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INTERNATIONAL TRADE AND THE MARKETING OF PETROCHEMICALS*

Prepared by

the UNIDO secretariat

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Preface

"International trade and marketing of petrochemicals" is based on a draft prepared for the UNIDO secretariat, Negotiations Branch, by E. Maurice Domengaux of the International Marketing Institute, Cambridge, Messachusetts, U.S.A. Additional contribution to this study are related to work on non-tariff barriers (NTB), prepared by Karen McCusker, new forms of trade, prepared by V.G. Gerus and additional and updated data drawn from UNIDO Data Base. The Secretariat of UNIDO/Negotiations Branch finalized the work in its present form.

Introduction

"International Trade and Marketing" is prepared in response to the recommendation of the Second Consultation on the Petrochemical Industry to deal with long-term arrangements for the development of the petrochemical industry, including, inter alia, aspects related to trade and international marketing.

The paper falls in four chapters. The first analyses the role and place of the chemical and petrochemical industry in international trade and development. The second chapter analyses the organization of the petrochemical markets both from the technical and organizational sides. It deals in some details with the specific characteristic of the U.S.A., Western Europeans and Japanese markets. Chapter three deals with factors influencing the future development of the market and shows the changing competitiveness of producers in various regions and the role being and will be played by new producers from the developing and energy rich countries. Special analysis is made of trade barriers and the implication of tariff and non-tariff barriers on the development of trade in petrochemicals. Detail analysis is also made of new forms of trade being widely practiced under conditions of recession shortage of foreign exchange, difficult financing and fluctuating rates of exchange and convertability of national currencies.

The fourth and last chapter deals with the obstacles and prospects of new petrochemical producers in international trade. Prospects are dependent on international co-operation, South/South co-operation, new division of international labour and concentration and specialization on the basis of mutual benefits and global development of the petrochemical industry.

1. Role and Place of Chemicals in World Trade and the Relative Position of Petrochemicals.

The chemicals industry has been one of the most dynamic sectors in the world economy during the 20th century. Modern chemical production and trade includes some 40 sub-branches which are the building blocks for thousands of products. The fast-paced growth of the international chemicals industry was born out of the technological creativity of scientists who invented new products and applications for chemicals within the framework of a generally favourable global economy.
Figure 1.1-1 illustrates the dramatic growth sustained by the developed countries in this sector over the past 20 years.

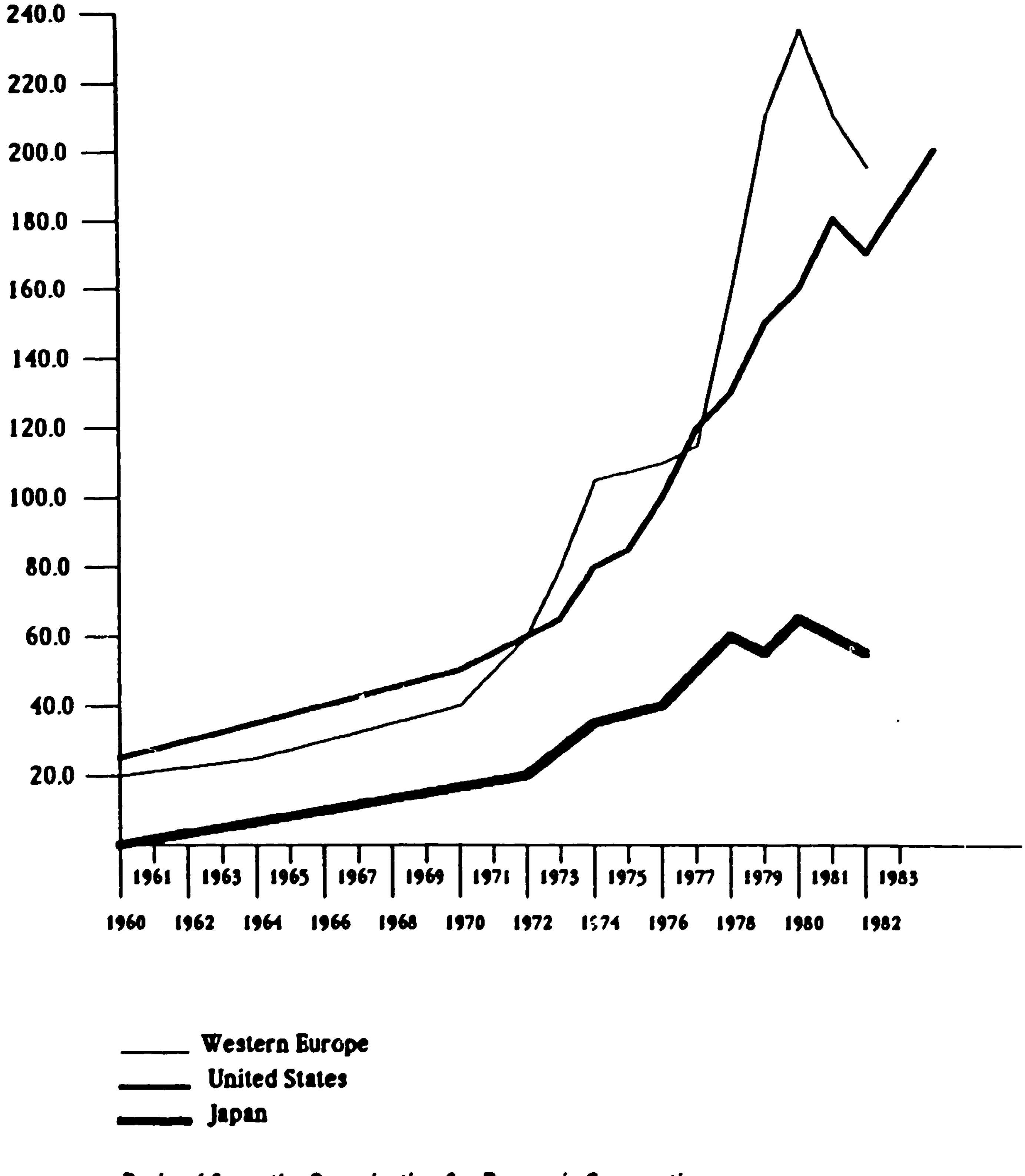
The dynamism of the chemicals industry can be appreciated by comparing its average annual growth rates to those of total average industrial growth. From 1950-1970, total world industry production rose by 5 times and averaged 5.7 percent annual growth compared to 8.4 percent in the chemical industry. Table 1-A details the growth rates of chemicals production and one of its major components, petrochemicals, in the developed countries from 1960-1985 1/:

Table 1-A

	Average annual growth rate %	EC Average growth rate%	
	1960-1973	1960/73	1974/85
Industrial production	5.5	5	2
Chemical production	9.0	10	3
Petrochemicals Industry*		25	3
Production of main primary petrochemicals			
Ethylene	17.0		
Propylene	16.5		
Benzene	13.0		
Butadiene	10.0		

* measured by ethylene production

Figure 1.1-1
Sales Value of Chemical Industry Production
1960-1982 in U.S. Billion Dollars



Derived from the Organization for Economic Cooperation and Development, "The Chemical Industry", annual publication

The preceding table demonstrates that from 1960-1973 total chemicals growth averaged 4.5 percent higher than average total industrial production growth, while petrochemicals growth rates were even more remarkable averaging between 10 and 17 percent. During the same period was the growth rate in Europe even more remarkable though shortly reduced in the past decade.

The growth rate of world chemical trade has been as extraordinary as chemical production. World exports of chemicals increased by ten times from 1950-1970, compared to a 5-fold increase for total world trade. For the same period, the annual growth rate for chemicals exports was 12.4 percent with total export growth averaging 8.3 percent. Figure 1.1-2 shows the phenomenal increase in international chemical exports from 1962-1982. From 1970 to 1980, the value of total world chemical exports rose 667 percent from 22 to over 147 billion dollars.

International trade in chemical products continues to be dominated by producers in the E.E.C., the U.S. And Japan. Although new producers have made a major impact on chemicals production, in 1983, these countries were responsible for only 18.4 percent of chemicals trade while the developed countries accounting for 64.8 percent. The major actors in chemicals trade are presented in Figure 1.1-3 with their corresponding share of international trade.

During the 1950's, the development and utilization of new technologies allowed the production of synthetic products from crude oil and natural gas refinery products which began replacing an ever-growing share of the end-use market for natural materials.

Growth in the man-made products sector was fast paced through the 1970's. Table 1-B lists the consumption (million tons) of man-made and natural fibres from 1951-1984 2/.

Table 1-B

	All Fibers	Cotton	Wool	Rayon	Synthetic Fibers	Share of synthetics
	(million t/yr)					(%)
1951	10.5	7.5	1.1	1.8	0.1	1
1960	12.6	8.8	1.2	2.3	0.3	2
1965	18.2	11.3	1.5	3.3	2.1	11
1970	21.8	12.1	1.6	3.4	4.7	22
1975	24.8	13.0	1.4	3.0	7.4	30
1980	30.4	14.1	2.0	3.6	10.7	35
1984	32.1	14.8	2.0	3.3	12.0	37

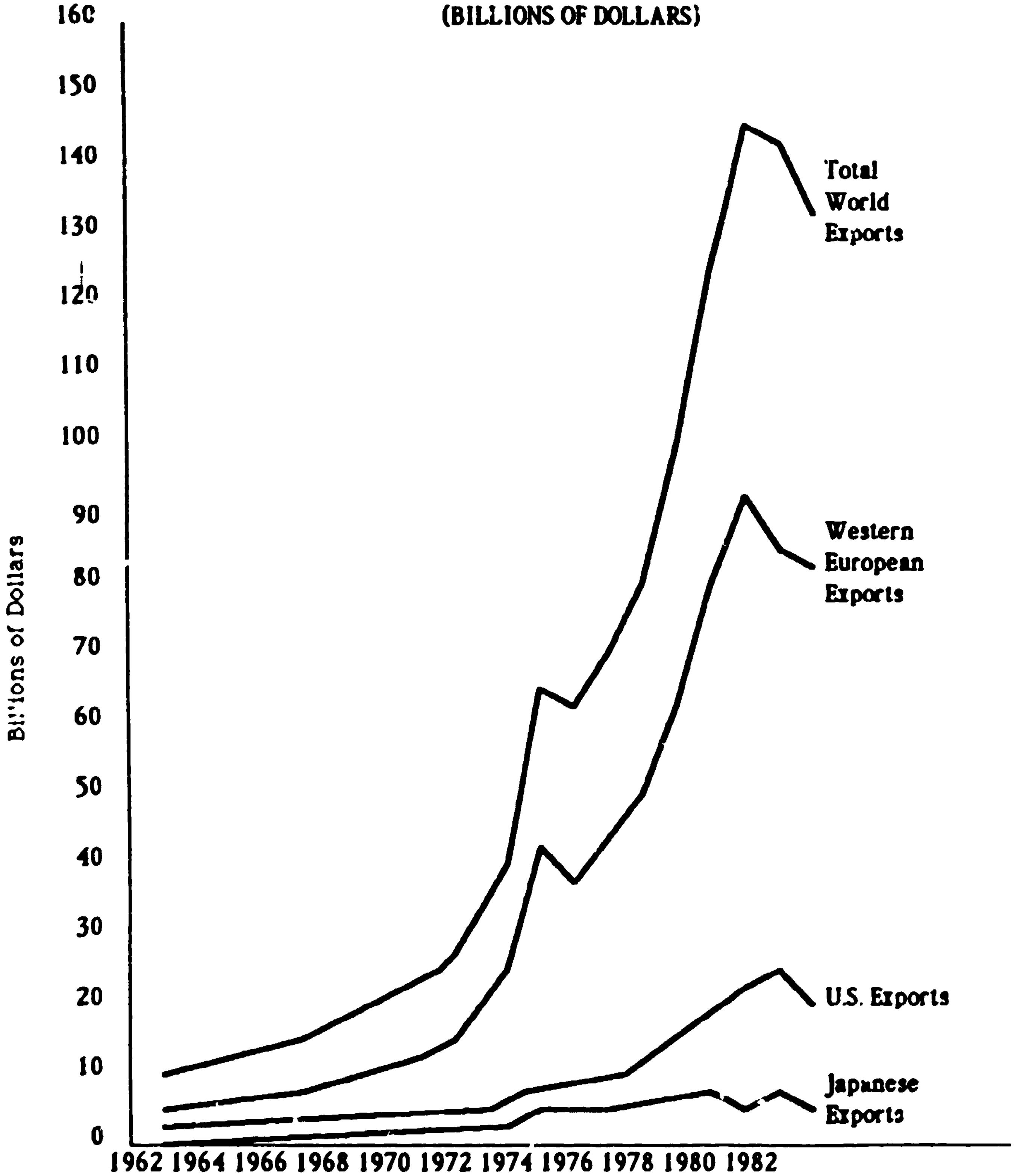
The table above shows the steady encroachment of synthetic materials on the market share held by natural materials in the fiber market. The percentage held by synthetics of total fiber sales rose from 1 percent in 1951 to 37 percent in 1984.

It is generally acknowledged that this period of rapid expansion ended during the mid-1970's, as a result of an increase in raw materials costs from two oil price increases and the deregulation of natural gas in the U.S. and Canada. This increase in variable costs was accompanied by a slowdown in world-wide economic growth, the maturing and saturation of final product markets. These events increased production costs for the traditional petrochemicals producers as demand for petrochemical products softened and competitors began introducing products manufactured with significant cost advantages.

An idea of the size of chemicals and petrochemicals trade as a percentage of total world trade can be deduced from the following comparison. Total world merchandise exports for 1983 valued $ 194,620,384 million, $ 19,994,649 million, or 10,2 percent of which was acoounted for by world chemicals trade [3/]. Petrochemicals account for approximately 55 to 65 percent of all chemicals trade, which indicates a total value of between $ 10,997,056 million and $ 12,996,521 million, or between 5.7 and 6.7 percent in 1983 [4/].

Figure 1.1-2

WORLD EXPORTS IN CHEMICALS
(BILLIONS OF DOLLARS)

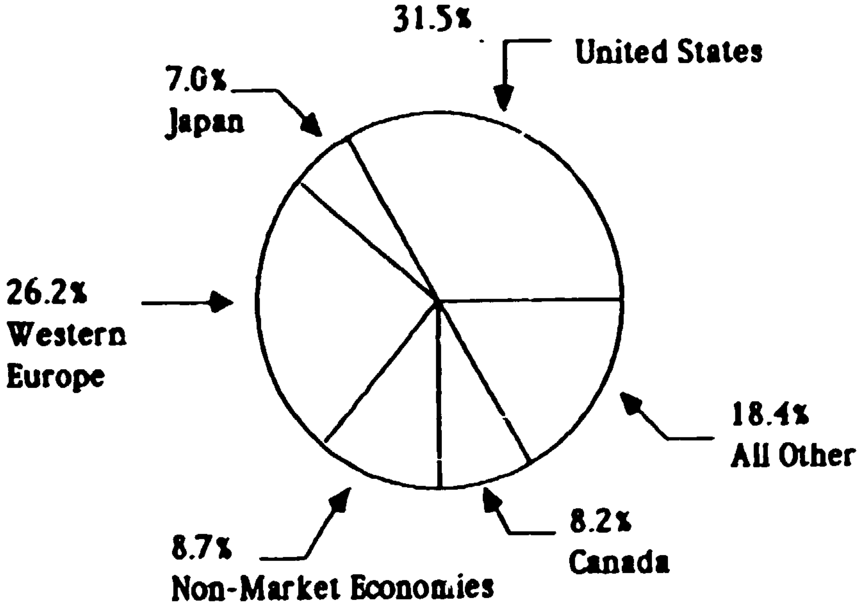


Source: United Nations-Monthly Bulletin of Statistics.
Arthur D. Little, Inc.

Figure 1.1-3

CHEMICAL-PRODUCING NATIONS' SHARE

OF WORLD EXPORTS, 1983



Source: United States International Trade Commission Data.

Note: "All other Nations" includes CERN's with new petrochemical capacity

Trade in chemicals follows the same pattern as total international trade with important distinctions. By far, the largest amount of trade is carried out between the developed countries. In 1983, chemicals exports by the U.S., the E.E.C. and Japan comprised 64,7 percent of world chemicals exports. However, a large portion of this trade was within the E.E.C. Almost 40 percent of world commerce in chemicals is between members of the Common Market. For 1982 net intercontinental trade looked like this:

Table 1-C

	Billions of Dollars
Reported World Trade in Chemicals	135.96
Less Intra-European Trade	53.24
Net Inter-continental Chemical Trade	82.72

Developing countries, especially those with abundant natural gas reserves, have the ability to significantly alter the world petrochemicals supply-demand scene. In 1983, these countries already accounted for 24.6 percent of world exports. These CERN's* enjoy production input incentives ranging from advantageous feedstocks, access to financial loans on favourable terms and tax credits. The tremendous impact of CERN's and other developing countries' entry into petrochemicals production has been the catalyst of a global restructuring and industrial relocation of the international petrochemicals industry.

* Conventional Energy-Rich Nations

2. The Organization of the Petrochemical Market

2.1 Market Integration: Technological aspects.

The 1970's and 1980's have seen a continued trend of downstream integration of major producers in the petrochemical industry. The vertical build-up of the industry is due principally to the desire to create economies in production costs by lowering transportation costs and facilitating feedstock and by-product transfer. Captive production occupies much of the market. This is particularly true of some products, such as ethylene where international trade in the product, due to techno-economic factors, is extremely limited: 10 % in U.S.A, 9.1 % in E.E.C. and 4.2 % in Japan in 1981. This vertical trend is also attributable to increased raw materials costs and competition from emerging petrochemicals producers. Stronger competition and higher production costs has led producers in developed countries to move into specialty chemicals production where the value-added to primary chemicals is greater and the inherent quality demanded by the product requires a technically advanced production process often associated with proprietary technology.

Through the 1970's, the major oil companies in Western Europe, taking advantage of their control over feedstocks and energy supply and of their surplus cash-flow situation, intensified their activities in the downstream production of petrochemicals.

Table 2.1-A below illustrates the downstream integration of Western European major oil companies into petrochemicals production 5/:

Table 2.1-A

Oil Companies' Share of Total Production Capacity (%)

	Ethylene	Ethylene oxide	Styrene	VCM	PVC	Polypropylene	LDPE	HDPE	Polystyrene
1970	50	23	24	9	16	29	28	20	-
1975	53	31	49	12	21	34	28	26	10
1980	60	42	51	19	21	39	41	29	18

The major oil companies control of ehtylene and styrene production in Western Europe is particularly striking. By 1980, major producers controled 60 percent of primary ethylene, 42 percent of ethylene oxide, and 51 percent of total styrene production. Table 2.1-B examines the structure of the ethylene market in Western Europe:

Table 2.1-B

Ethylene Feedstock Pattern and Structure of the Industry

Western Europe, 1982
(million tons naphtha equivalent; per cent)

	Chemical companies	Joint ventures	Oil company affiliates	Total
Naphtha	11.5 (35.7)	5.0 (15.5)	15.7 (48.8)	32.3 (100)
Gas oil	2.0 (37.7)	-	3.3 (62.3	5.3 (100)
LPG	2.6 (45.6)	0.5 (8.8)	2.6 (45.6)	5.7 (100)

Sources: Hydrocarbon Processing; European Chemical News.

Table 2.1-B shows that vertically integrated major oil companies control nearly half of all naphtha and liquid petroleum gas and 62 percent of all gas oil used to produce ethylene feedstocks.

To maximize capacity utilization, major producers strive to increase the proportion of captive production they control. The objective is to maximize the economies of scale available in ethylene crackers by controlling the production size and capacity utilization rate. Figure 2.1-1 demonstrates the relationship between production costs and cracker size. A vertically arranged complex which permits large capacity ehtylene plants creates predictability in feedstock supply and cost control. This has contributed to the clustering of these industries in certain locations where it would be possible for producers to purchase their needs within short distances from common grids or direct pipeline linkages.

While commodity and intermediate petrochemicals plants are frequently located in remote locations to be near raw materials sources, specialty production facilities tend to be located near their end-markets, in industrial centres which combine the scientific and technological expertise necessary for their production. This location also allows for communication between the manufacturer and his customer, which is crucial in the custom-made, high-quality specialty petrochemicals market.

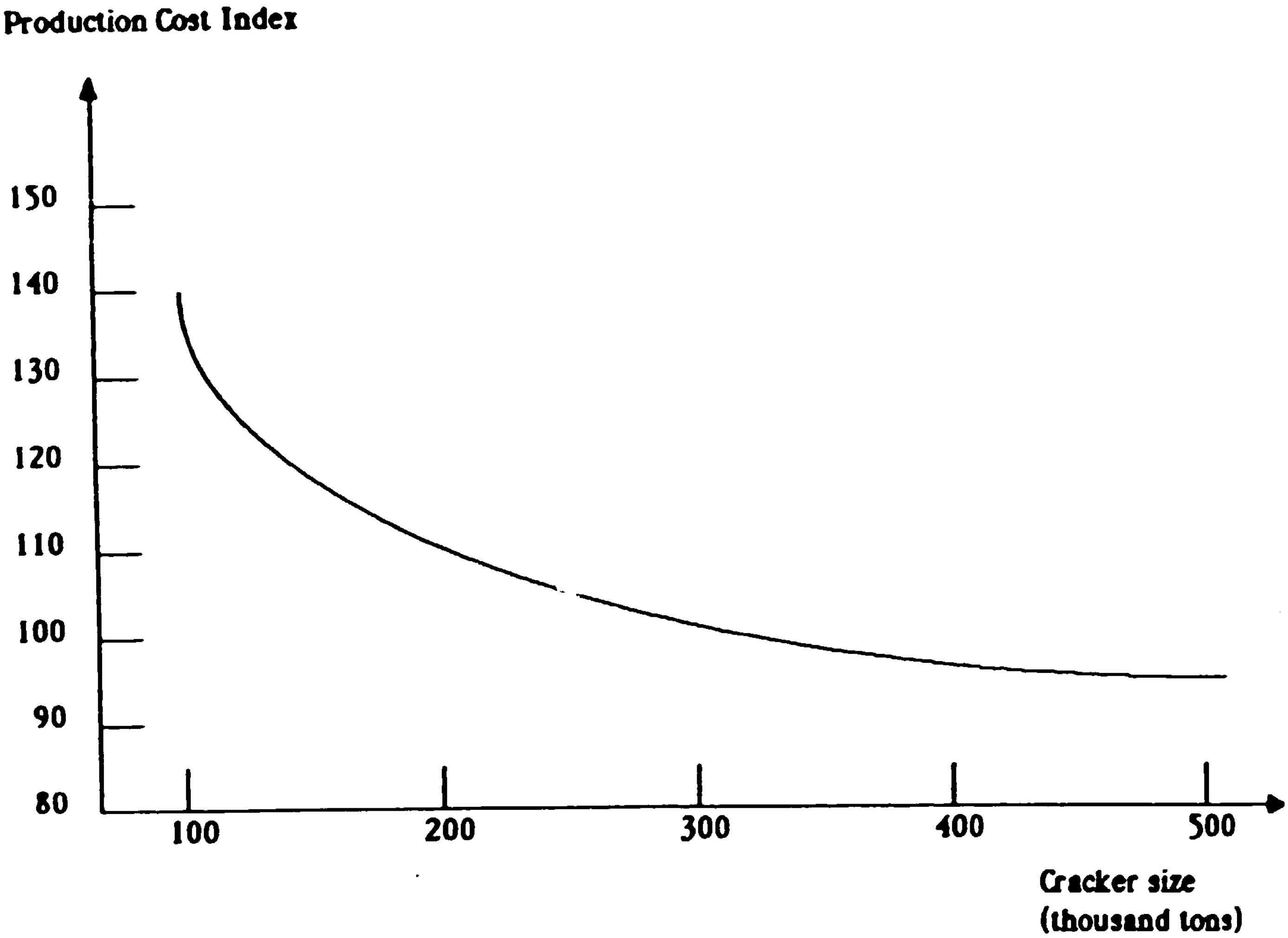
Table 2.1-C lists the most common primary petrochemicals products where integration efforts have been concentrated 6/:

Table 2.1-C

Ethylene:	HDPE, LDPE, ethylene oxide, ethylene glycol, styrene, ethylene dichloride, VCM.
Propylene:	Polypropylene, cumene, acrylonitrile
Butadiene:	SBR.
Benzene:	Styrene, cumene.
Paraxylene:	DMT/TPA.
Orthoxylene:	Phtalic anhydride.

Figure 2.1-1

Economies of Scale In Ethylene Cracking



Source: Economic Commission for Europe

The level of downstream integration is strongest in Western Europe and the U.S.A. and to a lesser extent in Japan.

2.2 Organizational Integration: Oligopolistic Structure of the Market

2.2.1 The special situation in the United States, Western Europe and Japan

The petrochemical industries in the U.S., Western Europe and Japan differ dramatically in their use of petrochemical feedstocks. The utilization of different feedstocks has had strong effects on the ability of these countries to compete internationally. The dependence of the Western European and Japanese industries on oil/based feedstocks made them vulnerable to the massive price increase in crude petroleum during the 1970's. The U.S.A. petrochemical industry's use of natural gas and its condensates as feedstocks and the price regulations governing natural gas sales in the U.S. and Canada temporarily protected N.American producers until their recent removal.

In the U.S., because of the early development of the automobile industry and the abundance of natural gas, petroleum refineries produced a large portion of lighter fractions. In response to a strong domestic demand, the refining industry built large-capacity, technologically advanced plants at an early stage, producing ethane and refining streams as by-products that are highly suitable as petrochemical feedstocks. Their access to relatively low-priced, highly suitable feedstocks has given petrochemical producers in the U.S. substantial cost advantages over Japanese and Western European rivals following the increase in oil prices.

In the U.S., naphtha is predominantly produced by oil companies from crude oil refining and transfered to a subsidiary for the production of petrochemicals. It may then be said that the naphtha market in the U.S. is primarily a captive one. With only 15 per cent of ethylene production in the United States in 1983 based on naphtha feedstocks and its captive-use nature, the spot market has played a very limited role in the pricing of U.S. naphtha and in pricing all petrochemical feedstocks in general.

In Japan and Europe, scarcity of natural gas and weak demand for gasoline developed a heavier oil fraction refining industry than in the U.S. Gasoline demand in Europe and Japan has generally been provided by straight-run naphtha. Despite their recent feedstock flexibility efforts, Japan and the E.E.C. remain dependent on naphtha as their primary feedstock. Figure 2.2-1 shows the U.S., Japanese and Western European petrochemical industries percentage use of feedstocks.

Over the past ten years, the spot market price of naphtha has caused large variations in feedstock prices for the petrochemical industries in the E.E.C. and Japan, especially during the oil price increases of 1974 and 1979. Naphtha feedstocks produced 83.7 percent of all ethylene in Western Europe and 94.5 percent in Japan during 1982. The relationship between contract and spot prices in Western Europe from 1972 to 1983 are shown in Figure 2.2-2.

In Europe there are two prices for naphtha,- the "spot" price and the "contract" price. The spot price is the daily value of small quantities of naphtha sold on the open market in Rotterdam. The spot market's share of the total naphtha market is relatively small, but its influence on contract pricing is profound because the European spot price is the basis from which long-term contract prices are negotiated.

The naphtha spot market from 1975 to 1980, reflecting the petrochemical industry fears of oil and consequently naphtha shortages, exaggerated the crude oil price increases as producers scrambled to secure feedstocks for their plants. During 1976, the rising cost of crude oil caused the traditional pricing link between crude oil and naphtha prices to break. Historically, naphtha feedstocks were sold at 1.3 times the current price of crude oil. As Figure 2.2-2 demonstrates, this link was broken in mid-1976 by dramatic increases in crude oil contract prices in 1974-1975. During 1976-1978 the figure rose to 1.8 and increased to 2.2 by 1980. However, the current weakness of oil prices has effectively adjusted this trend.

Figure 2.2-1

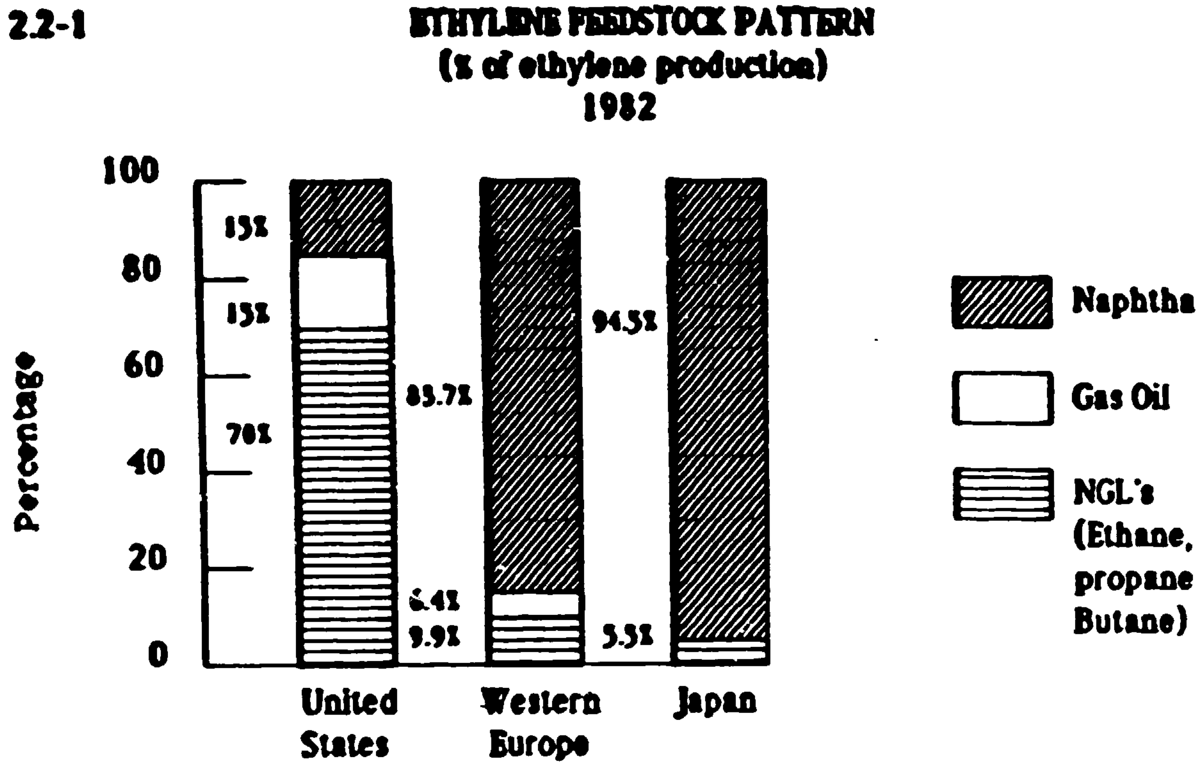
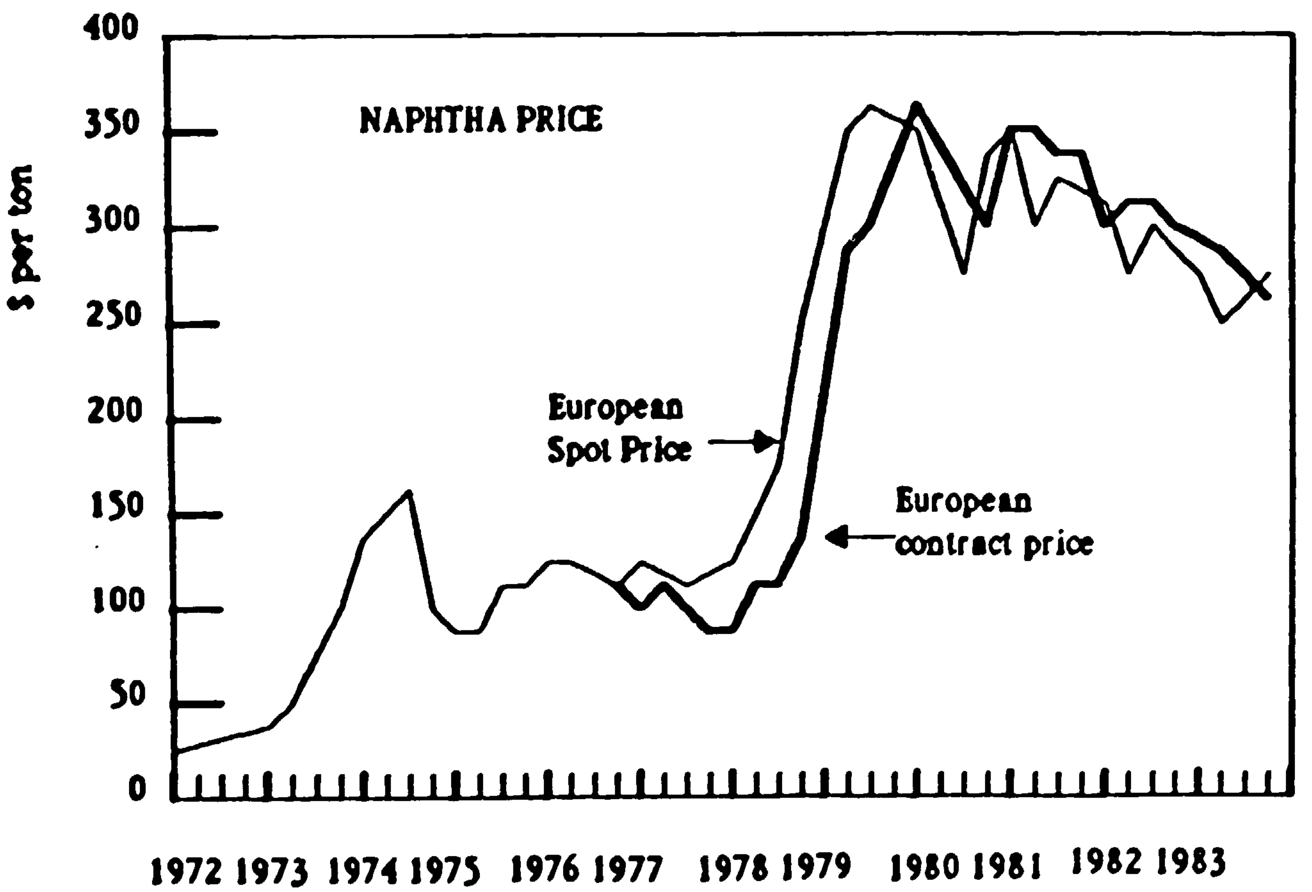


Figure 2.2-2



Sources: OECD, Energy Aspects of Structural Change

The consequences of the price increases for feedstock in Western Europe and Japan was devastating for petrochemical producers in these countries. Raw material input costs account for as much as 80 percent of total ethylene production costs. The petrochemical industries in Japan and the F.E.C. were caught between cost increases and the inability to pass them on through higher product prices due to competition from the U.S. and a weakening demand for petrochemicals products.

The U.S. petrochemical industry is almost as dependent on natural gas condensate feedstocks as the industries of Japan and Western Europe are on naphtha feedstocks. In the U.S., natural gas condensates accounted for 70 percent of that country's ethylene production in 1982.

Until recently petrochemicals producers in the U.S. using natural gas condensates did not experience the wide feedstock price variations their Japanese and European counterparts suffered. Due to the fact that while naphtha has other competing applications, ethane, a natural gas condensate, is alsmost exclusively used as a petrochemical feedstock. Domestic price controls have also served to hold-down ethane, propane and butane prices. Ethane and propane prices in the U.S. have remained below comparable global naphtha prices in equivalent energy units. By 1981 this feedstock price advantage gave U.S. producers a 40 percent cost advantage. Figure 2.2-3 shows the trends in feedstock prices in the U.S. and Western Europe from 1972-1983.

Figure 2.2-3

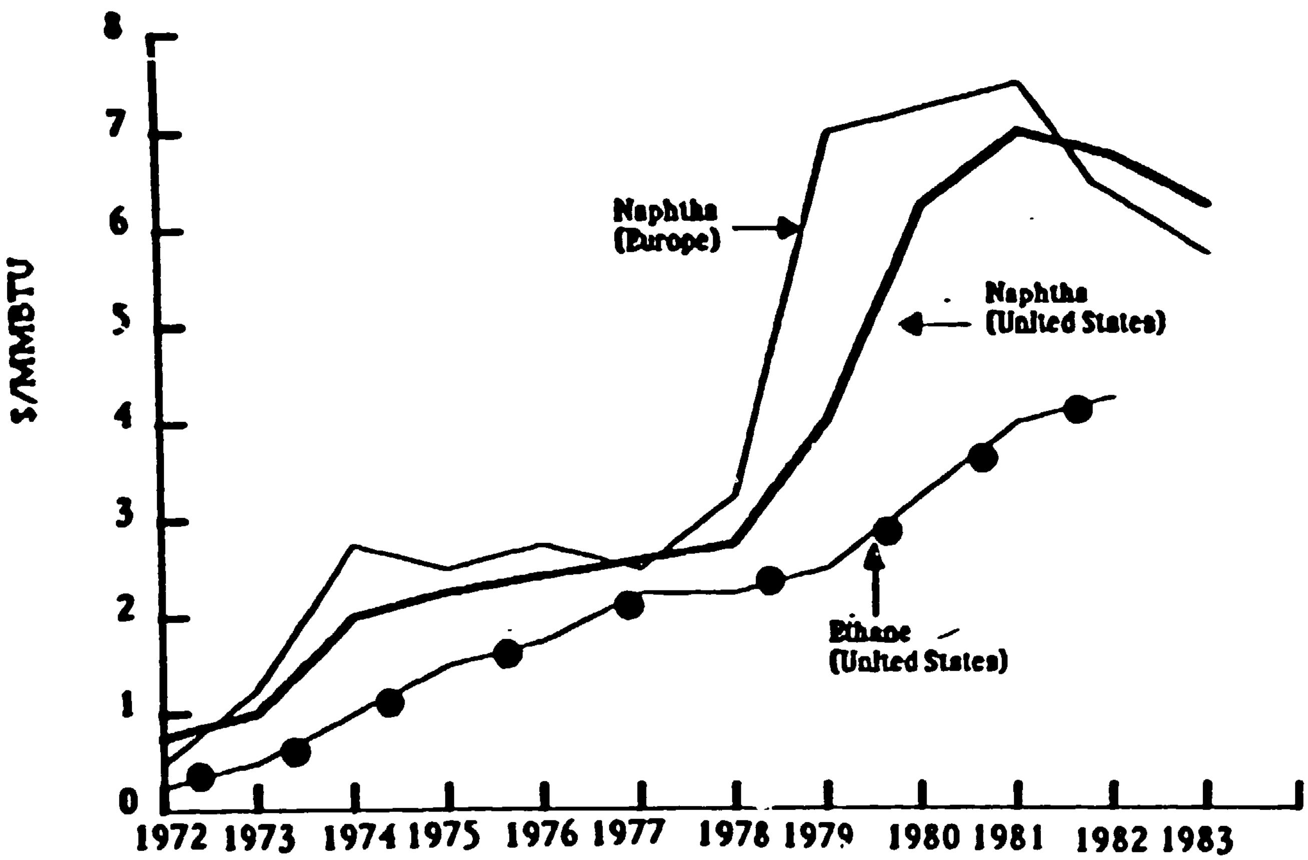

8
7
6
5
4
3
2
1
0
$/MMBTU
Naphtha
(Europe)
Naphtha
(United States)
Ethane
(United States)
1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983

Table 2.2-A below demonstrates the average cost advantage enjoyed by U.S. producers over their Japanese and Western European counterparts in 1980. 7/:

Table 2.2-A

	United States price ($/ton)	Cost advantage (%/ton)
Ethylene glycol	540	120
LDPE	950	160
Styrene monomer	795	140
Polystyrene	935	135
Para-xylene	630	110
Polypropylene	700	100
Acrylonitrile	760	130
Vinyl acetate monomer	640	200

An analysis of the change in the degree of concentration of the developed countries' ethylene market from 1980 to 1984 provided by Table 2.2-B reveals that major producers in Japan and the E.E.C. have maintained their dominance and that the U.S. market became more fragmented. As a rule it would be easier to compete in a less concentrated market than in one which is tightly dominated by few number of producers. With other things being equal, new producers from developing countries may find it easier to enter the first market categories than the second.

Table 2.2-B

Concentration Ratios for: Ethylene Supply in 1980 and 1984
(percentage of total)

Market	Largest 4 suppliers		Largest 8 suppliers	
	1980	1984	1980	1984
United States	40	27	66	47
Japan	39	41	70	67
EEC				
France	82	66	100	100
Italy	93	91	100	100
Netherlands	100	100	100	100
U.K.	95	88	100	100
FRG	60	57	89	91

Source: Based on information in Oil and Gas Journal, Sept.1,1980 and Sept.^,1984.

It is important to note, however, that as in 1980, there were several transnational firms in 1984 which registered as one of the four major producers in the E.E.C. and the U.S. This illustrates an international dominance by a few large firms that could inhibit new producers' access to all international markets. The tendency towards greater concentration of the market could be seen in table 2.2.-C for commodity plastic production in the European Economic Community countries where the number of suppliers have been reduced by 25 per cent during the last four years. 8/

Table 2.2.-C

Structural changes among producers of commodity plastics (1980-1984)

Commodity	Number of producers 1980	1984
Ethylene	38	29
HDPE	20	15
LDPE	23	12
PP	18	16
PVC	28	18
PS/EPS	19	17

Success in entering the developed country markets for new producers will depend on their ability to penetrate the merchant and final product markets within the U.S., Japan, and the E.E.C. The merchant market in the developed countries is made up of two parts, the spot market and the contract market. The nature of specific merchant markets depends upon the companies and suppliers and the product traded. Some products such as ethylene, propylene, butadiene, benzene and para-xylene are furnished by a few suppliers to a small number of manufacturers. These products tend to be purchased through long-term contracts which makes this market difficult to enter but relatively stable.

The spot market dominates products markets where price is the determining factor. For commodity petrochemicals, the spot market functions as a clearing house of excess supply and demand. The market used by speculators and business who try to keep their variable costs minimum and suppliers who seek to maximize profit. During times of surplus and weak prices, manufacturers increase the amount of feedstocks they purchase on the spot market to lower their total feedstock costs. Conversely, during times of scarcity and higher prices, suppliers avoid long-term agreements and sell large quantities of their products on the spot market to fatten profit margins. New producers would find this market relatively easy to enter if they offer the right price. Styrene and orthoxylene are examples of products traded in this market.

The current softening of demand for crude and petroleum products has effected the contract spot market purchase ratio. During the 1960's and through the 1970's, a typical company would obtain up to 90 percent of its feedstock requirements by negotiating long-term (3-5 year) contracts. The remaining 10 percent would be acquired on the spot market in an effort to reduce average feedstock costs. Today, the percentage purchased on the spot market has risen to approximately 40 percent as firms search out lower priced petrochemicals in a market characterized by excess supply.

The exposure international petrochemical manufacturers are willing to risk in the spot market, however, is limited by their desire to secure a consistent feedstock supply. International contract agreements remain at high levels because manufacturers avoid uncertainity and seek guaranteed supply sources which provide predictability in feedstock price, quality and availability. Predictability in product characteristics allows for efficient production runs, helps minimize variable costs, and permits production planning. Technically sophisticated speciality petrochemicals production processes require consistent quality feedstocks which can be insured by contract agreements. A dependable supply of feedstocks provides high capacity production runs which is crucial to profitability in the petrochemical industry.

The implications of long-term contracts for petrochemical prices is a smoothing out of the price variations seen in the spot market. The general pricing system that has evolved fixes price over an agreed time period with price reviews held quarterly. With the spot price as an indicator of current market values, most contracts include a provision whereby increases in variable costs such as materials, labor and feedstocks may be passed on to the purchaser. Contract prices are generally lower than spot prices.

3. FACTORS AFFECTING FUTURE TRENDS IN THE PETROCHEMICAL TRADE

3.1 Cost of Production and Changing Relative Advantages of Different Producers.

The shift in relative advantage in petrochemicals production from the Developed countries to the CERN's is due to the following developments:

a) A 800 percent increase in the price of crude petroleum and the parallel increase in naphtha prices used as feedstock, primarily in Japan and Western Europe.

b) The recent deregulation of natural gas prices in the U.S. and Canada and the subsequent rise in price of ethane as a petrochemical feedstock.

c) The availability of previously flared natural gas in CERN's at very low prices, approximately one-sixth world prices.

The principle effect of the oil price increases of 1973 and 1979 has been a drastic shift in relative advantage held by regional producers in the petrochemical industry in Japan and Western Europe. The deregulation of natural gas prices in the United States and Canada beginning in 1980 led to the rapid rise in feedstock prices in these countries as well. During the same period, Petrochemical manufacturers in Saudi Arabia, Mexico and other developing countries have had natural gas feedstocks available at very low cost and priced at as low as $ 0.43/1,000 cu.ft.[9/]

These events have created raw material cost advantages for those CERN's and developing countries whose petrochemicals industrie ethane and cost disadvantages for other countries using oil fractions. e economic factors are contributing to the current international restructuring of the industry to those countries with large reserves of natural and associated gas.

Table 3.1-A Illustrates the rise in wellhead crude oil and natural gas prices from 1955 to 1983 in the United States:

Crude Petroleum and Natural Gas:
U.S. Average Annual Wellhead Price
1955 - 1983

Year	Crude Petroleum: Price in current dollars	Crude Petroleum: Price in 1967 constant dollars	Natural Gas: Price in current cents	Natural Gas: Price in 1967 constant cents
	Per barrel		Per thousand cubic feet	
1955	2.77	3.15	10.4	11.8
1956	2.79	3.08	10.8	11.9
1957	3.09	3.31	11.3	12.1
1958	3.01	3.18	11.9	12.6
1959	2.90	3.06	12.9	13.6
1960	2.88	3.03	14.0	14.8
1961	2.89	3.06	15.1	16.0
1962	2.90	3.06	15.5	16.4
1963	2.89	3.06	15.8	16.7
1964	2.88	3.04	15.4	16.3
1965	2.86	2.96	15.6	16.1
1966	2.88	2.89	15.7	15.7
1967	2.92	2.92	16.0	16.0
1968	2.94	2.87	16.4	16.0
1969	3.09	2.90	16.7	15.7
1970	3.18	2.88	17.1	15.5
1971	3.39	2.98	18.2	16.0
1972	3.39	2.85	18.6	15.6
1973	3.89	2.89	21.6	16.0
1974	6.74	4.21	30.4	19.0
1975	7.56	4.32	44.5	25.4
1976	8.14	4.45	58.0	31.7
1977	8.57	4.41	79.0	40.7
1978	8.96	4.28	90.5	43.2
1979	12.51	5.31	117.8	50.0
1980	21.59	8.03	159.0	59.2
1981	31.77	10.83	198.0	67.5
1982	28.52	9.53	243.0	81.2
1983	26.19	8.64	260.0	85.8

Source: Compiled from official statistics of the U.S. Energy Information Adm,inistration by the U.S. International Trade Commission.

From 1972 to 1982 crude oil prices rose 841 percent from $ 3,39 to $ 28.52. Reflecting Western European dependency on naphtha as a feedstock, the percentage which ethylene comprised of total production costs in Europe rose from 46% in 1973 to 73% in 1977, and to 85% by 1980; Table 3.1-B describes the similar situation in Japan.

Table 3.1-B

Ethylene production cost and price increases in Japan
1972 - 1982
(Index: 1972 = 100)

	1972	1982
Imported naphtha cost	100	1,093
Domestic naphtha cost	100	852
Ethylene Price	100	670
Major Polymers price	100	200

Source: Industrial Review of Japan

The changes in petrochemical feedstock prices have registered different impacts at different times in the developed countries. Government price regulations on natural gas in the U.S. and Canada protected the petrochemical industries in these countries from the increases in world energy cost by holding ethane feedstocks at artificially lower price levels than their oil fraction counterparts. While ethane has historically been priced much lower than naphtha, the oil price increases exaggerated this distorted relationship. From 1980 to 1981 ethane in the U.S. and Canada was priced 40% lower per BTU than naphtha in Japan and Western Europe.

The disproportionate competitive disadvantage suffered by developed countries is also due to the difference in structure of refining in Japan and Wester Europe and the U.S. and Canada. While naphtha has several competing uses as a feedstock which tends to adjust its price more competitively in Japan and Western Europe, ethane only has petrochemical applications. The market for ethane in the U.S. and Canada is primarily a captive one due to its exclusive petrochemical use. This captive market for ethane diminishes the effect of market forces.

The competing demand for naphtha create wide price fluctuation which has considerable influence on naphtha prices in the E.E.C. and Japan. During times of oil shortage, the spot market is a mechanism for higher naphtha spot prices which in turn increases naphtha contract prices.

These divergent market characteristics created a temporary advantage for the North American petrochemical industries from 1980 to 1981 which has been, however, recently negated by the softening of world crude oil prices and the U.S. deregulation of natural gas and the resulting increase in ethane prices and the higher dollar exchange rate.

The CERN,s* derive their cost advantage by using natural gas which had been historically flared at the wellhead. In Saudi Arabia, the cost to the petrochemical industry for natural gas feedstock is $ .50/thousand cubic feet, and in Mexico it is priced at just above $ 1.00/TCF.10/ These prices are typical of the primary materials costs available to CERN's and compare to world prices between $ 2.50 and $ 5.00/TCF. These feedstock price differences are particularly crucial since energy costs in the production of ammonia, methanol, and ethylene can be as much as 80% of the total production costs in developed countries.

* The Conventional Energy Rich Nations (CERN's) are Saudi Arabia, Indonesia, Kuwait, Canada, Mexico, U.S.S.R. and People,s Republic of China.

3.2 Slow Down in Economic Activities and the Impact on Growth in Demand for Petrochemicals

As has been previously noted in Table 1-A, petrochemicals demand grew at a fast pace prior to the late 1970's. The average annual growth rate from 1960-1973 of was 17 percent for ethylene, 16,5 percent for propylene and 13.0 percent for benzene. The growth of synthetic materials during the period from 1950 to 1973 was truly spectacular. The increasing market for petrochemical products was made possible through constant work of innovative chemists and engineers who were able to devise new processes and petrochemical applications. Manufacturers were able to take advantage of increasing economies of scale as capacity utilization increased and the price of petrochemical feedstocks remained low.

The strong growth of petrochemicals began to slow down considerably as the 1960's ended, as a result of increasing market saturation, combined with a general economic slowdown. Between 1974 and 1980, aggregate production of the main petrochemicals increased by only an average of 1.5% per year as compared to 10% per year for the period 1960 to 1970.

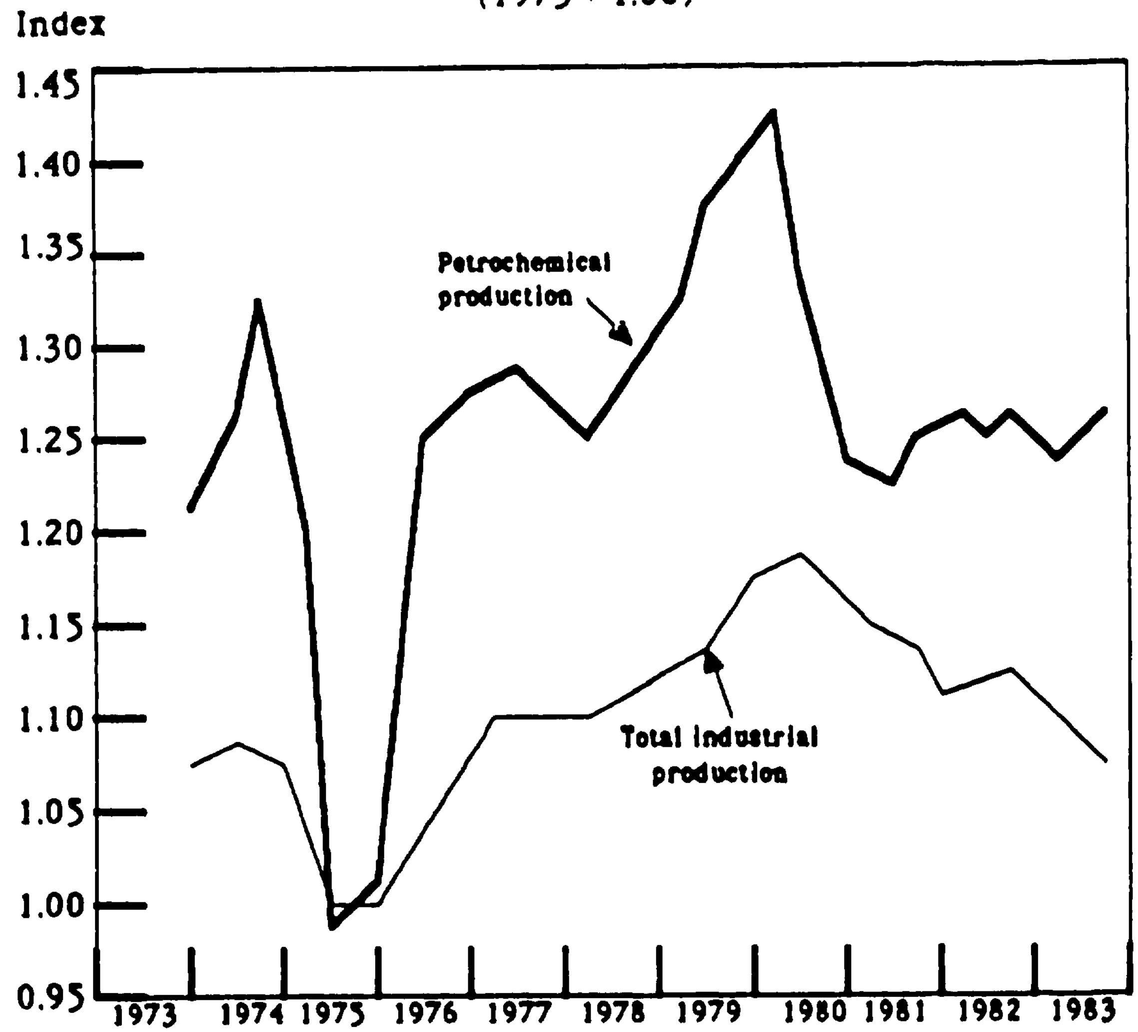
Through the 1970's, the direction of growth in the petrochemical industry in Western Europe has mirrored that of total industry production. Figure 3.2-1 demonstrates that when total industrial growth declined, the contraction of growth in the petrochemicals industry was even more severe.

By the early 1970's, the benefits to be gained from larger plants and energy savings had reached a plateau. The advancing market share of petrochemicals slowed and in some cases actually contracted as in the case of synthethic rubber used in the manufacture of vehicle tyres.11/.

The oil prices increases reversed a long-term trend of lower relative prices for synthetics vs. natural products. The price advantage strenthened over the 1950s and 1960s and was totally negated in the few years between 1973 and 1978. This is illustrated by the Figure 3.2-2.

Figure 3.2-1

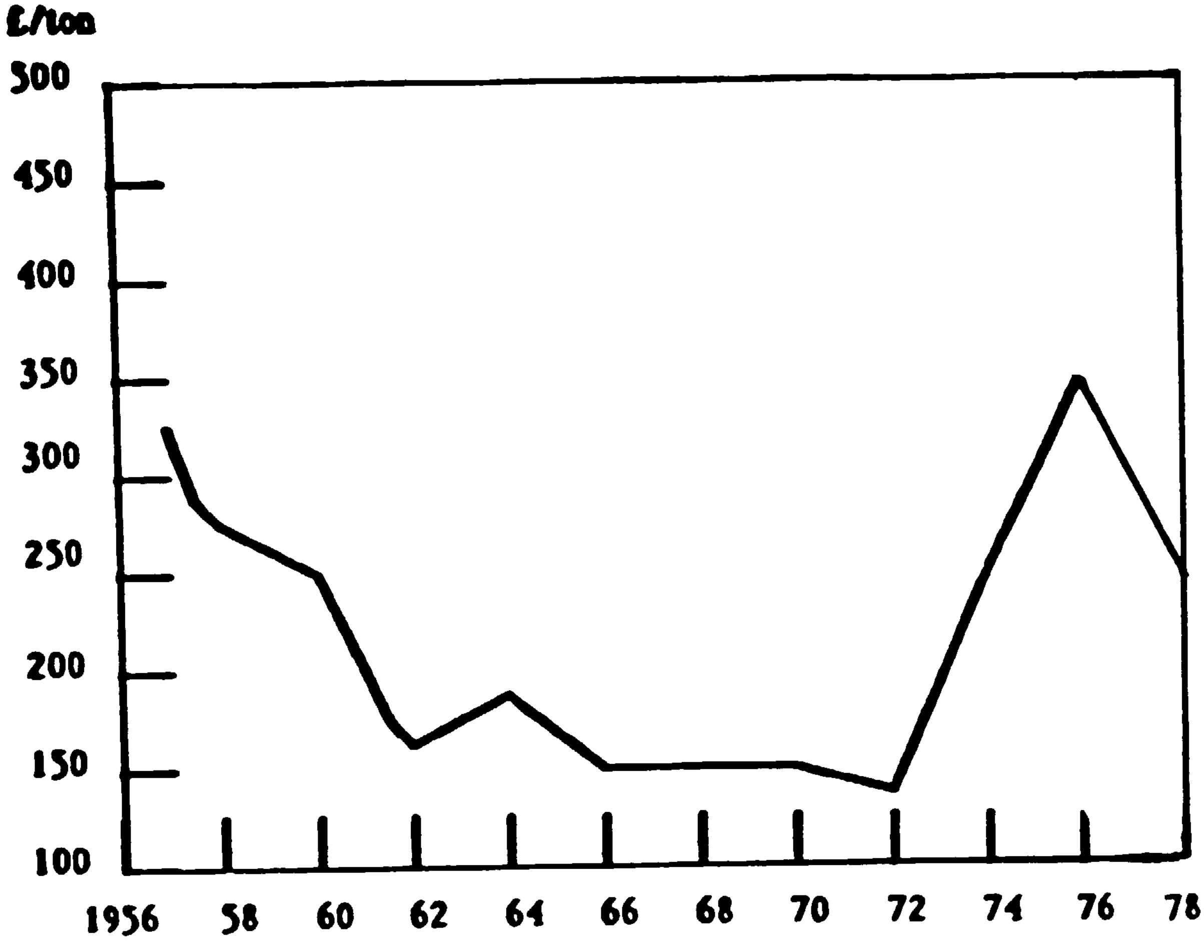
Western Europe
Relative Growth Of Total Industrial Production
And Of Petrochemical Production
(1975 = 1.00)



Source: David R. Clare, Essochem Europe Inc.

Figure 3.2-2

Pricing Pattern Of Ethylene In The United Kingdom, 1956-1978



Source: Shell Chemicals

3.3. Overcapacity, redeployment and rationalization

Overcapacity

The roots of the severe overcapacity in the international petrochemicals industry are:

1. The sharp economic downturn and worldwide recession of the late 1970s and early 1980s and resulting decrease in petrochemical demand.

2. The failure of the petrochemical industries in the developed countries to recognize the long-term demand implications of this economic down-turn and their inability to alter committed production capacity increases.

3. Many petrochemical products matured and lost their rapid growth rates.

4. The dramatic increase in world energy costs which constitute up to 85% of total production cost of some petrochemicals induced many CERN's to develop new petrochemical industries based on the abundance of relatively inexpensive feedstocks.

Table 3.3-A below shows the upward trends in ethylene capacity in the Japanese and Western European Petrochemical Industry from 1974 to 1981 12/:

Table 3.3-A

		Demand Peaks						Variation		
		1974	1979	1980	1981	1982	1983	1974-1979	1979-1981	1974-1981
W. Europe	Theoretical Capacity (MT)*	a) 12.7	15.6	15.6	17.6	16.5	14.4	+2.9	+2.0	+4.9
	Production (MT)	b) 10.4	12.3	10.9	10.3	10.1	..	+1.9	-2.0	-0.1
	Unused (MT)	c) 2.3	3.3	4.9	7.3	6.4	..	+1.0	+4.0	+5.0
	Capacity (% a)	d) 18%	21%	39%	41%	39%	..			
Japan	Theoretical Capacity (MT)	a) 3.1	6.1	6.1	6.1	6.2	6.2	+1.0	+0.0	+1.0
	Production (MT)	b) 4.2	4.8	4.2	3.7	3.6	3.7	+0.6	-1.1	-0.5
	Unused (MT)	c) 0.9	1.3	1.9	2.4	2.6	2.5	+0.4	+1.1	+1.5
	Capacity (% a)	d) 18%	22%	31%	40%	42%	40%			

*Million Tonnes

Source: Organization for Economic Co-operation and Development, Energy Aspects of Structural Change, 1985 pg. 83

Table 3.3-A demonstrates that Japan and Western Europe have had similar experiences: the production facilities planned before the first oil price increase had created overcapacity by 1973/1974. Therefore, even through demand and production collapsed in 1975 and remained depressed until 1978, productive capacity continued to grow. From 1975-1979 capacity increased by one million tons in W. Europe and by 400.000 tons in Japan. This growth represented 20 percent of both countries production capacity. Unused capacity in W. Europe grew from 18% in 1974 to 41% in 1981. A second, longer sustained downturn in demand occured in 1980, and capacity continued to grow to record peaks in W. Europe in 1981 and Japan in 1982. The supply-demand crisis produced 4 million tons surplus capacity in Europe from 1979-1981 and unused capacity in Japan peaked at 42% in 1982.

In the U.S., the same trend in ethylene capacity increases visibly. Nameplate ethylene-capacity increased from 20 billion pounds in 1970 to a peak of 41 billion in 1981. However, the supply/demand crisis resultant in effective overcapacity of 38 per cent in 1982.

Because of the long lag time between investment and plant operation, the petrochemical industries in the U.S.A., Japan and Western Europe were slow to react to this imbalance between supply and demand.

The immediate reaction to this crisis situation was the call for adjusting the supply situation through capacity reduction in Western Europe, Japan and the U.S.A. Table 3.3.-B. shows the reduction in capacities of selected petrochemicals in these regions during the period 1980-1983.

Table 3.3.-B. 13/
Capacity reduction of selected petrochemicals
(1980-1983) (1,000 M.T.)

Region	Ethylene		PVC		LDPE	
	(c)	(I)	(c)	(I)	(c)	(I)
U.S.A.	1700	3800	200	500[1]	830	--
W.Europe	3570	250	860	--	1820	--
Japan [2]	2250	520	440	--	270	--

(c) = permanently closed
(I) = idled
1/ postponed
2/ Planned closure upto August, 1985

The reshaping of the industry through major restructuring, rationalization and redeployment has been seen in actions to enhance the financial positions of firms and to eliminate operations which could not be made profitable.

Producers in developed countries have taken different competitive strategies when faced with lower priced commodity petrochemicals from CERN's entering the international petrochemical market. Some have made moves to incorporate these commodity petrochemicals into their downstream operations by treating basic and intermediate products from CERN's as feedstocks for their upgrading. The various joint ventures and contracts involving firms from developed countries such as Shell, Exxon and Mitsubishi and the Saudi Arabian plants are good examples.

Other companies have reacted with upstream integration. The recent acquisition of the Conoco Oil company by Du Pont Chemical Company is seen by industry analysts as a method of upstream integration to obtain petrochemical feedstocks.

The petrochemicals industry has redeployed its resources from commodity chemicals production into more profitable areas. Mergers and acquisitions occured at record levels in 1983 as many firms moved into specialty chemical production. According to the U.S. based Chemical Manufacturer's Association, 58 U.S. specialty chemicals firms were acquired in 1983, compared to 35 in 1982. In Japan, Mitsubishi Petrochemical plans to derive 30 percent of its total profit in 1990 from specialty chemicals by rebuilding its Kashima and Yokkaichi complexes into specialty chemicals plants.

A second redeployment strategy used by established petrochemicals companies has been the trading of product interests. The trading of product interests is an agreement wherein two companies exchange total interests in products or complete product lines. The result is a concentration on what the company can most competitively produce and market. Despite high initial costs of production transfer, these types of agreements have occured in Italy, France and the United Kingdom. In England, for example, two plastic companies traded interests in polyvinyl chloride (PVC) and LDPE. Each producer now specializes in only one of the products.*

The countries most affected by the increases in world oil prices and lower demand for petrochemicals were those countries who had little oil and natural gas reserves. Rationalization, the process by which older, less-efficient plants are closed or replaced by state-of-the-art facilities, was most extensive in Japan and Western Europe.

Due to its unique association with government agencies, the fastest and most effective rationalization and redeployment programs have taken place in the Japanese petrochemical industry. In December 1982 the Industrial Structure Council, an advisory group for the Ministry of International Trade and Industry, presented a proposal for rationalizing the Japanese petrochemicals industry to regain its competitive edge. This plan called for the elimination of 36 percent of excess ethylene capacity and between 24 and 36 percent of the total capacity of six other petrochemical derivatives. This rationalization policy was followed by temporary legislation regarding the improvement of the ethylene, polyolefins, polyvinyl chloride and ethylene oxide industries. By March 1985 Japan had rationalized 2,300,000 tons per year in ethylene production or just over 36 percent of total ethylene capacity.

An important aspect of the package was the formation of marketing consortias to efficiently dispose of excess production to avoid damaging overcompetition. These consortia are responsible for marketing the members' output and for rationalization and consolidation actions to improve production efficiency.

Since 1980 W. Europe has shut down 21 percent of its ethylene capacity, 19 percent of its LDPE, 17 percent of its polystyrene capacity and 12 percent of its PVC capacity. Of the 2.7 million metric tons of petrochemical capacity rationalized in W. Europe from 1979 to 1982, 1.6 million tons or 64 percent was in West Germany and the United Kingdom. In France and Italy rationalization concentrated on streamlining organizational and production structure.

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* see table 2.2.-C

3.4 The Emergence of New Producers from CERN's Countries

A major consequence of the second oil price increase was an improvement in the competitiveness of existing or planned petrochemicals plants in the CERN's. Industry experts agree that, today, petrochemicals production by developing countries can be internationally competitive as long as these facilities are provided with feedstocks at prices well below world prices.

Mexico, Saudi Arabia, Kuwait, Canada and Indonesia are already producing or soon will produce petrochemicals, chiefly for exports. In Saudi Arabia and Mexico, the petrochemicals industries associated with SABIC and PEMEX will have access to natural gas feedstocks at prices approximately one-sixth of their U.S. and other developed country counterparts. In Saudi Arabia the cost of natural gas for petrochemicals production is said to be $ .50/thousand cubic feet (TCF) and just over $ 1.00 in Mexico. Compared with world prices of between $ 2.50 and $ 5.oo/TCF, a significant cost advantage is apparent. This variable cost advantage is more striking when one notes that the feedstock and energy component of total cost of ammonia, ethylene and methanol can be as high as 80 percent.

CERN's find entry into the international petrochemicals market attractive for a number of reasons. The upgrading of natural gas and crude oil fractions can be employed to increase the value-added to CERN energy exports. Petrochemicals manufacture can also be used to substitute domestic production for previously imported petrochemicals products which improves the balance of trade. The creation of a petrochemical industry is a means of national, social, technological and educational advancement. Due to the strong interaction and linkages of petrochemicals with other economic activities it will have the added impact of vitalizing the general economic performance of their economies.

The planned and onstream petrochemicals production build-up in CERN ethylene capacity from 1984-1987 is shown in Table 3.4-A:

Table 3.4-A

Region/country	Capacity added (1984-87) billion lbs/yr
Canada	1.5
Mexico	1.1
Brazil	0.9
Southeast Asia	1.5
Saudi Arabia	3.5
Other Middle East and North Africa	2.3
Total	10.8

Source: Dewitt & Co

Table 3.4-B compares the 1983 known ethylene production capacities for the major new petrochemical producing areas with their predicted 1990 capacities 14/:

Table 3.4-B

Ethylene Production Capacity
(million tons)

	1983	1990
Canada	1.8	3.0-3.7
Middle East/North Africa	0.5	2.4-3.5
Latin America	2.4	3.6-4.4
Asia	1.4	3.2-4.1
Remainder of Africa	0.15	0.6

The CERN's face a number of impediments they must overcome to successfully enter the world petrochemicals market including high initial investment costs in plant and equipment, unskilled domestic labor, expensive imported labor, high transportation costs, and difficult access to the markets of developed countries.

The following is discussion of current status and plans of the petrochemicals industries of Canada, Saudi Arabia, Mexico, Kuwait, Nigeria, the Far East and the People's Republic of China.

Canada

Canadian capacities for ethylene, ammonia and methanol in 1980 and predictions for 1990 are shown in Table 3.4-C 15/:

Table 3.4-C

Product	1980	1990	Percentage increase Between 1980-90
Ethylene	1.600	3.700	131
Ammonia	2.065	4.105	99
Methanol	450	2,000	344

The projected figures for 1990 have been adjusted slightly downward in view of the 1982 general economic recession and the revision of the Canadian National Energy Plan (NEP). The recession reduced demand for petrochemical products within the Canadian market and the ability of Canadian petrochemical firms to compete internationally.

The up-front tax on oil and natural gas feedstocks called the "Petroleum and Gas Revenue Tax (PGRT) has reduced the compe[illegible]iveness of Canadian petrochemicals. According to Mr. James M. Hay, Chairman, Dow Ch[illegible]mical Canada, the PGRT was responsible for approximately $ 500 million in lost revenues in 1983 and 1984 as a result of increasing feedstock prices by as much as 75 percent.

The new government in Canada appears to be sympathetic to the needs of the petrochemical industry. In September 1984 the government saved the Petromont ethylene plant in Varennes, Canada, just hours before it was scheduled to close its doors. This joint venture of the province of Quebec and Union Carbide Canada received $ 15 million in short-term aid which matches a grant of equal amount from the Quebec government. The new government has just passed "The Western Accord" which immediately begins oil deregulation and schedules the reduction of natural gas price controls November 1, 1985. The PGRT has already been subjected to a process of reduction to culminate in eventual elimination.

Canadian petrochemical production for several products is listed in Table 3.4-D 13/16/:

Table 3.4-D

Product	1981	1982	1983	1984
Ethylene	1,330	1,013	1,196	1,464
Propylene	671	693	715	665
Benzene	572	519	580	557
Methanol	500	600	1,670	1,872
Ammonia, anhydrous	2,654	2,508	2,888	3,493
Urea	NA	1,231	1,445	2,110

Despite its set backs, the Canadian Petrochemicals Industry plans to double its share of the international petrochemicals market by 1990.

Saudi Arabia

Saudi Arabia's natural resources include 24 percent of the world's proven oil reserves and approximately 117 trillion cubic feet of natural gas. The Saudi government has taken a direct interest in petrochemicals industry development. Through the creation of the Saudi Arabian Basic Industries Company (SABIC) the Saudi's have moved into second and third generation petrochemicals production. SABIC has created a $ 10 billion industry with state-of-the-art production facilities.

Saudi Arabia's petrochemicals industry enjoys two crucial competitive advantages, namely, low raw materials costs and highly favourable financing. It has been reported that the SABIC joint venture projects are financed on a 70-30 debt-to-equity ratio with 60 percent of available capital with no-interest or payments during first five years and a repayment period of twenty years, with 3 percent interest and payment begining the six year. Feedstock prices are reported to range between $ .30 and 0.5 per million BTU for ethane, methane and natural gas. 17/

The construction of petrochemicals production facilities in Saudi Arabia has been advancing at a rate faster than originally anticipated. The Saudi plants, which are among the most efficient and modern in the world, and the marketing agreements with joint venture partners from the U.S., Japan and the E.E.C., provide Saudi producers with additional competitive advantages in the world market. In their agreement with the Saudi's, the multinational companies are responsible for marketing a large portion of the petrochemicals output during the first several years of operation.

Table 3.4-E shows estimates of the portion of Saudi petrochemicals production which is projected to be available for export in 1990:

Table 3.4-E

SAUDI ARABIA'S EXPORT POTENTIAL IN 1990

Product	Capacity	Domestic Consumption	Available for Export
LDPE	590,000	78,000	512,000
HDPE	90,000	34,000	56,000
Polystyrene	80,000	30,000	50,000
PVC	225,000	183,000	42,000
Ammonia/Urea	652,000	130,000	522,000
Methanol	1,250,000	250,000	1,000,000
EDC	456,000	364,800	91,000
Ethylene Glycol	520,000	-0-	520,000
Caustic Soda	377,000	-0-	377,000
MTBE	500,000	60,000	440,000

The nation's entire polymers market demand has historically been supplied by importers from Western Europe, Japan and North America. Once the Jubail and Yanbu plants are commissioned, the balance between supply and demand will change drastically as Saudi Arabia moves from a net importer to a net exporter for the products indicated in the table.

Mexico

Mexico, with 48,6 billion barrels of crude oil reserves ranks fourth among the world's largest petroleum concentrations after Saudi Arabia, Kuwait and the Soviet Union. Mexico's commodity petrochemical industries are state owned by Petroleos Mexicanos (PEMEX) and central control extends to some primary and secondary petrochemical products.

Within its abundant oil reserves and proximity to the enormous U.S. market, Mexico feels it should be able to enter the international petrochemicals market as a formidable competitor. Inexpensive energy supplies and reduced transportation costs could give Mexico a cost advantage over the Middle East in the U.S. market. However, honoring the nationalist tradition set in the 1930s when President Cardenas expropriated all U.S. oil holdings, PEMEX does not allow any joint ventures in the petrochemicals industry. Consequently, Mexico has not been able to use foreign companies' established marketing channels to gain access to new markets. Mexico slow penetration into international markets has induced in February 1984, the National Commission on Foreign Investment to announce a plan to bring in foreign investment to raise hard currency and to integrate Mexican industry downstream.

Table 3.4-F below shows the development of capacities of some petrochemical products in Mexico in 1980 and 1984 with the expected capacities in 1990.

Table 3.4-F
Development of capacity of some petrochemical products in Mexico
(1000 tpa)

Countries	1980	1984	1990
Ethylene	435	932	1840
Propylene	324	404	908
Benzene	124	299	723
Butadiene	55	100	355
Xylene	224	352	957
Methanol	171	171	1822
Styrene	33	290	440
Caprolactam	47	147	147
PVC	136	277	449
HDPE	100	100	300
LDPE	99	339	579
PP	154	154	354
PS	114	114	300
SBR	90	115	200
PB	30	30	30
Polyester	172	172	172
Polyamide	49	49	100
Acrylics	69	69	69

Source: UNIDO data base

Kuwait

Kuwait is the eighth largest producer of crude petroleum and has a per capita income of more than $ 20,000. Principally, as a result of crude petroleum exports, this country had accumulated financial reserves which totaled more than $65 billion by 1983.

Kuwait was the first Middle Eastern nation to produce ammonia and urea from natural gas feedstocks and is currently a large producer of fertilizers. Table 3.4-G below lists Kuwait's production capacity for urea, ammonia and melamine and predicted capacity in 1990 in thousands ton/year. 18/

Table 3.4-G

Product	1980	1985	1990
Urea	792	792	712
Ammonia	660	858	1,296
Melamine		15	15

The nation is now searching for a joint venture partner to build two major petrochemical plants, a 20,000-ton/year phthalic anhydride plant, and a 32,000 metric ton/year polystyrene plant. A number of planned capacities have been frozen recently.

Nigeria

Nigeria, which is a traditional exporter of crude oil has recently announced the planned construction of a $2 billion petrochemicals plant to be build in Port Harcourt, where its major petroleum refinery is located. The proposed facility will produce the petrochemical products noted in Table 3.4-H 19/:

Table 3.4-H

Product	Capacity
Butene	15
Ethylene	400
Ethylene Glycol	35
2-Ethylenexanol	26
Polyethylene	270
Propylene	100
Polypropylene	70
Phthalic anhydride	15
Plasticizers	30
Vinyl chloride monomer	145
Polyvinyl chloride	140

Nigeria's petrochemical industry began with the construction of a linear alkyl benzene plant near the petroleum processing plant in Kardina. Expansion is planned with the addition of carbon black and propylene processing plants to be built near the Warri refinery.

The Far East

The developing Far Eastern petrochemical industry consists of operations in Singapore, Malaysia, the Republic of Korea and other Asia. Petrochemical plants in these countries are fed primarily with naphtha feedstocks, with the exception of Malaysia whose natural gas reserves allow it some flexibility in raw material inputs.

These countries' entry into petrochemicals is not based on an abundance of cheap feedstocks, and they are not competitive with the CERN's. Almost all of these petrochemical plants are dependent on imported crude oil. Petrochemicals production for these Far Eastern nations is an up-stream integration to the basic commodities which supply textile and finished consumer goods industries. This move is to insure a stable supply of the plastic resins used in downstream export industries.

The countries in this region are expected to remain a net importer of petrochemicals.

Table 3.4-I shows some of the more important petrochemical capacities for plants in the Far East:

Table 3.4-I

Country	Product	Annual capacity 1980	1985	1990*
Korea	Ethylene	505	505	755
	Propylene	268	268	268
	Benzene	130	214	250
	Xylene	118	331	627
	Methanol	330	330	330
	Styrene	80	180	260
	VCM	210	210	410
	DMT/TPA	160	160	320
	PVC	236	555	605
	HDPE	140	140	220
	LDPE	150	150	310
	PP	185	185	262
	PS	147	312	357
Malaysia	Ethylene	-	-	250 1/
	Propylene	-	-	84 1/
	Methanol	-	600	600
	PVC	14	30	48
	HDPE	-	-	80 1/
	LDPE	-	-	135 1/
	PP	-	-	80 1/
	PS	8	8	13
Singapore	Ethylene	-	300	300
	Propylene	-	160	160
	Benzene	-	59	59
	Xylene	-	29	29
	Ethylene Oxide	-	80	80
	PVC	33	33	33
	HDPE	-	80	80
	LDPE	-	120	120
	PP	-	100	100
Other Asia	Ethylene	640	953	1075
	Propylene	230	490	490
	Benzene	200	350	450
	Xylene	150	330	330
	Methanol	116	202	602
	Styrene	100	200	200
	VCM	346	566	566
	DMT/TPA	175	400	400
	PVC	470	612	612
	HDPE	50	200	200
	LDPE	215	215	460
	PP	50	240	240
	PS	55	178	178

* including planned capacity
1/ 1993

People's Republic of China

The past massive expansion and planned addition to the Chinese production of petrochemicals has not been enough to meet domestic demand. Although China is the world's third largest producer of fertilizers after the U.S. and the Soviet Union with production of 13.8 million metric tons in 1983, it still relies on imports to satisfy local demand. Petrochemical demand should continue to increase with the industrialization and modernization plans of China. Considering the extremely low per capita consumption of petrochemicals and the huge population of China the potential Chinese market could be one of the larges in the world.

China has entered into agreements with Western nations to explore domestic crude petroleum and natural gas reserves and to begin joint venture relationship. The national goal is to quadruple domestic petrochemicals production by the year 2000.

China's current productive capacity is shown below 20/:

Product	Capacity (1000 t/y)
Ethylene	600
Other plastics resins	500
Polyolefins	400
Synthetic rubber	140

Proposed petrochemicals facilities are listed in Table 3.4-K (in thousand metric tons per year) 13/21:

Table 3.4-K

Product	Planned Annual Capacity
Ethylene	1200
Propylene	200
Benzene	170
Butadiene	120
Xylene	244
Methanol	400
Acetaldehyde	200
Ethyleneoxide	160
Vinylchloride monomer	400
Acrylonitrile	50
Caprolactame	90
DMT/TPA	225
PVC	400
HDPE	280
LDPE/LLDPE	600
PP	160
PS	120
Polybutadiene	50

*) Mostly under construction

Despite these ambitious projects, Chinese petrochemicals demand will continue to be met by imports.

Implication for International Markets

The domestic petrochemicals facilities already onstream and scheduled to start-up by 1990 in the CERN's and other developing countries has meant the retraction of many export markets and heightened competition in others. This trend will continue as these nations substitute domestic petrochemicals for previously imported ones and export their surplus commodity, intermediate and final petrochemicals.

In the intermediate future, new competition for developed country producers will be limited mainly to ethylene and ehtylene-based derivatives as CERN's petrochemicals industries are based on ethane feedstocks. This means that international markets will be extremely competitive in ethylene and its derivatives. Developed countries and other producers with naphtha-based petrochemicals industries, however, will not be affected at this stage in aromatics. It could be expected that while there will be an outflow of ethylene-based products from CERN to the outer world this will be mostly accompanied by inflow of naphtha-based and specialty petrochemicals.

3.5 Trade Barrier and General Protectionist Policies

A tariff is a tax applied to a product as a condition for entry into a country. As tariffs apply only to imported goods, the effect is to increase the cost of foreign products. The foreign producer must receive less revenue for his product than a domestic producer to maintain a competitive position in the market. The result is that the foreign producer must be more efficient to compete or the domestic producer can be less efficient and remain competitive.

Effective rate of protection

Table 3.5-A lists the tariff schedules of the U.S., Japan, and the E.E.C. for several selected petrochemical products.

Tariff schedules are least among basic petrochemicals such as ethylene and the aromatics (benzene, toulene and xylene). There are no tariffs applicable to the aromatics in any of the developed countries and ethylene is taxed only in Japan at a rate of 5.8 percent. Tariffs are significantly higher on the intermediate petrochemicals. In the developed countries, tariffs range from 9 to 14 percent. The tariff rates applicable to fibers range from 5 to 9 percent.

At first glance, an observer might assume that developed countries are relatively open to foreign-produced basic petrochemicals and that a little degree of cost efficiency would permit profitable entry to their markets.

Table 3.5-A

Average tariff rates for selected petrochemical products

(Ad valorum or ad valorum equivalent)

Product	E.E.C.	Japan	U.S.	Austria	Australia	Canada	Finland	New Zealand	Norway	Sweden	Switzerland
Basic petrochemicals											
Ethylene	F	F	F	3.0	5.0	F	F	F	10.4	--	--
Propylene	F	5.8	F	3.0	5.0	F	F	F	10.4	--	--
Butadiene	F	F	F	F	2.0	F	F	F	10.4	8.1	12.6
Styrene	6.1	8.0	9.0	3.0	30.3	F	F	F	F	--	--
Benzene	F	F	F	6.0	2.0	F	F	F	F	F	--
Toulene	F	F	F	6.0	2.0	F	F	F	F	F	--
Xylene	F	F	F	6.0	2.0	F	F	F	F	F	--
Ammonia	11.1	3.7	3.3	22.0	2.0	2.5	F	1856	F	F	6.4
Methanol	13.4	4.9	18.4	15.0	2.0	10.0	F	3227	10.4	F	8.9
Plastics											
Polyehtylene											
- LD	13.4	17.0	12.9	21.2	30.0	9.6	7.7	5.0	10.0	9.3	2.1
- HD	13.4	17.0	12.9	21.2	45.0	9.6	7.7	5.0	10.0	9.3	2.1
Polystyrene	13.4	14.0	9.2	21.2	30.0	9.6	7.7	5.0	20.0	9.3	2.1
Polypropylene	14.0	18.0	13.1	21.2	22.5	9.6	7.7	5.0	20.0	9.3	2.1
PVC	13.4	5.8	10.1	18.0	30.0	9.6	7.7	10.0	20.0	9.3	2.1
Fibers											
Polyester	8.2	5.8	9.0	10.4	17.5	7.1	7.6	F	10.4	F	6.4
Polyamide	8.2	5.8	7.6	F	2.0	7.1	7.6	F	10.4	F	6.4

F = Free of Duty
-- = less than 1 % ad valorem

Source: Official 1985 Customs Publications of listed countries.

In quantifying the effect of tariffs, it is important to realize that the extent of protection enjoyed by domestic producers is not limited to the nominal amount of the tariff. In most cases, the foreign producer must be significantly more efficient in petrochemicals production than a domestic competitor. To illustrate the actual competitive advantage produced by tariffs, consider the following example of polypropylene production from propylene. Approximately 55 percent of the total cost of polypropylene is contributed by raw materials costs, i.e. propylene. The remaining 45 percent is accounted for by local costs such as labor, utilities, transportation, etc.

Should a developing country choose to export propylene to France, it would face no competitive disadvantage because propylene may enter the common market duty-free. However, when a developing country decides to add local value to its propylene feedstocks by producing polypropylene for export, the product will be subject to a 14 percent E.E.C. tariff. It follows that if ff 11.00 worth of propylene is manufactured into ff 20.00 worth of polypropylene for export, the propylene will be subject to a duty of ff 2.8 (14 percent of ff 20.00), increasing the final price of foreign produced polypropylene in the French market to ff 22.80. A domestic producer with the same input costs would be able to process polypropylene for only ff 20.00 (ff 11.00 + ff 9.00 local value-added). To be competitive in the French market, the developing country producer must be able to process (ff 11.00 (propylene) + ff 6.72 (processing) + ff 2.28 (tariff) = ff 20.00). Therefore, to be competitive in the E.E.C., a developing country producer must be significantly more efficient in polypropylene production.

The obvious discrepancy in efficiency rates required of the two producers may be quantitatively valued by the <u>effective rate of protection</u> (ERP) which is calculated as follows:

$$ERP = \frac{T}{VA}$$

where T is the tariff rate and VA represents the total of value-added during local processing. This formula indicates that a developing country producer must be 31 percent (ERP = 14 : .45 = 31) more efficient in polypropylene production than its competitor to compensate for the cost advantage given to the French producer by the E.E.C. tariff.

The ERP isolates a crucial requirement for developing countries: To be internationally competitive in the petrochemicals industry, developing countries must utilize relatively inexpensive energy resources. An ERP of 31 percent prohibits developing countries who have input costs equal to those of established producers from exporting intermediate and advanced petrochemicals products to developed countries. Industries in developing countries must minimize the competitive disadvantage they suffer from tariffs by providing their petrochemicals industries with cheap feedstocks if they are to compete in developed country markets.

The ERP assumes that feedstocks are available to all producers at equal prices. This of course is not true. Many producers in CERN and developing countries have access to ethane gas and other petrochemical feedstocks below international energy prices. Tariffs in some developed countries also affects the ability of petrochemicals industries to compete internationally by raising input costs. Propylene entering the Japanese market is subject to a 5.8 percent tariff.

The increased cost of propylene feedstock for Japanese producers as it effects the competitiveness of developing country producers may be incorporated into the ERP formula as follows:

$$ERP = \frac{T}{VA} = \frac{T - at}{(1-a)}$$

where T is equal to the tariff rate for polypropylene, VA is equal to local value-added, t is the duty on propylene and "a" is the percentage of total costs accounted for by propylene feedstock. In the example of Japan, ERP = (.18 - .55 x .058) : (1 - .55) = 32.9 percent. Therefore, a developing country producer must be almost one-third more efficient in polypropylene production from propylene than his Japanese competitor to enter the Japanese market. The difference in the ERPs for France and Japan is due to the input cost increase suffered by the Japanese producer from the 5.8 percent tariff on imported propylene. Table 3.5-B lists the effective rate of protection in the developed countries for selected petrochemicals products.

There is a very important exemption to tariff barriers applicable to petrochemicals products originating from developing countries. Under the General Agreement on Tariffs and Trade (GATT) a provision exists called the Generalized System of Preferences (GSP) which disqualifies exports originating in developing countries from tariff duties in participating member nations.

Developing countries who export intermediate petrochemicals products to Japan, the E.E.C. and the U.S. are eligible for duty-free treatment under the GSP and would face no competitive disadvantage upon entering those markets. There are limits to the GSP, however. Should a developing country exporting under the GSP become a major supplier of a petrochemical product, it is likely that that nation would lose its duty-free priviledges and face the tariff schedules listed in Table 3.5-A. For example, the E.E.C. imposed a 13.5 percent tariff on methanol from Saudi Arabia in July 1984 when the Saudi exports reached 15,000 tons. Operating under GSP status also requires special documentation to determine the origin of products and duty-free cielings which limit the amount of product which may be exported under GSP status.

Table: 3.5- B

Effective Rates of Protection On Selected Petrochemical Products 1985

Product	EEC		Japan		U.S.	
	Tariff Rate	ERP Actual	Tariff Rate	ERP Actual	Tariff Rate	ERP Actual
Polyethylene						
High Density	13.4	53.6	17.0	77.3	12.9	51.6
Low Density	13.4	60.9	17.0	68.0	12.9	58.6
Polystyrene	13.4	89.3	14.0	93.3	9.2	61.3
Polypropylene	14.0	31.1	18.0	37.4	13.1	29.1
PVC	13.4	24.4	5.8	10.5	10.1	18.4
Ethylene Glycol	13.9	92.7	12.0	80.0	12.4	82.7

All tariff rates and effective rates of protection are expressed in percentage terms.

Non-Tariff-Barriers

In addition to tariffs, countries may revert to other types of protection from foreign imports. The call for protection has become stronger in recent years due to the continuation of the recession, the slackness in demand and the recent entry of new producers, with decisive cost competitive advantages in the market. While the rate of tariffs as trade barriers has been declining due to multi-national negotiations; non-tariff impedements to trade have become more visible. These non-tariff barriers to trade include a myriad of quotas, individual product inspection requirements, health and environmental standards, "voluntary" import restraints and import licensing regulations. All of these measures contribute to increase the cost of international trade or prohibit trade entirely.

The concept of non-tariff measures embraces all types of governmental non-tariff measures which have an actual or potential effect on trade flow. By introducing unequal treatment between domestic and foreign goods of the same or similar production, those measures, which create distortion in trade flows are known as non-tariff distortions.

Common non-tariff trade barriers are listed below:

- Import quotas which expressly limit the amount of product which may be brought into a country. Quotas may limit imports from a specific country or region or prohibit all products imports.
- Levying special import duties or border taxes.
- Import licensing programs, which are often arbitrary and affect intermediate products.
- Quality standards which require individual product inspection.
- Quarantine of product for long time-periods.
- Regulations which require all govcernment agencies and programs to purchase only domestic product.
- Exchange controls and import licensing requirements which discourage local domestic importers.
- Standards requirements which limit the amount of imports.
- Subsidies which make local producers more competitive such as export credits, tax credits and local marketing facilities.

In assessing the trade restrictive effect of non-tariff barriers or distortions, various measures can be employed. If the direct price effects can be determined, for example in the case of a minimum import price or variable levy, the ratio of the import charge to the final price of the product provides a fairly reliable estimate, of the "ad valorem" equivalent of the non-tariff barrier. When such "ad valorem" equivalent cannot be derived, other indicators must be applied. These include a "frequency index" which shows the ratio, in percentage terms, of the four digit CCCN product groups affected by the given measure to the total number of four digit CCCN product groups in the category. Another indicator is the "trade coverage index" which gives the ratio of the value of trade effected by NTM (Non-Tariff measures) to the total value of trade in the product group. 22/

With regard to types or categories of non-tariff measures affecting trade in petrochemicals, quantitative restraints, such as prohibitions, authorizations and quotas, on imports of petrochemicals appear to be more prevalent than price controls.

Table 3.5-C indicates categories of non-tariff measures applied by major developed market economy countries to petrochemical imports:

Table 3.5-C

Category of non-tariff measure	percentage share of imports from:		
	Developed ME countries	Developing countries	CPE of Eastern Europe and Asia
All measures	9.0	12.2	13.2
of which			
control of price levels	2.0	0.9	6.9
control of volume levels	7.0	11.3	6.3

Source: UNCTAD

Table 3.5-D indicates Frequency (F) and trade coverage (V) of non-tariff measures applied by major developed market economy country (percentage):

Table 3.5-D

Frequency (F) and trade coverage (V) of non-tariff measures applied by major developed market-economy countries (percentage)

PRODUCT GROUP	IMPORTS FROM: Developed market-economy countries		Developing countries		Socialist countries Eastern Europe / Asia	
	(F)	(V)	(F)	(V)	(F)	(V)
Organic petro-chemicals	3.7	12.7	5.8	13.4	9.4	7.0
Synthethic rubbers	0.2	3.0	0.0	0.0	0.0	0.0
Synthetic fibres	3.3	2.9	0.0	0.0	30.1	19.0
Plastics and synth.resins	4.6	3.3	7.4	8.6	11.5	20.6
Carbon black	0.0	0.0	8.3	55.0	0.0	0.0
Surfactants	3.1	11.8	2.9	0.4	0.0	0.0
TOTAL	3.9	9.0	6.0	12.2	9.9	13.2

Source: UNCTAD Data Base on Trade Measures (1983 trade data) (preliminary: subject to revision later in 1985).

- Anti dumping procedures.

Anti dumping procedures are provided for in the GATT agreements if subsidized imports can be proven to inflict harm on domestic industries. The E.E.C. held a series of hearings to determine the fairness of international competition. As can be seen in Table 3.5-E below, the committees were highly preoccupied with foreign competition in the chemical sector. From 1980 to 1982, 46 percent of all inquiries examined were chemical imports. The imposition of permanent duties on foreign products in each case was on imports from the U.S. or U.S. protectorates.

Table 3.5-E

Actions taken by the E.E.C. against dumping and subsidies; 1980-82

1) Procedures open during the period January 1, 1980 to December 31, 1982.

Products	1980	1981	1982
Chemicals and allied	12	23	25
Textiles and allied	2	1	0
Wood and paper	3	4	1
Mechanical engineering	6	18	2
Iron and steel	1	1	15
Other materials	0	0	6
Others	1	1	9
Total:	25	48	58

Table 3.5-E (continued)

2) Procedures opened concerning major organic chemicals

A Under investigation at the end of 1982
B Application of temporary duties
C Application of permanent duties
D Actions suspended following pricing agreement
E Action suspended owing to lack of evidence regarding dumping

1980		
Vinyl acetate monomer	United States	C
Styrene	United States	C
Orthoxylene	Puerto Rico	C
Orthoxylene	United States	C
Paraxylene	United States	C
Paraxylene	Puerto Rico	C
Paraxylene	Virgin Islands	C
1981		
Phenol	United States	C
Trichlorethylene	Czechoslovakia	E
Trichlorethylene	GDR	D
Trichlorethylene	Poland	D
Trichlorethylene	Romania	D
Trichlorethylene	Spain	D
Trichlorethylene	United States	D
PVC	Czechoslovakia	B
PVC	GDR	D
PVC	Hungary	D
PVC	Romania	D
1982		
Acrylonitrile	United States	A
Bisphenol	United States	A
Perchlorethylene	Czechoslovakia	D
Perchlorethylene	Romania	D
Perchlorethylene	Spain	D
Perchlorethylene	United States	D
Polyethylene	Czechoslovakia	A
Polyethylene	GDR	A
Polyethylene	Romania	A
Polyethylene	USSR	A

Source: Premier rapport annuel dela Commission des Communautés Européennes sur les actions antidumping et antisubventions de la Communaité (Septembre 1983).

3.6 Increasing Role of New Forms of Trade

There is a general and increasing trend of transition in international economic relations and trade from one-time one-way deal activity to package or complex forms of relations that are becoming characteristic of the general external economic relations. The most significant factors influencing the rapid growth of this trend are the alarmingly deteriorating balance of payment deficits and foreign debts situation of developing countries, the inflationery growth of prices, the sharp fluctuations in exchange rates and the partial or complete inconvertability of currencies of many countries. Under these circumstances, there is a tendency towards an increasingly broader linkage between imports and exports, which makes it possible to pay for purchases in national products. It is estimated that deals combining export and import account at present for 25-30 percent of total world trade. 23/

Counter trade is the general umbrella under which these transaction takes place. The ambiguity of the term countertrade allows different definitions for essentially similar deals and, converselv, to define different phenomena by one concept. The most simple form of trade relations consisting of non-cash exchange, e.g. barter, is included in the concept countertrade. A large group is constituted by the so-called counterpurchases or tied purchases, parallel deals offset operations, etc. Their general meaning is that, under the contract, the exporter assumes an obligation to purchase from the importer the goods for a certain part of the value of his export, or, in other words, the contract provides for some form of tying export to import. Countertrade is also regarded as comprising such new form as co-operation on compensatory basis which is often termed as buy-back-deals. Unclear definition of the criterion results in inclusion into the categorv of countertrade of such operations that are not independent forms of foreign trade relations, for example, switch operations as well as offset operations. Such operations characterize only the technical side of the deals.[24/]

The presence, in each particular case, of both export and import operations, i.e. counterflows of goods, serves as a general criterion that allows some economists to bring together all these different forms into a single concept.

If this criterion is applied one can define countertrade as comprising almost all modern forms of trade and economic relations (including industrial co-operation, intracompany trade, joint ventures, etc.) between all country groups and within those groups. Furthermore, this logic could lead to the inclusion into the countertrade category of any trade between two countries, provided that it does not represent a one-way operation.

Compensatory partnership involves ties aimed at the following objectives: provision of financial and material resources in the form of a stipulated credit; setting up new production capacities; repayment (compensation) of the credit by supplying goods produced with the new capacities of by supplying similar products of other enterprises. Thus to consider partnership on the basis of compensation as equal to barter trade and other similar commercial operations would be wrong from both the formal and sustantive points of view. In contrast with partnership on the basis of compensation, these operations do not involve long-term ties. In general, their objectives are limited to balancing trade between two countries and are within the non-production sphere. At the same time, partnership on the basis of compensation primarily touches upon the production sphere. It presupposes mutual adjustment by partners in certain fields of their production. This involves setting up new production capacities and using them to produce goods of such quality and in such quantities as required by a foreign partner. In general, such capacities are set up on the basis of long-term co-operation starting at the stage of design and up to equipment installation and setting it to work. Moreover, compensatory partnership directlv influence the investment process. Credits granted within the process serve as a source of financing part of the borrowing country's capital investments.

Compensation-type supplies of equipment for the development of the mining industry are characteristic of deals between developed and developing countries. In these contracts, developed countries firms provide for purchasing part of the products of plants under construction, proportional to their investment costs. Often, companies of several market economy countries participate in implementing such projects. The mechanism of compensation is used by developing countries on an increasing scale for implementation of new projects - most of all, in mining industries and in selling their products in new markets.

Compensation agreements have many advantages to the partners concerned as they offer opportunities to expand exports and to meet demand for certain products on a long-term basis, increase output and improve utilization of capacity and improve the employment situation. Through such agreements countries could obtain credits for the development of their industries. Co-operation on a compensatory basis brings in a dimension of stability under conditions of market fluctuations, facilitates production planning and marketing and opens up additional prospects for production specialization. Many of the large firms polled by the United Nations ECE Secretariat regard compensation deals as a factor protecting them against fluctuations on the market. 25/

The experience of co-operation, based on compensation agreements, shows that it does not replace traditional forms of trade and is used only when and where the partners involved find it mutually beneficial, therefore contributing to the growth of trade.

Moreover, methods and principles of this form of trade are in a process of constant evolution. The record shows that equipment purchases are not necessarily paid for by products from the compensation projects, but also by other products in quantities agreed among the countries involved. In many cases implementation of many large-scale projects becomes possible only through multilateral co-operation among countries, firms and banks.

Apart from compensatory arrangements and within countertrade deals, commodity swaps may be particularly well suited to international petrochemical trade as transportation costs can be significantly reduced. For example, Mexico's PEMEX recently delivered oil to Cuba in exchange for oil shipped from the U.S.S.R. to Mexican customers in the Federal Republic of Germany.

Countertrade is becoming so important in international trade that it has led to the establishment of countertrade departments within major firms in the developed nations.

Table 3.6-A illustrates the 1983 net balance of fertilizer counterpurchase agreements between several countries' exporters and the country of Indonesia.[26/]

Table 3.6-A

Companies Supplying Fertilizer	Commodities exchange
Amitrex (U.S.A.)	Aluminium Ingot
Chemie Export/import (GDR)	Black Pepper
Danubiana (Romania)	Cacao
Fred. Lekker (FRG)	Clothing
Hart Tindo (Singapore)	Coal
I.C.E.C. (U.S.A.)	Coffee
Kali Bergbau (GDR)	Nickel
Kuok (Singapore)	Palm Stearin
Mitsubishi (Japan)	Plywood
Transcontinental (U.S.A.)	Rubber
Woodward & Dickerson (U.S.A.)	Timber
	Veneer
Value of Fertilizers:	$ 126.4 million
Value of Commodities:	$ 87.9 million
Net Countertrade Balance:	$ 38.5 million

Compensatory and countertrade arrangements have important implications for the transfer of technology from developed countries to developing nations. One objective of chemicals firms, using these arrangements, is to provide an energy-rich developing nation with the technology necessary to initiate domestic petrochemicals production. In addition to technology, the firm would provide assistance in marketing the plant's production in the developed country. In exchange, the chemicals firm would receive production from the plant which would be sold or upgraded to specialty chemicals. The firm in the developed country will thus get access to efficiently produced feedstock petrochemicals in compensation for technology provided for their production.

Industry analysts suggest that some CERN,s have attempted to institutionalize counterpurchase agreements by requiring trade linkages. This arrangement would condition the export of crude oil to a developed countries' willingness to accept petrochemical exports. A second variation is to link petrochemical feedstock pricing to the prices of crude oil exports. This approach would be particularly effective in countries' whose petrochemicals industries are dependent on petroleum-based naphtha feedstocks, i.e. Japan and Western Europe. The petrochemical industries in these countries have recently undertaken efforts to diversify their feedstock use to include liquified petroleum gas (LPG), thus adding flexibility which would allow the use of cheapest feedstock available in the market. This attempt to reduce input costs would be eroded if the suggested linkage between LPG and oil prices is strictly applied.

In conclusion, some of more popular definitions of various forms and techniques linked to this type of trade are given below:

* Barter - The exchange of goods/services without monetary compensation

* Counterpurchase - An agreement in which goods or services are financed with a combination of cash and merchandise be purchased in an amount equal to a percentage stipulated in the contract.

* Compensation - An agreement in which future output of a manufacturing plan and/or other products are traded for technology, plant, or equipment necessary for its construction.

* Swaps - The exchange of products by two companies or countries to save transportation costs.

* Clearing Agreements - An arrangement in which two countries agree to purchase reciprocating amounts of each other's products through a "clearing currency" - usually the U.S. dollar or the French franc.

* Switch - The transfer of debt obligation incurred by the purchase of goods to a bilateral partner of the debtor nation.

* Evidence Account - An agreement between a company in a hard-currency country and the foreign trade organization in a soft-currency country in which sales by the hard-currency company must be balanced by purchases from the foreign trade organization in a special account.

* Block Currencies - A method of repatriating profits from a country which blocks investments repatriation by purchasing locally manufactured goods for export which will be sold internationally for cash.

* Development for import - The subsidizing of a foreign industry by low-interest loans to develop production processing of a raw material to guarantee export to the financing country.

4. OBSTACLES AND PROSPECTS TO NEW PETROCHEMICALS PRODUCERS FROM DEVELOPING COUNTRIES IN INTERNATIONAL TRADE

4.1 Obstacles to New Petrochemicals Producers

4.1.1 Trade Barriers in Developed Countries

Analysis of the tariff and non-tariff barriers established in developed countries indicates that developing countries will face difficulty in exporting petrochemical products to the world's largest markets. The effective rate of protection calculated for polystyrene reveals that new producers would have to be between 61.3 and 93.3 percent more efficient in polystyrene production than developed country producers to export this product to the E.E.C., Japan and the United States. A careful look at the tariff and non-tariff barriers applied by developed countries against petrochemical export from developing countries will confirm that many developed country markets are virtually closed to exports of intermediate and end petrochemicals.

Moreover, the structure of the tariff applied in developed countries is so construed as to dissuade or prohibit developing countries from exporting down-stream products. At the same time, the free duty status of all aromatics and of ethylene, (except in Japan where propylene is taxed at 5.8 per cent), leaves the basic petrochemicals market open.

The excalation in the cost of raw materials inputs has significantly raised the protection afforded to local petrochemicals producers by tariff duties and non-tariff protection measures. The increase in effective protection has been especially great for those products whose feedstock costs constitute a large percentage of their total costs. For example, feedstock costs account for 85 per cent of the manufacturing costs of ethylene glycol. If all countries have access to feedstocks at equal or similar prices, competing producers would have only 15 per cent of the total cost with which they may compensate for the economic disadvantage of the tariff through more efficient plant operations.

4.1.2 Competition Among Developing Countries

As most new global petrochemical capacity is based on inexpensive ethane feedstocks, there will be a resulting global surplus of ethylene and ethylene-based products. This will be particularly true considering that similar high cost plants located in developed countries will remain in operation under a shield of protectionist policy. Excess supply could set-off severe competition among developing countries whose production are geared for export which will attempt to maximize economies of scale by running their plants at high capacity levels.

Competition among the new producers of petrochemicals would depend upon their selection of market-entry strategies. Should they decide to compete in a manner which will not disrupt traditional market shares in developed countries, this will require linkage with firms who have established market positions. Under this scenario, the new producers would limit their production to amounts which would satisfy domestic demand plus the growth in demand within developed countries and other developing countries. Import demands in developed countries would originate from intermediates requirements to be used for increased end-product production and/or continued rationalization of commodity petrochemical facilities.

The efficiency rate in ethylene production depends upon factors which will influence the supply of basic and intermediate petrochemicals. To operate efficiently, ethylene production facilities must have a world scale capacity of 250 to 450 thousand tons and operate at high capacity levels to take advantage of production economies of scale. Once in place, new producers cannot economically limit their production runs. The domestic economies of many developing countries will not be able to absorb immediately all of their new petrochemical production and they will add to the surplus of petrochemicals in export markets. Under this scenario, there would be an increase in the supply of commodity and intermediate petrochemicals on the international market which would, in turn, exert downward pressure on prices. This would be true if very low growth rates of demand were assumed while at the same time all new capacities were implemented. However, if the global growth in demand for ethylene and its derivatives is predicted to be 25 per cent for the period 1985-1990, there is a good possibility that the world will face excess capacity levels of some 4 million tons only by 1990, i.e. out of a total of 56.4 million tons in 1990.[13/]

4.1.3 Linkage With Developed Country Producers

The prospects of major companies and other developed country representatives joining forces, on the basis of mutual benefit, with developing countries to undertake the construction and operation of new petrochemical production facilities in the future looks rather good.

Developing countries' successful entry into the global petrochemicals market will depend partly on their ability to cooperate with established producers in petrochemical industry. Aspiring producers in developing countries lack two crucial inputs necessary for profitable petrochemicals production: a) The technology to create a petrochemicals industry and b) An established marketing system to sell production in excess of domestic demand.

Multinational companies (MNC's) benefit from linkages with developing countries by the acquisition of low-cost raw materials and commodity petrochemicals. MNC's process low cost inputs into intermediate and final petrochemicals products for distribution in domestic and export markets. The increased cost of production of basic and bulk petrochemicals in traditional markets by the major chemical companies have led to a shift in their strategy towards concentration on the production of value-added specialty products. The adoption of this strategy could satisfy the interest of both groups of countries where developing countries' producers would supply basic, intermediate and commodity petrochemicals at competitive prices to the producers of specialties in the developed countries.

There remains the question as to how aggressively the MNC's will market petrochemical products produced by developing countries in their home markets. These major companies are most apt to follow a non-disruptive strategy of entering international markets, otherwise they would be acting against their own interest as producers of the same products. A non-disruptive pattern would limit exports to an amount equal to growth in petrochemicals demand less domestic rationalization. By competing in this manner, major companies will be able to protect their market share in petrochemicals and maintain price levels in their home markets.

This scenario of market entry may not be in the best interests of developing countries. By maintaining prices at a level adequate enough to operate their own plants with profit MNC's action may restrict growth of demand and slow down the rationalization process in their own countries which is detrimental to the interest of their partners, new producers from the developing countries. On the other hand, new producers of basic ethylene derivatives would like to expand their market share as far as possible, operate their plants at maximum load to improve production economics and expand their production capacities. By charging major producers from developed countries with marketing the plant's output, new producers can severely limit their ability to compete using their low-cost competitive advantage. Of course, the benefits of linking the established marketing channels of major producers must be judged against the cost of independently marketing their products.

4.1.4 Lack of Know-how and Technical Marketing Services

The technology necessary to manufacture basic petrochemicals is complex, involves sophisticated equipment, and demands astute personnel. This technology was invented in developed countries and is often protected by patents or licensing requirements. New producers in developing countries have traditionally been dependent upon joint ventures and other linkages with developed countries to establish petrochemicals industries.

Their lack of experience and expertise in the petrochemicals field remains a barrier to entry in the international petrochemicals industry and has induced many to enter into joint ventures and other collaborative efforts to obtain the technology necessary for plant construction. Often these agreements commit plant production and raw materials to the partner at favorable prices which inhibit the developing countries' ability to compete internationally. Major companies are not likely to aggressively market the production from the joint venture by cutting price in their home markets because this would injure their domestic operations. By surrendering raw materials at low prices, developing countries increase the international competitiveness of their partners and reduce or eliminate the extent of their competitive advantage. It is a very paradoxical situation, the developing countries need to export their raw materials to obtain the resources needed to upgrade their value, but by exactly doing this they are eroding their competitive advantage. An easy solution to this contradictory situation is not readily available since factors influencing prices are usually outside the control of the developing countries. The only precedent to this was the one set by the collective decision of OPEC, which has consequently set in motion the process of restructuring the petrochemical industry.

4.2 Prospects

4.2.1 Global Restructuring of the Petrochemical Industry on a Cost/Price Basis

The current global restructuring and relocation of the petrochemical industry is in response to shifting potential markets for petrochemical products and changing relative cost advantages in their production processes. Petrochemical production facilities were established in developed countries because cost savings realized by locating factories near the final markets for their products outweighed transportation costs of the raw materials necessary for their manufacture. Thus, the first petrochemicals facilities were established in the U.S., Japan, and Western Europe, close to the markets with strongest demand for their end-products and the required technology for production.

The first petrochemicals industries to be established outside the developed countries were in Latin America and Asia in the 1960s and early 1970s to satisfy internal demand for petrochemical products. Some of these plants had also the added advantage of low-cost ethane inputs, but their location was based on the same rationale as plants previously constructed in developed countries, that petrochemical production centers should be near their end markets. These countries first invested in downstream processing facilities and later integrated upstream to replace the intermediate feedstocks imported from developed countries.

The oil price increases of the mid- and late-1970s had the important consequence of raising the price of raw materials above those of transportation costs. The cost/price structure of the petrochemicals industry was changed decisively by the increases in variable costs. The surpassing of transportation costs by raw materials costs insured the viability of new petrochemicals plants in countries with abundant, inexpensive energy resources and instigated a series of rationalization efforts in the developed countries.

New producers in the petrochemical industry derive significant cost advantages in petrochemicals production from the use of previously-flared natural gas available at low cost (approximately one-sixth those of comparable international energy prices). Tables 4.2.1-A and 4.2.1-B illustrate some estimates of the cost advantages enjoyed by Saudi Arabia over the U.S. and W. Europe in 1985 for ethylene and LLDPE.

Table 4.2.1-A

Relative ethylene and LLDPE costs
1985 production costs
(100 = Western Europe)

	Feedstock	Ethylene	LLDPE
Western Europe	naptha	100	100
United States	ethane	75	87
Saudi Arabia	ethane	50	72

Source: BP Chemicals

Table 4.2.1-B

Delivered LLDPE costs
(1985 delivered costs at US Gulf)

Delivery	Origin from: US Gulf 1	US Gulf 2	North Western Europe 1	North Western Europe 2	Canada 1	Canada 2	Saudi Arabia 1	Saudi Arabia 2
US Gulf	100	100	150	138	134	117	112	161
San Francisco	117	112	143	157	110	123	115	163
New York	116	111	135	147	118	136	109	159
Rotterdam	139	127	114	116	126	146	108	158
Genoa	139	128	117	121	126	147	104	155
Venezuela	104	103	121	126	100	110	88	144
Argentina	115	111	124	130	106	118	87	143
Singapore	127	119	127	135	104	115	75	135
Japan	123	116	132	142	99	109	82	140
Mid East/Africa	136	125	139	151	120	138	96	149

1. Cash cost.

2. Total cost plus 25% on investment

Source. Dow Chemicals

Table 4.2.1-B shows that producers in Saudi Arabia and Canada could aggressively compete in traditional U.S. and W. European export markets on a basis of lower cash costs should they choose to do so. Regardless of the market entry strategy they elect, it is clear that variable costs, and therefore, prices for ethylene exports from Canada and Saudi Arabia are less than prices in the developed countries.

These changing relative advantages in production costs will lead to a significant restructuring of the international ethylene industry evidenced by the relocation of name plate capacity shown in Figure 4.2.1. 13/

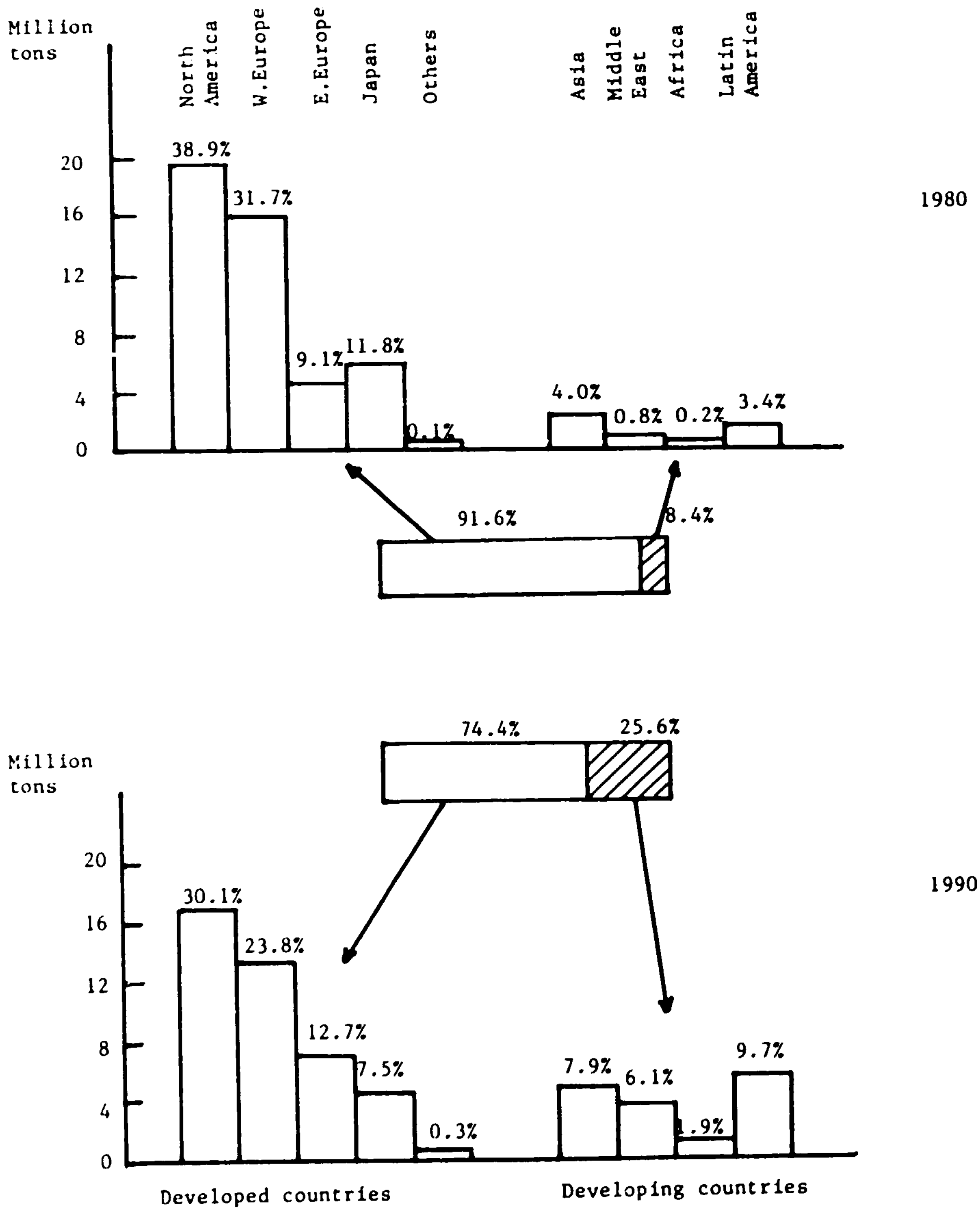
Figure 4.2.1 predicts that by the year 1990, developed countries will lose 17.2 per cent of total ethylene production capacity to producers whose share in world ethylene capacity is expected to be in Latin America (9.7 per cent), the Middle East (6.1 per cent), Africa (1.9 per cent), and Asia (7.9 per cent).

Figures 4.2.2, 4.2.3, and 4.2.4 illustrate the net trade balance of each of the major producing countries of ethylene, methanol and nitrogen in 1980 and the predicted net trade balance for 1990. These figures estimate the largest deficits in 1990 ethylene trade to be in the United States, -1,280,000 metric tons (MTs) and Asia, -2,825,000 MTs. Thus, the U.S. will move from a net ethylene exporter of 1,380,000 MTs in 1980 to a net importer by 1990. Japan will also move into a deficit trade position as it moves from an ethylene trade surplus 275,000 MTs to -352,000 MTs in 1990. Western Europe is the only developed area expected to hold its own against the new petrochemicals producers based on inter-continental trade within the E.E.C.

The Middle East and Canada should reg er the largest trade surpluses in 1990 with new productive capacity from the up-grading of cheap natural gas to ethylene and its derivatives. Canada has the potential to move from a small ethylene exporter of 215,000 MTs in 1980 to a major world supplier of 1,815,000 MTs by 1990. Saudi Arabia's trade surplus is predicted to rise by 870,000 MTs to 1,245,000 by the end of the decade.

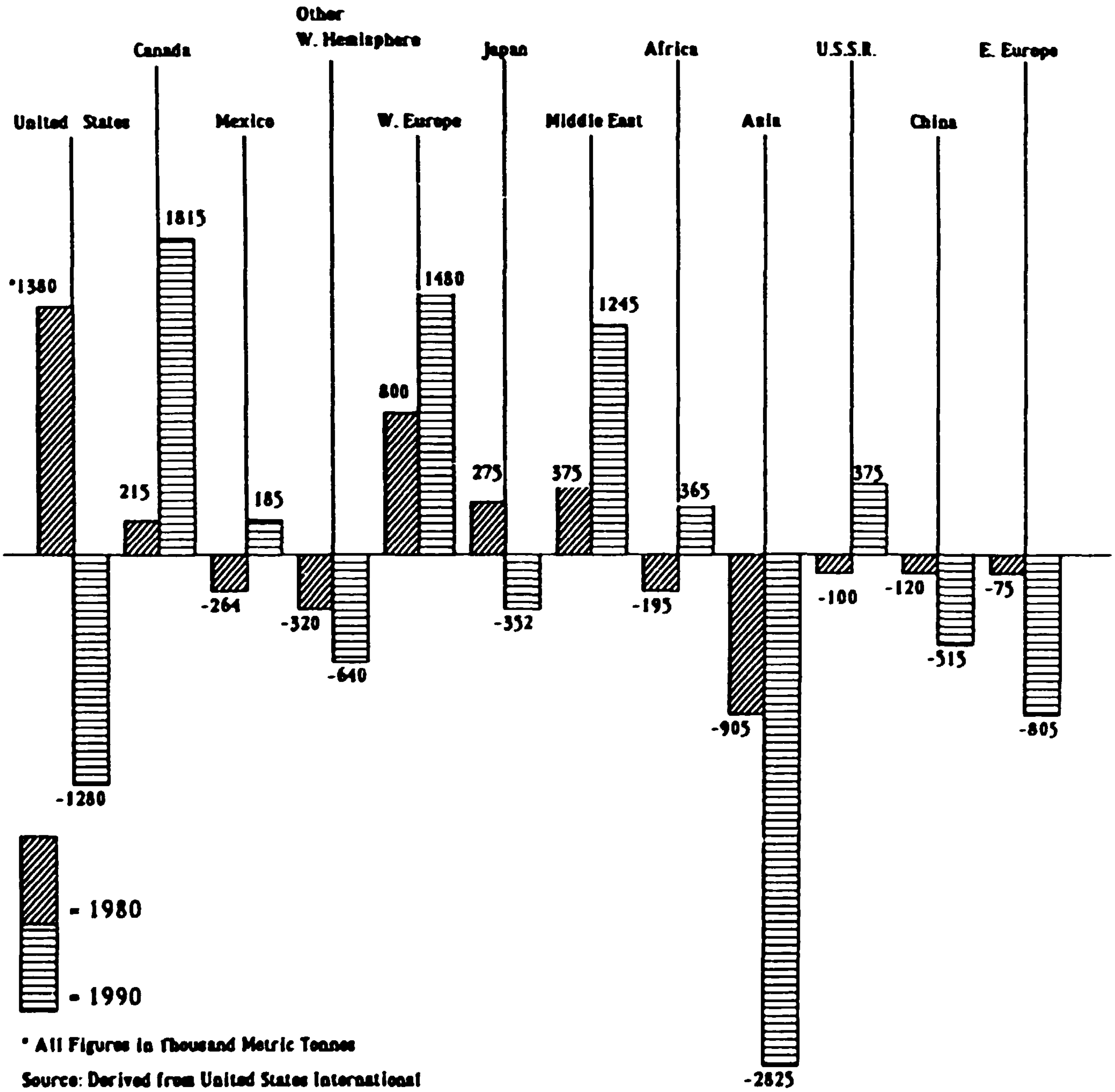
Figure 4.2-1

The changing distribution of ethylene production capacity between developed and developing countries (1980-1990)



Source: UNIDO Data Base 13/

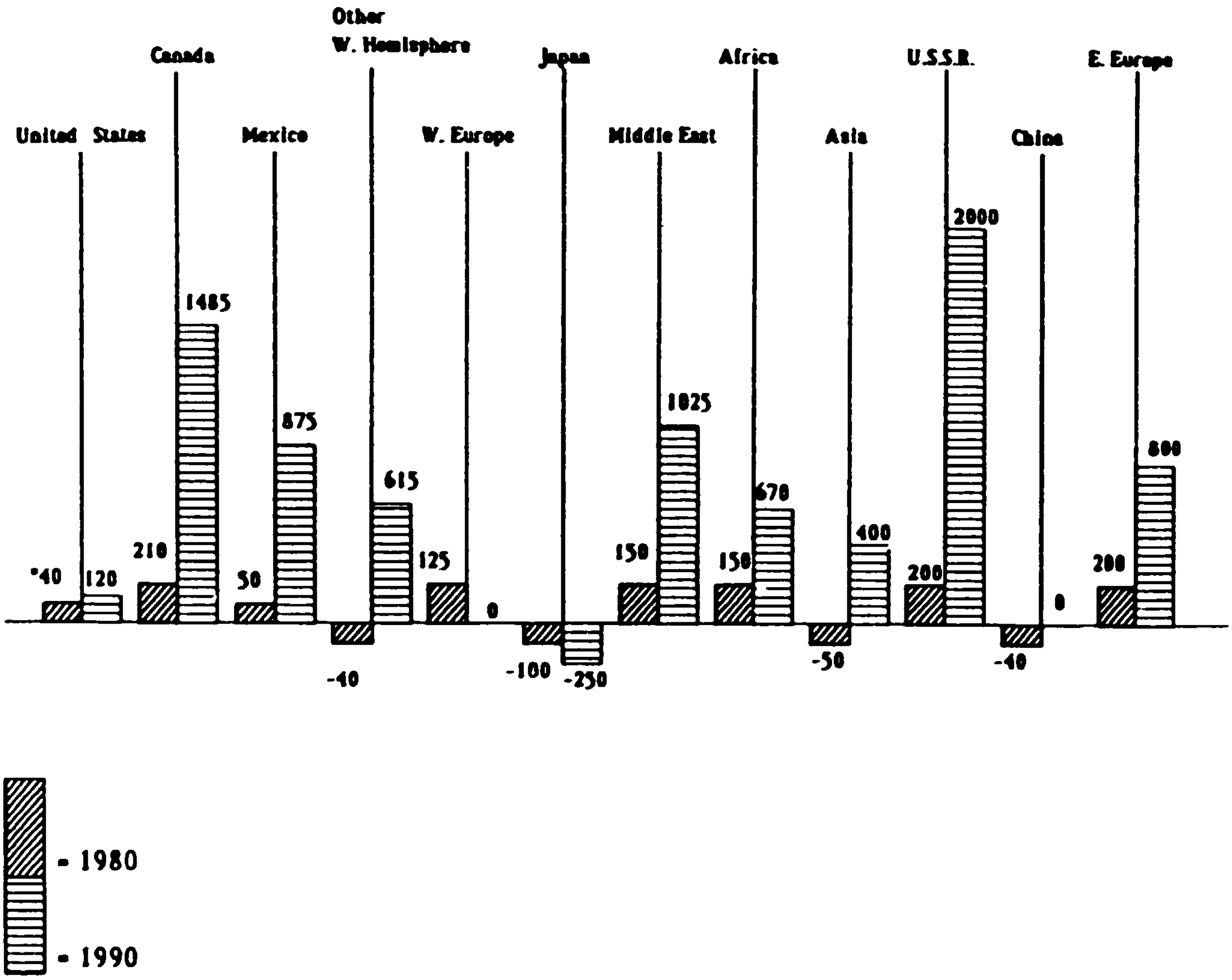
Figure 4.2-2 Net Trade Balances for Ethylene in 1980 And Predictions For 1990



* All Figures in Thousand Metric Tonnes

Source: Derived from United States International Trade Commission Data

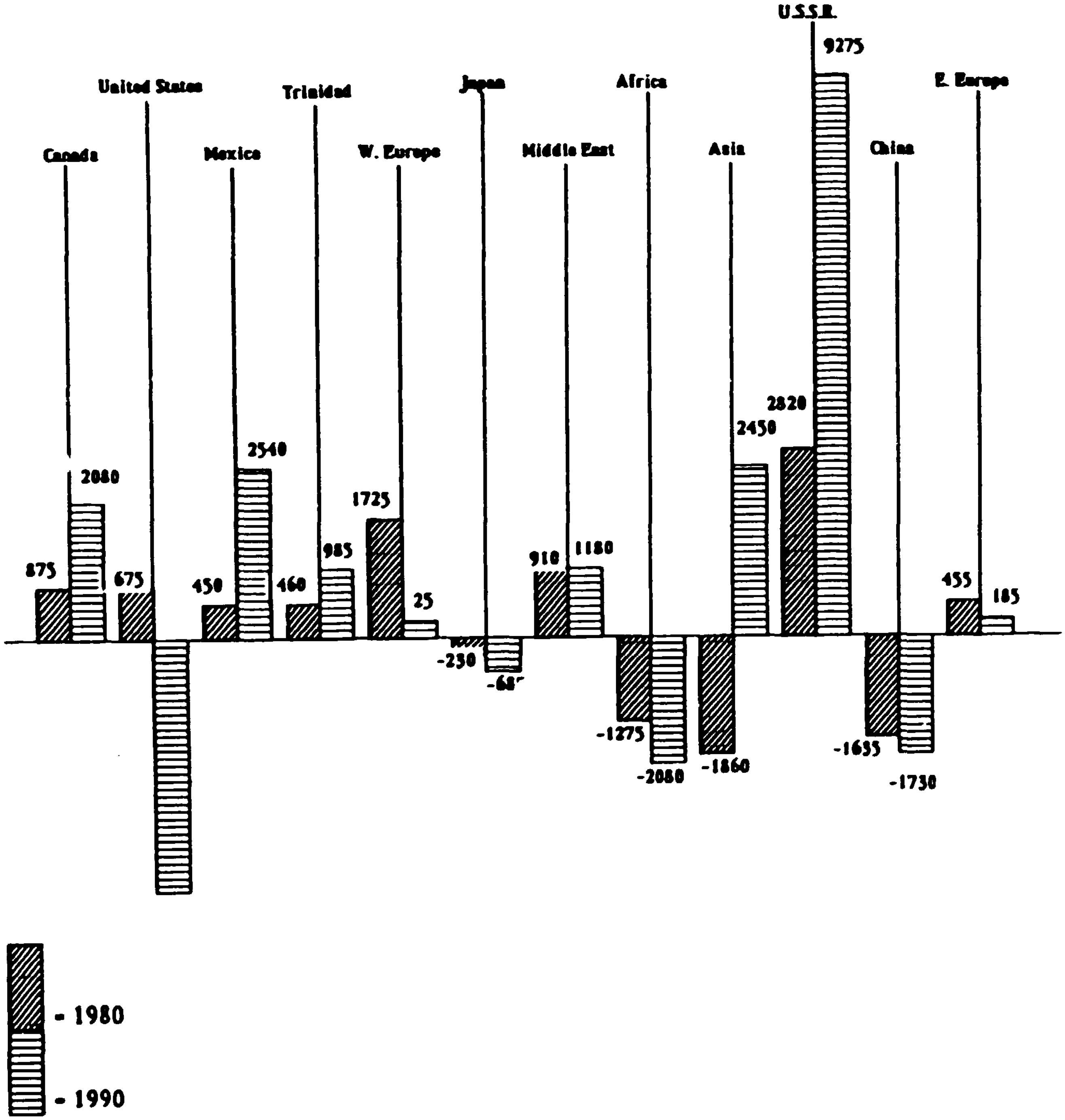
Figure 4.2-3 Net Trade Balances for Methanol in 1980 And Predictions For 1990



* All Figures in Thousand Metric Tonnes

Source: Derived from United States International Trade Commission Data

Figure 4.2-4 **Net Trade Balances for Nitrogen in 1980 And Predictions For 1990**



* All Figures in Thousand Metric Tonnes

Source: Derived from United States International Trade Commission Data

4.2.2 North/South Co-operation

Co-operation between the developed and developing countries is vital for the future success of the industry in both groups of countries. The painful process of restructuring and rationalization which has been going on in the developed countries since the late 1970s is the manifestation of structural and irreversible phenomena dictated by changes in the cost of production structure whereby variable costs (mainly raw material) assumed the greatest cost percentage thus rendering producers with access to low cost raw material more competitive than others. The adjustment needed to cater for this new situation will envolve finding the correct and timelv solutions to a most of economic, social and technological problems. As have already been explained in previous chapters of this report various actions have been and continue to be taken, including the adoption of rationalization plans at government, corporate and company levels, entailing plant closures, company regrouping, concentration and specialization and technological development, etc. in both developed and developing countries. Paralel to this, strategic realignement involving co-operation with CERNs have been undertaken in countries like Saudi Arabia, China, Canada, USSR and others, involving construction of new petrochemical plants, compensation and counter-trade agreements, marketing agreements, and joint ventures agreements have been widely seen during recent years as ways of finding medium and long term solution to the existing problems of the petrochemical industry. The elements of mutual benefits to the parties concerned in these deals are no coubt the driving force behind them and the only insurance for their future success.

The major elements involved in finding a successful equation for international co-operation in the petrochemical industrv are the following:

Technology and know-how + market + low cost raw material = success.

The right combination of these elements, acceptable to the parties concerned, constitute the pilar stones of any long-lasting co-operative arrangements. The first two elements in the above mentioned equation are assets predominantly enjoyed by the developed countries. Whereas the third element is mostly enjoyed by the developing countries.

Prior to the sharp increase in feedstock and energy prices the main motivation for co-operation between developed and developing countries was capturing the largest possible share in the markets of the larger developing countries. To guarantee a market share and to cut on transportation costs production facilities were established in developing countries on the basis of joint ventures between companies from the two groups of countries. Most of these joint ventures were reported to be successfully working during the last two decades. 27/

Under the new situation, where advantage of proximity to the market is off-set by proximity to low cost feedstock and energy resources the possibility of building up upon the previous co-operative experience of joint ventures could be utilized and developed to fit within the new situation, to the mutual advantage of partners from developed and developing countries. Viewed in a long-term perspective, the advantage of the ever-expanding virgin market of the developing countries could also be added to this. Such arrangement would not only present an answer to the aspiration of developing countries to successfully establish industry on their territories but would also provide a market outlet and new opportunities to developed countries companies.

Moreover, it is important to note that in most developing countries, the petrochemical industry has been fostered under the planning, guidance and protection of central governments. The petrochemical industries of Mexico and Saudi Arabia are the direct result of such national initiatives. The incentives of import substitution, exporting earning, industrial growth, food production and health programs are some common reasons for entry into petrochemicals production. The full backing of national governments to this industry adds additional guarantee to the co-operation commitments of the developing countries.

Through co-operative associations, developing countries have access to major companies' advanced technology, management techniques and marketing skills. Developing countries can benefit from the experience and expertise of the major firms in such areas as advanced production technology, environmental and operations safety, and daily operations.

Developed countries will have access to lower cost petrochemical products and raw materials in their own markets which through these co-operative arrangements will continue their access to the expanding developing countries markets.

4.2.3 South/South Co-operation

Many developing countries have gained long experience in running petrochemical plants, and have achieved a relatively high level of development in this field, including own creative research and development activities. This could present an important source and a start to joint co-operation between those countries. Unity of objectives, namely upgrading of natural resources, commitment to industrialization and general economic and social development add another impetus to the establishment of such co-operative arrangements. For indepth analysis regarding classification of developing countries in view of developing petrochemical production facilities reference is made to another paper presented to this consultation. 28/

It is common for countries who whish to establish petrochemicals industries to look to other developing countries for technical assistance in the following areas:

- training in plant operations, maintenance operations, quality control systems, and safety systems;

- in-plant research and development back-up;

- planning and project engineering.

Commercial plant operations offer two areas of possible co-operation, namely, co-operation in the establishment of intermediate and final product processing plants and regional marketing agreements. The raw materials necessary for basic petrochemicals production are available in many developing countries at costs which should allow them to be competitive internationally. Joint venture downstream production facilities could provide a means through which these countries could add value to their energy resources while sharing the burden of high initial investments. The output from the plant would enter domestic markets of participating countries and begin an import substitution process. Any surplus would be exported and become a source of foreign exchange. By serving the domestic markets of several countries, co-operative plants can be established at world scale capacity and operated at production rates that will allow for significantly higher economies than smaller plants operated by individual developing countries.

The obstacle faced by developing countries in attempts to co-operate in joint venture projects are:

- Insufficient capital to finance plant construction.

- Inability to agree on product repartition and marketing responsibility.

- Lack of technical and marketing expertise and inexperience in co-operative efforts.

- Failure to realize potential economic benefits.

Although at a first look these obstacles may sound to be formidable encouraging results have been achieved as a result of co-operative actions between developing countries, though very few of them are in the field of petrochemicals. 27/

4.2.4 Towards a new division of labour in the petrochemicals industry

Major inroads have been made in the production of basic and some intermediate petrochemicals by developing countries. The substitution of previously imported products with locally manufactured chemicals has initiated a reorganization of the petrochemicals industry. The series of capacity rationalizations in the developed countries and new plants commissioned in the developing countries pinpoint the trend setting the future structure of the industry based on a new division of labour whereby basic, intermediate and some of their derivatives are produced in countries abundant in low cost feedstock and energy resources and higher value-added and specialty products and services are produced and offered by developed countries. At present, the most important obstacle impeding the full development of this trend is represented by the protectionist tendencies and measures advocated by established producer in the developed countries, against imports of petrochemical products from the developing as well as some developed countries.

An attempt was made to assess the impact of trade liberalization on the development of the petrochemical industry.

It can be seen from tables 4.2.4-A and 4.2.4-B, that total trade expansion in petrochemical products if tariffs and "ad valorem" equivalents of non-tariff barriers are removed would amount to U.S.$ 1.7 billion for the world and U.S. $ 385 million for developing countries (in 1980 dollars). Combined imports of the E.E.C., the United States and Japan would increase by 8.1 percent from developing countries and by 10.8 percent from non-preference-receiving, or developed, countries. Since preferential treatment has also been eliminated, the developed countries would understandably benefit to a greater extent from trade liberalization. In addition, the trade expansion effect of the elimination of non-tariff barriers has been assumed to impact only the developed countries (see the notes to table 4.2.4-A)

The percentage trade expansion is higher for imports from developed countries in the markets of the United States and the European Economic Community, although not in Japan where imports from developing countries would show a slightly larger percentage increase. (It should be kept in mind that for Japan no NTB equivalents have been computed which this, presumably, underestimates the total value of simulated trade creation.)

Organic petrochemicals and plastics and synthetic resins account for over ninety percent of the imports from preference-receiving countries into these three markets. Trade expansion in the former product group would amount, solely from the elimination of tariffs, to $ 221 million for developing countries. By market, this implies a 7.4 percent increase (over 1980 import levels) in imports by Japan, a 7.1 percent rise in imports by the E.E.C. and a 4.4 percent increase in the imports of the United States. Trade liberalization would similarly increase imports of organic petrochemicals from developed countries by 5.9 percent in Japan, 10.6 percent in the E.E.C. and 7.7 percent in the United States; in the latter market, including the effect from removal of NTBs boosts imports by an additional 0.9 percent.

Table 4.2.4-A

Estimates of trade effects from the removal of post-Tokyo Round trade barriers

(values in 1980 million US dollars)

IMPORTING MARKET	Trade creation from removal of:			Trade diversion a_/		Net trade expansion	
	Tariffs		NTBs b_/				
	Developed countries	Developing countries	All trading partners c_/	Developed countries	Developing countries	Developed countries	Developing countries
European Economic Community d_/	582	351	171	+ 24	- 24	777	327
United States	290	11	51	+ 2	- 2	342	9
Japan	193	52	n.a.	+ 3	- 3	196	49
TOTAL	1 065	414	222	+ 29	- 29	1 315	385

Source: UNCTAD Data Base on Trade Measures

Notes: The results are computed using the UNCTAD Trade Policy Simulation Model (see Appendix I). 'Developed countries' indicates non-preference-receiving countries; 'developing countries' are equivalent to preference-receiving countries.

a_/ Trade diversion: potential gains to non-preference-receiving countries and potential losses to preference-receiving countries. Refers only to elimination of tariff preferences under the GSP. Informtion on the differential incidences of NTBs in ad valorem terms on developed and developing countries is not available.

b_/ Trade created by the removal of NTBs is under-estimated as it has not been possible to compute ad valorem equivalents for all products and for all countries.

c_/ The estimates are also based on computing the average price disadvantages in the importing country against world supplies as a whole (although there would normally be variations in the price disadvantages against different sources). Accordingly, results are not shown for developed and developing countries. However, an inspection of the NTM coverage in the UNCTAD Data Base suggests that developed countries would be the main beneficiaries of NTB removal. Accordingly in the columns on net trade expansion, the whole gain from NTB removal has been attributed to the developed countries.

d_/ Relates only to external trade of the EEC, and not trade among members of the EEC.

Table 4.2.4-B

Estimated trade expansion effects in petrochemicals

(1980 million US dollars)

IMPORTS FROM:	E E C		United States		Japan	
	1980 imports	percentage increase	1980 imports	percentage increase	1980 imports	percentage increase
DEVELOPED COUNTRIES						
Total petrochemicals of which:	5 491	14.2	3 961	8.6	2 682	7.3
Organic petrochemicals	3 247	10.6	2 839	8.6	1 971	5.9
Plastics, syn.resins	1 438	16.0	1 041	6.7	543	13.7
DEVELOPING COUNTRIES						
Total petrochemicals of which:	3 822	8.6	365	2.5	556	8.8
Organic petrochemicals	2 556	7.1	205	4.4	418	7.4
Plastics, syn.resins	1 136	12.4	157	0.0	100	16.0

Source and notes: see table 4.2.4-A

In the case of plastics and synthetic resins, tariff removal expands imports into the E.E.C. by 12.4 percent for developing countries and 16 percent for developed countries. In Japan, imports would increase by 16.0 percent and 13.7 percent from developing and developed countries, respectively, while in the United States market, imports from developing countries would actually decline slightly ('negative' trade creation due to trade diversion), although from developed countries they would increase by 6.7 percent.

4.2.5 Dynamics of the development of demand on petrochemicals in developing countries a major factor of future development.

Domestic demand is crucial to the profitable establishment of petrochemicals industries in developing countries. For this reason, developing countries with large populations, such as Mexico, the People's Republic of China, and nations in the Far East stand the good chances of establishing new manufacturing facilities.

International demand is crucial to the petrochemical industry because many developed country markets are closed. The effective rate of protection of tariff barriers in developed countries range from 30 to 90 percent. With the largest markets heavily taxed, developing countries must look first to their own economies to absorb much of their new petrochemicals production. The market to be supplied by new petrochemicals industries can be expanded by regional production and marketing agreements which could allow developing countries to specialize in different downstream products and share the high initial construction costs required.

4.2.6 Summary and Conclusion

The developed countries occupy the major share in production and consumption and in international trade in petrochemical products. This situation have been historically dictated by technological and market conditions.

After the sharp increase in energy cost a dramatic shift in the structure of production economies of petrochemical products occured, whereby variable costs, mainly raw material and energy, assumed the largest share. Countries with abundant low cost raw material and energy resources assumed competitive posture in production.

The high cost of inputs could not be easily transfered to products' prices under conditions of economic depression, market saturation and slackness in demand. High cost traditional producers faced losses and excess capacity. A process of rationalization was set in whereby, reorganization, capacity cuts, specialization and greater concentration were apparent everywhere in the developed countries. Together with this greater protectionist measures were taken to salvage the national industry's interests.

In the meantime, low-cost raw material and energy rich countries siezed the opportunities to establish their own industry to satisfy local markets and to compete in international markets. The course of action was often taken in co-operation with some of the largest multinational co-operations, mainly oil/chemical but also chemical companies.

The smooth development of this process is conditioned by the level of international co-operation, both on South/North and South/South basis, which include technology and know-how, markets, feedstock and financing. The combination of these elements in the right formula and according to the interests of the partners in co-operation would ensure the healthy development of the petrochemical industry to the mutual interest of the international community.

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