

Mergers and Restructuring in the World Oil Industry

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ABSTRACT: This study focuses on the world oil industry since the relevant markets are global. Merger and acquisitions (M&As) in the petroleum industry reflect the accelerating rate of M&A activity worldwide. The basic change forces are: technological advances, globalization, deregulation, industry dynamics, pressure for economies, and favorable economic environments. The change forces have blurred the boundaries of industries and have multiplied the forms and sources of competition. M&As and restructuring have had positive influences in the performance of the economy. Since the 1980s real GDP growth in the U.S. have been strong with only short interruptions. During the past two decades almost two million new jobs per year have been created. Patterns in the oil industry have mirrored these changes in the economy as a whole, emphasizing technological improvements and cost reductions. Instabilities of prices and other increased risks in the oil industry have triggered M&As and restructuring. Financial analysis of the BP acquisition of Amoco demonstrates that even if a fraction of the estimated cost savings are achieved, market values will be increased. If five major mergers are completed, the HHI for the world oil industry will rise from a very low 389 to 581, still well below the 1,000 critical level specified by the regulatory authorities. Analysis suggests that the BP Amoco acquisition will have positive economic effects on the economy of Alaska.

Mergers and restructuring have characterized the world oil industry for many years. This study looks at world dimensions because the oil industry is global in scope. The issues raised by recent oil mergers will be analyzed under the following ten topics: I. High M&A Activity, II. The Change Forces, III. Responses to the Change Forces, IV. Restructuring and Economic Performance, V. Impacts on the Oil Industry, VI. Models of Financial Analysis of Oil Mergers, VII. Concentration in the World Oil Industry, VIII. Opposing Theories of Concentration Implications, IX. Competition in the Alaskan Oil Industry, and X. Conclusions.

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I. HIGH M&A ACTIVITY

Mergers and restructuring in the world oil industry can only be fully understood in the framework of broader economic perspectives. Since 1992, mergers and acquisition (M&A) activity worldwide has been high and continuing to grow. Using the Mergerstat Data Series, the total dollar value of U.S. M&A announcements in 1998 increased to \$1.2 trillion, an 80% increase over the 1997 level. Data for M&A activity in the United States since 1990 are shown in Table 1. The forces that have produced the high level of M&A activities in the United States in the 1980s and in the 1990s must be understood to evaluate properly the heightened M&A activity in general and in the world oil industry in particular.

Table 1

Merger Activity: The Mergerstat Series

Year	Total Dollar Value Paid (\$ Billion)	Number Total	\$100 Million or More	\$1,000 Million or More	GDP Deflator (1992=100)	1992 Constant Dollar Consideration	Percent Change
1990	108.2	2,074	181	21	93.6	115.6	-53%
1991	71.2	1,877	150	13	97.3	73.2	-37%
1992	96.7	2,574	200	18	100.0	96.7	32%
1993	176.4	2,663	242	27	102.6	171.9	78%
1994	226.7	2,997	383	51	105.1	215.7	25%
1995	356.0	3,510	462	74	107.8	330.2	53%
1996	494.9	5,848	640	94	110.2	449.1	36%
1997	656.0	7,804	871	120	112.3	584.1	30%
1998	1,192.0	7,809	906	158	113.4	1,051.1	80%

II. THE CHANGE FORCES

We first consider the general forces. Six major change forces are shown in Table 2. Improvements in transportation and communication have created international markets. Privatization and deregulation have affected some industries more than others.

Industry instabilities have required restructuring and adjustments. Pressures for economies of scale, scope, and complementarities have increased.

Table 2

Some Change Forces

1. Technological change
2. Globalization and freer trade
3. Privatization and deregulation
4. Industry instability
5. Pressures for economies of scale, scope, and complementarities
6. Rising stock prices, low interest rates, strong economic growth

Technological change including computers, computer related products, and telecommunications have been pervasive. Rising stock prices, low interest rates, and strong economic growth have created a favorable climate for deal making and restructuring. The spectacular successes of individual companies have resulted from talented entrepreneurial leadership.

III. RESPONSES TO THE CHANGE FORCES

The change forces have had massive impacts. They have blurred the boundaries of industries. They have multiplied the forms and sources of competition.

Increased Intensity of Competition

The change forces listed in Table 2 have increased the intensity of competition. New competitive forces have emerged brought about by the impacts of the change forces. A more rapid pace of product introductions has occurred. Product life cycles are shorter.

The technological requirements for all companies have increased. Growth in some industries has increased but declined in others. The forms and numbers of competitors have increased. Distribution methods have changed. Industry boundaries have become blurred.

The changes in the computer industry illustrate the new patterns of competition. Two central concepts of strategy developed by Michael Porter (1980, p. 4), the five forces framework and the value chain concept, require extensions. Porter's five forces driving industry competition are: rivalry among existing firms, the threat of new entrants, the bargaining power of buyers, the bargaining power of suppliers, and the threat of substitute products or services. Grove (1996, p. 30) added a sixth force, the number and competence of complementors. Others would add a seventh — the degree of regulation by government authorities.

The computer industry is illustrative. Grove (p. 40) points out that when IBM reigned supreme in the computer industry in the 1970s, vertical integration dominated. IBM was strong in all aspects of the value chain including chips, hardware, operating systems, application software, sales and distribution, customer engineering, along with modification and maintenance facilities. But in the 1990s, the computer industry is only a segment of an expanded value chain of the information industry. A critical element of the information industry is high technology. The Morgan Stanley Dean Witter High-Tech 35 Index includes 12 technology segments, composed of electronics-based technology companies only. It excludes bio-technology, medical, test and instrumentation companies. Thus, the relevant value chain has at least 20 distinct nodes or segments each with intense competition. Change is so fast that firms must protect their vulnerability to change forces

and intensified competition in all areas, from design and manufacturing through distribution.

Similar changes have taken place in many other industries. Also, each firm seeks to find attractive growth opportunities in the current domain of current and potential rivals. Competition has indeed become multidimensional. The boundaries of industries and segments are no longer well defined.

M&As and Restructuring

The changing environments and the new forms of competition have created new opportunities and threats for business firms. The change imperatives are strong. Firms must adjust to new forces of competition from all directions. Firms have been forced to adopt many forms of restructuring activity. To survive and grow, firms use many forms of M&As and restructuring based on opportunities and limitations. The characteristics of an industry will influence the strategies employed.

The strategies include expansion, contraction, and efforts to improve the efficiency of operations. Joint ventures represent a flexible method of exploring new areas with partners whose capabilities are complementary. They also transfer learning and spread the risks of large complex undertakings. Joint ventures are particularly useful when one firm sells a segment to another. The joint venture can be used to have the seller transmit knowledge about the operation and the buyer to learn more about what is being acquired. A more informed basis for arriving at the sale price is thereby provided.

With regard to split-ups and spin-offs, a firm may improve motivations and performance by creating separate operations, when an activity does not fall into an effective organization structure of the parent. Similarly, leveraged buyouts, leveraged

recapitalizations, share repurchases, and stock splits may be effective parts of a strategic program for enhancing shareholder values. Especially promising in this connection are cross-border transactions either in the form of joint ventures or mergers and acquisitions to achieve new capabilities, new products, new technologies, and new geographic markets.

IV. RESTRUCTURING AND ECONOMIC PERFORMANCE

Strong change forces have produced an increase in mergers and restructuring. Increased intensity of competition has resulted. What have been the broader economic effects? Merger and restructuring announcements have been associated with stories of plant closures and job losses. Yet, for the economy as a whole, the number of jobs has increased.

In 1980, 99 million were employed in the U.S. By the end of 1998, employment levels had reached approximately 132 million representing an increase of 33 million over an 18-year period. This represents a gain of just under 2 million jobs per year. In the early 1980s, the unemployment rate was 9.7%. In 1998, the unemployment rate was at the 4.5-4.6% level.

A strong case can be made that the threat of takeovers during the 1980s stimulated firms to become lean and efficient. With only the short downturn associated with the initial uncertainties of the Gulf War in 1989-1990, the performance of the economy since 1980 has been outstanding. Real GDP growth during the decade 1988-1998 was 26% for the U.S. Jobs lost in restructuring have been offset by new jobs in the growth areas of the economy. Efficiency included effective utilization of the flow of technological advances and improved management systems.

V. IMPACTS ON THE OIL INDUSTRY

The oil industry, like other industries throughout the world, has been impacted by the massive change forces listed in Table 2. The oil industry has some special characteristics as well.

One, oil is a global market with 53% internationally traded. It accounts for about 10% of world trade, more than any other commodity. Two, oil continues to be strategically important for industrial, diplomatic, and military reasons. Three, the Organization of Oil Exporting Countries (OPEC) has an influence that appears to wax strongly and to wane. After the two major oil price shocks of 1973 and 1979, the impact of OPEC is less certain. Non-OPEC production has increased. Significant cheating on production quotas has taken place among the OPEC participants. Because of their low cost production, the market power of the OPEC countries is substantial, but their policies and practices uncertain. Four, environmental legislation and regulation standards and requirements involve large costs. Costs during the decade of the 1990s alone could aggregate as much as \$67 billion (Finizza, 1996, p. 10).

Five, the oil industry is relatively unique in experiencing large price instability. The oil price shock of 1973 moved oil prices from under \$3 per barrel to \$9 by 1978. The 1979 shock moved prices up to the \$37.75 level. The third oil price shock was in a downward direction. Saudi Arabia had been the buffer country to absorb supply increases of other countries to keep overall OPEC quotas on target. In late 1985, Saudi Arabia announced that it would stop performing this role and would seek to recover some of its lost market share. On 11/20/85, the price of West Texas intermediate crude was \$31.75 per barrel. The Saudi announcement was made on 12/9/85. By early 1986, oil

prices had dropped to \$10 per barrel, reducing oil prices by 68.5%. Oil prices near the end of 1996 had reached levels of over \$25 a barrel as shown in Table 3. By early 1999, oil prices had dropped to below \$11 a barrel, a decline of approximately 60%.

The many factors of change reflected in great price instability have characterized the oil industry over the years. The oil industry has been engaged in continuous efforts to deal with its turbulent environments.

Some Historical Perspectives

The organization of the oil industry has long been a theoretical and practical issue. In theory, no technical considerations require vertical integration. But the practical realities of the business have long provided strong incentives for vertical organization of the industry. Oil refining is a low-margin business with pressure for efficiencies which require an uninterrupted flow of supply of crude oil. In theory, oil supplies could be assured by purchases on the spot market. But several factors raise transaction costs. Petroleum is supplied by pipelines from a limited number of producing sources. Wide variations exist in the characteristics of crude oil. Refining processes need to be specialized for the characteristics of the crude oil used.

To provide for assured supply, refiners must integrate backward or use long-term contracts. Backward integration involves investment risks. Long-term contracts are subject to price risks. There is no easy solution. Most oil companies have pursued a policy of at least 50% self-sufficiency in crude oil. Oil companies experience adverse stock market price reactions when they fail during a given time period to add to oil reserves in an amount that at least covers rates of production activity.

In 1973, not only were oil prices raised by 300%, but also the nationalization of oil company assets also took place. U.S. domestic crude oil producers in the short run benefited from the higher prices. Oil refiners suffered reduced profitability because at the higher prices the quantity demanded of refined products declined. International oil companies experiencing nationalization of assets were affected adversely. Impacts on individual companies were varied, influencing the appropriate strategic responses. These developments put pressures for restructuring on the oil industry generally. One response was an increased rate of merger activity. Some representative transactions are listed in Table 4.

T. Boone Pickens stimulated a number of these transactions. The price of oil had dropped below lifting and production costs. As a consequence, immediate improvements in profitability could be achieved by shutting down exploration and development activity. However, this would have resulted in declines in reserves in relation to production operations. Hence, logical buyers were companies whose reserve positions were already relatively strong.

Table 4

Largest Oil Acquisitions in the 1980s

Year	Acquirer	Acquired	Purchase Price
1984	Chevron Corp.	Gulf Corp.	\$13,205.5
1981	E.I. du Pont de Nemours & Co.	Conoco Inc.	8,039.8
1981	U.S. Steel Corp.	Marathon Oil Corp.	6,618.5
1984	Mobil Corp.	Superior Oil Co.	5,725.8
1981	Societe Nationale Elf Aquitaine-France	Texasgulf Inc.	4,293.7
1987	Amoco Corp.	Dome Petroleum Ltd.-Canada	4,180.0
1989	Exxon Corp.	Texaco Canada Inc.-Canada	4,149.6
1982	Occidental Petroleum Corp.	Cities Service Co.	4,115.6
1985	U.S. Steel Corp.	Texas Oil & Gas Corp.	4,094.4
1979	Shell Oil Co.	Belridge Oil Co.	3,653.0
1985	Occidental Petroleum Corp.	MidCon Corp.	<u>3,085.6</u>
Total			<u>\$61,161.5</u>

Unrelated Diversification Efforts, 1975-1984

In addition to M&A activity, the major oil companies also engaged in diversification efforts to counter the bleak outlook for domestic exploration and developments and to find more attractive profitability opportunities. Amoco invested in a food company, microelectronics, biotechnology, a solar energy company, and coal mining and mineral companies. ARCO invested in Anaconda Copper, a metals producer, heart pace makers, precision metal casting, and some high-tech business ventures. Chevron invested in uranium mining and processing, metals mining, and geothermal power.

Exxon invested in nuclear activities, microelectronics and office equipment, an electrical motor company, semiconductors, coal mining and other metal mining activities. Mobil bought Montgomery Ward (a retailer and container corporation) plastic resins, fertilizers, uranium processing, a plastic bag operation, real estate, coal and metal mining. Texaco began uranium exploration, funded biotech and electronic start-ups and licensed a coal gasification technology.

Divestment and Restructuring, 1982-1992

The stock market reacted unfavorably to the efforts of the oil companies to engage in unrelated diversification. As the oil companies divested most of these unrelated activities in the late '80s and early '90s, the stock market responded favorably. By 1990, the oil companies had essentially completed the divestment of their unrelated acquisitions. They continued in hydrocarbons and petrochemicals.

From the mid-1980s, the oil companies developed more fundamental strategic identification of programs to improve returns to shareholders. These efforts were

accelerated during the 1990s. Programs for cost reduction were developed. Changes in organizational structure and systems sought to increase efficiency, flexibility, and responsiveness to change. Reductions in capacity and employment took place. Between 1980 and 1992, employment at eight major oil companies was reduced from 800,000 to 300,000, a reduction of 72%. For six major oil companies, headquarter's staff was reduced roughly during the period from 1988-1992 from 3,000 to 800. Because of fluctuating demand levels and fluctuating prices, efforts were made to change the cost structure from fixed to variable costs. These efforts included replacing owned assets, such as tankers, with leasing.

Fundamental changes in organization structures were made. Initially a "unitary" or functional organization structure was employed representing a relatively high degree of centralization of managerial authority. With diversification, the "H form" of structure was employed. This involved a holding company with unrelated activities. Finally, most companies moved toward the "M form," multidivisional activities. This form represented a strong central staff, decentralized divisional operations, effective communication between divisions, staff support from headquarters, as well as functional staff groups for related groups of activities.

It is the continuum of these efforts for cost reduction, utilization of technical progress, technological improvements and efforts to increase organization effectiveness that provide the background necessary for understanding the M&A activities of 1998 and 1999.

The Setting for Oil Industry Mergers in 1997-1999

In the face of price instability and a downward movement in prices after late 1996, oil companies continued their efforts to compete with other firms for resources by increasing returns to shareholders. On page 5 of its 1998 Annual Report, BP Amoco presented compilations of shareholder returns. Returns to shareholders were measured in the standard way as annual dividends plus stock price changes. Shareholder returns were calculated net of "returns from equivalent investments in the overall market." Over the previous 10-year period, only BP and Shell had earned returns significantly higher than the market. The returns for Mobil and Chevron were slightly positive but slightly negative for Exxon, Texaco, and ARCO. Shareholder returns net of the market were almost 50% negative for ARCO.

According to the BP Amoco calculations, for the most recent five years BP had significant shareholder returns above the benchmark, while the other seven companies had returns below, with ARCO substantially negative in relation to the market benchmark. For the most recent three years, the situation was similar. BP and Exxon had net shareholder returns that were positive, but negative for the other six companies. The bottom two firms in the ranking were Mobil and ARCO which became takeover targets. Amoco, before its acquisition by BP, had experienced negative net returns to shareholders for the three time periods analyzed. The data are consistent with the general pattern that in takeovers (not merger or "merger-like" transactions) the acquiring firms generally have had previous positive shareholder returns while targets have not performed up to potentials.

The data on returns to shareholders reflect considerable pressures on major producers in the oil industry. The pattern of net income has been highly unstable with downward trend pressures. This, in turn, reflected price instability with downward movements, particularly since 1995.

Since their business environments have been uncertain with recurrent downward price pressures, the oil companies had engaged in restructuring and other efforts to improve efficiency and reduce costs. After attempts at diversification, they sold unrelated businesses. They concentrated on those segments of oil industry activities in which they appeared to have superior performance. They invested in improved technologies to increase oil field recovery by more than 50%. Data from the annual Performance Profiles of Major Energy Producers 1997 (U.S. Energy Information Administration) shows improvements in finding costs and lifting costs. Finding costs (in 1997 dollars) for the 20 large companies covered by the performance profiles dropped from over \$20 per barrel of oil equivalent in 1979-1981 to less than \$5 per barrel by 1993-1995 (Performance Profiles, 1997, p. 69). Similarly, lifting costs including taxes had been reduced to \$4.60 per barrel in 1997 for onshore activity and to \$4.19 a barrel for foreign activity. Production costs which were \$7.20 in the mid-1980s had been reduced to the \$4.10 per barrel by 1990.

Despite restructuring, cost reduction, investment, and technology, the gains from these efforts began leveling off in the 1990s. During the first half of the 1990s, finding costs fell at half the rate achieved in the 1980s. After 1995, finding costs began to rise to a degree that erased the reductions of the early 1990s. For 1995-1997, compared to 1994-1996, worldwide finding costs rose 13% (Performance Profiles, 1997, p. 69).

Refined product margins since 1989 have been below \$1.50 per barrel and 1991-1996 were below \$1 per barrel.

The M&A activities of the oil industry should be viewed in this broader perspective. M&A activity should not be viewed apart from the wide range of other efforts by oil companies to increase efficiencies, reduce costs, invest in new technologies, look for profitable investment opportunities through joint ventures at home and abroad, and focus on activities in which they have developed specialized capabilities. The M&A activities should be viewed as one of a number of efforts to achieve cost reductions and develop new investment opportunities with positive returns.

VI. MODELS OF FINANCIAL ANALYSIS OF OIL MERGERS

Over a number of years, BP/Amoco had engaged in discussions about a joint venture involving their petrochemicals businesses. These exploratory discussions ended in February 1997 without an agreement. In May 1998, Sir John Browne, the Chief Executive of BP, met with H. Laurence Fuller of Amoco, to discuss other aspects of combining the businesses of the two companies. A month later, the financial advisors of the two companies, J. P. Morgan for BP and Morgan Stanley for Amoco, met to discuss aspects of a deal structure. A confidentiality agreement between the two companies was signed on July 24, 1998. On August 10, 1998, the two chief executives agreed on the exchange ratio and the composition of the new board. Later that day the merger was approved by the board of directors of each company. The next day, on August 11, 1998, the merger agreement was executed by the parties and the transaction was publicly announced. The merger was approved by the shareholders and became effective December 21, 1998.

In Table 5, the key aspects of the deal are set forth. Share prices one day before the merger announcement were \$76 for BP and \$41 for Amoco. Shares outstanding for BP were 976 million and 954.2 million for Amoco. The pre-merger total market values were, therefore, \$74.2 billion for BP and \$39.1 billion for Amoco, for a total of \$113.3 billion. Thus, the BP market cap was 65.5% of the total.

Table 5

BP/Amoco Deal Terms

Pre-Merger	Dollar Amounts		Total	Percentage	
	BP ⁽¹⁾	Amoco		BP	Amoco
Share Price ⁽²⁾	\$76	\$41			
Shares Outstanding (million) ⁽³⁾	976.0	954.2	1,930.2		
Total Market Value (billion)	\$74.2	\$39.1	\$113.3	65.5%	34.5%
Exchange Terms	0.66 for	1			
Post-Merger					
Number of Shares (million)	976.0	629.8	1605.8	60.8%	39.2%

(1) BP data is based on NYSE-traded ADRs.

(2) Share Prices are from one day before the merger announcement (8/10/98).

(3) Shares Outstanding are as of 6/30/98.

The exchange terms were .66/share of BP for one share of Amoco. Thus, the post-merger number of shares remained the same for BP, but declined to 631.4 for Amoco. The new total number of shares became 1,607.4 million. The ownership shares of the BP shareholders became 60.8% versus 39.2% for Amoco. This shows that a stock-for-stock merger has a major impact on the relative ownership in the new firm. The terms of the deal are of critical importance for the real cost to the original owners of each firm.

Other aspects of the transaction are shown in Table 6. Their respective book values as of 6/30/98 were \$24 billion and \$15.7 billion. The market-to-book ratio was 3.1 for BP and 2.5 for Amoco. The last 12 months' (LTM) net income for the two companies was about \$4 billion for BP and about \$2 billion for Amoco. Their price earnings ratios were approximately the same at somewhat over 18 times. The effective amount paid by BP to Amoco was \$49.1 billion. This represented a premium of \$8 billion or 20.5%. This represents the lower end of premiums paid in mergers. This transaction had been called a "merger of equals," but in practical terms it was a takeover of Amoco by BP.

Table 6

BP/Amoco Financial Relations

	BP	Amoco
Market Value (billion) ⁽¹⁾	\$74.2	\$39.1
Book Value (billion) ⁽²⁾	\$24.0	\$15.7
Market Value / Book Value	3.1	2.5
LTM Net Income (million) ⁽³⁾	\$4,046	\$2,097
PE Ratio	18.3	18.7
Total Paid (billion) ⁽⁴⁾		\$47.1
Premium Over Market		
Amount (billion)		\$8.7
Percent		22.3%
Premium Over Book		
Amount (billion)		\$32.2
Percent		204.9%

(1) Market Value is from 8/10/98, one day before the merger announcement; BP data is for the BP ADR.

(2) Book Value as of 6/30/98; source AN 2Q 1998 10Q, BP.

(3) LTM Net Income is through 6/30/98. LTM is Last 12 Months.

(4) The Total Paid = BP ADR share price*AN shares outstanding*exchange rate

Table 7 presents an accretion/dilution analysis. The first four lines of Table 7 summarize information from Tables 5 and 6. The last 12 months' earnings per share (line 5) are calculated by dividing net income (line 4) by total shares outstanding (line 2). The

new earnings per share to BP (based on the merger terms) would be the post-merger combined net income (line 4) divided by the total new number of shares outstanding of 1.6 billion or \$3.83. For Amoco, we multiply by the exchange ratio of .66 to obtain \$2.53. This represents EPS accretion for the Amoco shareholders of 14.9% and EPS dilution for BP of 7.7% as shown in line 7. Earnings accretion is predictable for Amoco since the deal P/E ratio paid to Amoco was 22.8 times while the P/E ratio of BP was 18.3 times. It is a generalization that if the P/E ratio of the acquirer is higher (lower) than the deal P/E ratio of the acquired firm, there will be earnings accretion for the buyer (dilution).

Table 7

Accretion/Dilution Analysis

	<u>a</u>	<u>b</u>	<u>c</u>	
	BP	Amoco	Post-Merger Combined	Column c Calculations
1 Share Price	\$76	\$41	\$70.56	3c/2c
2 Shares Outstanding (million)	976.0	954.2	1605.8	2a+(2b*ER)
3 Equity Market Value (billion)	\$74.2	\$39.1	\$113.3	3a+3b
4 LTM Net Income (billion)	\$4.046	\$2.097	\$6.143	4a+4b
5 LTM EPS-old (=4/2)	\$4.15	\$2.20		
6 LTM EPS-new	\$3.83	\$2.52 ¹	\$3.83	4c/2c
7 EPS Accretion (Dilution)	-7.7%	14.9%		
8 PE Ratio-old (=1/5)	18.3	18.7		
9 PE Ratio-paid		22.8 ²	18.4	1c/6c
10 New Market Price	\$70.56	\$46.57		
11 Market Price Acc. (Dil.)	-7.2%	13.6%		

1 6c*ER

2 (1a*ER)/5b

ER is the exchange ratio or terms

We next consider the market price effects. A number of assumptions could be made about future earnings and the pattern of P/E ratios. Initially we will take a neutral stance. It is assumed that the new combined equity market value will be the sum of the component firm equity values existing pre-merger. The result is shown in line 3 of Table 7 under the post-merger combined column c. The total new equity market value will be \$113.3 billion. We divide by the total shares outstanding of 1.6 billion to obtain \$70.49. In relation to the pre-merger share price of \$76 for BP, this represents a market price dilution of 7.3% for BP. In relation to the pre-merger market price of \$41 for Amoco, this represents a market price accretion of 13.8%.

The foregoing dilution and accretion analysis assumes no synergies. However, in the proxy sent to shareholders of each of the companies dated October 30, 1998, some estimates of synergies are presented. It was stated that the combination of the two companies will achieve "increased opportunities." The proxy statement also states that a cost savings of \$2 billion per year would be achieved. "The estimated cost savings, which are in addition to cost savings previously targeted by the two companies separately, are expected to come from staff reductions in areas of overlap, more focused exploration efforts, standardization and simplification of business processes (*e.g.*, information technology), improved procurement and the elimination of duplicative facilities (*e.g.*, distribution depots)." (p. 30)

Thus, the proxy statement predicts earnings enhancement from both new growth opportunities and cost reductions. Accordingly, Table 8 presents an EPS accretion/dilution analysis for BP Amoco based on a range of increases in net income from synergies, using increments of \$500 million. Amoco achieves earnings accretion of

14.9% (as in Table 7) and more for each increment of synergies. For an increase of net income of \$1 billion or more, BP achieves EPS accretion of 7.3% and up. Thus, for BP, if only one-half of the estimated \$2 billion per year cost savings are achieved, and assuming zero revenue enhancement, the transaction is accretive for BP shareholders.

Table 8

EPS Accretion/Dilution with Synergies for BP/Amoco

1	Synergies (millions)	\$0	\$500	\$1,000	\$1,500	\$2,000	\$2,500	\$3,000
2	New net income (millions)	\$6,143	\$6,643	\$7,143	\$7,643	\$8,143	\$8,643	\$9,143
3	New BP EPS ¹	\$3.83	\$4.14	\$4.45	\$4.76	\$5.07	\$5.38	\$5.69
4	BP EPS change	-7.7%	-0.2%	7.3%	14.8%	22.3%	29.8%	37.4%
5	New Amoco EPS ²	\$2.52	\$2.73	\$2.94	\$3.14	\$3.35	\$3.55	\$3.76
6	Amoco EPS change	14.9%	24.2%	33.6%	42.9%	52.3%	61.6%	71.0%

¹ (Row 2 / 1,605.8 million shares)

² (Row 3 * exchange terms)

In Table 9, we do a similar analysis for market price dilution and accretion. We use the P/E ratio based on the immediate post-merger market value of \$70.56 per share (line 1, column c) divided by net income of \$6.143 (line 4, column c) to obtain 18.4 in line 9, column c in Table 7. With synergies and earnings growth, it could be argued that the P/E ratio would be higher. So using 18.4 is conservative. Also, the earnings increments are discounted at 10% to perpetuity. These conservative estimates are presented in Table 9. Market price accretion occurs immediately for Amoco. At synergies of \$1 billion or more, the transaction becomes accretive for BP.

Thus, even if the projections contained in the proxy statement of 10/30/98 are not fully realized, the BP Amoco combination will be accretive for the shareholders of the

Table 9

Market Price Change for BP/Amoco

1	Synergies (millions)	\$0	\$500	\$1,000	\$1,500	\$2,000	\$2,500	\$3,000
2	Addition to value - 10% discount factor ¹ (billions)	\$0	\$5	\$10	\$15	\$20	\$25	\$30
3	New market value ² (billions)	\$113.3	\$118.3	\$123.3	\$128.3	\$133.3	\$138.3	\$143.3
4	New BP price per share ³	\$70.56	\$73.67	\$76.78	\$79.90	\$83.01	\$86.13	\$89.24
5	BP % change in market price ⁴	-7.2%	-3.1%	1.0%	5.1%	9.2%	13.3%	17.4%
6	New Amoco price per share ⁵	\$46.57	\$48.62	\$50.68	\$52.73	\$54.79	\$56.84	\$58.90
7	Amoco % change in market price ⁶	13.6%	18.6%	23.6%	28.6%	33.6%	38.6%	43.7%

1 Row 1 / 0.10

2 \$113.3 billion + Row 2

3 Row 3 / 1,605.8 million shares

4 (Row 4 / 76)-1

5 Row 4 * .66

6 (Row 5 / 41)-1

participant companies. None of these gains will come automatically, of course. Crucial are the combining of the corporate cultures, ironing out the requisite organization and personnel realignments and the implementation of all aspects of effectively combining the two operations. But the scenario depicted by the companies in the pre-merger proxy statement to shareholders of 10/30/98 and the 1998 BP Amoco Annual Report appear realistic. The merger appears to represent a plausible business risk.

Further support for the underlying logic of the BP Amoco combination is provided by the stock market reactions. Empirical studies suggest that these initial stock market reactions are good predictors of subsequent post-merger performance (Healy, Palepu, and Ruback, 1992). Table 10 and Figure 1 present the stock price behavior of the two companies for 11 days before the announcement of the merger and 10 days after.

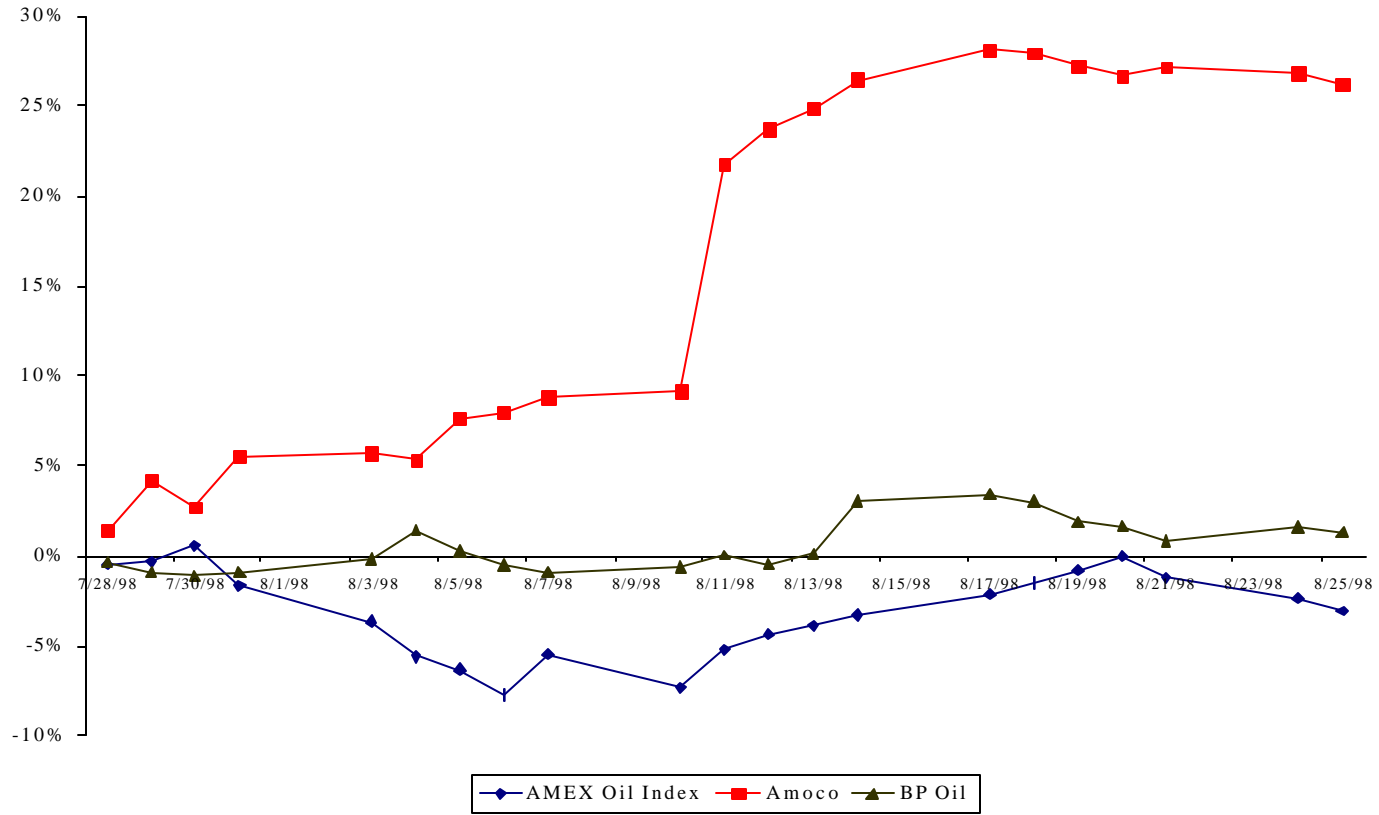
The stock price changes adjusted for the AMEX Oil Index are also shown.

Table 10

BP Oil and Amoco Stock Returns

Date	XOI AMEX Oil Index	Return on AMEX Oil Index	Cumulative Actual Return	AN	AN Return	Cumulative Actual Return	Cumulative Adjusted Return	BPA	BPA Return	Cumulative Actual Return	Cumulative Adjusted Return
7/27/98	439.68			40.19				82.38			
7/28/98	437.60	-0.473%	-0.473%	40.56	0.933%	0.933%	1.406%	81.69	-0.834%	-0.834%	-0.361%
7/29/98	438.34	0.169%	-0.304%	41.75	2.926%	3.859%	4.163%	81.38	-0.383%	-1.217%	-0.913%
7/30/98	442.12	0.862%	0.558%	41.50	-0.599%	3.261%	2.702%	81.94	0.692%	-0.525%	-1.084%
7/31/98	432.34	-2.212%	-1.654%	41.75	0.602%	3.863%	5.517%	80.25	-2.060%	-2.585%	-0.932%
8/3/98	423.76	-1.985%	-3.638%	41.00	-1.796%	2.067%	5.705%	79.25	-1.246%	-3.831%	-0.193%
8/4/98	415.58	-1.930%	-5.569%	40.06	-2.285%	-0.219%	5.350%	79.00	-0.315%	-4.147%	1.422%
8/5/98	412.54	-0.732%	-6.300%	40.69	1.560%	1.341%	7.641%	77.50	-1.899%	-6.046%	0.254%
8/6/98	406.71	-1.413%	-7.713%	40.25	-1.076%	0.265%	7.978%	75.81	-2.177%	-8.222%	-0.509%
8/7/98	415.94	2.269%	-5.444%	41.50	3.106%	3.370%	8.814%	77.25	1.895%	-6.327%	-0.883%
8/10/98	408.15	-1.873%	-7.317%	40.88	-1.506%	1.864%	9.181%	76.00	-1.618%	-7.945%	-0.628%
8/11/98	416.74	2.105%	-5.212%	46.88	14.679%	16.543%	21.755%	78.13	2.796%	-5.149%	0.063%
8/12/98	420.29	0.852%	-4.360%	48.19	2.801%	19.344%	23.705%	78.38	0.320%	-4.829%	-0.469%
8/13/98	422.44	0.512%	-3.849%	49.00	1.685%	21.029%	24.878%	79.25	1.116%	-3.713%	0.136%
8/14/98	424.81	0.561%	-3.288%	50.06	2.169%	23.199%	26.486%	82.00	3.470%	-0.243%	3.045%
8/17/98	429.65	1.139%	-2.148%	51.44	2.747%	25.945%	28.094%	83.25	1.524%	1.282%	3.430%
8/18/98	432.34	0.626%	-1.522%	51.69	0.486%	26.431%	27.954%	83.44	0.226%	1.508%	3.030%
8/19/98	435.36	0.699%	-0.824%	51.69	0.000%	26.431%	27.255%	83.06	-0.449%	1.058%	1.882%
8/20/98	438.95	0.825%	0.001%	51.81	0.242%	26.673%	26.672%	83.56	0.602%	1.660%	1.659%
8/21/98	433.69	-1.198%	-1.197%	51.44	-0.724%	25.949%	27.147%	81.88	-2.020%	-0.360%	0.838%
8/24/98	428.69	-1.153%	-2.350%	50.69	-1.458%	24.491%	26.842%	81.56	-0.381%	-0.741%	1.609%
8/25/98	425.65	-0.709%	-3.059%	50.00	-1.357%	23.134%	26.194%	80.75	-0.997%	-1.738%	1.322%

Figure 1
Cumulative Adjusted Returns



The cumulative adjusted return for Amoco is 21.8% through the announcement date, rising to 26.2% in the subsequent 10-day period. For BP, the cumulative adjusted return as of the announcement date was slightly positive. During the following 10 days in which the market had the opportunity to review and evaluate the outlook for the combined companies, the cumulative adjusted return for BP rose by 1.3%.

The BP/Amoco merger has been described within the framework of the broader forces operating in the oil industry. Particularly, oil price instabilities and the continuing uncertainties of the industry are shown to have influenced management strategies and policies. Based on the evidence available to date, the BP/Amoco merger appears to have a valid basis in business economics and financial analysis.

Similar analysis has been made for the proposed Exxon/Mobil and the BP Amoco/ARCO mergers in Appendix B. The results are similar from business economics and financial analysis standpoints. The three large oil mergers have a plausible business basis. But are they sound from a social standpoint? In the next section, we will consider the antitrust, political, and economic consequences of the oil industry mergers of the late 1990s.

VII. CONCENTRATION IN THE WORLD OIL INDUSTRY

As a part of a broader study of the effects of M&A activity on industry concentration measures, we have collected data for the petroleum industry. Table 11 lists the largest 60 oil companies with their total assets or total sales data for selected years since 1975. These basic data were used to calculate concentration data using the Herfindahl-Hirschman Index (HHI or H index) adopted by the U.S. regulatory authorities in Guidelines issued in 1982 and subsequently updated.

Table 11
Petroleum Industry
(Assets/Sales, in \$ billions)

1975		1979		1984		1990		1995		1996	
Company	Assets	Company	Assets	Company	Sales	Company	Assets	Company	Assets	Company	Assets
1 Exxon	32.84	Royal Dutch/Shell	59.57	Exxon	97.29	Exxon	87.71	Royal Dutch/Shell	117.75	Royal Dutch/Shell	124.14
2 Royal Dutch/Shell Group	28.35	Exxon	49.49	Royal Dutch Petr	77.12	Ente Nazionale Idrocarburi	60.34	Exxon	91.30	Exxon	95.53
3 Texaco-US	17.26	British Petroleum	34.69	Mobil Corp	59.00	British Petr Co	59.25	British Petr Co	50.47	British Petroleum	55.05
4 Mobil Oil-US	15.05	Mobil	27.51	British Petroleum	47.10	British Gas	51.87	Elf Aquitaine	49.43	Elf Aquitaine	47.14
5 British Petroleum	14.62	Texaco-US	22.99	Texaco	41.15	Petroleos Mexicanos	45.08	Mobil	42.14	Mobil	46.41
6 Standard Oil of Calif	12.90	ENI	19.73	Std Oil Co of Indiana	29.49	Ste.Nat.Elf Aquitaine	42.31	Petroleos de Venezuela	40.50	Petroleos Mexicanos	39.75
7 ENI	12.48	Standard Oil of Calif	18.10	Std Oil Co of Cal	29.18	Mobil	41.67	Chevron	34.33	Chevron	34.85
8 Gulf Oil-US	12.43	Gulf Oil	17.26	Gulf Oil	28.89	Chevron	17.26	Petroleo Mexocanos	31.98	Petroleo Brasileiro SA	33.74
9 Standard Oil (Ind.)	9.85	Standard Oil(Ind)	17.15	Atlantic Richfield	27.46	Royal Dutch/Shell	32.63	Petroleo Brasileiro SA	31.68	Amoco	32.10
10 ELF-Aquitaine	8.60	Shell Oil	16.13	ENI-ENTE Nazionale	25.02	Amoco Corp	32.21	Amoco	29.85	Total	30.20
11 Cie Francaise des Petroles	8.04	Elf Aquitaine	15.86	Shell Oil Co	19.88	Shell Oil	28.50	Total	28.36	Shell Oil	28.71
12 Atlantic Richfield	7.36	Francaise des Petroles	14.29	Elf Aquitaine	18.19	Texaco	25.98	Kuwait Petroleum	27.60	BHP Petroleum	28.06
13 Shell Oil	7.01	Atlantic Richfield	13.83	Conoco Corp	13.83	ARCO	18.00	Shell Oil	27.02	Kuwait Petroleum	27.66
14 Petrobras	6.77	Petroleos de Venezuela	13.09	Total Compagnie	16.76	Petroleos de Venezuela	22.10	Nippon Oil Company	25.69	Texaco	26.96
15 Tenneco	6.58	Tenneco	11.63	Sun Company	16.26	Total-France	20.64	Texaco	24.94	ARCO	25.72
16 Pemex	5.56	Petrobras	11.03	Pemex	16.20	Occidental Petroleum Corp	19.74	ARCO	24.00	Nippon Oil Company	25.45
17 National Iranian Oil	5.42	Conoco-US	9.31	Phillips Petroleum	15.41	BP (USA)	18.73	BHP Petroleum Pty	22.56	Chinese Petroleum Corp	19.09
18 Continental Oil	5.18	Standard Oil(Ohio)	5.18	Occidental Petroleum	15.33	Imperial Oil	17.63	Statoil	17.92	Statoil	19.00
19 Phillips Petroleum	4.54	Phillips Petroleum	8.52	Nippon Oil Company	15.31	Norsk Hydro	13.58	Occidental Petr	17.82	Occidental Petroleum	17.63
20 Sun Oil	4.38	Sun	7.46	Getty Oil	13.25	Petrobras Brasileiro	12.65	AGIP	16.95	AGIP	17.63
21 Standard Oil(Ohio)	4.22	Petrofina	7.22	BASF	12.89	Statoil	12.56	Norsk Hydro	15.64	Norsk Hydro AS	16.23
22 Idemitsu Kosan	4.14	Pemex	7.00	Kuwait Petroleum	12.87	Petrofina-Belgium	12.31	BP (USA)	14.61	Enron Corp	16.14
23 Petrofina	3.91	Getty Oil	6.03	Std Oil Co Ohio	12.07	Repsol SA	12.07	REPSOL	13.74	Conoco Inc	15.69
24 Union Oil of Calif	3.78	Union Oil of Calif	6.01	Union Oil Co-Cal	11.30	Phillips Petroleum Co	12.13	Pertamina	13.51	Pertamina	13.79
25 Pertamina	3.75	YPF	5.89	Idemitsu Kosen	10.77	USX-Marathon Group	11.93	Enron	13.24	Phillips Petroleum	13.55
26 BHP	3.64	Occidental Petroleum	5.56	Shell UK	10.77	Pertamina	11.83	Conoco	12.09	YPF SA	12.08
27 Occidental Petroleum	3.50	Esso Petroleum-Britain	5.36	Petroleo Brasileiro	10.65	Conoco Inc	11.64	Phillips Petroleum	11.98	Coastal Corp	11.61
28 Getty Oil	3.24	Idemitsu Kosan	5.09	Marathon Oil Co	9.81	Neste Corp	11.53	YPF SA	11.57	Petrofina SA	11.61
29 Cities Service	3.23	Union Pacific	5.09	Esso UK	9.45	Chinese Petr Corp	11.51	Petrofina SA	11.48	BP (USA)	10.47
30 Sonatrach	3.21	Amerada Hess	4.90	Ashland Oil	9.27	Enron Corp	9.85	Coastal Corp	10.66	USX-Marathon Group	10.15
31 Imperial Oil	2.90	Cities Service	4.77	Petrofina	9.22	Unocal	9.76	USX-Marathon Group	10.11	Egyptian Gen'l Petroleum	10.05
32 Burnah Oil	2.48	Marathon Oil	4.32	Amerada Hess	8.42	Coastal	9.23	Unocal Corp	9.89	Unocal Corp	9.12
33 Amerada Hess	2.39	Allied Chemical	4.21	CAMPASA Cia Arren..	8.29	Amerada Hess Corp	9.06	Imperial Oil	8.83	Amerada Hess	7.78
34 Esso Petroleum-Britain	2.15	Imperial Oil	3.98	Deutsche Shell	8.26	Petro-Canada	8.44	Amerada Hess	7.76	Imperial Oil	7.68
35 YPF	2.07	Vebe Oel-Germany	3.43	Agip	7.92	Amoco Canada Petr	7.33	Neste Corp	7.67	Empresa Colombiana de Petr	7.38
36 Marathon Oil	2.01	ENPETROL	3.37	Indian Oil Corp	7.83	Columbia Gas System Inc	6.20	SIDANCO	7.20	Ahland Oil	7.27
37 Ahland Oil	1.97	Ashland Oil	3.11	Vebe Oel	7.57	BHP Petr. Pty	5.48	Ashland Oil	6.99	Neste Group	6.81
38 ENPETROL	1.75	Norsk Hydro	3.02	Imperial Oil	7.24	Pennzoil Co	5.26	Columbia Gas System	6.06	Columbia Gas System	6.10
39 Nippon Mining	1.73	Esso-Germany	2.82	Canadian Pacific Enterprises	6.91	Oryx Energy Co	5.25	Empresa Colombiana de Petr	5.60	Consolidated Natural Gas	6.00
40 Gulf Oil Canada	1.70	Maruzen Oil	2.81	Yacimientos Petr.	6.78	Ashland Oil Inc	5.12	Consolidated Natural Gas	5.42	OMV AG	5.74
41 Maruzen Oil	1.68	Gulf Canada	2.81	Maruzen Oil Co	6.73	Arkla, Inc	5.11	Petro-Canada	4.75	Petro-Canada	5.67
42 Toa Nenryo Kogyo	1.62	British National Oil	2.74	Shell Francaise	6.65	Consolidated Natural Gas	5.01	Lasmo plc	4.53	Shell Canada	4.68
43 Esso-Germany	1.59	Superior Oil	2.72	Esso Eastern	6.40	Transco Energy Co	4.55	Shell Canada	4.51	Enterprise Oil	4.60
44 Union Explosivos Rio Tinto	1.56	Dome Petroleum	2.68	ARCO Oil & Gas	6.20	Ultramar plc	4.47	Amoco Canada Petr	4.49	Amoco Canada Petroleum	4.41
45 Turkiye Petrolleri	1.51	Chinese Petroleum	2.66	Petroleos de Venezuela	6.01	Gulf Canada Resources	4.37	OMV AG	4.41	Burlington Resources	4.32
46 Kerr-McGee	1.39	Nippon Mining	2.63	Charter	5.77	Husky Oil Operations	4.29	Pennzoil Co	4.31	Lasmo Plc	4.29
47 Mitsubishi Oil	1.37	Toa Nenryo Kogyo	2.58	Chinese Petroleum Corp	5.44	Yukong Ltd	4.10	Meridian Oil	4.09	Pennzoil	4.12
48 Egyptian Gen'l Petroleum	1.35	Mitsubishi Oil	2.41	ESSO Ag	5.40	Interprovincial Pipe Line	3.69	Enterprise Oil	3.90	China National Offshore Oil	3.79
49 Esso-France	1.34	Toa Nenryo Kogyo	2.38	Toa Nenryo Kogyo	5.38	Freepport-McMoRan	3.59	Sonat Inc	3.51	Sonat Inc	3.77
50 Vebe-Chemie	1.29	OMV	2.34	Shell Nederland	5.24	OMV Aktiengesellschaft	3.53	Enserch Corp	3.38	Saga Petroleum	3.77
51 Murphy Oil	1.17	Kerr-McGee	2.34	Nippon Mining Co	5.23	Norcen Energy Resources	3.48	Union Pacific Resources Group	3.48	Enserch Corp	3.73
52 Texasgulf	1.16	CEPSA	2.29	Daikyo Oil	5.12	Kerr-McGee Corp	3.47	Kerr-McGee Corp	3.23	Union Pacific Resources Group	3.65
53 Mobil Oil-Germany	1.04	Pennzoil	2.29	Mitsubishi Oil Co	5.08	Meridian Oil Inc	3.44	Vebe Oel AG	3.06	PanCanadian Petr.	3.62
54 OMV	1.02	Union Explosivos Rio Tinto	2.18	Showa Oil	5.00	PanCanadian Petr	3.36	MOL Ltd-Hungarian	3.01	Apache Corp	3.43
55 Gelsenberg	0.89	PETROGAL	2.04	Texaco Canada	4.65	Enserch Corp	3.26	Maxus Energy	2.72	Kerr-McGee Corp	3.12
56 Daikyo Oil	0.89	Saarbergwerke	2.03	Emp Nac Del Petr	4.39	Sonat Inc	3.20	Apache Corp	2.68	FINA Inc	2.86
57 Superior Oil	0.89	Burmah Oil	2.02	Shell Canada Ltd	4.22	Oil Co of Australia	3.13	Montana Power	2.59	Alberta Energy Co	2.84
58 Indian Oil	0.80	Texaco Canada	1.97	Esso Italiana	4.17	Empresa Colombiana de Petr	2.97	FINA Inc	2.49	Talisman Energy	2.74
59 Deutsche Texaco	0.79	Showa Oil	1.96	Gulf Canada Ltd	4.12	Union Energy Inc	2.91	Norcen Energy Resources	2.33	Santos Ltd	2.74
60 Neste	0.77	Murphy Oil	1.88	Neste Oy	4.08	American Petrofina Inc	2.85	Anadarko Petroleum	2.27	Montana Power	2.70

* Sources: Fortune World Business Directory (1975-79), The Fortune Double 500 Directory of the Largest U.S. Industrial Corporations (1975-79), Ward's Business Directory (1984), Oil & Gas Journal Data Book (1990-96)

The HHI is measured by the sum of the squares of the market shares of all of the firms in the industry. The economic justification for the use of the HHI measure is that it can be shown to be related to a measure of the price-cost margin measure of monopoly power $[(p - c)/p]$ (where p = price and c = marginal cost) (Landes and Posner, 1981).

The HHI calculation procedure is straightforward. For example, if 10 firms each had 10% of industry revenues, the H index would be 10 times 100 which equals 1,000. If five firms each had 20% of industry revenues, the H index would be 5 times 400 which equals 2,000. This illustrates how higher market shares result in higher industry concentration measures.

The critical H index specified in the Guidelines is 1,000. Below 1,000, concentration is sufficiently low, so that no further investigation is required to determine possible effects on competition. If a post-merger H index is between 1,000 and 1,800 and the index had been increased by 100 or more, the merger would be investigated. If the industry H index is more than 1,800 and it has been increased by at least 50, the merger would be challenged.

The H index measures are calculated for the petroleum industry in Table 12 for the years 1975 through 1996. In 1975, the H index started at about 410. It rose to 416 in 1979. In 1984, it dropped back to 377. In 1990, it declined again to 362, rising to 407 by 1995. In 1996, the index had moved to 415, about the same level as in 1979. It is clear that the H index for the petroleum industry has been well under the critical 1,000 level test in the Guidelines employed by regulatory authorities.¹

¹ We updated the analysis for 1997 using data from 280 oil companies. The data summarized in Appendix A are similar to the results we report for 1975 through 1996.

Table 12
Petroleum Industry
(Assets/Sales, in \$ billion)

	1975		1979		1984		1990		1995		1996	
	Assets	H-Index	Assets	H-Index	Sales	H-Index	Assets	H-Index	Assets	H-Index	Assets	H-Index
1	32.84	114.35	59.57	122.70	97.29	111.86	87.71	84.34	117.75	131.74	124.14	138.48
2	28.35	85.22	49.49	84.69	77.12	70.29	60.34	39.92	91.30	79.20	95.53	82.01
3	17.26	31.59	34.69	41.61	59.00	41.14	59.25	38.49	50.47	24.20	55.05	27.23
4	15.05	24.02	27.51	26.17	47.10	26.22	51.87	29.50	49.43	23.21	47.14	19.97
5	14.62	22.66	22.99	18.27	41.15	20.01	45.08	22.28	42.14	16.87	46.41	19.35
6	12.90	17.64	19.73	13.46	29.49	10.28	42.31	19.63	40.50	15.58	39.75	14.20
7	12.48	16.51	18.10	11.33	29.18	10.06	41.67	19.04	34.33	11.20	34.85	10.91
8	12.43	16.38	17.26	10.30	28.89	9.86	35.09	13.50	31.98	9.72	33.74	10.23
9	9.85	10.29	17.15	10.17	27.46	8.91	32.63	11.67	31.68	9.54	32.10	9.26
10	8.60	7.84	16.13	9.00	25.02	7.40	32.21	11.37	29.85	8.47	30.20	8.20
11	8.04	6.85	15.86	8.70	19.88	4.67	28.50	8.91	28.36	7.64	28.71	7.41
12	7.36	5.74	14.29	7.06	18.19	3.91	25.98	7.40	27.60	7.24	28.06	7.08
13	7.01	5.21	13.83	6.61	18.00	3.83	23.86	6.24	27.02	6.94	27.66	6.87
14	6.77	4.86	13.09	5.92	16.76	3.32	22.10	5.35	25.69	6.27	26.96	6.53
15	6.58	4.59	11.63	4.68	16.26	3.12	20.64	4.67	24.94	5.91	25.72	5.94
16	5.56	3.28	11.03	4.21	16.20	3.10	19.74	4.27	24.00	5.47	25.45	5.82
17	5.42	3.11	9.31	3.00	15.41	2.81	18.73	3.85	22.56	4.84	19.09	3.27
18	5.18	2.84	9.21	2.93	15.33	2.78	17.63	3.41	17.92	3.05	19.00	3.24
19	4.54	2.19	8.52	2.51	15.31	2.77	13.58	2.02	17.82	3.02	17.63	2.79
20	4.38	2.03	7.46	1.92	13.25	2.07	12.65	1.75	16.95	2.73	17.63	2.79
21	4.22	1.89	7.22	1.80	12.89	1.96	12.56	1.73	15.64	2.32	16.23	2.37
22	4.14	1.82	7.00	1.69	12.87	1.96	12.31	1.66	14.61	2.03	16.14	2.34
23	3.91	1.62	6.03	1.26	12.07	1.72	12.27	1.65	13.74	1.79	15.69	2.21
24	3.78	1.51	6.01	1.25	11.30	1.51	12.13	1.61	13.51	1.73	13.79	1.71
25	3.75	1.49	5.89	1.20	10.77	1.37	11.93	1.56	13.24	1.67	13.55	1.65
26	3.64	1.40	5.56	1.07	10.77	1.37	11.83	1.53	12.09	1.39	12.08	1.31
27	3.50	1.30	5.36	0.99	10.65	1.34	11.64	1.49	11.98	1.36	11.61	1.21
28	3.24	1.11	5.09	0.90	9.81	1.14	11.53	1.46	11.57	1.27	11.61	1.21
29	3.23	1.11	5.09	0.90	9.45	1.06	11.51	1.45	11.48	1.25	10.47	0.99
30	3.21	1.09	4.90	0.83	9.27	1.02	9.85	1.06	10.66	1.08	10.15	0.93
31	2.90	0.89	4.77	0.79	9.22	1.00	9.76	1.04	10.11	0.97	10.05	0.91
32	2.48	0.65	4.32	0.65	8.42	0.84	9.23	0.93	9.89	0.93	9.12	0.75
33	2.39	0.61	4.21	0.61	8.29	0.81	9.06	0.90	8.83	0.74	7.78	0.54
34	2.15	0.49	3.98	0.55	8.26	0.81	8.44	0.78	7.76	0.57	7.68	0.53
35	2.07	0.45	3.43	0.41	7.92	0.74	7.33	0.59	7.67	0.56	7.38	0.49
36	2.01	0.43	3.37	0.39	7.83	0.72	6.20	0.42	7.20	0.49	7.27	0.47
37	1.97	0.41	3.11	0.33	7.57	0.68	5.48	0.33	6.99	0.46	6.81	0.42
38	1.75	0.32	3.02	0.32	7.24	0.62	5.26	0.30	6.06	0.35	6.10	0.33
39	1.73	0.32	2.82	0.27	6.91	0.56	5.25	0.30	5.60	0.30	6.00	0.32
40	1.70	0.31	2.81	0.27	6.78	0.54	5.12	0.29	5.42	0.28	5.74	0.30
41	1.68	0.30	2.81	0.27	6.73	0.54	5.11	0.29	4.75	0.21	5.67	0.29
42	1.62	0.28	2.74	0.26	6.65	0.52	5.01	0.28	4.53	0.19	4.68	0.20
43	1.59	0.27	2.72	0.26	6.40	0.48	4.55	0.23	4.51	0.19	4.60	0.19
44	1.56	0.26	2.68	0.25	6.20	0.45	4.47	0.22	4.49	0.19	4.41	0.17
45	1.51	0.24	2.66	0.24	6.01	0.43	4.37	0.21	4.41	0.18	4.32	0.17
46	1.39	0.20	2.63	0.24	5.77	0.39	4.29	0.20	4.31	0.18	4.29	0.17
47	1.37	0.20	2.58	0.23	5.44	0.35	4.10	0.18	4.09	0.16	4.12	0.15
48	1.35	0.19	2.41	0.20	5.40	0.34	3.69	0.15	3.90	0.14	3.79	0.13
49	1.34	0.19	2.38	0.20	5.38	0.34	3.59	0.14	3.51	0.12	3.77	0.13
50	1.29	0.18	2.34	0.19	5.24	0.32	3.53	0.14	3.38	0.11	3.77	0.13
51	1.17	0.15	2.34	0.19	5.23	0.32	3.48	0.13	3.31	0.10	3.73	0.13
52	1.16	0.14	2.29	0.18	5.12	0.31	3.47	0.13	3.23	0.10	3.65	0.12
53	1.04	0.11	2.29	0.18	5.08	0.30	3.44	0.13	3.06	0.09	3.62	0.12
54	1.02	0.11	2.18	0.16	5.00	0.30	3.36	0.12	3.01	0.09	3.43	0.11
55	0.89	0.08	2.04	0.14	4.65	0.26	3.26	0.12	2.72	0.07	3.12	0.09
56	0.89	0.08	2.03	0.14	4.39	0.23	3.20	0.11	2.68	0.07	2.86	0.07
57	0.89	0.08	2.02	0.14	4.22	0.21	3.13	0.11	2.59	0.06	2.84	0.07
58	0.80	0.07	1.97	0.13	4.17	0.21	2.97	0.10	2.49	0.06	2.74	0.07
59	0.79	0.07	1.96	0.13	4.12	0.20	2.91	0.09	2.33	0.05	2.74	0.07
60	0.77	0.06	1.88	0.12	4.08	0.20	2.85	0.09	2.27	0.05	2.70	0.07
Total	307.11		537.79		919.86		955.04		1025.91		1054.92	
Top 10 H-Index	84.6%	346.49	83.7%	347.68	83.9%	316.04	80.1%	289.74	81.1%	329.72	81.8%	339.83
Top 20 H-Index	94.5%	387.21	95.1%	395.23	92.4%	348.42	93.3%	337.62	94.1%	382.83	94.3%	391.59
Top 30 H-Index	98.0%	401.55	98.0%	407.11	96.3%	362.87	97.5%	352.82	98.0%	398.73	98.1%	407.51
HHI	409.71		415.57		376.91		361.88		406.81		415.20	

In Table 13, the effects of mergers on the H index measures are shown. We begin with the merger of the two foreign oil firms, Total (SA) and Petrofina, using our 1997 data. The initial H index for Total (SA) was 4.93, for Petrofina the H index was 1.90. The sum of the original Hs is 6.83. Next we combine the revenues of \$32,781 million for Total (SA) and \$20,352 million for Petrofina to obtain \$53,133. This sum is divided by the industry total revenues of \$1,475,774 million to obtain a market share of 3.6%. This market share squared equals the new H index of 12.96 shown in Table 13. Thus, the industry H index is increased by 12.96 less 6.83 or 6.13 points. The oil industry H index in 1997 was 389.35, adding 6.13 gives the new H index of 395.48.

Table 13

Effects of Mergers on Oil Industry H-Index Measures

	Combined Revenues	Sum of Initial Hs	New H-Index	Change in H-Index	Cumulative Changes in Oil Industry H-Index
Original H-Index					389.35
Total/Petrofina	\$53,133	6.83	12.96	6.13	395.48
Elf Aquitaine/Total	\$98,220	22.29	44.30	22.01	417.49
BP/Amoco	\$123,871	41.27	70.45	29.18	446.67
Exxon/Mobil	\$203,148	106.42	189.49	83.07	529.74
BP Amoco/ARCO	\$143,143	42.98	94.08	51.10	580.84
Chevron/Texaco	\$88,572	18.08	36.02	17.94	598.78

Similarly, for the merger between Elf Aquitaine and another French company, Total (SA), that merger adds 22 points to the H index increasing it to 417. The BP Amoco merger adds 29 resulting in an oil industry index of 447. The Exxon/Mobil merger would add another 83 points bringing the index to 530. The BP Amoco/ARCO merger would add 51 points to bring the HHI for the industry up to 581. If the Chevron/Texaco took place, this would add another 18 points, so the new industry HHI would be 599. So with six mergers, among the top 23 petroleum companies in the world, the HHI for the petroleum industry would rise from 389 points to 599 points, a rise of 210

points. The total HHI for the industry of 599 would still be well short of the 1,000 critical level specified in the regulatory Guidelines.

The common sense of this is that although individual oil companies are large, they are in an industry that is also large, whether measured by revenues or total assets. These are multibillion-dollar companies, but they are in a 1.5 trillion-dollar industry. Thus, by the criteria of the U.S. regulatory authorities, the overall industry concentration measures are so far below the H index 1,000 threshold that from an aggregate industry standpoint, antitrust concerns are not raised.

Our calculations may be tested by other measures of concentration. The latest data as of this writing for U.S. measures of concentration is in the "1992 Census of Manufacturers Report MC92-S-2, Concentration Ratios in Manufacturing" (U.S. Department of Commerce). The petroleum industry segment included in manufacturing is petroleum refining which at the four-digit level is SIC 2911. The HHI calculated for 1992 is 414 which is in the ballpark with the 415 number we have calculated for firms in all segments of the industry in 1996 or the 389 for 1997. This provides a check on the reliability of the original calculations that we have been making.

Further corroboration is provided by an EIA analysis in its 1997 publication.

"Although the FRS companies account for the bulk of offshore oil and gas production, the non-FRS companies have increased their presence over the past decade. Between 1987 and 1997, average daily production by the non-FRS companies increased 40 percent to 1.2 million BOE per day from 871,000 barrels. Over the same period, production by the FRS companies increased by a more modest 11 percent, from 2.5 million barrels per day to 2.8 million BOE per day (Figure 23). As a result of this trend, the size distribution of production among the operators has become less concentrated. In 1997, the top ten operators accounted for 55 percent of offshore production as compared to 63 percent in

1987. As further evidence of this trend, the Herfindahl index of production declined from 567 in 1987 to 505 in 1997." (p. 69)

Again an HHI for the oil industry at slightly above 500 in 1997. This level was about 50% below the antitrust Guidelines' critical level of 1,000.

Issues have been raised about concentration in local market segments such as Alaska. Concern has been expressed that the BP Amoco/ARCO combination will give it undue monopoly power in that region.

How this monopoly power would be exercised has not been made clear. Relatively vague assertions have been made. One is that the new BP would have undue influence in bidding for oil drilling leases from the state of Alaska. A second is that BP would have power over pricing of product. A third is that Alaska would become a "colony" of BP.

VIII. OPPOSING THEORIES OF CONCENTRATION IMPLICATIONS

The evaluation of the issues raised involves two opposing fundamental views of industrial economics. The older, traditional view is the structural theory which holds that concentration measures can predict the conduct and behavior of firms. A directly opposite view is the dynamic theory which holds that the efficiency and effectiveness of firms in the market place determines market shares (industry structure).

The structural theory holds that high concentration results in recognized interdependence and mutual forbearance from competition by large firms. It holds that recognized interdependence is equivalent to tacit collusion which results in market power, monopoly behavior, supply restrictions, and high prices.

On the other hand, the dynamic theory holds that the most efficient firms increase their market shares. These market share increases can come about through internal

expansion, the acquisition of other firms, or some combination of both. Concentration measures in the industry may become higher, but competition is not diminished.

Competition takes place in so many areas that collusion would be impossible. In addition to competing on price, firms compete on product improvements, product quality, product innovations, new products, technological capabilities, in creating new approaches which result in new product lines and new industries, competition in organization effectiveness and efficiency, competition in management innovations, etc., etc. The spur is competition and potential competition. Competition in the oil industry is also stimulated by technological developments which have resulted in increased competition between oil industry firms and new forms of energy.

Mergers may help increase the ability to compete. Mergers may assist firms in their attempts to succeed in dynamic competition. Mergers help firms achieve the critical mass required for making high-risk investments. But increased size alone does not guarantee success. Merging firms face difficult problems of blending cultures and implementing programs for combining organizations to achieve the synergy potentials. Effective organization and management systems are required.

The oil and gas industry has changed over the years as described above. A major impact on supply conditions is held by the Middle East countries. Price instabilities continue to be substantial. Important technological developments have impacted methods of exploration. New technologies impact gas conversion and its competition with oil. Technological developments are taking place in photoelectric cells as a source of energy. Technological changes will also take place in the use of oil. The widening

use of energy saving communication and transportation technologies will affect the patterns and future growth rates in the use of oil.

In the new global economy, competition has increased within and between industries. Firms must face new organization challenges. New organization and management systems are required. The new information economy poses new challenges. Dynamic theory predicts the use of more complex decision making processes (Shapiro and Varian, 1998).

Continued adherence to the old structural theory of industrial economics will hamper competition and progress. The structural approach is equivalent to penalizing firms for improved management systems, improved efficiency, and increased effectiveness in the market place. The structural approach places handicaps on firms. It reduces the ability to compete in the new global market place. While well intentioned, the structural approach is harmful to competitive processes for creativity and innovation. These views are well documented in the industrial organization literature and have been set forth in a sample of my writings listed in the references. In the framework of this broad assessment of the nature of industrial economics, the issues with respect to mergers in the oil industry are next addressed.

IX. COMPETITION IN THE ALASKAN OIL INDUSTRY

Concern has been expressed that BP Amoco, with the addition of ARCO, would have a 70% share of Alaska oil leases. This appears to be an oversimplification. Bidwell and Marks (1998, pp. 50-51) convey the complexity of ownership patterns.

"Because some producers mostly own leases principally overlying oil reserves, while other producers mostly own leases principally over gas reserves, each producer's share of the Oil Rim differs substantially from that same producer's

share of the Gas Cap. While BP owns just slightly more than 50% of the working interest in the Oil Rim, it only has a 13% working interest in the Gas Cap. ARCO and Exxon together only have a 44% working interest in the Oil Rim (22% each), but together they own about 85% of the working interest in the Gas Cap (42.5% each). ARCO and Exxon's 85% interest in the Gas Cap does not mean they own 85% of the Sadlerochit reservoir gas because not all of that gas is in the Gas Cap. ... ARCO and Exxon each own 37% working interest in the total gas in the reservoir (both Gas Cap and Oil Rim gas) while BP owns a 24% working interest in this gas resource.

A related aspect is conveyed by a statement in the BP Amoco 1998 Annual Report:

"In Alaska, we added new acreage in August to complement our existing strong position, winning more than 90% of the blocks for which we bid." (p. 19)

This quotation has several implications. Different companies bid for different blocks depending upon their assessment of prospects, how the new acreage fits into their existing operations, as well as other considerations. In the bidding in August 1998, BP succeeded in over 90% of the blocks for which it bid. BP won because it paid the highest prices to the state of Alaska. Here is concrete evidence that a high market share in the bidding process reflected efficient competition and benefits to the state of Alaska.

Potential Competition

Also, competition and potential competition remain substantial. Competitors in bidding for leases would still include Shell, Exxon/Mobil, Chevron/Texaco, Occidental Petroleum, Phillips Petroleum, Unocal, as well as Conoco and Marathon. But the multi-billion dollar question here is whether the above companies are in the oil business or whether they are in the energy business. Gas is replacing oil in power generation. The gas and electricity markets are converging. The definition of an energy company is

undergoing transformation. "Fifty years ago, it was a coal company; 20 years ago, an oil company; now it is an oil and gas company; and in ten years' time it will be a gas and electricity company..." (Economist, 1999, p. 59). The deregulation of gas and power have widened the horizons of utilities and power companies. The largest gas and electricity firms are making acquisitions which create new forms of energy companies. "Such firms, by building companies that stretch back from the customer to the gas fields, are encroaching on oil's turf" (Ibid, pp. 59-60). The chairman of Dominion Resources, after his firm acquired Consolidated Natural Gas, an upstream gas company, creating the fourth largest gas-and-electricity firm in the U.S., stated: "We've created a firm that reaches from the wellhead all the way to the final destination, the customer" (Ibid, p. 59).

Convergence in the new energy market place is likely to create new forms of competition of the kind that has taken place in the information industry. The computer industry in the 1970s was vertically integrated. By the 1990s, the computer industry has become only a segment of an expanded value chain of the information industry. The relevant value chain now has at least 20 distinct nodes, each with multiple competitors. The segments include: processors, memory chips, hardware, operating systems, software, bio-technology, medical, test and instrumentation companies.

Just as telephone and cable companies have been seeking to develop relationships with the consumer, the same may develop in the energy industry. "Graham Brown, chief operating officer of Britain's National Power, explains that the reason the upstart utilities are such a threat to oil giants is because the real value now comes from owning the customer" (Ibid, p. 60). Texaco and Shell have already moved strongly in these directions. BP Amoco has developed a new global gas-marketing activity, including

power generation, but for the present, states that it will not deal directly with households. Converging markets and divergent competitive philosophies guarantee continued dynamic competition and change in the evolving energy business.

Alaska in the New Energy Universe

Articles on the Internet suggest that Alaska is investing in antitrust lawyers with the possibility of bringing actions against the merging oil firms. The risk is that such actions, while well intentioned, would simply diminish competition. Imposing handicaps on firms would hamper competition and reduce economic benefits for Alaska.

Mergers may reduce jobs in Alaska in the short run. But the contribution of mergers to efficiency have expanded jobs in the longer run. Beginning in 1980 when the highest merger activity in history began to get underway, the United States has added almost 2 million jobs per annum through 1998. Initial job reductions from mergers require adjustments, but longer-run effects are job creation.

The oil industry and Alaska will continue to move into the new high-tech information world. It is inevitable that Alaska will reduce its reliance on using up its natural resources. Alaska, too, will move into the world of new technologies, new industries, new and more intense forms of competition, and share in the benefits that advances in technology produce. A restrictive, narrow short-term view will have negative impacts on the aspirations of the Alaskan economy rather than positive effects.

The view that Alaska will become hostage to decisions made by BP in London has no basis in reality. Alaska will not be a colony subject to the decisions of a firm with headquarters in a foreign country. The decision processes in the modern business firm require effective communications from the bottom up as well as from the top down. The

firm decision process obtains as much information input as possible from the operating activities. Operating executives in Alaska, the United States, South America, Norway, Azerbaijan, Africa, and all of the other geographic areas in which BP operates, are involved in the overall strategic planning processes of the firm. This is not unique to BP, it has become "best-practice" management decision making processes in firms both large and small throughout the world.

Furthermore, offsetting the apprehensions expressed are some positive potential benefits. Bidwell and Marks (1998, pp. 49-50) note the obstacles to a large gas sale.

"The huge costs of such a project make the prospects for a gas sale uncertain. By present estimates, investors in the gas project would need to spend at least 15 billion dollars to construct the necessary infrastructure: a conditioning plant to remove carbon dioxide from the gas, a pipeline from the North Slope to Valdez, a liquefaction plant to liquefy the natural gas, and LNG tankers to take the gas to the Far East."

BP has stated that its enlarged presence in Alaska would enable it to develop gas extraction and sale programs which would greatly increase revenues to the state of Alaska and employment as well. BP has indicated that other programs would become feasible with a larger critical mass of its operations which hitherto might not have been possible.

X. CONCLUSIONS

M&A activity is one of many adaptive and adjustment processes impacting firms throughout the world. This is the new dynamism of operating in a world of exploding technologies, moving into the knowledge and information age. Concentration will increase in some industries. It will decline in others. But market share bookkeeping is a poor proxy for an economic assessment of the new drivers of world markets. Temporary

setbacks and adjustments may be required in the fast moving turbulent world market places. Artificial restrictions on these new dynamic forces will cause distortions and reduce the rate of progress.

It is important to understand these new forces, to embrace them, and to develop an expanded role for Alaska in the growing, dynamic world economy. This will achieve participation in progress and its benefits. Parochial fears should give way to the world view and the positive role of Alaska in the world economy with an extended future time horizon.

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Appendix Table A1
280 Oil Industry Companies and H-index Based on
Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
1	Royal Dutch/Shell	171,964	135.78
2	Exxon	137,242	86.48
3	British Petroleum (incl. US)	87,584	35.22
4	Mobil	65,906	19.94
5	Texaco	46,667	10.00
6	Elf Aquitaine	45,087	9.33
7	Chevron	41,950	8.08
8	Nat'l Iranian Oil	40,890	7.68
9	Amoco	36,287	6.05
10	China National	36,250	6.03
11	ENI	34,997	5.62
12	Petroleos de Venezuela SA	34,801	5.56
13	Petroleos Mexicanos	34,035	5.32
14	Total	32,781	4.93
15	Shell	28,959	3.85
16	Petroleo Brasileiro SA	27,944	3.59
17	Nigerian Nat'l Petroleum	25,808	3.06
18	Kuwait Petroleum Corp	23,572	2.55
19	Nippon oil Co. LTD	22,020	2.23
20	Repsol SA	21,947	2.21
21	Abu Dhabi Nat'l	21,891	2.20
22	Conoco	21,410	2.10
23	Petrofina SA	20,352	1.90
24	Enron	20,273	1.89
25	Arco	19,272	1.71
26	BHP Petroleum Pty Ltd	18,351	1.55
27	Statoil	17,672	1.43
28	National Oil (Libya)	16,045	1.18
29	USX-Marathon	15,754	1.14
30	Philips	15,424	1.09
31	Pertamina	15,393	1.09
32	Norsk hydro AS	13,647	0.86
33	Chinese Petroleum	13,282	0.81
34	Iraq Nat'l	12,966	0.77
35	Petronas	12,414	0.71
36	Veba Oel AG	9,967	0.46
37	Coastal	9,653	0.43
38	Sonatrach	9,624	0.43
39	Lukoil	9,272	0.39
40	Neste	8,837	0.36
41	Amereda Hass	8,340	0.32
42	Occidental	8,101	0.30
43	Imperial	8,035	0.30
44	Oil and Natural Gas(India)	7,481	0.26
45	OMV AG	7,396	0.25
46	Egyptian General	7,048	0.23

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280 Oil Industry Companies and H-index Based on
Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
47	YPF SA	6,114	0.17
48	Ounocal	6,064	0.17
49	Petroleum Authority of Thailand	5,990	0.16
50	Consolidated N.G	5,710	0.15
51	Columbia E.	5,094	0.12
52	FINA	4,468	0.09
53	Petro -Canada	4,403	0.09
54	Sonat	4,178	0.08
55	Shell Canada	3,934	0.07
56	Sasol	3,506	0.06
57	Hungarian	3,435	0.05
58	Hellenic	2,742	0.03
59	Pennzoil	2,654	0.03
60	Mobil Oil Canada	2,447	0.03
61	Western G. R.	2,385	0.03
62	PanCanadian	2,354	0.03
63	Equitable R.	2,151	0.02
64	Murphy	2,137	0.02
65	Burlington R.	2,000	0.02
66	Adams R.&E.	1,963	0.02
67	Union Pacific R.	1,924	0.02
68	INA	1,850	0.02
69	China National Offshore	1,792	0.01
70	Kerr-McGee	1,711	0.01
71	Suncor E.	1,556	0.01
72	Enterprise	1,551	0.01
73	Deminex	1,455	0.01
74	Saga	1,391	0.01
75	Canadian Occidental	1,275	0.01
76	National Fuel G.	1,269	0.01
77	Alberta E.	1,240	0.01
78	Gulf Canada R.	1,212	0.01
79	Oryx Energy Co	1,197	0.01
80	Lasmo plc	1,182	0.01
81	Apache	1,176	0.01
82	ONEOK	1,162	0.01
83	Dansk oile of Naturgas A/S	1,134	0.01
84	Noble Affiliates	1,117	0.01
85	Global Marine	1,075	0.01
86	Tailsman E.	1,033	0.00
87	Montana Power	1,024	0.00
88	Husky Oil	983	0.00
89	Questar	957	0.00
90	MCN Investment	951	0.00
91	Tesoro	945	0.00
92	Union Texas	933	0.00

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Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
93	Plain R.	862	0.00
94	Petroleum co. of Trinidad and Tobago	817	0.00
95	Mitchell E.&D.	799	0.00
96	Fletcher Challenge E.	739	0.00
97	TransTexas G.	736	0.00
98	Woodside	686	0.00
99	Renaissance E.	685	0.00
100	Anadarko Petroleum	675	0.00
101	Canadian N.R.	665	0.00
102	Santos	640	0.00
103	Japan Petroleum Exploration	629	0.00
104	Seagull E.	552	0.00
105	Pioneer N.R.	546	0.00
106	Anderson Exploration	542	0.00
107	Helmerich & Pavne	518	0.00
108	Santa Fe E. R.	517	0.00
109	Numac E.	504	0.00
110	Poco Petroleums	461	0.00
111	Vintage	417	0.00
112	Crestar E.	416	0.00
113	Oil & Gas Development	398	0.00
114	Barrett R.	383	0.00
115	Nuevo E.	358	0.00
116	Ranger	351	0.00
117	Forest	340	0.00
118	EEX	315	0.00
119	Black Hills	314	0.00
120	Devon E.	313	0.00
121	Ocean E.	294	0.00
122	Forcenergy	288	0.00
123	Pogo Producing	287	0.00
124	Southwestern E.	276	0.00
125	Premier Oil plc	272	0.00
126	United Meridian	267	0.00
127	Snyder	256	0.00
128	HS R.	234	0.00
129	Ouis Dreyfus N. G.	233	0.00
130	Chesapeake E.	233	0.00
131	Cross Timbers	201	0.00
132	Newfield Exploration	201	0.00
133	Enerplus	201	0.00
134	Patterson E.	192	0.00
135	Tarragon O.&G.	185	0.00
136	CMS Nomeco O. & G.	169	0.00
137	Canadian Occidental	166	0.00
138	Penn West Petroleum	157	0.00

Appendix Table A1
280 Oil Industry Companies and H-index Based on
Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
139	Rigel E.	156	0.00
140	Lomak	149	0.00
141	KCS E.	144	0.00
142	Rio Alto Exploration	135	0.00
143	Tom Brown	129	0.00
144	Belco O.&G.	127	0.00
145	Huston Exploration	118	0.00
146	Newport Petroleum	101	0.00
147	Patina O.&G.	100	0.00
148	Barrington	93	0.00
149	Ulster	93	0.00
150	St. Mary L.&E.	92	0.00
151	United Meridian	92	0.00
152	Coparex Int'l	91	0.00
153	Comstock R.	89	0.00
154	BHP (Americas)	88	0.00
155	Wiser	88	0.00
156	Denbury R.	86	0.00
157	Taurus Exploration	86	0.00
158	Belden & Blake	84	0.00
159	Pacalta R.	83	0.00
160	Arch Petroleum	81	0.00
161	Swift E.	80	0.00
162	Hugoton E.	77	0.00
163	Costilla E.	77	0.00
164	Kelley O.&G.	76	0.00
165	Clayton Williams E.	75	0.00
166	Titan Exploration	74	0.00
167	Petroleum Development	74	0.00
168	Castle E.	73	0.00
169	Chieftain Int'l	72	0.00
170	Chieftain Int'l	72	0.00
171	Stone E.	71	0.00
172	Anraxas	71	0.00
173	National G.&O.	70	0.00
174	Berry	69	0.00
175	Fidelity	68	0.00
176	Coho E.	64	0.00
177	Hardy O.&G.	63	0.00
178	Remington O.&G.	61	0.00
179	Meridian R.	58	0.00
180	National E.	56	0.00
181	Oil co. of Australia	56	0.00
182	Domain E.	52	0.00
183	Magnum hunter R.	50	0.00
184	San Juan Basin Royalty Trust	50	0.00

Appendix Table A1
280 Oil Industry Companies and H-index Based on
Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
185	Bellwether Exploration	46	0.00
186	Hallwood E. Partners LP	45	0.00
187	Callon	44	0.00
188	Key Prod.	42	0.00
189	Panaco	39	0.00
190	Prima E.	39	0.00
191	American R. of Delaware	38	0.00
192	Saba	36	0.00
193	Petrocorp	35	0.00
194	Howell	34	0.00
195	Hallwood Consolidated R.	32	0.00
196	Prime E.	29	0.00
197	Maynard	28	0.00
198	Sabine Royalty Trust	26	0.00
199	Basin Exploration	25	0.00
200	Penn Virginia O.&G.	25	0.00
201	Gothic E.	24	0.00
202	Permian Basin Royalty Trust	23	0.00
203	HarCor E.	22	0.00
204	Tatham Offshore	21	0.00
205	Crystal	20	0.00
206	Harken E.	19	0.00
207	Dorchester Hugoton	19	0.00
208	Inland R.	18	0.00
209	Equity	18	0.00
210	Wilshire of Texas	16	0.00
211	OEC Compression	16	0.00
212	Southern Mineral	15	0.00
213	Columbus E.	15	0.00
214	Petroz NL	15	0.00
215	McMoran O.&G.	14	0.00
216	Evergreen R.	13	0.00
217	Tipperary	13	0.00
218	Parallel	13	0.00
219	Goodrich Petroleum	13	0.00
220	LL & E Royalty Trust	13	0.00
221	Apache Offshore investment	12	0.00
222	Cross Timbers Royalty Trust	11	0.00
223	Middle Bay	11	0.00
224	Enex R.	11	0.00
225	Brigham Exploration	10	0.00
226	North Coast E.	10	0.00
227	Aviva	10	0.00
228	Vineyard O.&G.	10	0.00
229	Carrizo O.&G.	9	0.00
230	Mallon R.	9	0.00

Appendix Table A1
280 Oil Industry Companies and H-index Based on
Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
231	Royale E.	9	0.00
232	South Texas Drilling & Exploration	9	0.00
233	Home-Stake O.&G.	8	0.00
234	Miler Exploration	7	0.00
235	Texoil	7	0.00
236	Midland R.	7	0.00
237	Panhandle Royalty	7	0.00
238	Blue Dolphin E.	5	0.00
239	Pease O.&G.	5	0.00
240	Gulwest	5	0.00
241	Hallador	5	0.00
242	Questa O.&G.	5	0.00
243	United States Exploration	4	0.00
244	Fortune N.R.	4	0.00
245	Oakridge E.	4	0.00
246	GeoResources	4	0.00
247	F X E.	3	0.00
248	Venus Exploration	3	0.00
249	Credo	3	0.00
250	Reserve	3	0.00
251	Toreador Royalty	3	0.00
252	Basic Earth Science Sys.	3	0.00
253	Tatum Petroleum	3	0.00
254	Roseland O.&G.	3	0.00
255	Energy Search	2	0.00
256	Delta	2	0.00
257	Daleco R.	2	0.00
258	Foreland	2	0.00
259	Great Northern	2	0.00
260	Texas Vanguard	2	0.00
261	Pyramid	2	0.00
262	Spindletop O.&G.	2	0.00
263	Benz E.	1	0.00
264	MSR Exploration	1	0.00
265	The Exploration	1	0.00
266	Zydeco E.	1	0.00
267	Future	1	0.00
268	Kestrel E.	1	0.00
269	McGowen R.	1	0.00
270	Mexco E.	1	0.00
271	Tri-Valley Corp	1	0.00
272	Frontier N.G.	1	0.00
273	Caspen Oil	1	0.00
274	Double Eagle P.&M.	1	0.00
275	Petrominerals	1	0.00
276	Altex Ind.	1	0.00

Appendix Table A1
280 Oil Industry Companies and H-index Based on
Total Revenues (\$ millions) 1997

Rank by Revenue	Company	Total Revenue	H-index
277	Cotton Valley R.	-	0.00
278	Petro Union	-	
279	Mountains West Exploration	-	
280	Empiric Energy	-	
	total	1,475,774	389.35
	top 10	709,827	324.60
	top 20	996,691	363.52
	top 30	1,167,711	378.62

Companies with no data available

Bahrain Nat'l
Dubai
Empresa Colombiana de Petroleos
Empresa Nacional del Petroleo
Enterprise Tunisienne Activities
Ministry of E.&Infrastructure
Ministry of Petroleum&Minerals
Pakistan Petroleum
Petrleum Unit
Petroleos de Peru SA
Petroleos Del Ecuador
Qatar General
Saudi Arabian
State Oil co Suriname N.V.
Syrian
Tengasco
Turkish

Note: For the 11 companies with production data, but no 1997 revenue data available, we use the formula:

$$\text{Revenue} = \text{Production (in millions of barrels)} * \$20.61 (\text{avg price of crude oil in 97}) * 1.5$$

Sources: Oil and Gas Journal Data Book, Tulsa, Oklahoma, Pennwell Books, 1999.