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OPEC AND THE EXPERIENCE OF PREVIOUS INTERNATIONAL COMMODITY CARTELS

by

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1. INTRODUCTION AND SUMMARY

The Teheran and Tripoli agreements of 1971 between the oil exporting countries and the oil companies constituted the first significant pieces of evidence that a cartel was being operated by the oil exporting countries. The fact that the Organization of Petroleum Exporting Countries[1] (OPEC) now unilaterally fixes the price of oil further supports the hypothesis that an economically motivated cartel consisting of the oil exporter countries is dominating the world petroleum/energy market. Even if the oil companies provide a service for which there is no institutionalized organizational substitute, they are severely constrained in their ability to resist producer government initiatives.

The price-making power of OPEC was clearly demonstrated in the fall of 1973 and in 1974. The average price of crude in the Persian Gulf increased by 505% between October 15, 1973 and November 1, 1974. As long as the OPEC countries can agree on a joint market strategy they can take advantage of their monopoly power and enjoy monopoly profits. A cartel is, however, an unstable unit even from a theoretic point of view. The market solution resulting from explicit collusion among oligopolists cannot be uniquely determined. The OPEC countries are also a rather heterogenous group of countries. To learn about the efficiency and longevity of cartels, a review was made of the research findings on the efficiency and the longevity of international cartel agreements.

The economics and political science literature contains more than 50 studies of the operation of cartels in the trade of international commodities. Agreements have been formed by companies and countries

[1] The members of OPEC are Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, & Venezuela.

in commodities as far ranging as tin and tea; these agreements have lasted for varying lengths of time; and have had varying degrees of success in curtailing production and raising prices to consuming countries. The research literature has documented cartel "success" and has provided a number of reasons why some cartels have worked better than others. Here we review and compile research results in a way which should indicate central factors in the operation of workable versus unworkable cartel agreements.

Although there have been numerous cartels in almost every commodity in international trade, only a small number of these price-controlling organizations have been studied in detail. Of those studied, even a smaller number have been analyzed sufficiently completely to make it possible to tell the difference between cartel success or failure. We have found evidence on 51 cartel agreements in 18 industries. These constitute two samples from which we draw conclusions on the factors determining the success or failure of cartels.

Cartel success or "efficiency" has been defined in terms of the ability of the organization to raise price at least 200% above the unit costs of production and distribution. If the cost to the highest cost member of the cartel at the margin were $1.00 per ton then the cartel would be efficient if it raised prices to $3.00 per ton and kept them there for a significant period of time.

The review indicates that of the 51 significant cartel organizations reported, only 19 achieved price controls which raised the level of charges to consumers significantly above what they would have been in the absence of agreements. But even the efficient cartels did not seem to last very long. Cartels were able to raise prices for four years or

more, where concentration of production was high, demands inelastic, the cartel's market share was high, the membership had cost advantages over outsiders, and governments did not get involved in the operations of the cartel.

If OPEC were to follow the pattern set by the 19 earlier "efficient" cartels, then it would likely have a 4 to 6-year duration. The primary source of breakdown would likely be the uncontrolled additions of supply from the "fringe" of OPEC countries (Iraq, Indonesia, Nigeria) or from the non-member countries.

2. CARTEL CHARACTERISTICS

The information available on international cartel agreements is not sufficient for rigorous empirical hypothesis testing. The studies made on cartels differ significantly in terms of their level of detail and research focus. From a theoretic point of view all important aspects of a cartel agreement were not covered in the studies that have been reviewed. For the purpose of this study we therefore constructed two samples out of the 51 cartel agreements on which we had enough information to judge whether the cartel agreement had been successful or not. To identify the most important factors determining the "efficiency" and longevity of cartel agreements each cartel was summarized along a number of dimensions. Due to the anecdotal and/or vague nature of the data, we have been limited to a very tight range of response, often to binary representation. On the cartels belonging to sample 1 we had sufficient data to describe the cartels along 17 dimensions. Sample 2 consists of cartels on which we had sufficient data to code 5 dimensions only. The dimensions are intended to describe as completely as possible the known occurrences of cartel formation. The unavailability of information on the internal operating mechanisms of these cartels made it impossible to include these important aspects of a cartel agreement.

2.1 Cartel Characteristics of Sample 1

Dimension 1. The concentration of production in the industry is regarded as being high if the four largest producers in the industry produce more than 50 percent of the total output of the industry. If this is the case, the industry gets a score of 1; otherwise, a score of 0 is assigned.

Dimension 2. The concentration of the international market, the exports/imports market, is scored in the same way; if the four largest exporters constitute more than 50 percent of the total market, the score of this dimension is 1; otherwise it is 0.

Dimension 3. The elasticity of demand is also scored in a binary way. If the elasticity of demand is more than 1, the score is 1. If the elasticity of demand is less than 1, that is if the demand is relatively inelastic, the score is 0. As the time horizon of the cartels is usually less than the period needed to get a long-term adjustment to prices, it is the short-term elasticities that are considered relevant.

Dimension 4. The income elasticity is given a value of 1 if demand

for the commodity is income-elastic, that is if a percentage change in income implies an even larger percentage change in the demand for the commodity; otherwise, the value of 0 is assigned to this dimension.

Dimension 5. If short-term substitutes for a commodity exist, the value of 1 is assigned; if no substitutes exist, 0 is assigned to the commodity.

Dimension 6. The existence of long-term substitutes is treated the same as for dimension 5.

Dimension 7. If governments were involved in the cartel agreement, a value of 1 is assigned; otherwise a value of 0 is assigned.

Dimension 8. The length of survival of the formal agreement in years.

Dimension 9. If the cartel members'share of total production in the industry is above 75 percent, a score of 2 is assigned; if the cartel members share is between 50 and 75 percent a score of 1 is assigned. A score of 0 is assigned if the share is below 50 percent.

Dimension 10. If the cartel members are responsible for more than 75 percent of total exports in the international export/import market, a score of 2 is assigned. A score of 1 indicates that the cartel members export between 50 and 75 percent of the total; a value of 0 is assigned if the cartel members export less than 50 percent of that particular commodity.

Dimension 11. This dimension is included to test whether industries learn over time, that is if the number of previous attempts to organize a cartel influence the success of later attempts to organize. The score is equal to the particular cartel's number in this sequence of attempts.

Dimension 12. Members are given a score of 1 if the cost differences within the cartel are less than 50 percent--that is, if the high-cost

producers produce at a cost no larger than 50 percent above the low-cost producers. Otherwise, the dimension is given a score of 0.

Dimension 13. The efficiency of the cartel refers to the ability to charge prices close to the monopoly price, i.e., if price is 200 percent of marginal cost or more. Otherwise, the score of 0 is assigned. This very rough indicator of cartel efficiency was applied because information on the location and slope of the demand curve and the location and slope of the marginal cost curve usually was not sufficient to allow calculation of the monopoly price.

Dimension 14. This dimension is given a score of 0 if the cartel members' potential time horizon is more than 1 year and a score of 1 if the time horizon is less than 1 year.

Dimension 15. The dimension is given the score of 0 if a cartel breakdown was not-market-related, i.e., due to government intervention, war, etc., and a score of 1 if the breakdown was market-related, i.e., due to the loss of markets to outsiders or the emergence of competition between cartel members'.

Dimension 16. This expands on no. 15 by assigning a value of 1 if the breakdown was market-related and due to external forces, i.e., non-member suppliers or consumer retaliation, and a value of 0 if the cartel broke down due to an internal conflict between the cartel members.

Dimension 17. This final measure further expands on the breakdown issue by assigning a value of 1 if the external forces were outside supply, i.e., non-member supplies, and a value of 0 if the response of consumers or demand response constituted the external forces that caused the cartel breakdown.

2.2 Cartel Characteristics of Sample 2

This second sample was necessary because we did not have sufficient information to characterize the cartels along the full set of 17 dimensions shown above. The attributes of Sample 2, therefore, should be viewed as a quick summary, and are essentially a subset of the attributes of Sample 1.

Dimension 1. This refers to the length in years of the agreement, see no. 8 above.

Dimension 2. This attribute is similar but not identical to Dimension 1 of Sample 1 above. If the four-firm concentration ratio is more than 75 percent, a score of 2 is assigned. A 1 is given if between 50 and 75 percent. Concentration of less than 50 percent is designated as 0.

Dimension 3. Here we are referring to concentration within the cartel itself. See Dimension 9 of Sample 1 above.

Dimension 4. Cartel breakdown is analyzed as in Dimension 16 in Sample 1.

Dimension 5. Cartel efficiency is described as in Dimension 13 in Sample 1.

3. SAMPLE 1

Sample 1 consists of the industries on which we were able to obtain information to assign a numerical value to the 17 dimensions defined above. Ervin Hexner's International Cartels and G.W. Stocking and M.W. Watkins' Cartels in Action are the basic sources of information. In addition, however, it has been necessary to apply information given by Dr. James C. Burrows in his testimony before the Subcommittee on Economic Growth, July 22, 1974, some recent articles on international commodity markets, as well as our personal judgement. Due to the rather superficial scanning of the existing cartel literature, as well as the rather inaccurate state of the data given in this literature, a critical attitude on the part of the reader is recommended. By going through the cartel experience of various industries, and also explaining the way that we have coded this experience, we hope to give a feeling for the difficulties involved when trying to characterize cartels on the basis of such information. The results are shown in Tables 1 and 2.

1. Natural Rubber

The Stephenson Plan which was sponsored by the British government was an attempt to regulate the rubber industry. Even though the plan was a short-term success, it later failed completely. The plan lasted from 1922 to 1928. The large number of relatively small plantations made the rubber industry and the rubber trade fairly decentralized. According to Stocking and Watkins, demand for rubber was inelastic at that time. There were no substitutes for rubber in the production of tires and tubes. Synthetic rubber was, however, in the process of development.

The British colonies contained 72 percent of world capacity in 1922. The Dutch colonies contained another 25 percent of world capacity. The

TABLE 1

CHARACTERISTICS OF "EFFICIENT" CARTELS

Sample 1

	Rubber	Mercury		Aluminum					
Year	1934	1928	1939	1901	1906	1912	1923	1929	1931
1. Concentration of Production	0	1	1	1	1	1	1	1	1
2. Concentration of Exports/ Imports	0	1	1	1	1	1	1	1	1
3. Demand Elasticity	0	0	0	0	0	0	0	1	1
4. Income Elasticity	1	1	1	1	1	1	1	1	1
5. Short-term Substitutes	0	0	0	0	0	0	0	1	1
6. Long-term Substitutes	1	0	0	1	1	1	1	1	1
7. Government Involvement	1	0	0	0	0	0	0	0	0
8. Length of Formal Agreement	6	8	10	5	2	2	3	4	5
9. Cartel Members' Share of - Total Production	2	2	2	0	0	0	0	0	2
10. Cartel Members' Share of Exports/Imports	2	2	2	2	2	2	2	2	2
11. Number of Recorded Attempts to Set Prices	4	1	2	1	2	3	4	5	6
12. Cost Differences Among Cartel Members	0	1	1	1	1	1	1	1	1
13. Efficiency	1	1	1	1	1	1	1	1	1
14. Potential Time Horizon of Agreement	0	0	0	0	0	0	0	0	0
15. Break-down Market Related	0	0	1	1	1	0	1	1	1
16. Break-down Externally	-	-	0	0	1	-	0	1	0
17. Break-down due to External Supply	-	-	-	-	1	-	-	1	-

TABLE 2

CHARACTERISTCS OF "INEFFICIENT" CARTELS

Sample 1

	Rubber	Tin			Steel				Tea	Sugar			Copper	
Year	1922	1929	1931	1935	1926	1930	1931	1933	1933	1931	1937	1958	1955	1964
1. Concentration of Production	0	1	1	1	0	0	0	0	0	0	0	0	1	1
2. Cincentration of Exports/ Imports	0	1	1	1	0	0	0	0	0	1	1	0	1	1
3. Demand Elasticity	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Income Elasticity	1	1	1	1	1	1	1	1	1	1	1	0	0	0
5. Short-term Substitutes	1	0	0	0	0	0	0	0	1	1	1	0	1	1
6. Long-term Substitutes	0	0	0	0	0	0	0	0	1	1	1	1	1	1
7. Government Involvement	1	1	1	1	0	0	0	0	0	0	1	1	1	1
8. Length of Formal Agreement	6	2	3	2	4	0.5	0.17	6	6	4	2	3	2	2
9. Cartel Members Share of Total Production	1	2	2	2	0	0	0	2	1	0	2	2	0	2
10. Cartel Members' Share of Exports/Imports	1	2	2	2	1	1	1	2	2	2	2	2	0	2
11. Number of Recorded Attempts to Set Prices	3	1	2	3	?	?	?	?	?	5	6	?	?	?
12. Cost Differences Among Carte Members	0	0	0	0	1	1	1	1	1	0	0	1	1	1
13. Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14. Potential Time Horizon of Agreement	0	0	0	0	0	0	0	0	0	0	0	1	0	0
15. Break-down Market Related	1	1	1	1	1	1	1	0	0	1	0	0	1	1
16. Break-down Externally	1	0	0	0	0	0	0	-	-	1	-	-	1	1
17. Break-down due to External Supply	1	-	-	-	-	-	-	-	-	-	-	-	0	0

Dutch twice refused cooperation, but took advantage of the plan by increasing production. The British market share decreased from 67.5 percent in 1922 to 54.1 percent in 1927, whereas the market share of the Dutch colonies increased from 23.2 percent to 37.7 percent.

Outside production, internal rivalry, as well as the problems of timing of restrictions were the reasons for the failure of the Stephenson Plan.

The International Rubber Regulation Agreement of 1934 did, however, succeed in increasing prices so that the average producer, according to Stocking and Watkins, could enjoy a margin of 126 percent, and we judged the cartel to have been efficient, given the fact that the cartel lived with the threat of synthetic rubber.

British, Dutch, French, Indian and Siamese kept the agreement up until World War II, even though attacked by U.S. protests, which resulted in the organization of a semi-official resistance movement to conserve tires and use reclaimed rubber.

The consumption of rubber was assumed to be income-elastic.

2. Tin

Production of tin was dominated by a few governments in the Far East--Malaysia (Dutch), Thailand, Nigeria and the Belgian Congo. These producers tried to regulate tin prices, but our recorded attempts, 1929-1931, 1931-1935, and 1935-1937 were all failures due to lack of discipline and enforcement of the restrictive measures.

There was no satisfactory substitute for tin, even though there was some secondary recovery of tin from scrap. Tin was indispensible in armaments and we assumed that demand was inelastic as is also the case today, according to C. Fred Bergsten. The statement by Hexner that "production costs varied from mine to mine" is the basis for our assumption that costs

differed by more than 50 percent.

3. Mercury

According to Hexner and Burrows, the price of mercury has been close to the monopoly price since 1928. Spain and Italy have completely dominated the production of this commodity for which no substitute exists. As mercury is also indispensible in armaments, price-elastic and income-elastic demand is assumed.

The cost difference between Spanish and Mexican producers is assumed to be above 50 percent. The cartel established in 1928 broke down in 1936 due to the Spanish War. It was reestablished in 1939 and then lasted until 1949 when it broke down due to internal problems. Since 1950 there have never been more than 3 years of disagreement among the major mercury producers of the world.

4. Aluminum

Originally due to patent rights, and later due to inter-corporate ties, the aluminum industry has been highly concentrated. The sequence of cartels, 1901-1906, 1906-1908, 1912-1914, 1923-1926, 1926-1930, and 1931-1936, all seem to have been successful in stabilizing the monopoly level of the previous period.

According to Donald H. Wallace, the elasticity of demand increased in the latter twenties due to the conversion of latent into effective demand through the development of new alloys and products. Aluminum became at this time a capable substitute for various alloys of iron, copper, and zinc in heavy-duty components. The aluminum industry was under-going a process of transition from a condition of limited markets to one of diversified markets. We therefore assumed that demand moved from the inelastic to the elastic segment of the demand curve in the late twenties.

Demand also seems to have been income-elastic in this period. The importance of technology should imply that cost differences were small. The capital-intensity of consumption seems to indicate that no short-term substitutes existed even if long-term substitutes did exist.

5. Steel

The first international steel cartel, 1926-1930, consisted of national steel cartels united in an association. The national steel cartels had government support, but was primarily of a private charcter.

This first cartel produced 30 percent of the world's output of steel and 66 percent of world exports. It collapsed, however, in 1930 due to internal problems. In 1930 a second international steel cartel experienced half a year of frustration. In 1931 a third cartel lasted for only two months. A fourth cartel that lasted from 1933 to 1939 had, according to Stocking and Watkins, some success in keeping prices higher than otherwise would have been the case and was also able to discriminate between customers. The price series does not, however, seem to support a judgment on the cartel as being efficient.

6. Tea

There have been a number of attempts to organize cartels in the tea industry. The International Tea Cartel from 1933 to 1939 was regarded as an interesting example of a collective marketing control established by trade associations with the cooperation of governments. The concentration in the industry was low. Demand was probably price inelastic as is the case today, according to C. Fred Bergsten. Demand also seems to have been income-elastic in the relevant period. Cost differences were most likely high. The War prompted the British Ministry of Food to take over the whole

tea supply and fix prices according to the average price prevailing at the end of 1938. The price series seem to indicate that the cartel had no effect on prices.

7. Sugar (1864-1939)

The concentration in the sugar industry is low. In the export markets, however, the concentration is high due to common sales agencies. According to Stocking and Watkins, demand was price-inelastic prior to World War II. Demand seems to have been income-elastic in the same period.

In 1864, 1902-12, 1929, 1942, 1953, 1956 and 1958 cartel attempts in this industry are included in Sample 2. The first international sugar cartel we include in this sample is the so-called Chadbourne Agreement of 1931-1935, which was a private marketing control agreement, approved and enforced by the respective governments. Failure to restrict production efficiently and the rapidly increasing market share of outsiders made the Chadbourne Agreement collapse. On the initiative of the League of Nations, a new international agreement was signed on May 6, 1937. It was a diplomatic treaty between 21 governments representing 85-90 percent of the world's sugar production and consumption. Prices were stabilized some 30 percent above the 1935-1936 average prices, and the cartel was accordingly judged to be inefficient. The agreement was disrupted by the War in 1939.

8. Sugar (1958-1961)

Today nearly 90 percent of the world's sugar is either consumed in the areas where it is produced or is marketed under a quota system. This means that a very small proportion of all sugar produced is freely traded in international markets. In the short-term, corn syrup and other sweeteners can be substituted for cane or beet sugar. The precise elasticity

of demand is not well known, but it was judged to be inelastic in the near term.

Sugar trading receives protection from many government-backed commodity agreements. In the U.S. there is a U.S. Sugar Act. In Great Britian the comparable pact is the British Commcnwealth Sugar Agreement. In 1958 an International Sugar Agreement (ISA) was negotiated between all of the large producing nations in order to stabilize the wide fluctuations in prices. This international agreement was not able to restrict fluctuations, but it did serve to prevent any further declines in average prices. The ISA broke up in 1961 because of growing difficulties between the U.S. and its major sugar trading partner, Cuba. Until that time the U.S. had gotten 75 percent of its imports from Cuba. However, in mid-1961 the U.S. cancelled all international trade with Cuba and sought other sources of sugar elsewhere in Latin America. At the same time Cuba had huge supplies which had to be sold in otner, non-U.S. markets. This instability in market conditions was enough to cause the ISA to crumble and world prices to fall.

9. Copper (1950-1970)

Most of the free world's copper supply is found in fewer than 7 countries and is refined by what is known as "the big eight" firms. uses in electrical and other industrial processes. Quantitative estimates of the short-run elasticity of demand (between .21 and .48), have underscored that demand is relatively inelastic since not many short-run substitutes are available. In the long run (10 years or more), alternatives are more feasible and demand elasticity is relatively elastic (approximately 2.8). (Burrows, 1974).

During the mid-1950's, and again in the mid-1960's, producers made attempts to influence the market price. These actions were generally taken with the full knowledge and cooperation of the respective governments. Chile, Peru, Zambia, and the Congo have been the most active in this regard and have formed a joint body, CIPEC, to promote their common interests. The initial price experiment (1955-1956) was undertaken by a Zambian producer who felt that he could appreciably affect the price of copper by imposing a ceiling on price. The unilateral attempt was unsuccessful, however, in that the cooperation of other producing firms was not attained.

A second price experiment (1964-1966) found more support among the large producers, and consequently was far more successful from their perspective. In the two-year period, copper prices doubled as the "big eight", as well as smaller firms, temporarily agreed on common goals. After two years of steadily rising prices, agreement among producers faded as some began shading on prices. Explanations of the breakdown have noted that some of the less developed countries have vastly different time horizons than many of the private producers. For example, while Chile was interested in exploiting a short-run demand in elasticity, many of the private firms were much more conservatively inclined with an eye toward preserving long-run demand and discouraging the development of copper substitutes.

4. SAMPLE 2

Sample no. 2 consists of the industries on which we were able to obtain information sufficiently detailed only to code the five dimensional cartel table defined above. The sources of information are identical to those of Sample no. 1. The influence of our personal judgment is, however, more severe on this sample than on the first sample.The results are shown in Table 3.

1. Wheat

In 1933 the first international wheat agreement was established by governments of wheat-producing and importing countries., without direct reference to private entrepreneurs or their organizations . The agreement broke down within a year due to disagreement over quotas and acreage reduction in addition to a very unfavorable price development. In 1942 Argentina, Australia, England, the U.S. and Canada established a new pool, limited in scope, but to be extended after the war. This plan collapsed, however, in 1947 when Argentina abstained.

The post-war international wheat arrangements have been for three-year periods. The 1949 wheat agreement was renewed in 1953 and 1956, then revised substantially in 1959 and renewed in 1962, which is the last year on which we have any information.Too weak jurisdiction over members has made tnese agreements inefficient.

2. Copper (1918-1940)

In 1918 a cartel was formed to liquidate the tremendous stocks of copper piled up as a result of the war and to regulate new production and exports. It was wholly American in membership. It represented 95 percent of the American production The only outsider was Katanga, still in its infancy. The cartel was disbanded in 1924 after dissension arose between the companies with foreign properties and those with purely domestic properties.

TABLE 3

CHARACTERISTICS OF "INEFFICIENT" CARTELS

Sample 2

Year	Sugar							Wheat			
	1864	1902	1929	1942	1953	1956	1958	1933	1942	1949	1959
1. Length of Formal Agreement	0	10	0	0	0	0	0	1	5	10	3
2. Concentration of Production	0	0	0	0	0	0	0	0	0	0	0
3. Cartel Members' Share of Total Production	0	0	0	2	2	2	2	2	1	1	2
4. Break-down Externally (?)	0	0	0	0	0	0	0	0	0	0	0
5. Efficiency	0	0	0	0	0	0	0	0	0	0	0

CHARACTERISTICS OF "EFFICIENT" CARTELS

Sample 2

Year	Copper		Quebracho			Sulfur	Potash	Phosphate Rock	Magnesi
	1918	1929	1819	1926	1934	1934	1926	1933	1923
1. Length of Formal Agreement	6	3	3	5	8	6	13	6	18
2. Concentration of Production	2	2	2	2	2	2	2	0	0
3. Cartel Members' Share of Total Production	2	2	2	2	2	2	2	2	2
4. Break-down Externally (?)	0	1	0	0	0	1	1	1	1
5. Efficiency	0	1	1	1	1	1	1	1	1

TABLE 3 (Continued)

Platinum		Salt Lake		Coffee		
1918	1931	1926	1930	1957	1958	1959
0	2	4	9	1	1	3
2	2	0	0	2	2	2
2	2	0	0	1	1	2
0	1	1	1	1	1	0
0	0	0	0	0	0	0

Iodine	Diamonds
1878	1930
61	12
0	2
2	2
1	1
1	1

The cartel was successful in liquidating stocks without causing a sharp fall in prices , and also in regulating exports. It was consequently judged to have been efficient.

In 1926 Copper Exporters Inc. (a Webb-Pomerene association) was established. The company controlled 95 percent of the world's production of copper. The combined effect of the 1928-29 boom and cartel rationing sent prices upwards. The resentment against the cartel grew so strong, however, that a buyer's strike was called. From then until the dissolution of the cartel in 1932, with the enactment of the U.S. excise tax on copper, the power position of the cartel steadily declined. On the 1935-1941 international copper cartel information relating to world markets outside the U.S. is scarce.

3. Platinum

In 1918 several producers tried unsuccessfully to organize a cartel. In 1931, however, an agreement was signed,only to break down in 1933. Due to the fact that platinum is mainly a by-product and that palladium which is a substitute was not included, control of the market by the cartel seems to have been impossible.

4. Quebracho

Argentina and Paraguay have completely dominated this industry. In both countries the quebracho producers were organized in a government-sponsored cartel In the periods 1919-1922, 1926-1931, and 1934-1946 (1946 being the last year on which we have information) these two national cartels operated jointly in the international market through establishing exclusive sales agencies, export quotas and uniform price policies. In 1942 the American agents were indicted for violation of anti-trust regulations. As we have not been able to obtain additional information,this indictment (as well as a 1920-1939 price series) is the basis on which we have judged the cartels to have been efficient.

5. Sulfur

In 1838 the United Kingdom broke the Sicilian sulfur monopoly by sending gunboats. In 1934 a cartel was organized among the U.S. and Italian producers. The U.S. had at that time 80 percent, Italy 11 percent and Japan 6 percent of the world's production of crude sulfur. The cartel had complete control over export supplies and markets through the use of export quotas and uniform prices. According to Hexner, "Significant international agreements concerning sulfur are most characteristic of modern cartellization." U.S. anti-trust actions and some information on prices is the basis for judging the cartel to have been efficient up until World War II.

6. Sodium Sulphate (Salt Lake)

Important outsiders seem to have made life difficult for the cartels in this industry from 1926-1930 and 1930-1939.

7. Potash

Under strong pressure from the French and German governments, the potash exporters of these two countries formed a cartel in 1926. Germany was at that time responsible for about 60 percent and France for about 16 percent of the world's production of potash. Export prices were to be determined by production costs. American producers were ,however, indicted in 1939 under the Sherman Act because of alleged cooperation in price policies among themselves and with the European cartel. It was stated that this natural monopoly was abused by Germany and France.As export prices of potash were not published, the above-mentioned evidence is the basis for judging the cartel to have been efficient.

8. Pnosphate Rock

World phosphate exports were regulated by an agreement established in 1933 and further amplified in 1934 and 1935. The agreement embraced the whole international market. The agreement is surrounded by a high degree

of secrecy. From 1929 to 1939 phosphate prices tend, however, to support our judgment on the cartel as having been efficient.

9. Magnesite

In 1923 Czechoslovak and Austrian producers established a joint-stock sales company to regulate the international magnesite market. An "understanding" with American pruducers was also obtained. The large magnesite consumers were the shareholders of the magnesite companies involved. In 1941 there was a U.S. Justice Department indictment for U.S.-European division of world magnesite markets. On this basis we judged the cartel to have been efficient.

10. Diamonds

Government licencing and monopoly support have helped monopolize the diamond industry. In 1930 a diamond trading company was established as the sole selling agency for 99 percent of African diamond production or 95 percent of world diamond production. The British government took over the company in 1942, after what is assumed to have been 12 successful years.

11. Coffee (1957; 1958; 1959-1962)

Coffee is primarily grown in Brazil, other Latin American nations, and Africa. Since World War II, world production has sharply increased, while simultaneously Brazil's market share has steadily declined. Production is almost universally undertaken in the less developed countries and as such represents a substantial amount of these countries' GNP. Due to chronic conditions of over supply, especially in Brazil, several exporting nations have periodically attempted to stabilize or bolster sagging coffee prices.

In 1957, and again in 1958, there were Latin American Coffee Agreements that were signed. Most Latin producers agreed to hold back a percentage of their narvests from the market with Brazil leading the charge with a 40 percent reduction. Neither agreement was successful in [illegible] because African nations filled the gap with their own coffee.

In 1959 the African producers agreed to enter an International Coffee Agreement, in which there was 85 percent participation by world producers. The agreement set fixed export quotas which were based on 90 percent of past exports or 88 percent of estimated future exports. The agreement was renewed annually and was significant in that consuming nations were also included. The system has had the effect of providing a floor and increased stability for formerly volatile coffee prices.

5. CONCLUSIONS AND EXTENSIONS

There are nine efficient and fourteen inefficient cartels in sample 1. Also, ten efficient and eighteen inefficient agreements make up sample 2. Therefore, of the 51 significant cartel organizations only 19 achieved price controls which raised the level of charges to consumers significantly above what they would have been in the absence of the agreements. The results for these two samples are summarized in Tables 4 and 5.

The efficient cartels did not seem to last very long. Although formal organizational agreements (to set up cartel management, for example) lasted longer in the efficient cartels, the average length of effective controls on price was not more than four to five years. The mercury cartel in the 1930's and 1940's, and the potash, magnesite, and diamond cartels of the 1930's, seem to have been able to control prices for as long as a decade, but these were not major products in international trade. The more important products, such as rubber in the 1930's or aluminum, copper or sulfur before World War II, experienced cartel longevity from one to four years.

There are a number of factors important in the longevity of the efficient cartel. Without these factors, it would seem to have been impossible for most cartel organizations to last for more than a few months.

1. Concentration of production was characteristic of the efficient cartel. Approximately 90% of the efficient cartels in sample 1 had concentration levels higher than 50% (the largest four firms had more than 50% of total production or capacity to produce); but only 36% of the inefficient cartels had concentration levels this high. Similarly, the efficient cartels controlled a very high percentage of exports.
2. Demand conditions also strongly affected the chances that the cartel

TABLE 4

SUMMARY TABLE

Sample 1

	"Efficient"	"Inefficient"
A. Number of Cartels	9	14
B. Average Length of Formal Agreement (Years)	5	3.1
1. Concentration of Production (High:1, Low:0)	0.9	0.36
2. Concentration of Exports/Imports (High:1, Low:0)	0.9	0.5
3. Demand Elasticity (Elastic:1, Inelastic: 0)	0.22	0.06
4. Income Elasticity (Elastic:1, Inelastic:0)	1	0.78
5. Short-term Substitutes (No:0, Yes:1)	0.22	0.43
6. Long-term Substitutes (No:0, Yes:1)	0.77	0.43
7. Government Involvement (No:0, Yes:1)	0.11	0.58
9. Cartel Members' Share of Total Production (Very High:2, High:1, Low:0)	0.9	1.14
10. Cartel Members' Share of Exports/Imports (Very High:2, High:1, Low:0)	2	1.58
12. Cost Differences Among Cartel Members (High:0, Low:1)	0.9	0.58
14. Potential Time Horizons of Agreements (Long:0, Short:1)	0	0.08
15. Break-down(Non-market related:0, (Market-related:1)	0.66	0.70
16. If Market-related Break-down Then (Externally:1, Internally:0)	0.33	0.30
17. If External Reason for Break-down Then (Supply:1, Demand:0)	1	0.5

TABLE 5

SUMMARY TABLE

Sample 2

SAMPLE 2	"Efficient"	"Inefficient"
A. Number of Cartels	10	18
B. Average Length of Formal Agreement (years)	8	2.7
2. Concentration of Production (very high:2, high:1, low:0)	1.6	0.55
3. Cartel Members' Share of Total Production (very high:2, high:1, low:0))	2	1.2
4. Break-down (externally:1, internally:0)	0.6	0.28

agreement worked well and lasted for a reasonable period of time. The summary tables show that the efficient cartels were characterized by inelastic demands (lack of sensitivity of quantities demanded to price changes), and that they also were characterized by the lack of short term substitutes in most cases (only 22% of the efficient cartels in the first sample had no long term substitutes); but this was also true of the inefficient cartels. The presence of ability to substitute other products in the long run may have limited both the length of life time and the efficiency of the agreement.

3. Government involvement made a difference in the success of the agreement. Government agencies were involved in the setting up of the organization of the cartel in almost 90% of the cases in which the cartel was not successful, but in only 42% of the cases in which the cartel did work well. Although not much information was provided in the studies as to what the governments' activities were, it is presumed that at some stage political and diplomatic relations entered into the cartel organizations so as to break down the agreements.

4. Supply conditions differentiated efficient from inefficient cartels. Most of the successful cartels had as members one or two firms with production costs much lower than other firms, the lowest cost firms tending to "dominate" operation of the agreements. When cartels did break down, it was mostly because of entry of additional suppliers or the expansion of supply by small firms outside the cartels' agreements (as shown by line 14 of the summary table for sample 1, Table 4).

In summary, there seem to be several important factors differentiating

efficient from inefficient cartel agreements.

Cartels were able to raise prices for four years or more, where concentration of production was high, demands inelastic, and where few short term substitutes were available for the cartelized product. Governments were involved in breaking down agreements. Operating cost advantages and the presence of few outside sources of supply able to expand capacity were important for cartel success. These factors are shown in the summary table for sample 1, as those conditions of the 14 listed, for which the efficient cartel had significantly different values from the inefficient cartel.[1]

Much the same is shown by sample 2, because the concentration of efficient cartels is significantly higher than the inefficient. Also the cartel members' share of total production was much higher, and if cartel breakdown occurred, it was mostly because of entry into international markets by new firms.

There are further important dimensions not included in the findings from the earlier research studies. Indications scattered throughout the studies are that an important additional factor for cartel success or failure is tight control of distribution channels. The iodine cartel lasted more than 50 years as an organization without significant disruption, by making all iodine sales out of a single cartel association office in London (although there were no findings on the ability of this organi-

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[1] By "significant difference" we mean a rough qualitative difference in the magniture of the statistics between 0.0 and 1.0 in the two columns of the tables. For those six factors termed "significant" the differences in table values range from .32 to .66. Although there are smaller differences indicated by other factors, we chose to ignore them at this time because of small sample size and the highly qualitative nature of the values assigned between 0 and 1 between each cartel attribute.

zation to raise unit price above unit cost). There are other examples in which additional elements of control seem to have followed from cartel supervision of distribution, but these are too scattered to lead to a research conclusion at this time. Similarly, the factor of the level of concentration among consumers seems to be important in some cases. Where there are only a few consumers and they are able to play one cartel member off against the other, then the efficiency of the cartel would appear to have been limited. But high buyer concentration was found only in very few cases and cannot be said to be a "finding" from the research analysis.

Probably the most important determinant of the longevity of a cartel agreement is the way production and profits are allocated among the cartel members. The unavailability of information on this aspect of a cartel agreement made it impossible to determine the level of conflict among the cartel members. Given the fact that the "efficient" cartel broke down more often due to the emergence of competition among the members rather than due to the response of non-members, the internal operating mechanisms of cartels have to be analyzed if we want to learn more about the stability of cartel-dominated markets.

The conclusions on important factors for cartels' success, and the summary tables themselves, are based upon the reading and evaluation of research materials in a wide variety of industries and cases. There is a strong element of personal judgment in the assigning of such attributes as "high concentration" or"lack of short term substitutes." It should be stressed that another review of this material might well establish somewhat different factors in the efficiency of agreements, or whether in fact an agreement was efficient or inefficient. But the overall impression that efficient cartels do not last very long would probably not be dispelled.

Neither would the finding that high concentration, the presence of a dominant producer, and the lack of expansion by those outside the cartel, contribute very strongly to cartel price control over the 4 to 6-year lifetime of a typical organization.

6. IMPLICATIONS FOR OPEC

What do these factors tell us about the causes for the efficiency and longevity of the present day petroleum cartel? There have been petroleum cartels at an earlier time; the "as is" or "Achnacarry" agreement of the late 1920's to maintain output shares of American oil exporting companies collapsed in 1930 without having had a significant effect on European markets. Later similar agreements with quotas and fines did not collapse, but there is little or no evidence that they had an appreciable effect on price levels before World War II. From 1945 to 1960 there were no formal agreements.

But prices were "high" in the sense that marginal production costs plus user charges could not have exceeded $1.00 per barrel, while prices were mostly centered around $2.00/barrel. Since the advent of the highly efficient OPEC cartel operation in the early 1970's, price-cost differences have increased to many times those expected from the earlier cartels.

The present day OPEC agreement has many of the characteristics found in the earlier cartels that were successful for limited time periods in other industries. The demands for final product are inelastic, and there are few short term substitutes for this product. Concentration within the cartel is substantial, and OPEC itself as an organization supplies about 90% of the total flow in international trade. The Arab subset of OPEC supplies 54% alone of the total international flow. There are substantial cost differences among firms, with the Persian Gulf producers having significant cost advantages and significantly greater capacity than the "fringe"

of Southeast Asian, East African and South American countries.

The Teheran and Tripoli agreements in 1971 between the oil exporting countries and the oil companies may be considered as the first evidence of an efficient producer country petroleum cartel. Since then the producer countries have been able to successfully raise prices to a level that makes OPEC the most efficient cartel in modern times. The OPEC countries have not, however, been able to agree on and stick to a formal system for sharing production among the member nations. As long as the OPEC members accept the way the major oil companies allocate the reductions in production due to the higher prices and the world recession, the intra-cartel level of conflicts can be kept at a minimum. The lack of formal production and/or profits allocation systems, however, makes OPEC as vulnerable to emergence of internal competition as the cartels that have been reviewed, even if the willingness to accept production cutbacks and to live with a huge excess capacity has been impressive.

If OPEC were to follow the pattern set by the 19 earlier "efficient" organizations, then it would likely have a 4 to 6-year duration. The primary source of breakdown of price controls would likely be the significant additions of supply from either the "fringe" of OPEC members, or the non-member countries (in this case, the North Sea countries, Canada, and the United States) which by self-supply reduce the demands placed on the low cost Persian Gulf states.

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