement was through Klockner's U.K. subsidiary Klockner INA Industrial Plants, which was involved with Davy Powergas in construction and also in the financial arrangements. ICI and Klockner will market the deliveries of methanol.[58] Various other British companies were sub-contracted to provide plant and equipment for the two complexes; for example, Tonnes Forces provided $ 267,700 worth of electric hoists, S.W. Farmer and Sons Ltd. provided 2,000 tons of structural steel worth $ 2.6 million, and GEC Electrical Projects Ltd. supplied $ 6 million worth of electrical equipment for the two plants.[59] In total some 65,000 tons of equipment were delivered to the two sites in the biggest Soviet-U.K. contract ever.[60] The methanol plant at Tomsk was due to come onstream during 1981-1982 but did not actually start up until late 1982 with the first methanol being produced in July 1983. During 1984 the plant was still operating well below design capacity.[61] Both the polypropylene plant and the methanol plant suffered construction delays due to a shortage of cranes, cables, piping and other equipment.

In the case of the methanol plant a full year's work was lost due to poor site selection, the plant site having to move due to potential pollution problems.[62] Once the plant was operational it was unable to operate at capacity due to insufficient supplies of natural gas and inadequate repair facilities. When the plant reaches design capacity it will add 750 thousand tons to Soviet methanol production, representing a 39 percent increase in production capacity (Table 6.8). The Gubakha and Tomsk complexes with a combined production of 1.5 million tons will almost double Soviet methanol production. Half of the methanol produced by these complexes will be used to produce formaldehyde for the construction industry, and the rest will be used for solvents, fibres, anti-freeze, explosives, herbicides, insecticides and protein manufacture. According to Sobeslavsky and Beazely (1980, p. 139) the third stage of the Tomsk complex was to consist of a massive $ 4 billion complex provided by a West German consortium. However, no contracts have been announced. Given the poor track record of the Tomsk complex and the present emphasis upon improved economic efficiency the third stage has probably been postponed for the time being.

In East Siberia Western imports have been used in the creation of a series of chemical centres in the Zima-Angarsk-Irkutsk region along the Angara River in Irkutsk Oblast'. A combination of hydrocarbon feedstocks from the Angarsk refinery, local salt deposits (a source of chlorine), fresh water, and hydro-power has provided ideal conditions for the construction of a plastics-producing centre and naptha-based

Table 6.8

Soviet Production of Selected Chemicals, 1970-1983

(Thousand Tons)

	1970	1975	1980	1981	1982	1983
Methanol	1004	1447	1900	2030	1989	2174
Polyethylene and Ethylene	267	420	623	807	776	873
Polyvinylchloride and Vinyl Chloride	160	334	398	404	383	414
Polystyrene and Styrene	82.2	144	247	329	306	358

Source: Sovet Ekonomicheskom Vzaimopomoshchi (1984), Statisticheskiy ezhegodnik stran - Chlenov Soveta Eknomicheskoy Vzaimoposhchi. Moscow: Finansy i Statistika, pp. 88-91.

ammonia and urea plants for fertilizers and plastics. The basic products are ethylene and in the near future benzene. An ethylene plant has been constructed at Angarsk with a capacity of 450,000 tons per year. The plant is Soviet-built and uses a process developed in cooperation with East Germany. Ethylene from Angarsk now provides the basis for a plastics complex at Zima. Ethylene is transported 230 km along an 8 inch (203.2 mm) pipeline system built by John Brown Construction using Soviet pipe and imported compressors. The system has an annual throughput of 200,000 tons. Local salt deposits at Zima provide raw materials for the production of vinyl chloride and PVC. In 1972 a compensation deal was signed with a number of West German companies to construct a vinyl chloride plant with an annual capacity of 270,000 tons. The plant was constructed by Uhde using a Goodrich/Hoechst process and was due to be completed in 1979, but it did not start production until 1983. The construction of the ethylene pipeline from Angarsk was also delayed and was completed in 1981.[63] Also in 1974 the West German company Klockner signed a compensation deal to construct a 250,000 tons a year PVC plant at Zima worth $ 71 million. The plant uses a Huls process. In addition Salzgitter provided storage and packing facilities and Hooker a chlorine plant for the complex (Sobeslavsky and Beazely, 1980, p. 140). The plant was scheduled for operation in 1979 but like the vinyl chloride plant was delayed until the early 1980s. The design capacity of the Zima complex will raise Soviet PVC production by over 60 percent of 1981 production levels (see Table 6.8). In addition to the plastics complex, a carbon tetrachloride plant and

epichlorhydin plant have been imported for the Zima complex to produce epoxy rubber, resins, varnishes and paints.

The ammonia plant constructed at Angarsk by Toya and Mitsui was one of 14 complete plants supplied by them to the Soviet Union since 1969. This plant was however the first constructed by the two companies to produce ammonia from naptha (the others used natural gas) and was also the first ammonia plant constructed by them in Siberia. A urea plant has also been constructed at Angarsk, creating a basis for fertilizer production. While it is clear that imported plant and equipment have played a major part in the development of the Siberian chemical industry, it is also apparent that the Far East has not benefited from such imports. The reasons for this lie with the lack of adequate feedstocks. Petroleum refineries at Komsomol'sk (connected by pipeline to Sakhalin) and Khabarovsk cannot even meet local demands, let alone supply a large petrochemical industry. There are signs however that once the Sakhalin Continental Shelf project starts to deliver oil and gas to the mainland, a gas-based chemical complex may be constructed in the Far East with Japanese help. In addition the development of apatite deposits in the South Yakutian TPC will provide the basis for fertilizer production, thus reducing the need to import fertilizers into the Far East.

On the basis of the information presented above it is possible to make a number of observations concerning the role of Western technology in the development of the Siberian chemical industry. Firstly, despite the lack of detailed regional production figures, it is clear that individual

complexes at Omsk, Tomsk and Zima have made significant contributions to increasing production of certain chemicals, namely polypropylene, vinyl chloride, P.V.C. and methanol. Siberia's share of these chemicals is much greater than its share of total Soviet chemical production. Soviet studies of the development of the Siberian chemical industry (Listov, 1978, Kalashnikova, 1980 and Fridman, 1984) identify Omsk, Tomsk, Tobol'sk, Zima and Angarsk as the focus of investment since the early 1970s. With the possible exception of Tobol'sk, all of these complexes have relied on large-scale importation of Western turnkey chemical plants.

Secondly, the effectiveness of these imports has been reduced by construction delays and production problems. While the conditions in Siberia probably contribute to these delays, construction delays have been symptomatic of the entire Soviet chemical industry. In 1976 Leonid Kostandov, the Minister of Chemical Industries, reported that only 76 of 251 chemical construction projects were on schedule, and of those 76 only 17 were actually producing. In many cases the main structures were completed, but the building of access roads and other infrastructure had fallen behind. In addition shortages and misuse of railway transportation had contributed to delays. As a result the chemical industry experienced declining growth rates and did not meet targets set by the 10th FYP (Ogawa, 1980, pp. 30-31). Surveys of Western companies which have supplied chemical equipment to the Soviet Union suggest that construction projects do tend to take longer than equivalent projects in the West (Holliday, 1984, pp. 76-78). The CIA

study of the chemical industry noted that while there were delays in projects involving Western plant, domestic projects often suffered even longer delays, suggesting that Western involvement provided a project some priority status. The data on estimated and actual completion times presented in Table 6.7 show an average delay of almost 4 years. Given the large size of many of these projects, such delays represent a substantial waste of capital, labour and equipment in a region where such resources are in short supply. Once a plant is operational there is no guarantee that it will operate at design capacity, nor that it will operate as efficiently as in the West. Nevertheless, Western analysts generally agree that imported plant performs more efficiently than Soviet-built equivalents (Holliday, 1984, pp. 77-78).

Thirdly, because of the delays in the installation of productive capacity the full impact of imported plants is not yet apparent in the production statistics. As the large plants at Omsk, Tomsk and Zima come onstream the volume of Siberian chemicals will increase. But this does not necessarily mean that Siberia's share of national production will increase. Most investment in the Soviet chemical industry and most purchases of Western plant have been directed towards the European regions of the Soviet Union. Thus, while Siberian production has increased as a result of imported plant, production has probably grown more rapidly in other regions.

Finally, the structure of Western equipment imports to Siberia suggests a somewhat truncated chemical industry with emphasis upon basic and to a lesser extent secondary products.

While there are consuming industries in Siberia it is likely that a large amount of Siberian production is transported by rail to other consuming regions. In sum, one can conclude that imports have been very important in the recent development of the Siberian chemical industry, but Siberian production remains of limited national importance.

6.6. Transportation

The final section of this analysis of Western imports and Siberian development focuses upon the Siberian transportation system. The role of Western imports in the development of the various pipelines systems has already been discussed. In this section three aspects of the transport system are examined: the role of Western imports in the development of the Northern Sea Route, the development of the port at Nakhodka-Vostochnyy, and the use of imported equipment in the construction of the BAM railway.

6.6.1. The Northern Sea Route

During the 1970s the Soviet Union invested considerable sums in extending operations along the Northern Sea Route (see Figure 4.7 for a map of the route). By 1976 operations from Murmansk to Dudinka had been extended from three and a half to four months to more or less year-round. In the eastern sector the season has remained about three months but the level of activity has increased (Armstrong, 1983, p. 254). The expansion of operations in the western sector has been in response to oil and gas development in Western Siberia and the expansion of mining activity at Noril'sk. It is possible to identify three general tasks for the Northern Sea Route; first,

the movement of fuel, freight and river craft to northern settlements and river basins in Siberia and the Far East; second, the movement of Noril'sk ore to Murmansk and Igarka timber to export markets; and third, the movement of shipping through the route to deliver grain from Western Canada to European Russia or freight to the Far East from the Baltic. To expand operations it has been necessary to increase the number of ships working the route as well build special ships suited to arctic conditions. Efforts to extend operations have required investment in additional icebreakers of various types and ice-strengthened freighters and tankers, and it is here that Western shipbuilders have made a major contribution.

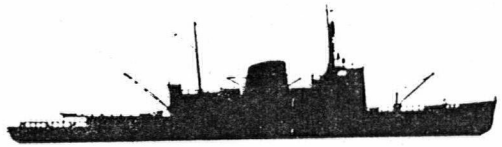
The Soviet Union has without doubt the world's largest and most powerful fleet of icebreakers. The flagships of the icebreaker fleet are the four atomic icebreakers, "Lenin" (1959), "Leonid Brezhnev" (1974), "Sibir'" (1977) and "Rossiya" (1985). These ships are all Soviet-built and the three most recent ships have two reactors capable of producing 75,000 horsepower (shp.). In addition to these large atomic icebreakers the Soviet Union has since 1960 purchased no less than thirty-one icebreakers of various types from the Finnish company Wartsila (see Table 6.9 and Figure 6.1). Not all of these ships are operating on the Northern Sea Route, but the vast majority of them have been assigned to ports in Siberia and the Far East. As was mentioned in Chapter 2, Soviet trading relations with Finland are somewhat different from those with other Western nations, being based on a clearing system (see Holopainen, 1983, pp. 173-180). As part of this

Table 6.9

Icebreakers Supplied to the Soviet Union by Wartsila

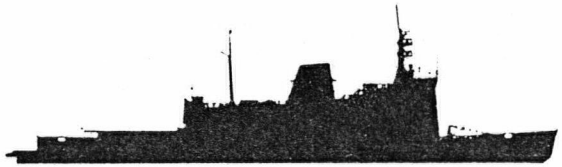
Class and Delivery Dates	Type, Size and Power,	Ships built in class
"MOSKVA" 1960-1969	Polar Icebreaker 22,000 shp Displacement 13,290 tonnes	Moskva - 1960 Leningrad - 1962 Kiev - 1965 Murmansk - 1968 Vladivostok - 1969
"ERMAK" (YERMAK) 1974-1976	Polar Icebreaker 36,000 shp Displacement 20,240 tonnes	Yermak - 1974 Admiral Makarov - 1975 Krasin - 1976
"KAPITAN SOROKIN" 1977-1981	Shallow-draught Icebreaker 22,000 shp Displacement 14,900 tonnes	K. Sorokin - 1977 K. Nikolaev - 1978 K. Dranitsyn - 1980 K. Khlebnikov - 1981
"KAPITAN CHECHKIN" 1977-1978	River Icebreaker 4,490 shp Displacement 2,300 tonnes	K. Chechkin - 1977 K. Plakhin - 1977 K. Chadaev - 1978 K. Krutov - 1978 K. Zarubin - 1978 K. Bukaev - 1978
"MUD'YUG" 1982-1983	Sub-arctic Icebreaker 12,400/10,000 shp	Mud'yug - 1982 Magadan - 1982 Dikson - 1983
"KAPTIN EVDOKIMOV" (YEVDOKIMOV) 1983-1986	River Icebreaker 5,170 shp	K. Evdokimov - 1983 K. Babichev - 1983 K. Chudinov - 1983 K. Borodkin - 1984 Avraamiy- Zavenyagin - 1984 K. Mecaik - 1984 K. Demidov - 1984 Unnamed - 1986
"TAYMYR" 1988-1989	Shallow-draught Nuclear Icebreaker 52,000 shp (Soviet-built reactor)	Taymyr-1988 Unnamed-1989

Source: Wartsila (1984), Icebreakers Built or on Order at Wartsila's Helsinki Shipyard. Helsinki : Nova.

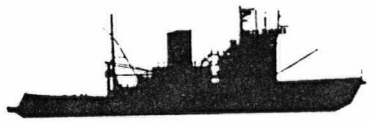


pi MOSKVA, 22000 s.h.p.,
diesel-el., built 1960

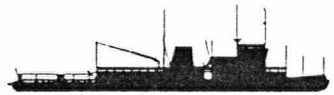
ri KAPITAN CHECHKIN, 4490 s.h.p.,
diesel-el., built 1977



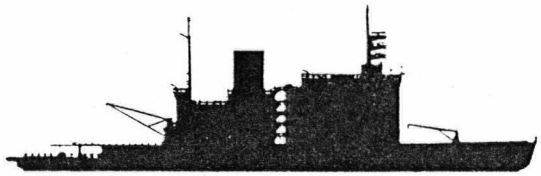
pi ERMAK, 36000 s.h.p.,
diesel-el., built 1974



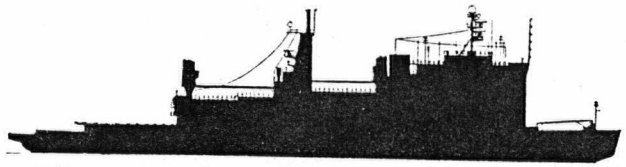
si MUDYUG, 12400/10000 h.p.,
diesel, built 1982



ri KAPITAN EVDOKIMOV, 5170 s.h.p.,
diesel-el., built 1983



pi KAPITAN SOROKIN, 22000 s.h.p.,
diesel-el., built 1977



npi Yard nr. 474, 52000 h.p.,
nuclear turbo-el., delivery 1988

Figure 6.1 Icebreakers Supplied by Wartsila, 1960-1986

special trading relationship the Soviet Union has signed a number of long-term agreements on the importation of ships. In the last thirty years Finnish shipyards have delivered 1,500 ships of various types to the Soviet Union. Between 1976 and 1980 the value of ship deliveries exceeded 1.3 billion roubles. Between 1981 and 1985 contracts worth 2.5 billion roubles were signed and in the period from 1986 to 1990 orders could reach 3 billion (Smelyakov, 1983, p. 107). The delivery of ships under these agreements has been dominated by three companies: Wartsila, Valmet, and Rauma Repola. Between 1935 and 1985 Wartsila delivered a total of 481 ships to the Soviet Union; in 1985 Valmet delivered its 600th ship to the Soviet Union; and in 1986 Rauma Repola delivered its 850th vessel.[64] These companies have all supplied ships for the Northern Sea Route. Wartsila has specialised in icebreakers, Valmet in ice-strengthened freighters and Rauma-Repola in ice-strengthened tankers.

Of the nineteen icebreakers of 10,000 shp. or more operating on the Northern Sea Route fifteen have been supplied by Wartsila (79 percent). If one examines the list of ships supplied in Table 6.9 it is possible to relate the various types of ship to specialist tasks associated with the extension of operations along the route. The "Moskva" class of polar icebreaker is a conventional icebreaker used in combination with the atomic icebreakers to escort freighters. The "Yermak" class of polar icebreaker is more powerful than the "Moskva" class and is equipped with Wartsila's "air-bubbling" technology which reduces the friction between the ice and the hull of the

icebreaker (see Johansson, 1972, p. 32). The "Yermak" class is also used to escort freighters.

While polar icebreakers enable shipping to pass throught arctic sea lanes, shallow-draught icebreakers are required to get inshore or up the various river estuaries. The "Kapitan Sorokin" class of icebreaker is specially designed to operate in the relatively shallow lower reaches of the Ob' and Yenisey rivers and has a draught of 8.5 metres. Vessels of this class pick up convoys at the mouth of the Yenisey and deliver them to the port of Dudinka. They have also been assigned to Murmansk and Vladivostok.

At the same time as the shallow-draught icebreakers were being built Wartsila was also delivering a series of much smaller river icebreakers. The majority of these ships of the "Kapitan Chechkin" class have been assigned to the Volga-Kama river system, but the "Kapitan Chechkin" has been assigned to the Yenisey river fleet and the "Kapitan Plakhin" to the Irtysh. In 1982 three smaller sub-arctic icebreakers, the "Mud'yug" class, were ordered, one of which, the "Dikson", is stationed at Dudinka. The "Mud'yug" has been assigned to Arkhangel'sk and the "Magadan" is keeping shipping lanes out of Magadan open. In an interesting development the icebreaker "Mud'yug" has recently undergone conversion in a West German shipyard where a new icebreaking bow was put on the ship. The new design has been developed by Thyssen-Wass and could represent a threat to Wartsila's monopoly of Soviet icebreaker orders.[65] A second class of river icebreaker was ordered in 1983. These ships of the "Kapitan Demidov" class have an

extremely shallow draught of 2.5 metres and have evolved out of the "Kapitan Chechkin" class. They have been designed to operate on Siberian rivers in ambient temperatures down to minus 50°C. To allow passage below bridges the vessels have been fitted with an automatic system for lowering masts and aerials. As with many of the other ships, some of the equipment has been provided by the Soviet Union.[66] These ships will be used throughout the Siberian river system on the Ob', Irtysh and Yenisey.

The most recent order from the Soviet Union is for two shallow-draught nuclear-powered icebreakers. The "Kapitan Sorokin" class of shallow-draught icebreaker has proven to be very successful. The "Kapitan Sorokin" and "Kapitan Dranitsyn" operate year-round out of Dudinka; however, these ships use a lot of fuel and often have to sail long distances to refuel. One of the obvious advantages of the nuclear-powered ships is that they can operate for long periods without refuelling. The "Taymyr" class of shallow-draught atomic icebreakers is the result of cooperation between Wartsila and the Soviet Union that began in 1980. These ships will only have a draught of 8.0 metres with a power output of 52,000 shp.. The vessels are being built in Wartsila's Helsinki shipyard, and the nuclear reactor will be installed in the Soviet Union. In addition to the reactor the Soviet Union is providing steel and the main and auxiliary turbines. The ships will operate in ambient temperatures down to minus 50°C and are specially designed for north Siberian rivers. This new generation of atomic icebreaker together with the conventionally-powered and ice-

strengthened LASH carrier "Aleksey Kosygin" and the ice-strengthened atomic LASH carrier "Sevmorput'", both Soviet-built, suggest a long-term commitment to operations on the Northern Sea Route.

The various classes of icebreaker built by Wartsila for the Soviet Union have enabled the expansion of operations along the route and the penetration of shipping services into the Gulf of Ob' and the Gulf of Yenisey in the Western sector. Freighters loaded with large-diameter pipe from Europe and Japan now deliver straight to northern Siberia, while ore from Noril'sk is delivered year-round to Murmansk. In the eastern sector, ports at Tiksi and Pevek have operated as transhipment points to deliver freight to remote mining operations in the Northeast.

The disasters of the 1983 shipping season, when a number of ships were trapped in the ice, one sank and one was badly damaged, illustrate the dangers of using ill-suited shipping in arctic waters (see Barr and Wilson, 1983). Even before those events the administrators of the Northern Sea Route were aware of the need for additional ice-strengthened freighters. In 1977 G.D. Burkov, a senior inspector for the administration of the Northern Sea Route, pointed out that in 1971 there were only 13 of the strongest ice-strengthened freighters working the route and that in 1977 that number was lower as some ships had been downgraded due to old age.[67] To improve this situation the Soviet Union has sought to increase the numbers of ice-strengthened freighter and tankers operating on the route. East Germany has supplied a series of bulk carriers of

the "Dmitriy Donskoy" class to transport ore between Dudinka and Murmansk; on the eastward leg of the journey these ships can be fitted for containers.[68] The Finnish shipbuilder Rauma Repola has supplied two series of ice-strengthened tankers. The first order was for eight "Samotlor" class tankers with a displacement of 14,500 tonnes and a power output of 12,000 shp.. These ships were delivered between 1975 and 1977. In 1983 Rauma Repola was contracted to supply five "Arktika" class products tankers. These vessels have a displacement of 5,570 tonnes and are designed to carry oil products, methanol and other liquids in arctic waters. The hull has a double shell and the ship has an icebreaker bow. The main engine is Soviet-built. In 1985 Rauma Repola was contracted to supply a further five "Arktika" class tankers.

The final series of ships supplied by Finnish shipyards for the Northern Sea Route is the "Noril'sk" class SA-15 general cargo ship (see Figure 6.2). This ship is of particular interest because versions have been built by both Wartsila and Valmet. The ship has a displacement of 15,000 tonnes, can maintain movement in 1 meter-thick ice, has the Wartsila "air bubbling system" and can operate in temperatures down to minus 50 ^{o}C. The highly versatile design incorporates features for containers, refrigerated cargoes, roll-on-roll-off and bulk carrying. The ship does not require port facilities to unload and has a stern ramp for unloading onto fast ice. In addition the vessel can be equipped with an air-cushion lighter capable of lifting 38 tons.[69] The first consignment of nine SA-15s was delivered between 1982 and 1983. Six were built by

Figure 6.2 Noril'sk Class SA-15 Ice-Strengthened Freighter

Wartsila and three by Valmet, but the design was Wartsila's. Wartsila also supplied nine air cushion vehicles for the ships. Following the initial delivery a further five ships were ordered, three from Wartsila and two from Valmet. Some of the first order of SA-15s were involved in the 1983 shipping crisis and according to one Soviet source, " were put to the most severe 'trial' conditions and passed the examination honourably".[70] Perhaps as a result of this success, a further five ships were ordered from Valmet for delivery between 1985 and 1987. (During 1986 Valmet and Wartsila merged.) The first of these ships, the "Anatoliy Kolesnichenko" was delivered in 1985 and is described as an "SA-15 Super". It incorporates a number of modifications as a result of experiences operating on the Northern Sea Route. These SA-15 ships have played a major role in expanding operations in the north. In 1984 five SA-15s delivered grain from Vancouver, in Western Canada, to European Russia via the Northern Sea Route, and in the same year the SA-15 "Igarka" delivered a cargo of pipe from Bremen to Nakhodka-Vostochnyy.[71] Despite their special design for arctic waters some of the SA-15 have been used as general cargo ships in southern waters, a rather illogical use of specialised shipping.

On the basis of the information presented above it is quite evident that the importation of specialist shipping from Finnish shipyards has been an essential factor in the extension of operations along the Northern Sea Route. Not only have specialised icebreakers been supplied, but also special tankers and freighters to deliver fuel, supplies and equipment to

northern construction sites and mining operations. Consistent reliance upon Finnish shipbuilders has enabled companies like Wartsila to become world leaders in icebreaker technology, so that both sides have benefited.

6.6.2. Nakhodka-Vostochnyy

As trade between Japan and the Soviet Union has expanded so has the demand for port facilites in the Far East. To facilitate timber exports related to the various forest agreements, the expansion of container traffic on the landbridge and coal deliveries from South Yakutia a special port has been been built at Vostochnyy. In December 1970 Japan provided $ 80 million worth of credit to the Soviet Union to expand port facilities in the Nakhodka region. As a result of this agreement a large export-oriented port has been built at Vostochnyy. Between 1972 and 1978 the $ 80 million credit was used to complete the first stage of the port, which consists of a timber-loading complex capable of handling 400,000 tons a year, a wood chip production and loading facility with a capacity of 800,000 tons a year, a container port with a capacity of 700,000 tons a year and a coal export terminal capable of loading 6 million tons of coal a year. Japanese companies provided equipment for the construction of the port, including bulldozers, excavators, cranes, and steel products. The vast majority of the contracts under the credit agreement were awarded to three companies: Mitsubishi, Sumitomo and Mitsui (Mathieson, 1979, p. 34). Mitsui provided $ 27.2 million worth of equipment for the coal terminal (this was discussed earlier in relation to the South Yakutian Coal

Project), as well as conveying and ship loading equipment for the wood chip terminal. Container-handling equipment was also provided by Mitsui, as was a computer centre for the container terminal (Zhebelev, 1982, p. 27). The container terminal is designed to ship 700,000 containers a year but is reported to have handled only 100,000 containers in 1981. In addition to port facilities Oki Electric Industry Co. provided a ship traffic-control systen for the port complex at Nakhodka-Vostochnyy. The system includes a medium-sized computer, 10 microcomputers, display panels and microwave communications devices.[72] The sale was approved by CoCom. In their early stages operations at Vostochnyy were problematic. Timber did not arrive in standard packages and had to be repacked at the port, there were insufficent logs to operate the chip plant at capacity, and storage space was insufficient to handle imported containers. These problems have since been resolved and thanks to Western equipment Vostochnyy now acts as a model of Soviet efficiency. The second stage of development presently under way will add an additional 7 million tons to the capacity of the coal terminal and expand the container terminal and general cargo facilities. Eventually Vostochnyy will have 64 berths with a total length of 18 km and will be capable of handling 40 million tons a year, making it the biggest port in the Soviet Union.

As a result of the increasing use of containers the Soviet Union has imported two container-production facilities. The larger of the two, capable of producing 40,000 containers a year, was supplied by Kawasaki Heavy Industries to the Abakan

railcar plant in the Sayan TPC. The Soviet Union has also purchased special container ships and container-handling equipment not only to operate the Landbridge, but also to meet domestic demands. In the Far East container facilities are being built at Vanino and Magadan and containers are being used on the Northern Sea Route. Thus, the importation of modern port equipment has enabled the Soviet Union to expand foreign trade and also improve the domestic transportation system.

6.6.3. The Baykal Amur Railway

Given the obvious strategic importance of the BAM railway it is not suprising that the there has been a minimal amount of Western involvement in the project. Nevertheless, both West European and Japanese companies have supplied equipment. Two West German companies, O & K Orenstein and Koppel Ag., supplied 200 completely equipped trucks for servicing construction machinery on the BAM. The contract, worth $ 23 million, called for 100 triaxial 29-ton tool and gear trucks, 59 biaxial 16-ton trailers equipped with repair tools and 15 19-ton trucks for lubricating work.[73] Another West German company, Faun-Werke Nurenburg, won a $ 7 million contract to supply 80 heavy-duty prime movers designed to operate in very cold temperatures.[74] The French heavy equipment company Poclain supplied $ 5 million worth of heavy duty excavators, again specially designed to operate in cold temperatures.[75] The Japanese company Kato provided a large number of cranes and exacavators and Komatsu sold numerous bulldozers for construction work on the BAM. So many Komatsu bulldozers were imported that special training facilites were created to train Soviet operators. The Japanese

company Furukawa sold 12 tunneling units worth nearly $ 5 million. This equipment was used to build the 15-km Muya tunnel (Alexandrov, 1982, p. 26). Streif Consulting (West Germany) was contracted to built a turnkey factory in Siberia to produce mobile homes for workers constructing the BAM.[76] Finally, Telettra (Italy) provided a microwave communication systen worth $ 2 million to allow high-quality transmissions along the BAM.[77]

Given the harsh operating conditions prevalent along the route of the BAM railway it is perhaps not surprising that the Soviet Union had to import specialised machinery. These orders provide yet another illustration of the inability of the Soviet machine-building industry to meet the needs of Siberian construction projects. In terms of the total investment in the BAM Western equipment imports played a very small role. However, they provided the necessary specialised equipment to enable construction in extreme conditions, thus their worth was probably greater than their share of investment.

In sum, it would seem that imports of Western equipment have been used to meet the specialised requirements of Siberia and the Far East by providing machinery and ships capable of operating in extreme conditions. In addition imports have provided additional inputs necessary to move Siberian resources to both domestic and foreign markets.

6.7. The Spatial Distribution of Western Technology in Siberia and the Far East

So far this chapter has presented a detailed analysis of the role of Western imports in Siberian industry. This section provides a brief regional summary of the role of Western technology in the Siberian economy. As with export production, the regionalisation scheme presented in Chapter 4 provides the framework for this discussion.

The Ob'-Irtysh sub-region specialises in the production and transportation of oil and gas. It is therefore not surprising to find that Western imports have been used to develop the hydrocarbon potential of the West Siberian basin. Special operating conditions in West Siberia have sometimes required specialised equipment that is not available domestically. Within the oil and gas sector the most important recipients of imports have been the oil and gas pipeline systems. Ironically, the large-scale import of pipe and pipe-laying equipment has acted against increased industrial development within the West Siberian TPC by enabling the export of unprocessed hydrocarbon resources to consuming and processing centres in the European USSR. Within the West Siberian TPC the petrochemical industry is using casing-head gas as a feedstock. Western imports have played a part in increasing the region's gas processing capacity and in developing the petrochemicals industry. Much of the Western technology delivered to the Ob'-Irtysh sub-region has been financed by compensation agreements. For example, deliveries of natural gas have paid for imports of large-diameter pipe.

Western imports appear to have played a minor role in the

the development of the Kuzbass-Altay sub-region. There have been imports of mining equipment and the construction of a slurry pipeline, and Western chemical equipment has been installed at Kemerovo. But the ferrous-metallurgy and machine-building industries in the region have not benefited from imports. The limited role of imports is matched by the region's relative neglect in recent economic plans and its very small contribution to exports to the West.

As with export production, discussion of the role of imports in the Angara-Yenisey sub-region is divided between the northern and southern areas. In the north imports have played an important role in the expansion of production at the Noril'sk metallurgical combine. Finnish companies have supplied much of the plant and equipment for the Nadezhda smelter. In addition Finnish shipyards have delivered ships that have enables the year-round transportation of Noril'sk ore to smelters on the Kola Peninsula. In the south Western turnkey plants have been important in the development of the large industrial centres that constitute the Angara-Yenisey system of TPCs. Imported forestry equipment has been installed in the large forestry centres of the Bratsk-Ust'-Ilimsk TPC. The Sayan TPC has benefited from a large compensation agreement which is providing an aluminum smelter and associated facilities. Also within the Sayan TPC the Abakan railcar plant has received Western equipment to produce containers. In the Irkutsk region the Angarsk-Zima chemical centre has relied heavily upon Western technology. So far the Kansk-Achinsk TPC has not been a major recipient of Western technology. However,

in the future synfuel technology may be imported to process the complex's coal resources. In sum, within the Angara-Yenisey system Western imports have been used to develop the national specialisations of the various TPCs and industrial centres.

Neither the Transbaykal nor the Amur regions have benefited from substantial imports of Western technology. Western machinery has been used to a limited extent in the construction of the BAM railway, and the Amur sub-region received forestry equipment under the various compensation agreements with Japan. Most of the equipment delivered under these agreements has been used in extensive development of the region's forest resource. In addition a limited amount of processing equipment has been installed at Khabarovsk and Amursk.

As with export production, the Pacific sub-region has benefited the most from trade with Japan. The forest industry, on the mainland and on Sakhalin Island, has received both harvesting and processing equipment. Exports of coal, lumber and wood chips and the movement of containers have promoted the expansion of port facilities at Nakhodka and Vostochnyy. The Sakhalin Continental Shelf Project has created the potential for increased oil and gas production in the Far East, as well as the possible development of the chemical industry. The vast majority of the technology and equipment deliveries described above are associated with long-term compensation agreements between Japan and the Soviet Union.

In the harsh environmental conditions of the Lena-Kolyma sub-region specialised mining equipment has been imported to

compensate for the inadequacies of the domestic machine-building industry. While imports of excavators, bulldozers and dump trucks cannot really be considerd "high-tech", they have played an important part in mining operations in the north, particularly at the South Yakutian TPC. Although no longer operational, the Yakutia Natural Gas Exploration Project provided the Soviet Union with access to "high-tech" exploration equipment and delineated the natural gas deposits of the Vilyuy basin. In the extreme north the expansion of operations along the Northern Sea Route has played an important role in the development of mining operations. While the South Yakutian Coal Project is the only compensation agreement in the region, the gold and diamond mines generate substantial amounts of foreign currency that more then compensate for the cost of importing equipment.

In general, the spatial distribution of imports follows that of domestic investment and export production, concentrating upon the northern and Pacific regions. Unlike exports, the pattern of imports is not dominated by a single region. Instead, Western plant and equipment tends to be concentrated within the TPCs and larger industrial centres. Within the TPCs there is a strong correlation between Western imports and specialisation industries. Finally, the juxtaposition of exports and imports results from the popularity of compensation agreement for promoting Siberian development.

6.8. The Role of Western Technology in Siberian Development: Conclusions

A number of concluding remarks can be made about the role of Western technology in Siberian development. Firstly, in most cases imported plant and equipment have been used to further the exploitation of Siberian natural resources. In other words imports have served to perpetuate the primary resource specialisations of Siberia and the Far East. There are a limited number of cases where imports have served to intensify the level of economic activity, namely the chemical complexes of the West Siberian TPC and the Irkutsk region, the forest complexes at Bratsk-Ust'-Ilimsk, and the Sayan TPC. These industrial centres are all located within the southern regions of Siberia. In the north, imports have clearly been dedicated to resource production, primary processing and transportation.

Secondly, in many instances imports have been used to enhance export production. This results from the use of compensation agreements to obtain Western technology. In most compensation agreements about 30 percent of the productive capacity of the plant is dedicated to compensation deliveries. In a sense Siberian resources have been mortgaged to pay for imported equipment.

Thirdly, the efficiency of technology transfer is often reduced by problems inherent in the Soviet economic system. There are numerous examples of Western projects experiencing long construction delays. In other cases Western equipment, once installed, is unable to operate at capacity, usually because of problems of raw material and/or energy supply.

These delays are often the result of a lack of horizontal planning, which leads to a neglect of economic infrastructure. Even within the TPCs, which are designed to promote integration and cooperation, delays and inefficiences result from poor planning. Thus, even the high priority often attached to projects with Western involvement is insufficient to overcome the problems of the planning system. These "systemic" problems occur throughout the Soviet Union but seem particularly acute in Siberian construction projects, where inputs are in short supply and operating conditions difficult.

Finally, the machine-building industry needs to be seen as a special case. Despite the importance of machine-building in the regional economies of Siberia and the Far East, this sector does not seem to have been the recipient of Western imports. This reflects that fact that until recently the Siberian machine-building industry was relatively neglected. In part this is because it has exported a large part of its production to other regions and has not been oriented to benefit from increased activity in the resource sector. In fact the machine-building industry as a whole seems to have been incapable of supplying equipment for Siberian resource projects. Given the immediate necessity for specialised equipment during the 1970s, the Soviet Union imported products rather than production lines. In recent years Soviet heavy machinery has started to replace imports, and the re-orientation of the Siberian machine-building industry has been recognised as a means of increasing the economic efficiency of Siberian development.

Notes

1. Quoted in Hoffman and Laird (1982), p. 92. Both references are in the reference list.

2. EastWest Markets (1977), 22 August, p. 4.

3. East European Report (1977), Vol.6, No. 20, p. 160.

4. East European Report (1978), Vol. 7, No. 29, p. 232.

5. Seatrade (1982), November, p. 45.

6. Petroleum Economist (1984), Vol. LI, No. 10, p. 387 and The Oil and Gas Journal (1984), Vol. 82, No, 35, p. 28.

7. The Oil and Gas Journal (1985), Vol. 83, No. 47, p. 36 and Seatrade (1986), January, p. 77.

8. East European Markets (1986), Vol.6, No. 14, p. 14.

9. The Oil and Gas Journal (1985), Vol. 83, No. 32, p. 67 and Petroleum Economist (1985), Vol. LII, No. 8, p. 299.

10. EastWest Markets (1976), 29 November, p. 6 and EastWest Markets (1977), 30 May, p. 6.

11. Shabad, T. (1986), "News Notes," Polar Geography and Geology, Vol. 10, No. 1, pp. 80-82.

12. Moscow Narodny Bank Press Bullentin (1986), No. 984, 19 March, p. 20 and No. 986, 21 May, p. 9.

13. Strishkov, V.V. (1976), "Soviet Union" in Minerals Yearbook, U.S. Bureau of Mines, p. 1073.

14. From: Joint Economic Committee (1983), Soviet Pipelines Sanctions: The European Perspective. U.S. Congress, Washington, D.C.: GPO, pp. 4-5.

15. Moscow Narodny Bank Press Bulletin (1985), No. 980, 20 November, p. 16.

16. Quoted from Pravda in Moscow Narodny Bank Press Bulletin (1983), 19 October, pp. 6-7. The same figures are quoted from Sotialistcheskaya Industriya in Shabad, T. (1983), "News Notes," SG:R&T, Vol, 24, No. 10, pp. 777.

17. Business Eastern Europe (1982), Vol 11, No. 1, p. 3.

18. Shabad, T. (1983), "News Notes," SG:R&T, Vol. 23, No. 10, p. 775.

19. Moscow Narodny Bank Press Bulletin (1984), 9 December, p. 5.

20. Business Eastern Europe (1983), Vol 12, No.12, p. 87.

21. See Narodnoye khozyaystvo SSSR v 1984g., p. 175.

22. Business Eastern Europe (1982), Vol. 11, No.11, p. 15.

23. East European Report (1975), Vol. 4, No.2, p. 31 and The Mining Journal (1982), Vol. 298, No. 7638, p. 31.

24. Chemical Week (1985), Vol. 137, No.9, p. 53 and Moscow Narodny Bank Press Bulletin (1985), 16 October, p. 11.

25. East European Report (1976), Vol. 5, No. 24, p. 191, and (1977), Vol. 6, No. 36, p. 287 and Business Eastern Europe (1977), Vol. 6, No. 5, pp. 55.

26. Soviet News and Views (1986), No. 12-13, p. 5.

27. Strishkov, V.V. (1976), "The Soviet Union," in Minerals Yearbook, U.S. Bureau of Mines, p. 1095.

28. Mining Journal (1972), Vol. 278, No. 7135, p. 414.

29. East European Report (1975), Vol. 4, No. 14, p. 184 and The Mining Journal (1978), Vol 291, No. 7470, p. 314.

30. East European Report (1977), Vol. 1, No. 3, p.14.

31. Mining Magazine (1974), Vol. 131, November, p. 462 and Soviet News and Views (1983), No. 21-22, p. 4.

32. East European Report (1977), Vol. 6, No. 38, p. 304.

33. Shabad, T. (1978), "News Notes," Polar Geography and Geology, Vol. 2, No. 2, p. 131 and Shabad, T. (1981), " News Notes," Polar Geography and Geology, Vol. 5, No.4, p. 252.

34. Soviet News and Views (1983), No. 21-22, p. 4.

35. East European Report (1978), Vol. 7, No. 31, p. 247 and Business Eastern Europe (1982), Vol. 11, No. 47, p. 366.

36. Chemical Week (1975), Vol 117, No. 4, p.9.

37. Mining Journal (1974), Vol 283, No. 7269, p.?

38. Mining Journal (1980), Vol. 295, No. 7584, p. 531.

39. Mining Journal (1980), Vol. 295, No. 7566, p. 151.

40. Shabad, T. (1985), "News Notes," SG:R&T, Vol. 26, No. 7, pp. 579-580 and Shabad, T. (1986), " News Notes," SG:R&T, Vol. 27, No. 2, pp. 137-138.

41. Chemical Week (1972), Vol. 111, No.1, pp. 21-22.

42. Business Eastern Europe (1977), Vol. 6, No. 10, p. 86., East European Report (1975), Vol. 5, No. 18, p. 241 and EastWest Markets (1977), 18 April, p. 5.

43. Business Eastern Europe (1976), Vol. 5, No. 36, p. 288 and East European Report (1975), Vol. 4, No. 18, p. 24.

44. World Wood (1978), Vol. 19, No. 4, p. 32.

45. Business Eastern Europe (1976), Vol. 5, No. 42, p. 336 and (1983), Vol. 12, No.10, p. 296.

46. Extracts from the Soviet Press on USSR Forestry (1983), June, pp. 5-6.

47. East European Report (1975), Vol. 4, No. 10, p. 144.

48. Moscow Narodny Bank Press Bulletin (198?), NO. 984, p. 12.

49. East European Report (1973), Vol. 2, No. 41, p. 315.

50. Extracts from the Soviet Press on USSR Forestry (1982), June/July, p. 15.

51. Calculated by converting the annual rouble exchange value of imports, obtained from Vneshnyaya torgovlya, to U.S. $ on the basis of the annual exchange rates in Appendix 1.

52. The data on the share of chemical equipment in Western imports was obtained from Cooper 1985, p. 94, and the data on capital investment from Narodnoye khozyaystvo SSSR v 1984g., p381.

53. The Oil and Gas Journal (1984), Vol. 81, No.1, p. 26.

54. Chemical Week (1974), Vol. 115, No. 8, p. 14.

55. Chemical Week (1977), Vol. 120, No. 4, p. 15 and The Oil and Gas Journal (1984), Vol. 82, No. 18, p. 20.

56. The Petroleum Economist (1984), Vol. LI, No. 5, p. 196.

57. Shabad, T. (1981), "News Notes," SG:R&T, Vol. 22, No. 5, pp. 346-348.

58. Chemical Week (1977), Vol. 120, No. 21, p. 21.

59. East European Report (1978), Vol. 7, No. 19, p. 143, Business Eastern Europe (1978), Vol. 7, No. 35, p. 278 and Moscow Narodny Bank Press Bulletin (1981), No. 930, p. 6.

60. Moscow Narodny Bank Press Bulletin (1983), No. 954, p.7.

61. The Oil and Gas Journal (1984), Vol. 82, No. 46, p. 70.

62. Shabad, T. (1981), "News Notes," SG:R&T, Vol. 22, No. 5, p. 358.

63. Shabad, T. (1983), "News Notes," SG:R&T, Vol. 24, No. 1, p. 77.

64. Soviet Shipping (1983), Vol. 3, No. 1, p. 25, Shipping World and Shipbuilder (1986), Vol. 182, No. 4025, p. 285 and Moscow Narodny Bank Press Bulletin (1985), No. 976, p. 16.

65. Partner of the World (1986), Technical documentation from the Federal Republic of Germany's Pavilion at Expo 86, pp. 72-73.

66. Wartsila Press Release (1984), 24 November.

67. Armstrong, T. (1978), "The Northern Sea Route, 1977", Polar Record, Vol. 19, No. 119, p. 184.

68. Norwegian Shipping News (1979), No. 2, Vol. 35, p. 67.

69. For a Soviet evaluation see Anon. (1983) "Multipurpose Vessel for the Arctic," Soviet Shipping, Vol. 3, No.1, pp. 22-24. For a Western review see Anon. (1983), "Wartsila delivers first Arctic multi purpose vessel to USSR," Norwegian Shipping News, Vol. 39, No. 3, pp. 58-65.

70. Anon. (1984), "The Arctic, Autumn 83," Soviet Shipping, Vol. 4, No. 1, p. 33.

71. Shabad, T. (1984), "News Notes," Polar Geography and Geology, Vol. 8, No. 3, pp. 259-261.

72. East European Report (1976), Vol. 5, No. 7, p. 55.

73. East European Report (1974), Vol. 3, No. 25, p. 367.

74. East European Report (1975), Vol. 4, No. 15, p. 211.

75. EastWest Markets (1976), 13 December, p. 7.

76. East European Report (1975), Vol. 4, No. 19, p. 268.

77. East European Report (1977), Vol.6, No. 36, p. 288.

Chapter 7

Conclusions

This concluding chapter is divided into three parts. The first part summarises the findings of the study and addresses specific questions concerning the relationship between East-West trade and Siberian development. The second part uses a simple model to place those findngs within the broader context of contemporary Soviet economic development and East-West trade relations. The final part examines the nature of Soviet regional development and the influence of the Soviet economic system on locational decision-making.

7.1. East-West Trade and Siberian Development

This study has sought to answer two interrelated questions: firstly, what is the role of Siberia and the Far East in Soviet trade with the West, and secondly, what is the role of East-West trade in Siberian development?

7.1.1. The Role of Siberia in East-West Trade

There are two dimensions to this question. The first concerns the contribution of Siberia and the Far East to Soviet exports to the West. The analysis of Siberian export production presented in Chapter 5 showed the region's share of total Soviet exports to the OECD to have risen from 18.5 percent in 1970 to 53.9 percent in 1984, with the value of those exports increasing from $ 472.7 million in 1970 to $ 13.9 billion in 1984. The reason for this rapid increase is the development of the West Siberian TPC and the increase in the value of Soviet oil and gas exports to the West.

The second dimension to the question concerns the proportion of Soviet imports from the West which is consumed in Siberia and the Far East. Chapter 2 showed Soviet imports from the West to be composed of machinery and equipment, manufactured goods, and agricultural products. Chapter 6 focused on the role of Western machinery and equipment within the Siberian economy. Siberia's overall share of Western imports is difficult to determine, but it is probably much lower than its share of exports. One reason is because Siberia has relatively few industries with a high degree of reliance on Western technology. A second reason is that, with only 11 percent of the total population of the Soviet Union, Siberia and the Far East consume a small proportion of agricultural imports, even allowing for Siberia's poor agricutural base.

In sum, we can conclude that in terms of the relationship between imports and exports, Siberia and the Far East generate a sizeable foreign currency surplus. The size of the surplus is impossible to measure. But that surplus is used to purchase machinery and equipment, manufactured goods, and agricultural products for the European USSR, where the majority of the Soviet population reside and where Soviet industry is concentrated.

7.1.2. The Role of East-West Trade in Siberian Development

Again there are two dimensions to this question: firstly, the role of export production in promoting Siberian development, and secondly, the role of Western imports in enabling Siberian development.

The pro-Siberians in the USSR have suggested that one of

the reasons for the apparently poor performance of Siberian industry is the nature of the Soviet pricing system, which they maintain undervalues Siberian resource production. Granberg (1980, pp. 58-56) has suggested that if world prices are used to evaluate Siberian industrial production (West and East Siberia only) then Siberia no longer consumes more income than it produces; instead, according to 1975 data, it generates a positive balance of $ 8-9 billion roubles. Unfortunately for the pro-Siberians, the economic efficiency of Siberian development is evaluated with domestic rather than world prices, and while there have been some improvements in the pricing system it still works to the disadvantage of Siberia. Domestic consumers of Siberian resources do not pay world prices, but Western purchasers do. Thus, it is possible that Siberian foreign currency exports to the West may help to offset the fact that domestic prices are too low. The impact of the higher value of export production would be hidden from domestic evaluations of the economic efficiency of Siberian development because these would use domestic prices, but the higher export price would influence politicians and planners by making the apparent high cost of Siberian development more palatable.

Dienes (1982, pp. 222-223) has explored the impact of foreign currency exports on Siberian economic performance, concluding that West Siberia's contribution to national income in 1975 is increased by almost 3.9 billion roubles when export earnings from oil and gas are included in the calculations. As a result, instead of a deficit the region showed an income

surplus of about 2.4 billion roubles. Unfortunately Dienes' figures cannot be compared with data in this study, because he fails to provide sufficient information on the destination and value of oil and gas exports used in his calculation. But it is clear that since 1975 the value of West Siberian oil and gas exports has grown rapidly. At the same time the cost of developing the West Siberian TPC has also increased, as has the domestic price of oil and gas. Therefore it seem likely that, prior to the recent collapse in the world price of energy resources, the difference between the domestic and export values of West Siberian oil and gas generated a "hidden surplus" which more than compensated for the apparent high domestic cost of developing the West Siberian TPC. Since the collapse in oil prices, the cost of West Siberian production has continued to increase; the "hidden surplus" has been much reduced, and the West Siberian TPC may become a burden on the Soviet economy.

Oil and gas exports are by far the most important sources of foreign currency, but what of gold and diamond exports? Dienes (1979) examined the impact of gold and diamond exports on the economic performance of the Yakut ASSR and Magadan Oblast'. Here he concluded that the Soviet domestic price in 1975 was in fact higher than the world price, and therefore exports could not compensate for the very large net income deficit of the Far Eastern economic region (5.4 billion roubles). Since 1975 the size of the income deficit has undoubtedly increased with the construction of the BAM. The accuracy of data on Soviet gold and diamond exports is open to

question but the information presented in this study suggests that gold and diamond exports have not experienced the very rapid increases in the value of exports associated with oil and gas. Therefore export earnings are unlikely to have supplied a "hidden surplus" that would compensate for the very high cost of Far Eastern development.

There is, of course, another dimension to the value of Siberian export production and that is the fact that it provides convertible foreign currency necessary to purchase imports. The desire to purchase imports from the West may transcend domestic cost considerations, giving exports a significance that goes beyond their capacity to generate an income surplus. It may also be the case, as Vanous (1982) has suggested, that it is cheaper and easier to produce oil and gas to purchase grain than it is to increase domestic grain production. Factors such as these would partly explain the relatively high level of economic development in the Soviet North. Clearly many of the mines in the Soviet North do not make money, yet their development is promoted because they generate convertible currency, as well as contributing to self-sufficiency. When domestic cost considerations are combined with the need to earn foreign currency, it is clear that Siberia's prominent place in foreign currency exports to the West plays a major part in promoting resource development within the region.

7.1.3. The Role of Western Technology in Siberian Development

When examining the role of Western technology in Siberia it is first necessary to determine the nature of the Western

plant and equipment imported into the region. Two aspects of technology transfer are considered here: the level of technology transferred, and whether or not that technology embodies a production process.

There are no generally accepted measures of the various levels of technology, but for the purposes of the present discussion we can distinguish between "high technology", embodying sophisticated components and processes which are the focus of current research and development and which are not widely available, and "low technology", embodying components and processes which do not represent current research and development, and are widely available. As the product-cycle model suggests, the level of technology is a dynamic concept, and a given technological process may move from being considered high technology to low technology as it is replaced by new methods of production. The level of technology is also a relative concept reflecting the level of technological sophistication within particular economies. Thus, what is presently considered low technology in the United States may be the "state of the art" in the Soviet Union. In the context of East-West technology transfer, high technology is often defined as that which is not available in the socialist economies.

Another way of looking at technology transfer is to distinguish between "process" and "product" transfers. Strictly speaking technology is the "design and manufacturing know-how required to produce goods" (Bucy, 1980, p. 134), but studies of Western technology in the Soviet economy tend to

adopt a broader definition that also includes products, such as pipelayers and ships (Cooper, 1985, p. 83). The transfer of process technologies provides the means by which the Soviet Union can produce products of a type and/or quality that they would be incapable of producing using domestic equipment. Product technologies, on the other hand, provide a finished product that can be used in the Soviet economy to compensate for domestic inadequacies. Importing products does not automatically provide access to process technology, although the product can be dismantled and, via reverse-engineering, provide the necessary know-how to produce a Soviet version of the orginal product. In general, process technology transfer involves a higher level of technology than product transfers, although there are cases of high technology product transfers such as seismic exploration equipment.

The various types of technology transfer described above compensate for different problems within the Soviet economy. High technology process transfers compensate for problems with the Soviet innovation process and generally represent technologies that are not currently available to the domestic economy. It is these types of technology transfer that the CoCom strategic embargo was created to monitor. Low-technology product transfers generally embody technology that is available in the domestic economy, particularly in the military sector, but which for various reasons cannot be produced in sufficient quantity and/or quality for the domestic economy. These different types of technology transfer play different roles in regional development.

In Siberia most high-technology process transfers have been used to intensify the level of industrial production through processing technologies which make more efficient use of the region's natural resources. The best examples are the chemical and forest products industries, where Western turnkey plants have been used to create large integrated processing complexes. Imports of low-technology products have been used to carry out the extensive development of Siberia's resources: for example, by providing heavy equipment to expand mining and forestry operations and large-diameter pipe to move ever-increasing volumes of oil and gas to external markets. Of course there are exceptions to these generalisations: high-technology products have been imported to explore oil and gas in Yakutia and offshore of Sakhalin Island.

Most imports of Western technology to Siberia are oriented towards the production and semi-processing of natural resources which are then consumed outside the region. Siberia's role as a resource-producer is then reflected in the type of Western technology employed within the region, the bulk of which is relatively low-technology products imported to compensate for the inability of the Soviet economy to produce capital goods suited to the Siberian environment.

The primary role of Western technology in Siberia is to aid in the production of natural resources. Because those resources provide the commodities that the Soviet Union exports to purchase imports from the West there is some correlation between industries and regions that participate in export production and those that receive Western technology. This

interrelationship is clearest in compensation agreements. Compensation agreements not only provide access to Western technology, they also provide an additional source of capital. In Siberia and the Far East compensation agreements with the West have provided at least $ 11.5 billion of additional capital investment. In a region which registers a large net deficit in national income, and in an economy where investment capital is in short supply, compensation agreements may provide the necessary capital investment to initiate projects now rather than later. Thus Siberian resources are mortgaged to obtain additional capital and access to Western technology, which enables larger-scale and more rapid development than would be possible with domestic resources alone.

7.2. East-West Trade and Soviet Economic Performance

This study has dealt with the relationship between East-West trade and Siberian development during the period of the Brezhnev/Kosygin leadership, a time in which the Soviet economy experienced a marked deterioration in economic performance. For the Soviet leadership the politics of detente and the actions of OPEC provided an opportunity to use trade with the West to compensate for the poor performance of the domestic economy. Although external conditions during the 1970s made increased trade with the West an economic possibility, the stimulus for such trade was domestic economic policy, in particular the "scientific-technical revolution" and the intensification of the economy. Thus, export production can be seen as a consequence of the decision to use imports of Western technology and agricultural products to sustain the Soviet

economy. In other words, East-West trade was not intended to promote Siberian development; rather the development of Siberia's resources was a prerequisite for the purchase of Western imports. This being the case, to understand the interrelationship between foreign trade and regional development it is necessary to place the findings of this study within the wider context of Soviet economic development since the early 1970s.

7.2.1. The Trade and Development Process

The regional impact of Soviet foreign trade is the product of the commodity structure of foreign trade and the industrial structure of the various regions that comprise the Soviet economy. Figure 7.1 presents a simple model that can be used to describe the relationship between East-West trade and regional economic development. The aim of the model is to relate the commodity structure of East-West trade to the regional development process.

The starting point in the trade and development process is a decision on the part of Soviet policy makers to use imports from the West to solve particular problems: for example, the poor performance of Soviet agriculture, or industrial characteristics that inhibit the innovation process or restrict domestic capacity to produce particular products. In some instances these imports reflect particular regional development problems, such as the need for vehicles suited to the northern environment.

Once the decision has been made to import from the West the Soviet Union has to obtain sufficient foreign currency to

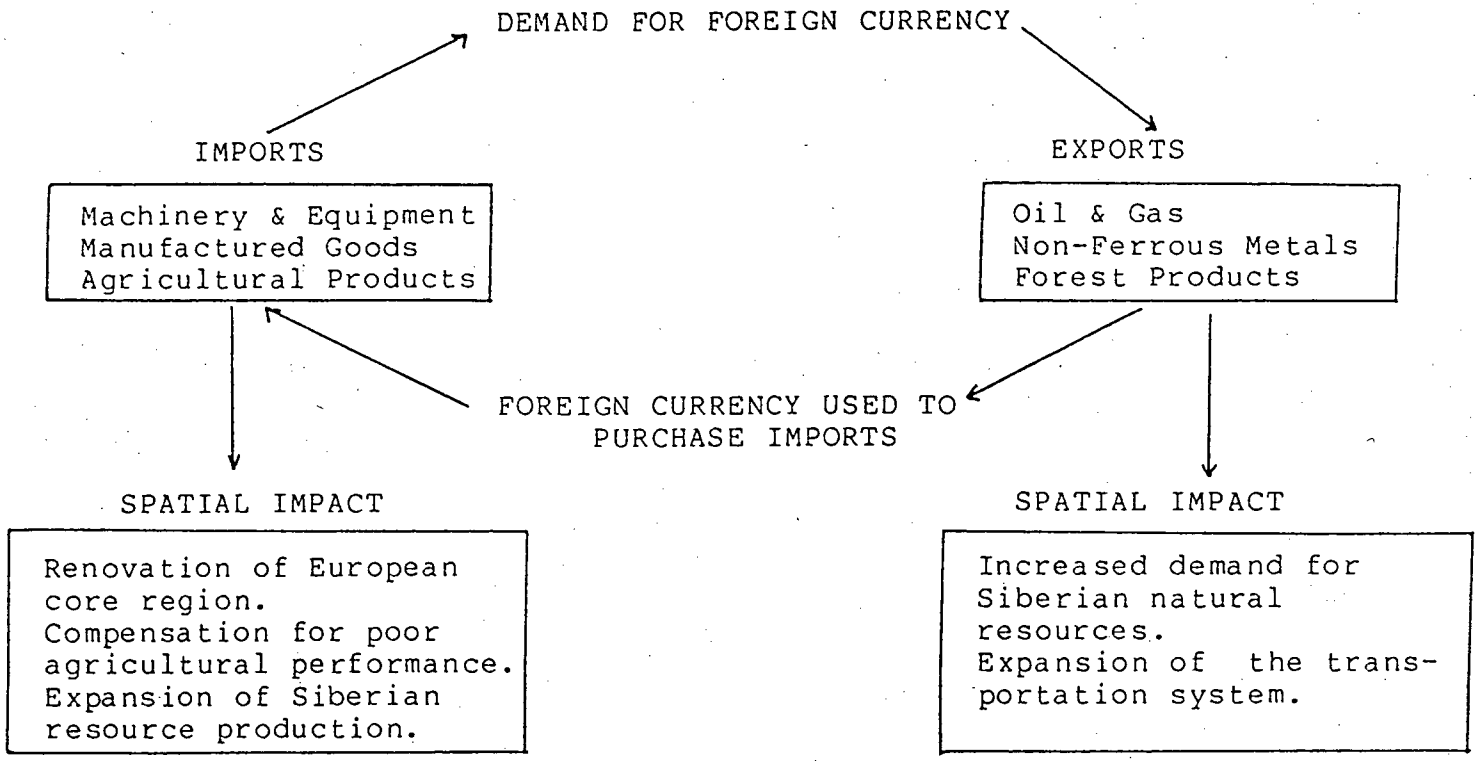


Figure 7.1 The Trade and Development Process

pay for those imports. Credits and compensation agreements can be used to cover a certain amount of the cost, but because the Soviet Union does not wish to create a large debt to the West most imports are paid for by foreign currency exports. As this study has shown, those exports are dominated by natural resources, the bulk of which are produced in Siberia and the Soviet Far East. Thus, the direct spatial impact of foreign currency export production is felt as an increased demand for Siberian natural resources. In addition to the direct impact of export production, trade also promotes the expansion of the transportation system, specific examples being the Urengoy export gas pipeline and the port at Vostochnyy. As North (1983, p. 99) has suggested, these developments may improve the attractiveness of particular regions for domestic producers. However, the primacy of national and sectoral interests over regional interests means that increased export production in Siberia does not generate a sizeable export base multiplier.

To substantiate the regional impact of Western imports at the national scale requires a comprehensive study of Western technology transfer throughout the Soviet Union. Nevertheless, one can identify at least three distinct components to the spatial impact of Western imports. The first is the import of high technology to compensate for problems with the domestic innovation process. It is this type of import that has been the focus of Western studies on technology transfer and Soviet economic performance. Taking into consideration the sectoral structure of imports of Western technology and the geography of Soviet industry, one can conclude that most of these imports

are used in the industrial heartland of the European USSR. These imports have been an important part of attempts to increase the technological efficiency of the Soviet economy and so create a more intensive mode of economic development.

A second set of impacts is related to the import of agricultural commodities. Because 80 percent of the Soviet population resides within the European regions, it is there that the direct benefits of food imports are felt. However, imports of agricultural products also mean that less has to be invested in domestic agriculture. In a regional development context it may be easier and less costly to produce Siberian oil and gas to pay for imported grain, than to provide the necessary investment to boost domestic grain production. There is also a political dimension to the use of imports. It may be that to improve the technological efficiency of Soviet industry or to increase agricultural production would require radical economic reform; thus, the rapid expansion of oil and gas exports postpones the need to introduce reforms that could create political instability. For the Soviet leadership during the 1970s East-West trade served to reduce the pressure for reform by helping to sustain the existing political and economic system.

Because this policy is dependent upon the continued supply of Siberian natural resources to pay for imports, Siberian resource projects were assigned priority and imports of Western technology were used to maintain production. Therefore the third component of the spatial impact of Western imports is the use of Western machinery and equipment to maintain Siberian

resource production. The introduction of the TPC as the cornerstone of the Siberian development strategy has enabled the planners to concentrate investment upon the production of resources for domestic and foreign markets. Only a limited amount of attention has been paid to the diversification of the Siberian economy.

From the information presented in this study it would seem that by the early 1980s a conscious decision had been made to reduce the importation of Western technology, partly because it was not supplying the anticipated benefits, and also because the continued poor performance of agriculture was consuming more foreign currency. At the same time Siberian oil and gas production was becoming increasingly more expensive, and world resource markets more competitive. In addition the political climate in the West did not favour East-West cooperation.

One should be careful not to ascribe too much importance to foreign trade as a factor in Soviet economic performance. However, it is clear that Brezhnev's import-led growth strategy was not a great success. The study of Western technology imports and Siberian development presented in Chapter 6 suggests that in many cases the effectiveness of Western technology transfer was reduced by "systemic" problems within the Soviet economy, in particular the lack of horizontal integration. Thus the use of imports did not succeed as an alternative to economic reform because problems within the economic system undermined the effectiveness of the more advanced Western technologies.

The very essence of Mikhail Gorbachev's economic strategy

is the need for radical economic reform. Such a policy is unlikely to foster an increased reliance upon imports of Western technology. Instead changes within the Soviet economy will increase domestic innovative capacity. Clearly this restructuring of the Soviet economy will take time and in the interim one can expect the continued use of East-West trade to address problems within the Soviet economy; indeed imports of Western technology could play a crucial role in the restructuring process. So in the short term one can expect to see a continued reliance upon Siberia's resources to pay for imports of technology and grain. The most immediate problem for the Soviet Union is the fact that the fall in oil prices has reduced its foreign currency purchasing power. In the long term the situation is likely to change: firstly, because Gorbachev's economic policy aims to create a greater degree of technological self-sufficiency; and secondly, because Gorbachev wishes to improve the structure of Soviet trade with the West by increasing the level of value added and reducing the reliance upon resource exports. Such a change in the structure of trade will reduce the pressure upon Siberian resource production, but domestic and CMEA demand will sustain the level of economic activity within Siberia and to a lesser extent the Soviet Far East.

In sum, the model presented in Figure 7.1 has been used to describe the situation since the early 1970s during which East-West trade served to enhance the existing core-periphery relationship between the western and eastern regions by using exports of Siberian natural resources to provide additional

inputs for the renovation and supply of the industrial core. The same model can be used to described the spatial impact of Soviet trade within the CMEA. While the Soviet Union is more successful in exporting machinery and equipment to its CMEA partners, natural resources still dominate Soviet exports. Thus, CMEA exports combine with foreign currency exports to increase the demand for natural resources. The spatial consequences of this demand are slightly different in that the East European nations have been involved in joint investment projects such as the Friendship oil pipeline and the Orenburg gas pipeline to deliver natural resources from the European regions of the Soviet Union. Construction is now underway on the Progress pipeline to deliver natural gas from West Siberia. East European demands for non-ferrous metals and forest products are being satisfied by the development of TPCs in Siberia. Soviet imports from Eastern Europe are predominantly machinery and equipment, most of which are used in European regions. This European orientation is amplified by the region's proximity to the East European market and the use of cooperative projects that serve both domestic and East European markets. When the spatial impacts of East-West trade and intra-CMEA trade are combined one can conclude that Soviet foreign trade serves to promote the resource specialisations of Siberia and the Soviet Far East but does little to diversify the economic structure of the region, because the majority of the imports purchased with the region's natural resources are consumed in the European USSR.

7.2.2. East-West Trade Relations: Policy Implications

While this study has not been directly concerned with the political dimensions of East-West trade, the findings shed some light on the problems of evaluating the impact of East-West trade on the Soviet economy, and of creating an effective trade policy that protects the strategic interests of the West.

One of the starting points for this study was the belief that existing studies of East-West trade and Soviet economic development were lacking because they failed to consider the geographical dimensions of the trade and development process. The findings of this study suggest that there are distinct spatial impacts associated with East-West trade and that imports from the West are used to solve regional development problems. In addition, consideration of the interrelationship between exports and imports has shown that the use of Western imports to renovate the European heartland is dependent upon the successful exploitation of Siberian resources. In the context of technology transfer, low-technology product imports such as large-diameter pipe and pipelayers are necessary to enable the purchase of advanced process technologies to promote increased economic efficiency.

From a methodological viewpoint this means that studies that seek to evaluate the impact of East-West trade on the Soviet economy should be aware of the complex interrelationship between exports and imports, and should recognise that while imports may be used to overcome specific "sectoral bottlenecks" those bottlenecks may also reflect particular regional development problems.

From a policy viewpoint a geographical approach to the trade and development process helps to highlight the problems of trying to use a high-technology strategic embargo to control East-West trade. As the case of Siberian development demonstrates, low-technology imports play a crucial role in enabling the import of high-technology. In fact the bulk of Soviet imports from the West do not comprise high technology. Therefore, East-West trade cannot be regulated simply on the basis of its technological content. It has to be acknowledged that trade with the Soviet Union is a political issue that requires a political solution. This is a problem because it is clear that at present the various members of the Western Alliance have different opinions as to the costs and benefits of trade with the Soviet Union. In very simple terms, the United States as the other superpower has tended to see East-West trade as enabling the Soviet Union to maintain its military industrial complex. However, there are differences of opinion within the U.S. administration, and while the United States has tried to stop high-technology trade it continues to sell the Soviet Union grain. The West Europeans and the Japanese on the other hand, while accepting the need for a strategic embargo, see East-West trade as an economic opportunity and important part of improving relations between East and West.

The difference in opinion between the United States and her allies has little to do with the specifics of technology transfer and much to do with the fact that, as the other superpower, the United States has a very different perception

of the Soviet Union from that of her allies. The practical expression of this difference in attitude is that the United States is no longer a major actor in East-West trade. As a consequence, as the Urengoy pipeline fiasco clearly demonstrated, the U.S. government can do little to influence East-West trade relations without causing political tension within the Western Alliance. Because this deep-rooted difference of opinion remains unresolved it continues to undermine attempts by the West to reach a consensus on trade with the Soviet Union. Hopefully a clearer understanding of the role of East-West trade in Soviet economic strategy can contribute to the development of a more effective Western policy towards trade, that acknowledges the strategic, political and economic dimensions of cooperation between East and West.

7.3. Industrial Location and Regional Development Under Soviet Socialism

While this study has concentrated on East-West trade and Soviet regional development; it also provides a forum within which to examine the nature of the regional development process under Soviet Socialism.

Gregory and Stuart (1980, pp. 24-25) have suggested that there are three basic forces influencing economic outcomes within an economic system: the nature of the economic system itself, the policies pursued, and environmental factors (conditions in the economy). The pattern of regional development in the Soviet Union reflects the nature of the Soviet socialist economic system, the content of the policies that influence the regional allocation of investment, and the

national economic environment. This study has already presented information on the current economic environment in the Soviet Union. Therefore the following sections elaborate on the policies which have affected regional development, and the ways in which the Soviet economic system shapes the regional development process.

7.3.1. Contemporary Soviet Regional Development

The Soviet economy is planned by sector rather than region and as a result regional development policy is a consequence of the planning process rather than an objective of it. That is not to say that regional questions have no place in the planning process: clearly they do, but more as an afterthought than an initial intention. A clear indication of a lack of regional planning is the inability of Soviet central planners to solve problems that are of a regional nature and require horizontal integration, such as the creation of TPCs.

Despite the apparent lack of a cohesive regional policy central planners and industrial ministries have to make locational decisions, and these have regional implications. Soviet geographers and planners maintain that there exists a theory of industrial location which provides a list of location principles or laws that guide decision makers (Lavrishchev, 1986, pp. 27-29 and Shaw and Pallot, 1981, pp. 140-147). Some Western scholars have used these principles to examine Soviet industrial location decision-making (Hamilton, 1973 and Wagner, 1973). These studies suggest that the location principles serve as general guidelines rather than a coherent location theory. Other Western scholars have suggested that the

principles have little or no influence on location decision-making (Rodgers, 1974, p. 235 and Pallot and Shaw, 1981, p. 146). While the location principles are outlined in some Soviet texts on economic geography (Lavrishchev, 1986), there is no evidence of the planners at Novosibirsk, for example, using them to lobby for Siberian development.

In reality locational decisions are the outcome of a complex bargaining process in which sectoral and regional interest groups use broader goals to push their own positions (Hamilton, 1970, p. 87 and Bradshaw, 1984). A review of the Western literature on Soviet regional development suggests that there are three general goals which have guided locational decision-making: the ideological goal of equality of the levels of economic development between regions, the economic goal of maximising the return on investments, and the strategic goal of meeting the needs of national security. Each of these general goals needs to be analysed to examine the different ways in which they have been interpreted over time and also to assess their importance in explaining the contemporary pattern of Soviet regional development.

The ideological goal of regional equality has its origins in the Marxist position that it is the capitalist system which promotes regional inequality. In the pre-World War Two period Stalin's economic policies stressed the goals of uniform development and regional self-sufficiency. The steel mill at Komsomol'sk is a legacy of that period. In the post-War period reconstruction and economic growth became the central goals of economic policy and Western analyses have shown that regional

inequality increased at the Republican level (Schiffer, 1985, Fuchs and Demko, 1979, p. 307 and Koropeckyj, 1970). Despite the apparent divergence of regional development trends, in 1972 Leonid Brezhnev announced that "the problem of equalizing the levels of economic development of the national republics has in the main been solved" (Holubnychy, 1973, p. 25). For regional interest groups such as the pro-Siberians this removed a powerful ideological argument in favour of remote area development. Therefore, for the purposes of understanding contemporary regional development, the ideology of equality and regional self-sufficiency are no longer goals of the central planners.

The goal of maximum economic efficiency is of questionable utility in an economic system that is not guided by a realistic price mechanism. As we have seen with the case of oil and gas exports, the price system can easily distort regional industrial performance. Likewise figures can be manipulated to suit a particular point of view (Holzman, 1957). Western studies examining the regional distribution of investment have concluded that it is not guided by the principle of maximum economic efficiency (Koropeckyj, 1970, p. 262 and Dienes, 1972, p. 446). One Western analyst has suggested that in the 1950s and 1960s Soviet planners simply did not possess techniques for the accurate analysis of the efficiency of comparative locations (Holubnychy, 1973, p. 32). As a result many poor decisions were made and, once construction was underway it was difficult to reverse them. Clearly the situation has changed since then: for example, the planners at Novosibirsk use

complex models to evaluate regional development strategies. But the problems of the price system remain.

The goal of maximum economic efficiency, which after all is no longer considered the goal of locational decision making in market economies, is more realistically replaced by the satisfaction of plan targets set by the central planners. With plan fufillment as the criterion for performance, it is then the function of the industrial ministries to fulfill their plan targets with the resources provided. Because the plan targets are usually over-ambitious, and sufficient resources are seldom provided, the industrial ministries operate in an environment of scarcity where plan targets are frequently unfulfilled. Within this system each industrial ministry allocates its resources in such a way as to maximise its chances of fulfilling its own plan targets. The pursuit of sectoral goals by different ministries in such an environment creates the problems of departmentalism, many examples of which have been provided in this study. The net result is a pattern of regional development that reflects the sum of sectoral interests, rather than regional interests. Of course those sectoral interests also reflect the plan directives of the central planners; consequently a region's economic structure is dominated by sectors that are considered of national importance and relatively little attention is paid to local needs or support facilities. The development of the Siberian machine-building industry is a good example of such a situation.

When making decisions about the regional distribution of investment the industrial ministries do not ignore cost

considerations, but they are equally concerned with issues of security of supply and economic infrastructure. The desire to secure supplies leads to duplication and cross-hauls as each ministry relies on its own supply network. The desire to avoid excessive investment in infrastructure, which is non-productive, leads to concentration of investment in already established regions and the avoidance of new projects in regions such as Siberia. In the end this self-centered drive for plan fulfillment is self-defeating, for as we have seen in this study, departmentalism and neglect of infrastructure eventually hinder the operation of the specialisation industries. This is the essence of the pro-Siberian position: that if one does not provide the necessary support facilities the Siberian economy will not be able to meet the demands placed on it by the national economic system. The TPC can be seen as a short-term response to the problems created by a lack of regional planning and horizontal integration. In the long term only radical economic reform of the price mechanism and performance criteria can improve the situation.

The third factor influencing the regional allocation of investment is strategic interests. Clearly the notion of what is in the strategic interest of the Soviet Union has changed with time as the range of weaponry has increased and the Soviet Union has widened its arena of operations. Prior to the Second World War the desire to reduce vunerability from attack led to the duplication of key industrial facilities and the development of a heavy industrial base in Siberia because of its isolation from Western Europe. This strategy has left a

lasting mark on the structure of the Siberian economy. However, since the Second World War the ICBM has rendered everywhere vulnerable to attack and the nature of strategic interests has changed. Now the effective occupation of vulnerable border regions and the provision of support facilities for offshore activities have become the major considerations. These factors are particularly important in the Soviet Far East because of the vulnerability of the Sino-Soviet border region and the increased Soviet presence in the Pacific (Dienes, 1985b). The building of the BAM railway was in large part motivated by the desire to improve access to the Pacific and provide an alternative to the Trans-Siberian Railway. The fact that the BAM and port facilities also promote increased trade with the Pacific basin serves to strengthen the calls for development of the Far East.

Another aspect of strategic interests is the goal of economic self-sufficiency. As a consequence of Stalin's policy of "socialism in one country", maximum self-sufficiency has long been considered a critical aspect of Soviet national security. One consequence of this policy has been the development of mineral resources for security of supply rather than economic gain. The diamond industry is perhaps the best example of how strategic interests can override economic considerations. While the Soviet Union has increased its role in the World economy, it still remains reasonably self-sufficient and in many instances continues to promote the high-cost domestic production of strategic minerals rather than rely on imports. If cost considerations were paramount, it is

unlikely that the Noril'sk Metallurgical Combine would have developed as it has or that the mining operations in the Far North would be as extensive. In sum, strategic interests have tended to favour remote-area development and have therefore countered the high cost of economic development.

The current pattern of regional development in the Soviet Union reflects the complex interplay of number of factors. Over time some have been more important than others and the nature of those factors has also changed. For example, the present pattern of Siberian development reflects Stalin's concerns for even development and national security as much as it does the contemporary concern for national economic growth.

7.3.2. The Soviet Industrial System and Spatial Decision-Making

It is the nature of the economic system itself as much as specific policies that influences the pattern of regional development in the Soviet Union. This final section uses a global industrial system approach (Hamilton and Linge, 1979) to examine the nature of the Soviet economic system and the way in which it influences spatial decision-making. Three aspects of the Soviet economic system are considered: the degree of access, the nature of control and the allocation system (Figure 7.2). The use of a comparative framework helps to clarify the distinctive influence of the Soviet system on the process of spatial decision-making and consequently the pattern of regional development.

1. Access. While Soviet decision makers are paying increasing attention to economic integration within the CMEA,

CAPITALIST	SOCIALIST	
OPEN	CLOSED	ACCESS
DECENTRALIZED	CENTRALIZED	CONTROL
MARKET	PLANNED	ALLOCATION

Figure 7.2 A Simple Classification of Industrial Systems

for the most part the Soviet economic system can be considered "closed" in the sense that locational decisions are made on the basis of the resources available in the domestic economy. Thus when deciding on the location of an aluminum smelter in Siberia, Gosplan and the Ministry of Non-Ferrous Metallurgy consider its locational efficiency within the confines of the domestic economy. When ALCAN makes a decision as to where to locate an aluminum smelter in Canada, it not only has to consider whether that location is competitive within the Canadian economic system, but also if it is competitive within the international market. This is because the capitalist system is relatively open and domestic producers have to compete with foreign producers in their home market, and may also themselves wish to export to foreign markets. Similarly, when deciding whether or not to develop a particular mineral deposit in the Soviet North, the Soviet decision maker considers the possible alternatives in the Soviet Union, while a Western Mining company in the Canadian North may consider the alternatives worldwide. Thus, the degree of "openess" or access affects the range of locational alternatives faced by a decision maker. The net result is that within the Soviet Union industrial enterprises are found operating in locations and conditions that would not be considered feasible within the capitalist system. At the national scale we find that the level of economic activity in peripheral regions, such as the Soviet North, is much greater than equivalent regions in the capitalist system, such as the Canadian North (Bradshaw, 1982).

2. Control. In the Soviet economic system decision-making

power is centralized with the political leadership, the central planners and the industrial ministries who control the economy. The basic operational unit, the industrial enterprise, has a very limited amount of autonomy. In the capitalist system the basic decision-making unit is the firm or corporation which exercises a high degree of autonomy, but operates in an economic environment over which it has a limited amount of control. A high level of centralization has both negative and positive implications for spatial decision-making (North, 1979, pp 228-229).

On the positive side the centralization of locational decision-making enables the consideration of a wide range of alternatives and the choice of the best location to meet the goals set by the leadership. As a result of this process the pattern of industrial activity within a given region reflects the role assigned that region in solving national problems. Thus, the West Siberian TPC concentrates on the production of oil and gas and little else. The expansion of industrial activity in the specialisation industries of a region will not result in economic diversification unless the plan dictates it. From the point of view of the region, this may be seen as a disadvantage. As a result any multiplier effect that may promote regional development in a capitalist system is negated by central control and its consequent reduction of regional autonomy. For example, the Siberian machine-building industry has not expanded to meet the needs of the resource sector because the central planners have not directed it to do so.

In theory at least, central control enables locational

decisions to be made so as to reduce wasteful duplication. This also leads to a tendency to build large plants to gain economies of scale. In reality ministerial departmentalism leads to excessive duplication of production facilities, and economies of scale are often undermined by increased transportation costs.

A further disadvantage of extreme centralization is that it limits the ability of central planners to make effective decisions because it reduces their regional sensitivity. Planners in Moscow are often unaware of the conditions in the regions where they are locating industrial plants or increasing production targets. As a result they may make decisions that are inappropriate to the regional context. This reduces the likelihood of plan fulfillment and may lead to disatisfaction in the regions. The problem of sensitivity is a reflection of the fact that the centralized decision makers seldom have the necessary information to make appropriate decisions. In a centralized system where decision-making power is in the hands of a few, this lack of information or similarly lack of ability can result in poor decisions (North, 1979, p. 229). In a decentralized system a bad decision has a limited impact, but in a highly centralized system such as the Soviet economy poor decisions made by central planners are seldom questioned by lower authorities and often their consequences are not realised until it is too late. In sum, the high degree of centralization within the Soviet economic system has provided the leadership with the ability to control the regional development process; at the same time it has created a

decision-making process that is often insensitive to the needs of the region.

3. Allocation. In the capitalist economic system the market allocates resources and is the final judge of locational efficiency. Although profitability is not the only goal of decision makers, in the final analysis a firm has to make a profit to stay in business. If a firm consistently makes a loss at a particular location it is likely to shut that operation down; if it is a single-plant enterprise it goes out of business. In some situations the state may intervene and provide a subsidy or even nationalise the operation. As firms respond to changes in market conditions so the geography of economic activity changes.

In the socialist economic system there is no official market. Instead, the central planning system allocates resources, and economic growth via plan fulfillment is the key success indicator. Because Soviet economic plans reflect non-economic goals such as self-sufficiency and national security, economic efficiency is not the only factor to be considered in the spatial decision-making process. Indeed because of the price system the whole notion of an efficient location is open to question. This makes the comparative analysis of locations a complex process. It also means, as we have seen in the previous section, that the pattern of regional development reflects a number of often contradictory goals. For the most part economic goals dominate, but in peripheral regions non-economic factors often intervene.

In conclusion the pattern of regional development in the

Soviet Union reflects the nature of the economic system, the content of the policies that influence the regional allocation of investment, and the economic environment (Figure 7.3). The pattern of economic activity in Siberia reflects the interplay between these forces; no single force can explain the outcome. For example, to understand why the very rapid increase in resource production has not fostered diversification within the region it is necessary to realise that it is in the very nature of the economic system to pursue national goals at the expense of regional interests, but it is also necessary to appreciate the existing economic conditions of labour shortage, a scarcity of capital and the concentration of resource-consuming industries in the European regions. The resulting pattern of economic activity is one of extreme specialisation because it is not in the national interest to promote the diversification of the Siberian economy. Similarly, it is the nature of the economic system that enables foreign trade policy to be used to overcome specific national economic problems. Without the central planning system and the foreign trade monopoly the Soviet leadership would be unable to use East-West trade to address specific problems in the Soviet space economy.

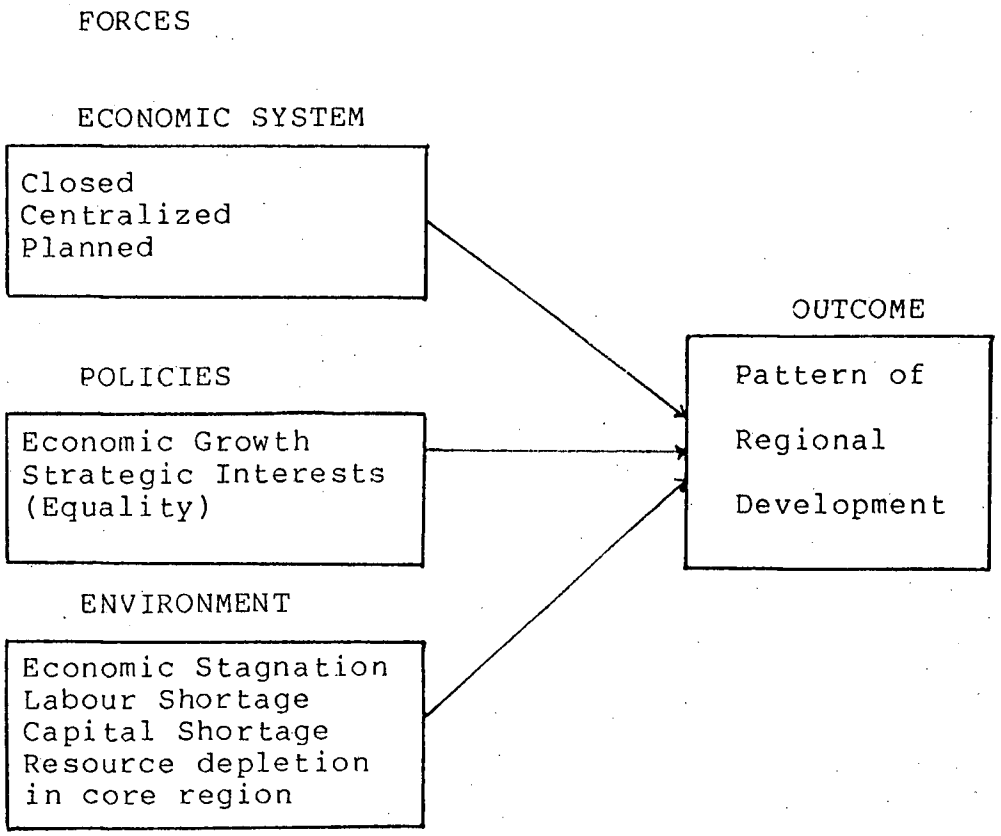


Figure 7.3. The Forces Influencing Soviet Regional Development

Source: adapted from Gregory, P.R. and Stuart, R.C. (1980), Comparative Economic Systems. Boston, Mass.: Houghton Mifflin Co., p. 24.

Abbreviations

CDSP	Current Digest of the Soviet Press
CIA	Central Intelligence Agency
CPSU	Communist Party of the Soviet Union
EKO	Ekonomika i organizatsiya promyshlennogo proizvodstva
IANSG	Izvestiya Akademii Nauk, seriya geograficheskaya
ISOAN SSSR	Izvestiya Sibirskogo otdeleniya Akademii Nauk
OECD	Organisation for Economic Development and Co-operation
OTA	Office of Technology Assessment
PKh	Planovoye khozyaystvo
SG:R&T	Soviet Geography: Review & Translation
VE	Voprosy ekonomiki

References

Adams, R.B. (1983), "Nickel and Platinum in the Soviet Union," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad and A.W. Wright. Chicago: University of Chicago Press, pp. 536-555.

Agafonov, S. (1985), "The Neryungri Project," Current Digest of the Soviet Press (hereafter CDSP), Vol. 37, No. 36, pp. 16-17. Translated from Izvestiya, 9 September 1985, p. 5.

Aganbegyan, A.G. (1979), "Tyumen': kompleks i yego grani," Ekonomika i organizatsiya promyshlennogo proizvodstva, (hereafter EKO) No. 3, pp. 3-32.

Aganbegyan, A.G. and Bandman, M.K. (1984), "Territorial Production Complexes as Integrated Systems: Theory and Practice," Geoforum, Vol. 15, No. 1, pp. 25-32.

Alexandrov, V. (1982), "Siberia and the Soviet Far East in Soviet-Japanese Economic Relations," Far Eastern Affairs, No.2, pp. 21-32.

Andelman, D.A. (1982), "Economic Crisis and Soviet Trade," The Washington Quarterly, Vol. 5, No. 3, pp. 82-91.

Arbatov, A.A. and Shakay, A.F. (1981), Obostreniye syr'yevoy problemy i mezhdunarodnyye otnosheniya. Moscow: Mezhdunarodnyye Otnosheniya.

Armstrong, T. (1985), "The Northern Sea Route, 1984," Polar Record, Vol. 22, No. 140, pp. 523-528.

Armstrong, T. (1983), "The Northern Sea Route Today," Cold Regions Science and Technology, Vol 7, pp. 251-257.

Avdeichev, L.A. and Zaytsev, I.F. (1976), Geografiya proizvoditel'nykh sil SSSR i mezhdunarodnoye ekonomicheskoye sotrudnichestvo. Moscow: Mysl'.

Ballinger, P.R. (1985), "Probability of Continued Soviet Mineral Self-Sufficiency," Resources Policy, Vol. 11, No. 3, pp. 160-176.

Bandman, M.K. (1984), "Territorial'no-proizvodstvennyye kompleksy kak ob''yekt planirovaniya i upravleniya," in Territoral'no-proizvodstvennyye kompleksy, planirovaniye i upravleniye. Edited by A.G. Aganbegyan. Novosibirsk: Nauka, Sibirskoye otdeleniye (hereafter Nauka, SO), pp. 7-59.

Bandman, M.K. (1980), "The Significance, Sequence and Instrument of Optimising the Formation of Territorial Industrial Complexes," in Territorial Industrial Complexes: Optimisation Models and General Aspects. Moscow: Progress, pp. 15-84.

Baranova, T.B. (1982), "Osnovnyye pokazateli razvitiya promyshlennosti Sibiri v desyatoy pyatiletke," Izvestiya Sibirskogo otdeleniya Akademii Nauk SSSR (hereafter ISOAN SSSR), No. 11, pp. 71-76.

Baranova, T.B. (1979), "Osnovnyye pokazateli razvitiya promyshlennosti Sibiri v sed'moy-devyatoy pyatiletkakh," ISOAN SSSR, No. 1, pp. 28-33.

Barclay, D.J. (1979), "U.S.S.R.: The Role of Compensation Agreements in Trade with the West," in Soviet Economy in a Time of Change, Vol.2. U.S. Congress, Joint Economic Committee. Washington, D.C.: Government Printing Office (hereafter GPO), pp. 462-481.

Barr, B.M. (1984), "The Soviet Forest in the 1980s: Changing Geographical Perspectives", in Changing Geographical Prespectives on the Soviet Union, Essays in Honour of Chauncy D. Harris. Department of Geography, Research Paper No. 211. Chicago: University of Chicago Press, pp. 235-256.

Barr, B.M. (1983), "Regional Dilemmas and International Prospects in the Soviet Timber Industry," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, A.W. Wright. Chicago: University of Chicago Press, pp 411-441.

Barr, W. and Wilson, E.A. (1985), "The Shipping Crisis in the Soviet Eastern Arctic at the Close of the 1983 Navigation Season," Arctic, Vol. 38, No. 1, pp. 1-17.

Belorusov, A.V. (1981), " Problemy razvitiya Zapadno-Sibirskogo TPK na novom etape," in Problemy ekonomicheskogo i sotsial'nogo razvitiya rayonov RSFSR. Edited by M.P. Danilova and L.I. Polyanskaya. Moscow: Sovet po Izucheniyu proizvoditel'nykh sil pri Gosplane SSSR, pp. 81-96.

Biryukov, V. (1981), "Vazhnyy etap kompleksnoy programmy razvitiya transporta," Planovoye khozyaystvo (hereafter PKh), No.5, pp. 15-25.

Blandon, P. (1983), Soviet Forest Industries. Boulder, Col.: Westview Press.

Bond, A.R. (1984), "Economic Development at Noril'sk," Soviet Geography: Review and Translation (hereafter SG:R&T), Vol. 35, no. 5, pp. 354-368.

Borin, V. (1980), "The Export Potential of the Soviet Chemical Industry," Foreign Trade, No. 8, pp. 10-11 and 22.

Bornstein, M. (1976), "Soviet Price Policy in the 1970s," in Soviet Economy in a New Perspective, Vol. 2. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 17-66.

Borovikov, V. and Krivoruchko, O. (1984), "Formirovaniye territorial'no-proizvodstvennykh kompleksov v zone BAM (na primere Yuzhno-Yakutskogo TPK)," Voprosy ekonomiki (hereafter VE), No.2, pp. 54-60.

Bradshaw, M.J. (1984), "The Western Conception of Soviet Industrial Location: Policy: The Need for Reappraisal," in Topics in Cartography and Physical and Human Geography. Edited by N.M. Waters. Vancouver: Tantalus Research Ltd., pp. 43-54.

Bradshaw, M.J. (1982), A Comparative Study of Remote-Area Development in the Northlands of Canada and the Soviet Union. Unpublished MA Thesis. Calgary: Department of Geography, The University of Calgary.

Bradshaw, M.J. and North, R.N. (1984), A Bibliography on Soviet Industrial Location 1965- 1983. Vancouver: Department of Geography, The University of British Columbia.

Braden, K.E. (1983), "The Role of Imported Technology in the Export Potential of Soviet Forest Products," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 442-463.

Braden, K.E. (1981), Technology Transfer to the USSR Forest Products Sector, Unpublished Ph.D. Dissertation. Seattle: Department of Geography, University of Washington.

Brainard, J. (1983), "Foreign Economic Constraints on Soviet Raw Materal Development in the 1980s," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 668-676.

Brezhnev, L.I. (1981), Report of the Central Committee of the CPSU to the XXVII Congress of the Communist Party of the Soviet Union on the Immediate Tasks of the Party in Home and Foreign Policy. Moscow: Novosti Press Agency.

British Geological Survey (1986), World Mineral Statistics, 1980-1984. NERC, London: HMSO.

British Geological Survey (1984), World Mineral Statistics, 1981-1983. NERC, London: HMSO.

Byrne, A.O., Cole, J.E. Brickerton, T. and Malish, A.F. (1982), "U.S.-U.S.S.R. Grain Trade," in The Soviet Economy in the 1980s: Problems and Prospects, Part 2. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 60-85.

Bucy, J.F. (1980), "Technology Transfer and East-West Trade: A Reappraisal," International Security, Vol. 5, No. 3, pp. 132-151.

Bud'kov, S.T. (1983), "Lesoresursnyye potentsial Tyumenskoy Oblasti i ego rol' v formirovanii Zapadnosibirskogo TPK," Geografiya i prirodnyye resursy, No. 3, pp. 114-119.

Cadieux, F. (1984), Western Technology and the Development of the Soviet Oil and Gas Pipeline Network. Unpublished MA Thesis. Ottawa: Department of Soviet and East European Studies, Carleton University.

Campbell, R.W. (1985), "Technology Transfer in the Soviet Energy Sector," in Trade, Technology and Soviet-American Relations. Edited by B. Parrott. Bloomington: Indiana University Press, pp. 141-168.

Campbell, R.W. (1980), Soviet Energy Technologies: Planning, Policy, Research and Development. Bloomington: Indiana University Press.

Carr, W. (1979), "The Soviet Merchant Fleet: Its Economic Role and Its Impact on Western Shipowners," in Soviet Economy in a Time of Change, Vol. 2. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 663-677.

CIA (1985a), Handbook of Economic Statistics, 1985. Washington, D.C.: GPO.

CIA (1985b), USSR Energy Atlas. Washington, D.C.: GPO.

CIA (1983), Handbook of Economic Statistics, 1985. Washington, D.C.: GPO.

CIA (1978), Soviet Chemical Equipment Purchases from the West: Impact on Production and Foreign Trade. National Foreign Assessment Center. Washington, D.C.: GPO.

Chichkanov, V.P. and Minakir, P.A. (1986), "Economic Development of the Soviet Far East," in Soviet-American Horizons on the Pacific. Edited by J.J. Stephan and V.P. Chichkanov. Honolulu: University of Hawaii Press, pp. 95-113.

Chichkanov, V.P. and Orlov, V. (1983), "Biologicheskiye resursy okeana," PKh, No. 1, pp. 62-69.

CPSU (1986), "Draft Basic Guidelines for the Economic and Social Development of the USSR in 1986-1990 and in the Period up to the year 2000," CDSP, Vol. 37, No. 49, pp. 17-22, and p. 32. Translated from Pravda and Izvestiya, 9 November,1985, pp. 1-6.

CPSU (1985), "The Draft Program of the Communist Party of the Soviet Union (New Version)," CDSP, Vol. 37, No. 44, Special Supplement. Translated from Pravda, 26 October, 1985, pp. 1-6.

CPSU (1980), "Basic Guidelines for the Economic and Social Development of the USSR in 1981-1985 and in the Period up to 1990," in CDSP, Vol. 32, No. 48, pp. 1-21. Translated from Pravda, 2 December, pp. 1-6, and Izvestiya, pp. 2-7.

CPSU (1976)," Basic Guidelines for the Development of the USSR National Economy in 1976-1980," CDSP, Vol. 27, No. 50, pp. 1-26. Translated from Pravda and Izvestiya, 14 December, pp. 1-6.

CPSU (1971), "The Directives of the 24th CPSU Congress for the Five-Year Plan for the Development of the USSR National Economy in 1971-1975," CDSP, Vol. 23, No. 7, pp. 6-16. Translated from Pravda and Izvestiya, 9 February, pp. 1-5.

Conolly, V. (1975), Siberia Today and Tomorrow. London: Collins.

Consolidated Goldfields Ltd. (1986), Gold 1986. London: Consolidated Goldfields Ltd.

Cooper, J. (1985), "Western Technology and Soviet Economic Power," in Technology Transfer and East-West Relations. Edited by M.E. Schaffer. New York: St. Martin Press, pp. 80-110.

Crovitz, G. (1983), Europe's Siberian Gas Pipeline, Economic Lessons and Strategic Implications. Institute for European Defence and Strategic Studies, Occasional Paper No. 6. London: Alliance Pub. Ltd.

De Souza, P. (1982), An Extended Description of the Structure of Territorial Production Complexes, preliminary survey. University of Gothenburg, Department of Human and Economic Geoghraphy, Occasional Paper, No.4. Gothenburg: Department of Geography.

Dienes, L. (1985a), "Economic and Strategic Position of the Soviet Far East," Soviet Economy, Vol. 1, No. 2, pp. 146-176.

Dienes, L. (1985b), "The Energy System and Economic Imbalances in the USSR," Soviet Economy, Vol. 1, No. 4, pp. 340-372.

Dienes, L. (1984), "The Development of Siberia: Regional Priorities and Economic Development," in Changing Geographical Perspectives on the Soviet Union. Essays in Honour of Chauncy D. Harris. Department of Geography, Research Paper, No. 211. Chicago: University of Chicago Press, pp. 189-213.

Dienes, L. (1972), "Investment Priorities in Soviet Regions," Annals of the Association of American Geographers, Vol. 62, No. 3, pp. 437-454.

Dienes, L. and Shabad, T. (1979), The Soviet Energy System: Resource Use and Policies. Washington, D.C.: V.H. Winston & Sons.

Dowie, D. (1976), "Soviet Gold in 1975," Appendix II in Gold 1976. London: Consolidated Goldfields Ltd., pp. xii-xvi.

Dyker, D. (1982), "Technological Progress and the Development of Siberia and the Far East," Radio Liberty Research Bulletin, RL 443/82.

Edmonds, R.L. (1983), "Siberian Resource Development and the Japanese Economy: The Japanese Perspective," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 214-231.

Egyed, P. (1983), Western Participation in the Development of Siberian Energy Resources: Case Studies. East-West Commercial Relations Series, Research Report No. 22. Ottawa: Carleton University, Institute of Soviet and East European Studies.

Ellman, M. (1986), "The Macro-Economic Situation in the USSR-Retrospect and Prospect," Soviet Studies, Vol. 38, No. 4, pp. 530-542.

Epstein, E.J. (1982), The Rise and Fall of Diamonds: The Shattering of a Brilliant Illusion. New York: Simon and Schuster.

Ericson, P.G. and Miller, R.S. (1979), "Soviet Foreign Economic Behaviour: A Balance of Payments Perspective," in Soviet Economy in a Time of Change, Vol. 2. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 208-243.

Eronen, J. (1985a), " Location Strategies of the Soviet Pulp and Paper Industry," SG:R&T, Vol. 26, No. 8, pp. 587-608

Eronen, J. (1985b), Location Strategies and Patterns in Soviet Forest Industries, Paper Presented at the IIIrd World Congress for Soviet and East European Studies, November, 1985, Washington D.C..

Eronen, J. (1983), "Routes of Soviet Timber to World Markets," Geoforum, Vol. 14, No.2, pp. 205-210.

Feytel'man, N. (1985), "Kapitaloyemkost' i fondoyemkost' mineral'no-syr'yevoy bazy SSSR, VE, No. 11, pp. 50-61.

Fridman, Yu. A. (1984), Khimicheskaya promyshlennost' v khozyaystvennom komplekse Sibiri. Novosibirsk: Nauka, SO.

Fuchs, R.J. and Demko, G.J. (1979), "Geographic Inequality Under Socialism," Annals of the Association of American Geographers, Vol. 69, No. 2, pp. 304.

Gardner, H.S. (1982), Soviet Foreign Trade: The Decision Process. The Hague: Kluwer-Nijhoff Pub.

Gladyshev, A.N. and Mozhin, V.P. (1982), Territorial'no-proizvodstvennyye kompleksy SSSR. Moscow: Politizdat.

Goldman, M.I. (1982), "Soviet East-West Trade: Can the Means Become an End?," in Soviet Foreign Policy in the 1980s. Edited by R.E. Kanet. New York: Praeger, pp. 247-259.

Gomulka, S. and Nove, A. (1984), East-West Technology Transfer I, Contribution to Economic Growth: An Econometric Evaluation. Paris: OECD.

Gorbachev, M. (1986), Political Report of the CPSU Central Committee to the 27th Congress of the Communist Party of the Soviet Union. Ottawa: The USSR Embassy Press Office.

Gorbachev, M. (1985), "Accelerating Scientific-Technical Progress: Fundamental Issues of the Party's Economic Advance," Reprints from the Soviet Press, Vol XLI, No.1, pp. 9-29. Translated from Pravda, 12 June.

Gorst, I. (1985), "Oil Exports Rise Again," Petroleum Economist, Vol. LII, No. 2, pp. 57-58.

Gorst, I. (1984), "Big Boost for Offshore Oil Search," Petroleum Economist, Vol. LI, No. 4, pp. 145-147.

Granberg, A.G. (1986), "Vzaimosvyaz' strukturnoy i prostranstvennoy politiki ekonomicheskogo razvitiya Sibiri," ISOAN SSSR, No. 1, pp. 23-35.

Granberg, A.G. (1985), "Structural Changes and Intensification in Siberian Industry," Problems of Economics, 1986, Vol 24, No.3, pp. 39-60. Translated from EKO, No. 6, pp. 3-27.

Granberg, A.G. (1981), "Mesto Sibiri v narodnom khozyaystve strany na sovremennom etape," in Sibiri v yedinom narodno-khozyaystvennom komplekse. Edited by M.K. Bandman, V.A. Kalmyk, V.P. Orlov, and Ye.P. Tsimdina. Novosibirsk: Nauka, SO, pp. 9-18.

Granberg, A.G. (1980), "Siberia in the National Economic Complex," Soviet Review, Vol. 22, No.2, pp. 44-68. Translated from EKO, No. 4, pp. 84-106.

Gregory, P.R. and Stuart, R.C. (1980), Comparative Economic Systems. Boston, Mass.: Houghton Mifflin Co..

Gruzinov, V.P. (1975), Upravleniye vneshney torgovli. Moscow: Mezhdunarodnoyye Otnosheniya.

Gukov, V.P. and Dyatlov, V.N. (1981), "Osobennosti formirovaniya sotsial'noy infrastruktury Bratsko-Ust'-Ilimskogo TPK," in Territorial'no-proizvodstevnnye kompleksy: voprosy struktury i razvitiya. Edited by M.K. Bandman. Novosibirsk: Nauka, SO., pp. 122-132.

Gustafson, T. (1985a), "Soviet Adaptation to Technological Pressures: The Case of the Oil and Gas Sector, 1975-1985," in The Adaptability to New Technologies of The USSR and East European Countries. Edited by P. Joseph. Brussels: NATO Economics Directorate, pp. 151-198.

Gustafson, T (1985b), "The Origins of the Soviet Oil Crisis, 1970-1985," Soviet Economy, Vol. 1, No.2, pp. 103-135,

Gustafson, T. (1984), "The Soviet Response to the American Embargo of 1981-82: The Case of the Compressors for the Export Gas Pipeline," in The Politics of East-West Trade. Edited by G.B. Smith. Boulder, Col.: Westview Press, pp. 129-142.

Hamilton, F.E.I. (1973),"Spatial Dimensions of Soviet Economic Decision-Making," in The Soviet Economy in a Regional Perspective. Edited by V. Bandera and Z. Melnyk. New York: Praeger, pp. 235-260.

Hamilton, F.E.I. (1970), "Aspects of Spatial Behaviour in Planned Economies," Papers of the Regional Science Association, Vol. 25, pp. 83-104.

Hamilton, F.E.I. and Linge, G.J.R. (1979), "Industrial Systems," in Industrial Systems, Volume I. Edited by F.E.I. Hamilton and G.J.R. Linge. New York: John Wiley & Sons, pp. 1-23.

Hannigan, J.B. and McMillan, C.H. (1984), "The Soviet Union and World Trade in Oil and Gas," in The Soviet Impact on Commodity Markets. Edited by M.M. Kostecki. London: Macmillan, pp. 68-99.

Hannigan, J.B. and McMillan, C.H. (1981), "Joint Investment in Resource Development: Sectoral Approaches to Socialist Integration," in East European Economic Assessment, Part 2. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 259-295.

Hanson, P. (1985), "The Soviet Economic Stake in European Detente," in The Future of Soviet Policy Toward Western Europe. Edited by H. Gelman. Santa Monica: The Rand Corporation (R-3254-FF/NATO), pp.29-47.

Hanson, P. (1982), "Soviet Western Technological Co-operation," in East-West Relations-Prospects for the 1980s. Edited by G. Schiavone. Macmillan: London, pp. 179-184.

Hanson, P. (1982b), "The Role of Trade and Technology Transfer in the Soviet Economy," in Economic Relations with the USSR. Edited by A.S. Becker. Lexington, Mass.: Lexington Books, pp. 23-48.

Hanson, P. (1981), Trade and Technology in Soviet-Western Relations. London: Macmillan.

Hanson, P. (1980), "The Impact of Western Technology: A Case Study of the Soviet Mineral Fertilizer Industry," in East European Integration and East-West Trade. Edited by P. Marer and J.M. Montias. Bloomington: Indiana University Press, pp. 252-282.

Hardt, J.P. and Holliday, G.D. (1977), "Technology Transfer and Change in the Soviet Economic System," in Technology and Communist Culture. Edited by F.J. Fleron. New York: Praeger, pp. 183-223.

Hewett, E.A. (1986), "Minerals in East-West trade," Resources Policy, Vol. 12, No. 3, pp. 175-186.

Hewett, E.A. (1983), "Foreign Economic Relations" in The Soviet Economy: Toward the Year 2000. Edited by A. Bergson and H. S. Levine. London: George Allen & Unwin, pp. 269-310.

Hoffman, E.P. and Laird, R.F. (1982), "The Scientific-Technical Revolution" and Soviet Foreign Policy. New York: Pergamon Press.

Hohmann, H.H. (1986), "The Soviet Economy at the End of the Eleventh Five-Year Plan: Counting on Gorbachev," in The Soviet Union 1984/85 Events, Problems, Perspectives. Boulder, Col.: Westview Press, pp. 123-138.

Holliday, G.D. (1985), "Western Technology Transfer to the Soviet Automotive Industry," in Trade, Technology and Soviet-American Relations. Edited by B. Parrott. Bloomington: Indiana University Press, pp. 82-116.

Holliday, G.D. (1984), East-West Technology Transfer II, Survey of Sectoral Case Studies. Paris: OECD.

Holliday, G.D. (1979), Technology Transfer to the USSR, 1928-1937 and 1966-1975: The Role of Western Technology in Soviet Economic Development. Boulder, Col.: Westview Press.

Holopainen, K. (1983), "The System of Payment Between Finland and the Soviet Union," in Finnish-Soviet Economic Relations. Edited by K. Mottola, O.N. Bykov and I.S. Korolev. London: Macmillan, pp. 173-180.

Holubnychy, V. (1973), "Spatial Efficiency in the Soviet Economy," in The Soviet Economy in a Regional Perspective. Edited by V. Bandera and Z. Melnyk. New York: Praeger, pp. 235-260.

Holzman, F.D. (1957), "The Soviet Ural-Kuznetsk Combine - A Study in Investment Criteria and Industrialization Policies," Quarterly Journal of Economics, Vol. 71. pp. 368-405.

Hought, G.V. (1985), "Liquified Natural Gas: Growing Dominance of Japan," Petroleum Economist, Vol. LII, No. 12, pp. 431-433.

Huzinec, G.A. (1983), "Soviet Decision Making in Regional Planning and its Potential Impact on Siberian Resource Exports," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 124-132.

Huzinec, G.A. (1976), "Some Initial Comparisons of Soviet and Western Regional Development Models," SG:R&T, Vol. 17, No. 8, pp. 552-565.

Jasny, N. (1962), Essays on the Soviet Economy. New York: Praeger.

Jensen, R.G., Shabad, T. and Wright, A.W. eds. (1983), Soviet Natural Resources in the World Economy. Chicago: University of Chicago Press.

Johansson, B. (1972), " OY Wartsila AB, Polar Shipbuilders," Polar Record, Vol. 16, No. 100, pp. 29-40.

Kalashnikova, I. (1980), "Razvitiye khimii i neftekhimii v Sibiri," PKh, No.3, pp. 26-31.

Kamerling, D. (1982), "The Role of Territorial Production Complexes in Soviet Economic Policy," in Soviet Economy in the 1980s: Problems and Prospects, Part 1. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 242-266.

Kanet, R.E. (1983), "Soviet and East European Arms Transfer to the Third World: Strategic, Political and Economic Factors," in External Economic Relations of CMEA Countries: Their Signifiance and Impact in a Global Perspective. NATO Economic Directorate, Brussels: NATO, pp. 171-194.

Kaser, M. (1984), "The Soviet Impact on World Trade in Gold and Platinum," in The Soviet Impact of Commodity Markets. Edited by M.M. Kostecki. London: Macmillan, pp. 156-172.

Kaser, M. (1983), "Soviet Gold Industry", in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 556-596.

Kazanskiy, N. and Singur, N. (1984), " Sibir' i Dal'niy Vostok v narodno-khozyaystvennom komplekse strany," PKh, No. 4, pp. 98-103.

Kerov, V.A. (1982), Problemy khozyaystvennogo osvoyeniya novykh rayonov. Moscow: Mysl'.

Khrushchev, A.T. and Nikol'skiy, I.V. (1985), Ekonomicheskaya geografiya SSSR, Chast' 1. Moscow: Izdatel'stvo Moskovskogo Universiteta.

Khryaschev, V. (1982), "Trans-Siberian Container Service," Soviet Shipping, No. 2, pp. 25-27.

Kibal'chich, O.A. and Stepanov, M.N. (1979), "Problemy ekonomicheskogo rayonirovaniya SSSR i formirovaniya territorial'no- proizvodstvennykh kompleksov," Itogi Nauki i Tekhniki, Seriya Geografiya SSSR, No. 15, pp. 66-99.

Kirby, S. (1984), Siberia and the Far East, Resources for the Future, Special Report No. 117, London: The Economist Intelligence Unit.

Kolesov, L.I. (1982), Mezhotraslevyye problemy razvitiya transportnoy sistemy Sibiri i Dal'nego Vostoka. Novosibirsk: Nauka, CO.

Kolosovskiy, N.N. (1947), "The Territorial-Production Combination (Complex) in Soviet Economic Geography," Orginally published in 1947 and reprinted in 1958 in Osnovy ekonomicheskogo rayonirovaniya. Translated in the Journal of Regional Science, (1961), Vol. 3, No. 1, pp. 1-25.

Kontorovich, V. (1985), "Discipline and Growth in the Soviet Economy, " Problems of Communism, Vol. 34, No. 6, pp. 18-31.

Koropeckyj, I.S. (1970), "Industrial Location Policy in the USSR During the Postwar Period," in Economic Performance and Military Burden in the Soviet Union. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 232-295.

Kosnik, J.T. (1975), Natural Gas Imports from the Soviet Union. Praeger: New York.

Kostinsky, B.L. (1974), Description and Analysis of Soviet Foreign Trade Statistics, U.S. Department of Commerce, Foreign Demographic Analysis Division, FER- No.5. Washington, D.C.: U.S. Department of Commerce.

Kramer, J.M. (1985), "Soviet-CEMA Energy Ties," Problems of Communism, Vol 34, No. 4, pp. 32-47.

Kravalis, H.J., Young, J.P., Oechsler, R.G. and Lamb, D.A. (1979), "Soviet Exports to the Industrialized West: Performance and Prospects," in Soviet Economy in a Time of Change, Vol. 2. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp. 414-461.

Krivoruchko, O.N. (1975), "Maritime Economic Systems of the USSR," SG:R&T, Vol. 17, No. 3, pp. 153-159. Translated from Geografiya v Shkole, 1974 , No.3, pp. 10-14.

Kromyshev, V.V. (1983), "Sotrudnichestvo s firmami kapitalisticheskikh stran na kompensatsionnoy osnove," in Effektivnost' vneshneekonomicheskikh svyazey: aktual'nyye problemy. Edited by V.A. Brykina and G.M. Tuchkina. Moscow: Mezhdunarodnyye Otnosheniya, pp. 152-162.

Krotov, V.A. (1976), " Voprosy territorial'noy organizatsii proizvoditel'nykh sil Sibiri i Dal'nego Vostoka," in Ekonomicheskaya Geografiya, Papers of the 26th Congress of the International Geographical Union. Leningrad: Geographical Society of the USSR, pp. 96-109.

Krotov, V.A. (1969), "Problemy ekonomicheskogo rayonirovaniya Sibiri i Dal'nego Vostoka," ISOAN SSSR, No. 6, pp. 3-11.

Kulev, I.A. (1983), "Soviet-Finnish Cooperation for Joint Construction of Industrial Objects," in Finnish-Soviet Economic Relations. Edited by K. Mottola, O.N. Bykov, and I.S. Korolev. London: Macmillan, pp. 122-136.

Kurbatova, G. Ya. (1980a), "Mashinostroyeniye," in Ocherki eknomiki Sibiri. Edited by V.V. Alekseev. Novosibirsk: Nauka, SO, pp. 273-297.

Kurbatova, G. Ya. (1980b), "Problemy razvitiya mashinostroyeniya v Sibiri," PKh, No. 3, pp. 26-31.

Lavrishchev, A.N. (1986), Ekonomicheskaya geografiya SSSR. Moscow: Ekonomika.

Lavigne, M. (1985), Economie Internationale des Pays Socialistes. Paris: Armand Colin.

Lebahn, A. (1983), "The Yamal Gas Pipeline from the USSR to Western Europe in East-West Conflict," Aussen Politik, Vol. 34, No. 3, pp. 258-281.

Leggett, R. (1982), "Soviet Investment Policy in the 11th Five-Year Plan," in Soviet Economy in the 1980s: Problems and Prospects, Vol. 1. U.S. Congress, Joint Economic Committee. Washington, D.C.: GPO, pp 129-146.

Levine, R. M, (1984), "The Mineral Industry of the USSR," reprint from the Minerals Yearbook, U.S Bureau of Mines. Pittsburg, Pa.: Bureau of Mines.

Listov, V.V. (1978), Bol'shaya khimiya Sibiri. Moscow: Khimiya.

Loginov, V. (1970), "Regional Problems of Technical Progress," in SG:R&T, Vol. 11, No. 1, pp. 47-56. Translated from VE, 1969, No. 8, pp. 41-50.

Lydolph, P.E. (1979), Geography of the USSR: Topical Analysis. Elkhart Lake: Misty Valley Publishing.

McIntyre, J.R. and Cupitt, R.T. (1980), "East-West Strategic Trade Control: Crumbling Consensus?," Survey, Vol. 25, No. 2, pp. 81-108.

Malish, A.F. (1985), "Soviet Trade in Agricultural Commodities and Technology," in Trade, Technology and Soviet-American Relations. Edited by B. Parrott. Bloomington: Indiana University Press, pp. 203-240.

Marris, S. (1984), "East-West Economic Relations: A Longer-Term Perspective," OECD Observer, No. 128, pp. 10-16.

Maslov, Ye. P. (1970), "The Significance and Role of Sectoral Production Complexes in the Formation and Evolution of Economic Regions," SG:R&T, Vol. 11, No. 11, pp. 746-754. Translated from Izvestiya Akademii Nauk SSSR, Seriya Geograficheskaya (hereafter IANSG), 1969, No. 4, pp. 69-77.

Mathieson, R.S. (1979), Japan's Role in Soviet Economic Growth: Transfer of Technology since 1965. New York: Praeger.

Mayergoyz, R.S. (1975), "The Unique Economic-Geographic Situation of the Soviet Far East and Some of the Problems of Using it Over the Long Term," SG:R&T, Vol. 15, No. 428-435. Translated from Vestnik Moskovskogo Universiteta, Geografiya, 197 No. 4, pp. 3-7.

Meyerhoff, A.A. (1983), "Soviet Petroleum: History, Technology, Geology, Reserves, Potential and Policy," in Soviet Natural Resource in the World Economy. Edited by R.G. Jensen, T. Shabad, and A.W. Wright. Chicago: University of Chicago Press, pp. 306-362.

Miller, E.B. (1981), "Soviet Participation in the Emerging Pacific Basin Economy: The Role of Border Trade," Asian Survey, Vol. XXI, No. 5, pp. 565-578.

Miller, E.B. (1978), "The Trans-Siberian Landbridge: A New Trade Route Between Japan and Europe: Issues and Prospects," SG:R&T, Vol. 19, No. 4, pp. 223-243.

Milling-Stanley, G. (1986), "Gold," Mining Annual Review, pp. 15-20.

Mirolevich, V. (1986), "Calgary Firm Co-Developer of New Vehicle," Soviet News and Views, No. 6, p. 5.

Mote, V.L. (1985), "A Visit to the Baikal-Amur Mainline and the New Amur-Yakutsk Rail Project," SG:R&T, Vol. 26, No. 9, pp. 691-716.

Mote, V.L. (1984a), "Containerization and the Trans-Siberian Landbridge," Geographical Review, Vol. 74, No. 3, pp. 304-314.

Mote, V.L. (1984b), "Transport Asepcts of the Pacific Basin Prospects for the USSR," in Pacific Basin Transportation Prospects. Edited by A.S. Whiting and V.L. Mote, Soviet Transportation Research Project Working Paper # 8. Washington, D.C.: Wharton Econommetric Forecasting Associates, pp. 23-125.

Mote, V.L. (1977), "The Baykal-Amur Mainline: Catalyst for the Development of Pacific Siberia," in Gateway to Siberian Resources (The BAM). Edited by T. Shabad and V.L. Mote. Washington, D.C.: Scripta Pub. Co., pp. 63-115.

Mozhin, V.P. (1983), "Ratsional'noye razmeshcheniye proizvoditel'nykh sil i sovershenstvovaniye territorial'-nykh proportsiy," PKh, No. 4, pp. 3-12.

Mozhin, V.P. (1980), Ekonomicheskoye razvitiye Sibiri i Dal'nego Vostoka. Moscow: Mysl'.

Nakayasu, A. (1981), "Our Experience in Plant Construction Work in West Siberia," Chemical Economy and Engineering Review, Vol. 13, No. 12, pp. 33-39.

Nekrasov, N.N. Ed. (1981), Razvitiye mezhdunarodnogo razdeleniya truda i razmeshcheniye proizvoditel'nykh sil SSSR: teoriya, metody, praktika. Moscow: Nauka.

Nekrasov, N.N. and Adamesku, A.A. (1981), Territorial'no-proizvodstvennyye kompleksy SSSR. Moscow: Ekonomika.

Nemchinov, N. (1983), "Fleet for Offshore Gas and Oil Business," Soviet Shipping, Vol. 3, No. 3, pp. 17-19.

Nikol'skiy, I.V. (1973), "The Role of Economic Sectors in the Formation of Regional Production Complexes," SG:R&T, Vol. 14, No.2, pp. 16-25. Translated from Vestnik Moskovskogo Universiteta, Seriya Geograficheskaya, No. 2, pp. 42-51.

Nirsha, T. (1981), "Compensation-Based Cooperation-A Mutually Advantageous Form of Economic Relations Between East and West," Foreign Trade, No. 8, pp. 36-40.

Nobuhara, N. and Akao, N. (1983), "The Politics of Siberian Development," in Japan's Economic Security: Resources as a Factor in Foreign Policy. Edited by N. Akao. Aldershot, Hants.: Gower, pp. 197-215.

North, R.N. (1987), "Transport and Communications," in Siberia: Progress, Problems and Prospects. Edited by A. Wood, Croom Helm: London, forthcoming.

North, R.N. (1984), "Transport in Siberia: Problems and Perspectives," in Siberie I. Edited by B. Chichlo. Paris: Institut D'Etudes Slaves, pp. 265-289.

North, R.N. (1983), "The Impact of Recent Trends in Soviet Foreign Trade on Regional Economic Development," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad and A.W. Wright. Chicago: University of Chicago Press, pp. 77-123.

North, R.N. (1979), Transport in Western Siberia: Tsarist and Soviet Development. Vancouver: University of British Columbia Press.

North, R.N. and Solecki, J.J. (1977), "The Soviet Forest Products Industry: Its Present and Potential Exports," Canadian Slavonic Papers, Vol. 19, No. 3, pp. 281-311.

Nove, A. (1977), The Soviet Economic System. London: George Allen & Unwin.

OTA (1982), Western Technology and Soviet Energy Availability. Boulder, Col.: Westview.

Ogawa, K. (1980a), "Expansion of Soviet Natural Gas Production and Steel Pipe Imports," Chemical Economy and Engineering Review, Vol 21, No. 12, pp. 19-23.

Ogawa, K. (1980b), "Soviet Economic Trends and Chemical Industry," Chemical Economy and Engineering Review, Vol. 12, No. 10, pp. 27-32.

OECD (1980), East-West Trade in Chemicals. Paris:OECD.

OECD (1979), "The Transfer of Technology from East to West," OECD Observer, No. 101, pp. 25-30.

Orlov, V.P. (1971), "O ratsional'nykh metodakh osvoyeniya prirodnykh resursov v novykh rayonakh Sibiri," EKO, No. 2, pp. 26-38.

Os'movoy, M.N. (ed.) (1983), Vneshneekonomicheskiye svyazi SSSR so stranami Severnoy Yevropy. Moscow: Izdatel' stvo Moskovskogo Universiteta.

Pallot, J. and Shaw, D.J.B. (1981), Planning in the Soviet Union. London: Croom Helm.

Probst, A. Ye. (1977), "Territorial-Production Complexes," SG:R&T, Vol 18, No. 7, pp. 195-203. Translated from IANSG, 1976, No. 2, pp. 47-58.

Pustopalov, B. (1984), "Ugol' po trubam," Eknomicheskaya gazeta, No. 19, p. 9.

Rodgers, A.L. (1983), "Commodity Flows, Resource Potential and Regional Economic Development: The Example of the Soviet Far East," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad and A.W. Wright. Chicago: University of Chicago Press, pp. 188-213.

Rodgers, A.L. (1974), "Locational Dynamics of Soviet Industry," Annals of the Association of American Geographers, Vol. 64, No. 2, pp. 266-240.

Roscoe, B. (1985), "Chips off the ice block," Far Eastern Economic Review," Vol. 130, No. 51, pp. 51-52.

Rozanov, G.L. (1977), Politika sotrudnichestva: Veleniye vremenii SSSR i kapitalisticheskiye strany, 70-e gody. Moscow: Mezhdunarodnoyye Otnosheniya.

Rumer, B.Z. (1984), Investment and Reindustrialization in the Soviet Economy. Boulder, Col.: Westview Press.

Rumer, B.Z. (1982), "Soviet Investment Policy: Unresolved Problems," Problems of Communism, Vol 31. No. 5, pp. 53-68.

Ruoho, S. (1985), "Finnish-Soviet Trade and Technology Transfer," Nordic Journal of Soviet and East European Studies, Vol. 2, No. 2, pp. 23-38.

Russell, J. (1983), Geopolitics of Natural Gas. Cambridge, Mass: Ballinger Pub.

Sagers, M.J. (1984), Refinery Throughput in the U.S.S.R.. U.S. Department of Commerce, Bureau of the Census, Centre for International Research, CIR Staff paper No. 2. Washington, D.C.: U.S. Department of Commerce.

Sagers, M.J. and Green, M.B. (1985), "Transport Constraints in Soviet Petroleum," Energy Policy, Vol. 4, No. 13, pp. 371-380.

Sagers, M.J. and Tretyakova, A. (1985), Restructuring the Soviet Petroleum Refining Industry. U.S. Department of Commerce, Bureau of the Census, Centre for International Research, CIR Staff Paper No. 4. Washington, D.C.: U.S. Department of Commerce.

Saushkin, Yu. G. (1980), Economic Geography: Theory and Methods. Moscow: Progress Publishers.

Savin, V. (1980), "Cooperation on a Compensation Basis," Foreign Trade, No. 4, pp. 20-25.

Savin, V., Osorgin, A. and Shlykh, N.L. (1974), "U.S.S.R.'s Far Eastern Export Base," Foreign Trade, No. 11, pp. 26-32.

Scherer, J.L. (1986), USSR Facts and Figures Annual, Vol. 10. Gulf Breeze, Fl.: Academic International Press.

Schiffer, J.R. (1985), "Interpretations of the Issue of 'Inequality' in Soviet Regional Policy Debates," International Journal of Urban and Regional Research, Vol. 9, No. 4, pp. 508- 532.

Semenov, S. (1986), "Teplokhod 'Anatoliy Kolesnichenko'", Morskoy Flot, No. 5, pp. 43-47.

Shabad, T. (1983a), "The Soviet Potential in Natural Resources: An Overview," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad and A.W. Wright. Chicago: University of Chicago Press, pp. 251-274.

Shabad, T. (1983b), "The Soviet Aluminum Industry: Recent Development," SG:R&T, Vol. 24, No. 2, pp. 89-99.

Shabad, T. (1979), "Soviet Regional Policy and CMEA Integration," SG:R&T, Vol. 20, No. 4, pp. 230-254.

Shabad, T. (1977), "Siberian Resource Development in the Soviet Period," in Gateway to Siberian Resources (The BAM). Edited by T. Shabad and V.L. Mote. Washington, D.C.: Scripta Pub. Co..

Shaw, D.J.B. (1985), "Branch and Regional Problems in Soviet Transportation," in Soviet and East European Transport Problems. Edited by J. Ambler, D.J.B. Shaw and L. Symons. London: Croom Helm, pp. 1-23.

Shlyk, N. L. (1986), "The Soviet Far East and the International Economy," in Soviet-American Horizons on the Pacific. Edited by J.J. Stephan and V.P. Chichkanov. Honolulu: University of Hawaii Press, pp. 114-125.

Shlyk, N. L. (1981), "Eksportnaya spetsializatsiya Dal'nego Vostoka: osnovnyye upravleniya razvitiya," ISOAN SSSR, No. 6, pp. 34-37.

Shniper, R. (1977), "Narodnokhozyaystvennyye problemy Sibiri v svete resheniy XXV s'ezda KPSS," Ekonomicheskiye nauki, No. 2, pp. 64-73.

Singur, N. (1984), " Nauchnyye osnovy osvoyeniya zony BAMa," Ekonomicheskaya gazeta, No. 20, p. 16.

Slavin, S.V. (1982), Osvoyeniye severa Sovetskogo Soyuza. Moscow: Nauka.

Smelyakov, N.N. (1983), "Industrial Cooperation and Joint Production in Soviet-Finnish Economic Ties," in Finnish-Soviet Economic Relations. Edited by K. Mottola, O.N. Bykov and I.S. Korolev. London: Macmillan, pp. 100-109.

Smith, A.H. (1985), "International Trade and Resources," in The Soviet State: The Domestic Roots of Foreign Policy. Edited by C. Keeble. Aldershot, Hants.: Gower Pub., pp. 106-124.

Sobeslavsky, V. and Beazley, P. (1980), The Transfer of Technology to Socialist Countries: The Case of the Soviet Chemical Industry. Farnborough, Hants.: Gower, Pub..

Sobolev, Yu. A. (1980), Transport i razvitiye ekonomiki Sibiri i Dal'nego Vostoka. Novoye v Zhizni, Nauke, Tekhnike, Seriya 'Transport', No. 8, Moscow: Znaniye.

Sobolev, Yu. A. and Stratula, D.S. (1983), Yuzhno-Yakutskiy TPK i drugiye kompleksy zony BAM. Moscow: Zaniye.

Solecki, J.J. (1979), "A Review of the U.S.S.R. Fishing Industry," Ocean Management, Vol. 5, pp. 97-123.

Soule, M.H. and Taaffe, R.N. (1985), "Mathematical Programming Approaches to the Planning of Siberian Regional Economic Development: A Nonmathematical Survey," Soviet Economy, Vol. 1, No. 1, pp. 77-98.

Spandaryan, V. (1975), "The Development of Soviet-Japanese Economic Relations," Foreign Trade, No. 4, pp. 23-29.

Special Contributor, (1981), "The Soviet Union," Mining Annual Review, pp. 77-98.

Stein, J.B. (1983), The Soviet Bloc, Energy and Western Security. Lexington, Mass.: Lexington Books.

Stern, J.P. (1985), International Gas Trade in Europe: The Policies of Exporting and Importing Countries. London: Heinemann.

Stern, J.P. (1983), "Soviet Natural Gas in the World Economy," in Soviet Natural Resources in the World Economy. Edited by R.G. Jensen, T. Shabad and A.W. Wright. Chicago: University of Chicago Press, pp. 363-384.

Stern, J.P. (1982), " Specters and Pipe Dreams," Foreign Policy, No. 48, pp. 21-36.

Stolyarov, Yu. S. and Pevzner, Ya. A. (eds.) (1984), SSSR-Yaponiya: problemy torgovo-ekonomicheskikh otnosheniy. Moscow: Mezhdunarodnyye Otnosheniya.

Strishkov, V.V. (1979), "Minerals Industry of the U.S.S.R.," reprint from the Mining Annual Review, U.S. Bureau of Mines, Pittsburg, Pa.: U.S. Bureau of Mines.

Styrikovich, M. and Popov, V. (1983), "Problems and Options: The Coal Branch's Prospects," CDSP, Vol. 35, No. 4, pp. 11-12. Translated from Pravda, 9 October, p. 2.

Sushkov, V. (1977), "Compensatory Long-Term Trade and Industrial Cooperation Between the USSR and the Industrial Capitalist Countries," Foreign Trade, No. 5, pp. 17-22.

Tishina, T.S. (1978), "Otraslevaya i territorial'naya struktura eksportnogo proizvodstva Sibiri," ISOAN SSSR, No. 1, pp. 50-53.

Tishina, T.S. (1977), "Siberia's Exports Base," Foreign Trade, No. 2, pp. 38-43.

Toda, Y. (1985), The Case Study of Soviet Japanese Economic Relations: The Northern Pacific Fishery, Paper Presented at the IIIrd World Congress for Soviet and East European Studies, November 1985, Washington, D.C..

Treml, V.G. (1983), "Soviet Dependence on Foreign Trade," in External Economic Relations of CMEA Countries: Their Significance and Impact in a Global Perspective, NATO Economic Directorate. Brussels: NATO, pp. 35-52.

Treml, V.G. and Kostinsky, B.L. (1982), Domestic Value of Soviet Foreign Trade: Exports and Imports in the 1972 Input-Output Tables. U.S. Department of Commerce, Bureau of the Census, Foreign Demographic Analysis Division, FER-No.20. Washington, D.C.: U.S. Department of Commerce.

Treml, V.G. and Hardt, J.P. eds. (1974), Soviet Economic Statistics. Durham, N.C.: Duke University Press.

U.N. Economic Commission for Europe (1982), "Large-Scale and Long-Term Compensation Agreements in East-West Trade," Economic Bulletin for Europe, Vol. 34, No. 2, pp. 171-195.

Utkin, N. (1978), "Pearl of the Arctic," CDPS, Vol. 33, No.8, pp. 8-9. Translated from Pravda, 25 February, p. 2.

Vanous, J. (1983), "Prepared Statement by Dr. J. Vanous: Soviet Participation in Western Trade and Its Impact on the Domestic Economy", in The Premises of East-West Commercial Relations. U.S. Senate, Committee on Foreign Relations. Washington, D.C.: GPO, pp. 89-102.

Vanous, J. (1982), "Comparative Advantage in Soviet Grain and Energy Trade," Centrally Planned Economies, Current Analysis, 10 September. Washington, D.C.: Wharton Econometric Forecasting Associates.

Volkov, V. (1985), "Razvitiye Sovetskogo eksporta lesnykh i tsellyulozno-bumazhnykh tovarov," Vneshnyaya Torgovlya, No. 10, pp. 47-49.

Wartsila (1984), Icebreakers Built or on Order at Wartsila's Helsinki Shipyard. Helsinki: Nova.

Wein, N. (1984), "Agriculture in the Pioneering Regions of Siberia and the Far East: Present Status, Problems and Prospects," SG:R&T, Vol. 25, No. 8, pp. 592-620.

Wilson, D. (1986), "Serious Implications in Oil Shortfalls in USSR," Petroleum Review, Vol. 40, No. 468, pp. 18-19.

Wilson, D. (1982), Soviet Oil and Gas to 1990. Economist Intelligence Unit Special Series No. 2, Cambridge, Mass.: Abt Books.

Zaleski, E. and Wienert, H. (1980), Technology Transfer Between East and West. Paris: OECD.

Zhebelev, G. (1982), "Port Vostochnyy," Soviet Shipping, No. 2, pp. 26-28.

Zhebrovoskiy, B. and Ponomarev, A. (1986), "Sotrudnichestvo s zapadnymi firmami na kompensatsionnoy osnove v proshedshey pyatiletke," Vneshnyaya Torgovlya, No. 10, pp. 18-20.

Zhinkin, V. (1978), "Transit Container Shipments by the Trans-Siberian Route," Foreign Trade, No. 12, pp. 23-28.

Zvyagitseva, K.M. (1984), "Ugol' kak osnovnoy prirodnyy resurs KATEKa," in KATEK i razvitiye otrasley khozyaystva Sibiri. Edited by V.E. Popov and P.V. Shemetov. Novosibirsk: Nauka, SO., pp. 22-30.

Appendix 1

Exchange Rates

	Dollar/Rouble	Dollar/Pound	Dollar/Yen
1970	0.9	2.4	360.0
1971	0.9	2.434	350.7
1972	0.9	2.502	308.0
1973	0.739	2.452	272.2
1974	0.756	2.339	291.5
1975	0.720	2.222	296.8
1976	0.754	1.806	296.6
1977	0.736	1.746	268.5
1978	0.681	1.920	210.5
1979	0.654	2.122	219.2
1980	0.649	2.326	226.8
1981	0.719	2.028	220.5
1982	0.762	1.751	249.1
1983	0.743	1.517	237.5
1984	0.842	1.336	237.5
1985	0.764	1.296	238.5

Sources: Rouble: 1970-1983 from CIA Economic Handbooks, 1984 and 1985 from Moscow Narodny Bank Press Bulletin.
Pound Sterling and Japanese Yen: Economic Research Ltd. (various years), Oil and Energy Trends.

Appendix 2

The Role of Siberian and the Far East in National Economic Plans

The Ninth Five-Year Plan, 1971-75

In Siberia: "to ensure high growth rates in the power-intensive production lines of ferrous and nonferrous metallurgy, the chemical, lumber, wood-processing, pulp and paper and fuel industries and electric power engineering..."

In West Siberia: "To create the country's largest petroleum-industry base in Western Siberia; by 1975 to bring petroleum extraction to at least 120 million to 125 million tons and to build gas refineries with an annual capacity of 5 million to 6 million cubic metres of gas processed. To accelerate the development of the extensive gas deposits in northern Tyumen' oblast'. To begin construction of large petrochemical complexes in the vicinity of Tobol'sk and Tomsk; to commission capacities of the Surgut State Regional Power Station; and to complete the construction of the Tyumen-Tobol'sk-Surgut railroad."

"To ensure the construction of gas pipelines for the delivery of gas to the Urals and the European part of the USSR and of petroleum pipelines to petroleum refineries in Siberia, Kazakhstan and the European part of the USSR."

"To bring the total volume of coal extraction in the Kuznetsk basin to 135 million tons."

In East Siberia:"To carry out the accelerated construction of the Achinsk petroleum refinery , to complete the construction of the Krasnoyarsk aluminum plant, and significantly to expand the production of copper and nickel at the Noril'sk metallurgical combine. To expand the extraction and utilisation of Kansk-Achinsk coal. To begin the formation of the Sayan Territorial- Production Complex, consisting of the Sayan Hydro-eletric station, aluminum and railroad-car plants, a large steel foundry, enterprises for processing of nonferrous metals, and enterprises of the electrical equipment industry, light industry and the food industry. To accelerate the construction of the Zima electrochemical combine."

"To ensure the further development of the Bratsk Territorial-Production Complex; to complete the construction of the Bratsk aluminum plant and the Bratsk lumber industry complex; to commission the first aggregates of the Ust-Ilimsk hydro-electric station, and to start the construction of the Ust-Ilimsk lumber industry complex. To carry out the construction of the Zhireken molybdenum mining and enriching combine in Chita oblast'."

"To increase the felling and integrated processing of timber in Siberia and to start construction of major new enterprises of the sawmill-and-woodworking, pulp and paper and microbiological industries in this area."

In the Far East: "To increase the extraction of coal, tin, tungsten, mercury, gold and diamonds. To complete the expansion of the Komsomol'sk petroleum refinery, and to begin the construction of a new petroleum refinery. To commission the first aggregates of the Zeya hydro-electric station and the Primorsk state regional power station, and to begin the construction of the Kolyma hydro-electric station. Significantly to increase the production of lumber, pulp, cardboard, furniture, foodstuffs and fish products. To strengthen the material and technical base of the fishing industry, to increase the capacity of ship-repair plants, and to reconstruct and expand seaports and piers."

Source: CPSU (1971), "Directives of the 24th C.P.S.U. Congress for the Five Year Plan for the Development of the USSR National Economy in 1971-1975," in CDSP, Vol. XXII, No.7, pp. 9-10. Translated from Pravda and Izvestiya, 9 February, pp 1-5.

The Tenth Five-Year Plan, 1976-80

In Siberia: "To provide for the accelerated development of the fuel industry and of power-intensive production units of ferrous and non-ferrous metallurgy and the chemical and pulp-and-paper industries. To ensure further development of the lumber and wood-processing industry."

In West Siberia: "To continue the formation of a major territorial-production complex--the country's principal base for the extraction of petroleum and gas. By 1980 to bring the extraction of petroleum in this region to 300 million to 310 million tons and gas to 115 billion to 145 billion cubic metres. To continue the construction of the Tomsk petrochemical combine. To expand the construction of the Tobol'sk petrochemical complex. To build plants for processing casinghead gas, a pipeline system for transporting petroleum and gas and a railroad from Surgut to Nizhnevartovsk. To develop the electric power base.

"To bring coal extraction in the Kuznetsk basin up to 161 million tons."

In East Siberia: "To develop the construction of a large opencast coal mine in the Kansk-Achinsk basin and on this basis the construction of the Berezovskoye state regional power station. To ensure the commissioning of the first section of the Achinsk petroleum refinery."

"To continue the development of the Sayan Territorial-Production Complex. To commission the first aggregates of the Sayan-Shushenskoye hydro-electric station, to ensure the commissioning of the first electrolysis building of the Sayan aluminum plant, and to build the first section of a complex of electrical equipment plants in the city of Minusinsk. To begin the construction of the Boguchany hydro-electric station. To complete in the main the formation of the Bratsk-Ust'-Ilimsk Territorial-Production Complex, ensuring the commissioning of the Ust'-Ilimsk hydro-electric station at full capacity and the construction of a pulp plant with the participation of CMEA member countries. To continue the construction of the Gusinoozersk state regional power station."

In **the Far East:** "To ensure the comprehensive development of the economy and increases in the extraction of nonferrous, rare and precious metals and diamonds and in the output of the lumber, pulp and paper and furniture industries. To complete the construction of the Zeya hydro-electric station and expand the construction of the Bureya hydro-electric station, and to commission the first aggregates of the Kolyma hydro-electric station. To continue the development and reconstruction of existing ports, the updating of the fleet and construction of the deepwater port at Vostochnyy."

"To increase the catch of fish and other ocean products and the production of an expanded assortment of high-quality fish food products."

"Significantly to step-up geological prospecting and research work on the comprehensive development of productive forces in the zone adjacent to the Baykal-Amur mainline. To provide for the development of the natural resources in this zone as the construction of individual sections of the main line are completed."

"To begin the formation of the South Yakutian Territorial-Production Complex. To build a rail line from Tynda to Berkakit. To develop the construction of the Neryungri opencut coal mine and concentrating factory and the Neryungri state regional power station."

Source: CPSU (1976), "Basic Guidelines for the Development of USSR National Economy in 1976-1980," CDSP, Vol. XXVII, No. 50, pp. 22-23. Translated from Pravda and Izvestiya, 14 December, pp. 1-6.

The Eleventh Five-Year Plan, 1981-85

In Siberia: "To provide for the accelerated growth of the fuel industry, electric power engineering, non-ferrous metallury and chemical and petrochemical, timber, lumber, pulp-and-paper, microbiological and construction industries. To strengthen the food base in every way by achieving an upswing in agriculture and in the branches that process agricultural raw materials."

In West Siberia: "To ensure the further development of the major territorial-production complex in northwestern Siberia. To bring the extraction of petroleum (including gas condensate) there to 385 million to 395 million tons by 1985, and gas extraction to 330 billion to 370 billion cubic metres. To commission production capacities at the Tobol'sk petrochemical combine, the Tomsk chemical plant and the Surgut state regional power station. To expand the construction of a plant to produce chemical-industry and petroleum-refining equipment. To reinforce the construction base, step up the construction of housing and social and cultural facilities, and expand road building. To put the Surgut-Urengoy railroad into operation."

"To increase the extraction of steam and coking coal in the Kuznetsk basin."

In East Siberia: "To continue the formation of the Kansk-Achinsk Territorial-Production Complex. To commission the first sections of the Berezovskoye opencut coal mine No. 1 and the Krasnoyarsk heavy-duty excavator plant and capacities of the Berezovskoye state regional power station No.1. To ensure the further development of the Sayan Territorial-Production Complex. To basically complete the construction of the Sayan-Shushenskoye hydro-electric power station, commission capacities at the Abakan railroad plant and the Sayan aluminum plant, and continue the construction of electrical-equipment enterprises in the city of Minusinsk."

"To expand construction of the Boguchany hydro-eletric station, commission the first power-generating units of the Kharanor state regional power station and complete the construction of the Gusinoozersk state regional power station. To conduct preparatory work for the development of the Ozerny polymetallic-ore deposit."

In the Far East: "To ensure the further development of non-ferrous metallurgy and the petroleum-refining, fish, timber, lumber and pulp-and-paper industries."

"To expand work on the agricultural development of the zone adjacent to the Baykal-Amur Mainline. To complete design work on the Udokan copper deposit. To continue the formation of the South Yakutian Territorial-Production Complex and complete the construction of an opencut coal mine, a coal preparation plant and the first section of the Neryungri state regional power station."

"To commission the first power-generating aggregates of the Bureya hydro-electric station and the Yakutia state regional power station No.2 and complete the construction of the Maritime state regional power station and Kolyma hydro-electric station No.1. To build a metallurgical processing plant. To carry out further development and reconstruction of existing ports. To begin building the second section of the Vostochnyy deepwater port."

Source: CPSU (1980), "Basic Guidelines for the Economic and Social Development of the USSR in 1981-1985 and the Period to 1990," in CDSP, Vol. XXXII, No. 48, p. 21. Translated from Pravda, pp. 1-6 and Izvestiya, 2 December, pp. 2-7.

The Twelfth Five-Year Plan, 1986-1990

In Siberia: "To ensure the accelerated development of Siberia's economy. To step up work on building up the capacities of the fuel and power base in this region. To carry out measures aimed at ensuring the comprehensive processing of mineral, raw-material and timber resources and increasing the region's share in the all-Union production of the energy-intensive branches of industry and the proportional development of manufacturing branches, especially machine-building. To strengthen the local food base. To develop the construction industry, the building materials industry and transportation at priority rates."

In West Siberia: "To continue the formation of the West Siberian Territorial-Production Complex. To step up prospecting for petroleum and gas deposits and their outfitting and development. To build trunk gas pipelines in the European part of the country and the southern regions of Siberia. To complete the construction of Surgut state regional power station No.2, and to commission capacities at the Nizhnevartovsk and Urengoy state regional power stations."

"To accelerate the construction and the reconstruction of coal enterprises in the Kuznetsk basin... To carry out the reconstruction of the Kuznetsk metallurgical combine."

In East Siberia: "To commission power-generating units at Berezovskoye state regional power station No.1 and coal-extraction capacities at Berezovskoye opencut mine No. 1, begin construction of Borodinsky opencut coal mine No.2, launch the construction of Berezovskoye state regional power station No.2. and carry out other work in the formation of the Kansk-Achinsk Territorial-Production Complex."

"To ensure the commissioning of capacities at enterprises under construction in the Sayan Territorial-Production Complex, and to accelerate the construction of the Sayan aluminum plant. To launch the development of the lower Angara region's resources, continue the construction of the Boguchany hydro-

electric station, and begin preparatory work on the construction of the middle Yenisey hydro-electric station and the development of the Gorev lead and zinc deposit. To begin the development of the Ozerny pollymetallic-ore deposit and launch the construction of the second section of the Gusinoozersk state regional power station, and to commission capacities at the Ulan-Ude heat and power station No.2."

In **the Far East:** " To increase the extraction of non-ferrous and rare metals. To ensure the priority development of the fuel industry and electric power engineering."

"To put the entire length of the Baykal-Amur Mainline into regular operation, and begin the large-scale economic development of the zone adjacent to the railroad. To continue the formation of the South Yakutia Territorial-Production Complex. To build the second section of the Neryungri state regional power station, to begin the construction of the Denisovskaya coal mine and a mining and concentrating combine at the Seligdar apatite deposit, and perform preparatory work on the creation of a metallurgical base in the Far East using local coking coal and iron ores. To launch the construction of the Berkakit-Tommot-Yakutsk railroad."

"To commission the Okha-Komsomol'sk gas pipeline and the first aggregates of the Vilyui hydro-electric power station No.3 and the Bureya hydro-electric power station and the Yakutsk state regional power station No.2. To complete the construction of the first section of the Deputatsky mining and concentrating combine in the Yakut Autonomous Republic. To increase the fish catch, the taking of other maritime products and the production of high-quality seafoods."

"In order to retain personnel in Siberia and the Far East, to ensure priority growth in the living standard of the population in these regions."

Source: CPSU (1986), "Draft Basic Guidelines for the Economic and Social Development of the USSR in 1986-1990 and in the Period up to the Year 2000," in CDSP, Vol. XXXVII, No. 49, p. 20. Translated from Pravda and Izvestiya, 9 November, 1985, pp. 1-6.