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# The Impact of Environmental Compliance Costs on U.S. Refining Profitability

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# Preface

This report assesses the effects of pollution abatement requirements on the financial performance of U.S. petroleum refining and marketing operations. The analysis draws heavily on financial and operating data from the Energy Information Administration's Financial Reporting System (FRS). Pursuant to Section 205(h) of the Department of Energy Organization Act, which established the FRS, the Energy Information Administration, through its Form EIA-28, collects financial information and other measures of energy-related business efforts and results for major energy companies. Since the FRS data are collected on a uniform, segmented basis, the comparability of information across energy lines of business is unique to this reporting system. In 1995, 24 companies filed Form EIA-28. Also essential to the analysis are data on pollution abatement costs and capital expenditures collected and published separately by the Bureau of the Census and the American Petroleum Institute. The information in this report is intended for use by the U.S. Congress, Government agencies, industry analysts, and the general public.

# Introduction and Summary

The profitability of U.S. refining operations in the 1990's has been low and generally declining. This trend raises concerns about the long-term prospects for investment in this key energy sector. Growth in capacity, modest growth in product demand, and heightened environmental standards have contributed to this development. In particular, U.S. refiners have sharply increased their capital expenditures in response to the requirements of the Clean Air Act Amendments of 1990. The main focus of this presentation is on the financial impacts of these U.S. refining pollution abatement investment requirements in the 1990's.

The analysis presented in this report utilizes a financial reporting framework drawing on government and industry data sources. The results are for the major energy companies reporting to the Energy Information Administration's Financial Reporting System (described below). For these companies, the results in this report indicate that the financial effects of pollution abatement requirements on U.S. refining operations in the 1990's have been minor in relation to the overall deterioration in the financial performance of the industry.

Comparing financial measures for 1988 and 1989, which were years of high refining/marketing profitability just prior to the passage of the (Federal) Clean Air Act Amendments of 1990, to the most recently available results for 1993 through 1995, suggests that about 5 percent of the $1.52 ($1995) per barrel decline in the majors' net cash margin from U.S. refining and marketing operations came from increased operating costs traceable to pollution abatement. Further, of the 12 percentage point decline over the 1988 to 1995 period in the return on investment to the majors' U.S. refining/marketing operations, slightly over 1 percentage point can be attributed to increased capital expenditures and operating costs for pollution abatement.

This analysis draws on data from the Energy Information Administration's Financial Reporting System (FRS), the Bureau of the Census' *Pollution Abatement Costs and Expenditures*, and the American Petroleum Institute's *Petroleum Industry Environmental Performance*.[1] The FRS is an annual survey that collects, through Form EIA-28, financial and associated operating information from the top 24 U.S.-based major energy producing companies. The data are reported on a line-of-business basis, including the U.S. petroleum refining and marketing line of business. The FRS companies occupy a major part of the U.S. refining industry. For example, during the 1990's thus far, the FRS companies' share of U.S. crude distillation capacity has ranged from 66 percent to 69 percent. However, the FRS does not collect financial data on pollution abatement. Capital expenditures and operating costs for pollution abatement for the FRS companies are prorated, on the basis of their share of refining capacity, from totals for the entire U.S. refining industry reported in various issues of the Census publication through 1994. Pollution abatement data for 1990 through 1995 were also collected by the American Petroleum Institute. These data are used for estimates of the FRS companies' pollution abatement expenditures and costs for 1995.[2] Both of these data collection programs recognize that estimates may be necessary in order to provide pollution abatement expenditures and costs. Nevertheless, the data are provided by the companies actually incurring the expenditures and, consequently, are based on operating experience rather than engineering estimates alone.

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[1]U.S. Bureau of the Census, *Pollution Abatement Costs and Expenditures: 1994*, MA200(94)-1 (Washington, DC, 1996), pp. 6-7. American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997), pp. 47-48. The FRS data and associated analyses of financial developments in energy markets are reported annually, most recently in Energy Information Administration, *Performance Profiles of Major Energy Producers 1995*, DOE/EIA-0206(95)(Washington, DC, January 1997).

[2]Although the capital expenditures reported by the American Petroleum Institute were about 23 percent greater than capital expenditures reported by the Bureau of the Census, year-to-year changes were close in value (Figure 3). Operating costs reported by the two sources differed by only 8 percent over the 1990-1994 period of overlapping data collection. Consequently, pollution abatement capital expenditures for 1995 were estimated as Census expenditures for 1994 plus the change in capital expenditures from 1994 to 1995 reported by the American Petroleum Institute. In comparing operating costs for 1993-1994 with 1995 operating costs, the American Petroleum Institute data were used.

# Key Findings

**Over the past decade, the profitability of the FRS companies' U.S. refining/marketing operations has been volatile and, in the 1990's thus far, below that of their other businesses generally (Figure 1).**

The measure shown in Figure 1, termed return on investment (ROI), is net income contributed by the FRS companies' U.S. refining / marketing line of business (excluding unallocable items, mainly interest expense) per dollar of net fixed assets in U.S. refining and marketing, expressed as a percent. Also shown in Figure 1 is the analogous measure for all of the other FRS companies' lines of business on a combined basis. The profitability of the FRS companies' U.S. refining / marketing operations reached an all-time peak in the 1988 to 1989 period. Since then, profitability steadily declined to near zero in 1992 and, although registering a sharp uptick in 1996, was below the profitability of other businesses throughout the 1990's. As a general economic tendency, chronic subnormal profit performance should discourage investment.

**The poor financial performance of the majors' U.S. refining/marketing operations was echoed by the corporate profitability of smaller, specialized refiners (Figure 2).**

The measure shown in Figure 2 is return on equity (net income as a percent of shareholders' equity, shareholders' equity being the book value of ownership), a commonly-used measure of a corporation's profitability. Profitability of publicly-traded, non-FRS companies specializing in U.S. refining / marketing operations (representing an additional 12 percent of U.S. refining capacity in 1996) has also declined sharply in the 1990's and generally has been below that of the FRS companies and industry overall.

**Although U.S. refining/marketing profitability has been low in the 1990's, the FRS companies noticeably increased their capital expenditures for their U.S. refining operations (Figure 3).**

Adjusted for general inflation (via the implicit gross domestic product deflator), the FRS companies' capital expenditures for U.S. refining doubled from 1989 to 1992. Since 1992, capital expenditures have steadily fallen to historically average levels. The only comparable surge in capital expenditures was in the late 1970's through the early 1980's. During this earlier period, the U.S. majors upgraded their refineries to process heavier, more sulfurous crude oil inputs into relatively greater proportions of lighter products, particularly gasoline. These investments were largely premised on wide price spreads between higher and lower quality crude oils and lighter and heavier refined products (see Figure 7).

Unlike the earlier surge in refinery investment, the upswing in capital expenditures in the 1990's appeared to be largely driven by increased expenditures for pollution abatement. In particular, the Clean Air Act Amendments of 1990 required production of oxygenated gasolines by late 1992, lower sulfur diesel fuels by late 1993, and reformulated gasoline by January 1, 1995. (It must be noted that both the Census and the API instruct the respondents to their surveys to include capital expenditures and operating costs incurred in meeting the Clean Air Act Amendments.)

**The share of total U.S. refining capital expenditures for pollution abatement increased from slightly over 10 percent shortly before the Clean Air Act Amendments of 1990 to over 40 percent in recent years (Figure 4).**

The imposition of heightened environmental quality requirements on the U.S. refining industry stemming from the Clean Air Act Amendments occurred while industry profitability declined sharply and continued at low levels. This observation suggests that heightened environmental quality requirements may have played some role in profit performance. The remainder of this report attempts to assess the impact of heightened environmental standards on operating costs, capital requirements, and profitability in U.S. refining and marketing.

**Since the relationship between refining/marketing profitability and the net refined product margin is strong, some of the effects of pollution abatement standards on profitability can be assessed by examining the net refined product margin (Figure 5).**

The net refined product margin (net margin), shown in Figure 5, is the gross refining margin (refined product revenues less purchases of raw material inputs to refining and refined product purchases) minus out-of-pocket operating costs per barrel of refined products sold. The net margin represents the before-tax cash earnings from production and sale of

refined products and excludes ancillary activities such as non-fuel sales from convenience stores. The net margin is an important determinant of short-term decisions in refining operations. Basically, for a given scale and configuration of a refinery, output will tend to be expanded as long as the added output adds to cash earnings. The net margin is also closely related to refining / marketing profitability. Figure 5 shows that when cash earnings per barrel sold (adjusted for inflation) are high, so is refining / marketing profitability. The correlation between ROI and the net margin is 0.92, which is highly significant by the usual statistical conventions.[3] Some insights can be gained by examining the effects of pollution abatement operating costs on the net margin. More specifically, this report examines components of the net margin for 1988 through 1989, the peak years of profitability, and just prior to The Clean Air Act Amendments, and 1993 through 1995, the most recent years for which data are available.

**Pollution abatement operating costs have been and continue to be a small part of overall operating costs (Table 1).**

As a share of total refining / marketing operating costs, pollution abatement operating costs ranged from 6 percent in 1988 to 1989 to 10 percent in 1995. Further, the increase in pollution abatement operating costs ($1995) over this period was 7 cents per barrel of refined products sold, or 5 percent of the $1.52 per barrel decline in the net margin. Based on these results, the direct effects on operating costs of heightened environmental standards from 1990 on appear to have had only a small role in the deterioration of cash margins in U.S. refining and marketing. This conclusion must be tempered with the possibility that the Census and API pollution abatement operating costs may not have captured all the costs of manufacturing reformulated gasoline, which commenced in late 1994. However, the results presented in this report are reinforced by one of the conclusions of a recent EIA report which did examine the added costs of reformulated gasoline, that "A close examination reveals that the change in refining costs attributable to RFG [reformulated gasoline] had no major impact on margin behavior between 1993 and 1995. In fact, other market factors overwhelmed any impact of the introduction of RFG."[4]

**Table 1. Components of the Net Refining Margin for FRS Companies, 1988-1989, 1993-1994, and 1995**
($1995 per barrel of refined products sold)

| | Census-based Data[a] | | API-based Data[b] | |
|---|---|---|---|---|
| | 1988-1989 | 1993-1994 | 1993-1994 | 1995 |
| Gross Refining Margin | 8.29 | 6.58 | 6.58 | 5.51 |
| Pollution Abatement Operating Costs | 0.38 | 0.40 | 0.43 | 0.48 |
| Other Refining and Marketing Costs | 5.88 | 5.38 | 5.35 | 4.52 |
| Net Refining Margin | 2.03 | 0.80 | 0.80 | 0.51 |
| Refined Products Sold (Mbd) | 13,607 | 13,317 | 13,317 | 13,641 |

[a]Pollution abatement operating costs from Bureau of the Census. The last year of data collection was 1994.
[b]Pollution abatement operating costs from American Petroleum Institute. Data were collected for the years 1990-1995.
Note: All dollar amounts are 1995 dollars per barrel of refined products sold by the FRS companies. Gross refining margin=refined product revenues less raw material purchases and refined product purchases. Net refining margin=gross margin less operating costs.
Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System). U.S. Department of Commerce, Bureau of the Census, *Pollution Abatement Costs and Expenditures* (various issues) (Washington, DC). American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997).

**The main factor affecting the net margin from 1988 on has been a near continual decline in the spread between refined product prices and raw material input costs (Figure 6).**

The FRS companies' consolidation of U.S. refining / marketing operations and direct reductions in energy expense, gasoline marketing expenses, and other refining and product supply expenses have reduced operating costs (excluding pollution

[3]The regression corresponding to Figure 5 is
ROI = -1.28 + 6.14*Net Margin ($1995), $R^2$=0.85, with a t-ratio of 10.22 for the net margin coefficient.
[4]Energy Information Administration, *Petroleum 1996: Issues and Trends*, DOE/EIA-0615(97)(Washington, DC, September 1997), p. 137. The quoted conclusion is largely based on findings presented in John Zyren, Charles Dale, and Charles Riner, "1995 Reformulated Gasoline Market Affected Refiners Differently," Energy Information Administration, *Petroleum Marketing Monthly*, DOE/EIA-0380 (96/01) (January 1996).

abatement operating costs) by slightly more than $1.30 per barrel of product sold between the period 1988 to 1989 and 1995, with most of the reductions occurring since 1992. However, the decline in the FRS companies' gross margin of nearly $2.80 per barrel more than offset the effects of consolidation and cost-cutting. The gross margin has clearly trended downward since 1988, unlike the 1977 through 1988 period when the gross margin, though volatile from year to year, showed no upward or downward trend. Although the FRS companies' raw material prices for inputs to refineries declined after 1988-1989, refined product prices realized by the companies have declined even more (Table 2).

**Table 2. Components of the Gross Refining Margin and Average Refined Product Revenues for the FRS Companies, 1988-1989, 1993-1994, and 1995**
($1995 per barrel of refined products sold)

| | 1988-1989 | 1993-1994 | 1995 |
|---|---|---|---|
| Average Refined Product Revenues | 28.25 | 24.79 | 24.24 |
| Raw Material Acquisition Costs | 14.50 | 12.41 | 12.50 |
| Refined Product Purchases | 5.46 | 5.80 | 6.23 |
| Gross Refining Margin | 8.29 | 6.58 | 5.51 |
| **Average Refined Product Revenues** | | | |
| Motor Gasoline | 32.27 | 27.63 | 27.13 |
| Distillate | 26.97 | 23.61 | 22.14 |
| Other Products | 22.08 | 20.36 | 20.77 |
| All Refined Products | 28.25 | 24.79 | 24.24 |

Note: Revenues exclude excise taxes.
Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

**The decline in the price spread between crude oils of differing qualities contributed to the overall deterioration in the gross margin (Figure 7).**

The FRS companies directed much of the surge in their refining investment in the late 1970's to early 1980's (Figure 3) toward increasing their capability to process heavier, more sulfurous crude oils. For example, the FRS companies' capacity for increased processing of heavy-sour crude inputs, relative to basic crude distillation capacity, rose from 22 percent in 1974 to 30 percent in 1980 to 47 percent in 1993.[5] The expected returns on these type of investments were based on a growing spread in the price of high quality crudes relative to the price of lower quality crudes. For example, Figure 7 shows a large price differential until 1982, followed by a sharp decline in the price differential and then a steep rise in the late 1980's. The growing price spread between crude qualities in the late 1980's increased the returns to processing investments and contributed to the growth in U.S. refining/marketing profitability. Conversely, when the spread narrowed, returns to process upgrading investments deteriorated. During the 1990's, the quality price spread narrowed sharply, adversely affecting the gross margins realized by process-upgraded refineries, and did not register an uptick until 1996.

**Lower refined product prices also contributed to the decline in gross margins in the 1990's (Table 2).**

The FRS companies' average refined product prices in 1995 were down $4 per barrel ($1995) from the peak profitability years of 1988 to 1989. Gasoline registered the sharpest price decline over this period ($5.14) followed closely by distillate prices (down $4.83 per barrel) while the composite price of other products (mainly residual fuel oil and chemical feedstocks) was down a less steep $1.31 per barrel. That is, not only did refined product prices decline, but the spread in price between light products and heavy products deteriorated. This latter development was especially adverse for refiners who invested heavily in refinery upgrades to yield higher proportions of light products. In particular, the FRS companies increased their capability to produce greater yields of light products, relative to crude distillation capacity, from 56 percent in 1974 to 80 percent in 1993.[6]

[5]Energy Information Administration, *Performance Profiles of Major Energy Producers 1993*, DOE/EIA-0206(93)(Washington, DC, January 1995) p. 88.

[6]Energy Information Administration, *Performance Profiles of Major Energy Producers 1993*, DOE/EIA-0206(93)(Washington, DC, January 1995) p. 88.

These disproportionate price reductions in the 1990's in large part reflect the growth in U.S. refiners' capability to produce greater quantities of light products in the face of moderately growing demand for these products. Part of the growth in light product capability was integral with meeting requirements to produce reformulated fuels by 1995. For example, according to a recent EIA publication,[7] the Clean Air Act Amendments resulted in downstream capacity additions ranging from 7 to 10 percent while the U.S. capacity to produce oxygenate additives (MTBE plus TAME) has more than doubled since 1990. However, the effects of complying with the Clean Air Act Amendments on light product capability and prices are transitory and basically a matter of timing. That is, compliance with heightened environmental standards can be viewed as having placed some capacity expansions in service earlier rather than later. Nevertheless, if future product demand growth is considerably lower than currently anticipated, then capacity expansions occasioned by pollution abatement compliance can prove to be a longer-term drag on refining/marketing profitability.

**The additional capital expenditures stemming from heightened pollution abatement requirements for the U.S. refining operations of the FRS companies have added to the capital intensity of U.S. refining in the 1990's (Figure 8).**

The capital intensity of a process refers to the amount of capital needed to produce a unit of product. Since capital goods tend to be heterogeneous, a common measure (such as dollars) is used to measure capital. For the U.S. refining operations of the FRS companies, capital intensity is measured by the ratio of net property, plant, and equipment (i.e., the balance sheet value of productive long-term assets adjusted for depreciation) to refinery capacity (barrels per calendar day of crude distillation capacity).

The capital intensity of U.S. refining registered a sharp rise in the 1978 through 1983 period, reflecting the surge in investments for upgrading refineries to process lower quality crude oils and increase light product yields. During this period, capital expenditures for pollution abatement in refining, adjusted for inflation, declined in amount and as a share of overall refining expenditures, from 30 percent to 10 percent. By contrast, during the latest rise in capital intensity, beginning in 1989, the FRS companies' pollution abatement expenditures for U.S. refining operations rose sharply, both in amount (Figure 3) and relative to overall capital spending for U.S. refineries (Figure 4) accounting for 31 percent of capital expenditures in the 1990-1995 period.

Profitability and capital intensity are related in that if a process becomes more capital intensive, then profitability will decline unless there is an offsetting increase in profit per unit of output.

**Although pollution abatement requirements clearly reduced the rate of return to refining/marketing assets, these requirements appear to account for only a small part of the steep decline in the rate of return to U.S. refining/marketing operations in the 1990's (Figure 9).**

One way to assess the effects of environmental requirements on refining/marketing profitability is to compare the actual return on investment (ROI) with an ROI that excludes operating costs and depreciation attributable to pollution abatement from income and excludes the value of net assets traceable to pollution abatement capital expenditures from the investment base. The ratio of income (after adjustments) to net assets (after adjustments) is an accounting-based measure of profitability excluding the effects on income and assets of pollution abatement requirements. This measure does not take into account the possible market dynamics that might have occurred in the absence of pollution abatement requirements.

The ROI (percent) shown in Figure 9 is the ratio of the FRS companies' annual U.S. refining/marketing operating income (i.e., revenue minus operating expenses) to the value of net property, plant, and equipment (PP&E) allocated to U.S. refining and marketing. This measure correlates highly with the ROI based on net income shown in Figure 1 but avoids having to allocate gains from asset sales and affiliate income.

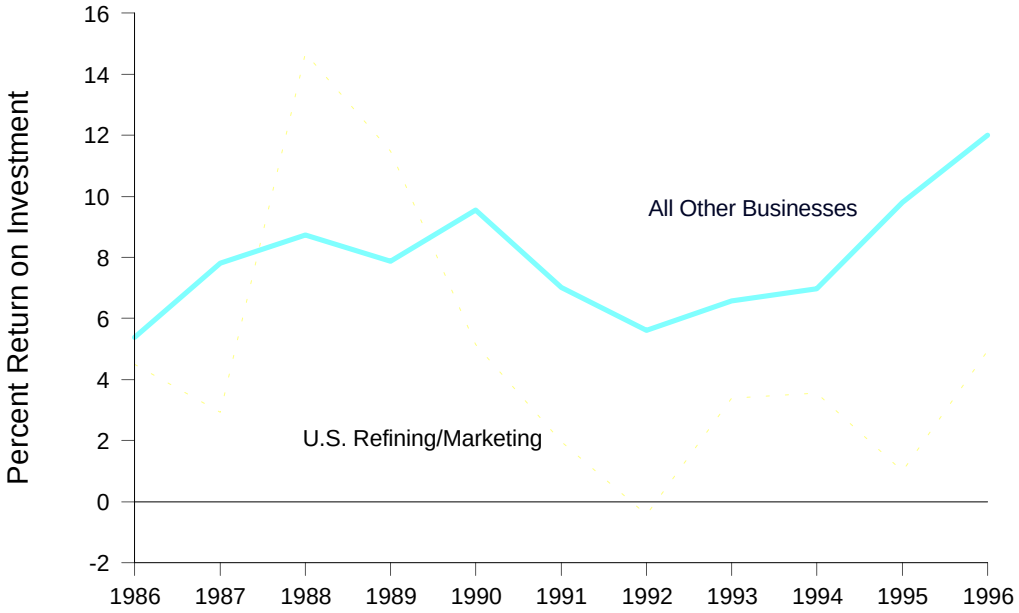
To adjust for the effects of pollution abatement requirements, operating costs and depreciation charges traceable to pollution abatement requirements were excluded from operating income, and the value of net property, plant, and equipment (PP&E) allocable to pollution abatement was excluded from the denominator.

[7]Energy Information Administration, *Petroleum 1996: Issues and Trends* (Washington, DC, September 1997), p. 15.

The key observation from Figure 9 is that the difference between actual ROI and ROI excluding the accounting effects of pollution abatement requirements was 5.2 percentage points in 1988 to 1989, compared to 5.6 percentage points in 1990 (the year of the Clean Air Act Amendments) and 6.9 percentage points in 1995 (the first full year of reformulated gasoline production).

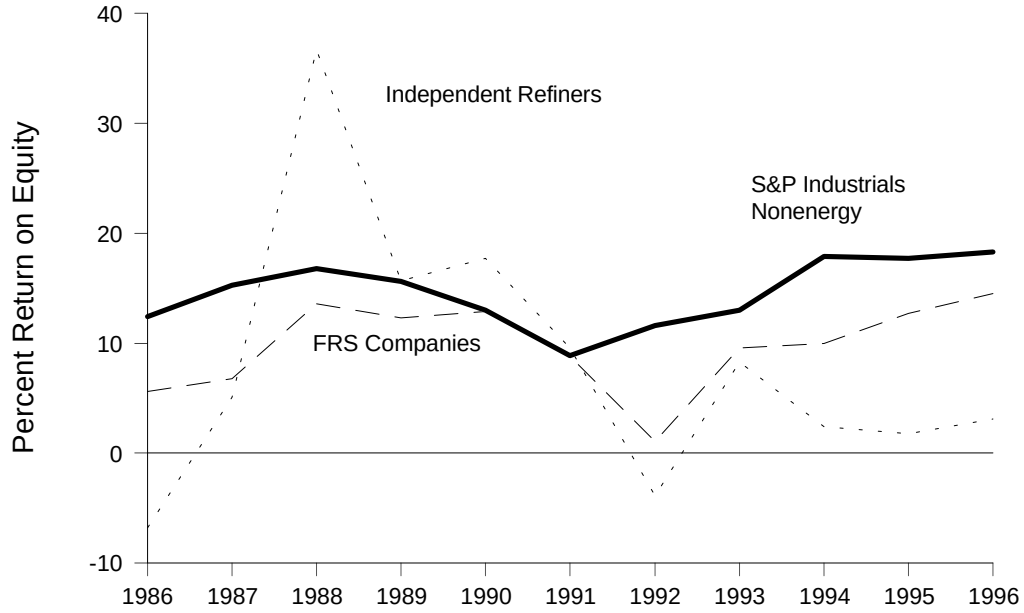
Based on these comparisons, the effect of additional pollution abatement requirements in the 1990's is a reduction of 1.7 percentage points in the operating ROI (i.e., 1988 to 1989's differential of 5.2 percentage points minus 1995's differential of 6.9 percentage points). Since operating ROI is a before-tax measure, the after-tax effect (based on the Federal corporate tax rate of 35 percent) is 1.1 percentage points. This reduction is only a small part (9 percent) of the decline of 12 percentage points between 1988 to 1989 and 1995 in the FRS companies' after-tax return on investment in U.S. refining and marketing.

## Figure 1. FRS Companies' Return on Investment in U.S. Refining/Marketing and All Other Lines of Business



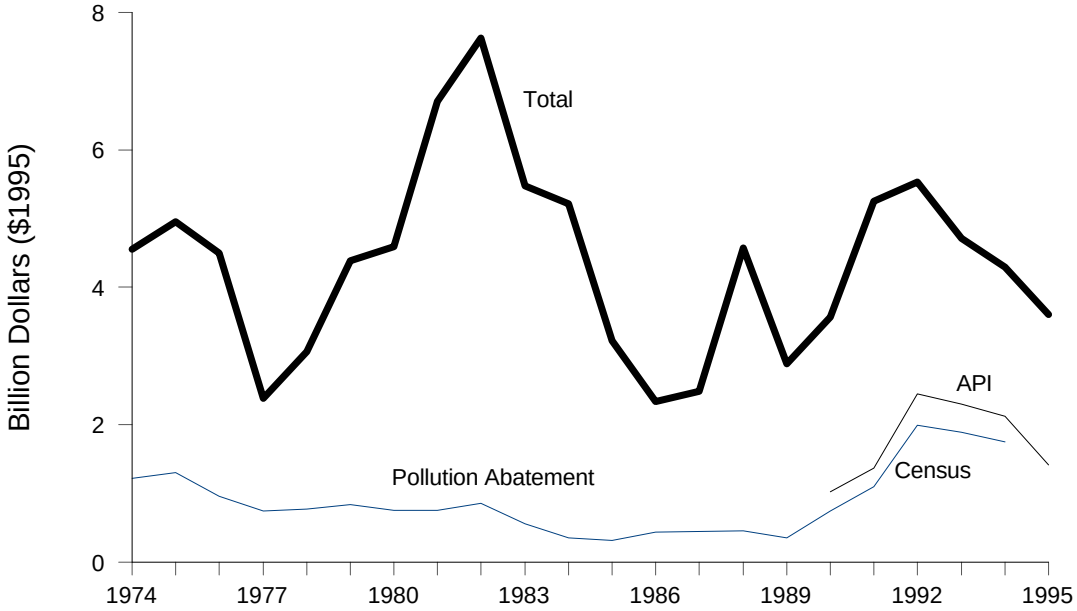

Return on Investment = Net Income Divided by Net Investment in Place.
Source: Energy Information Administration, Form EIA-28(Financial Reporting System) .

## Figure 2. Annual Return on Equity for Petroleum Companies and U.S. Industry



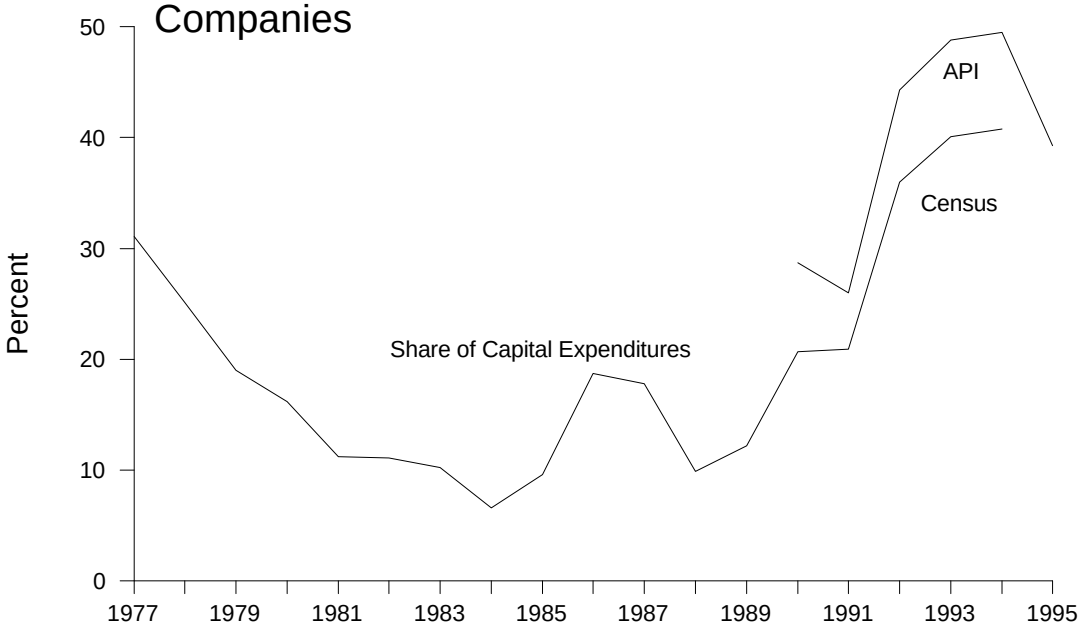

Return on Equity = Net Income as a Percent of Shareholders' Equity.
Source: FRS Companies: Energy Information Administration, Form EIA-28(Financial Reporting System).Other Companies: Compustat and Third Quarter Press Releases for 1996 Results.

## Figure 3. U.S. Refining Capital Expenditures for FRS Companies



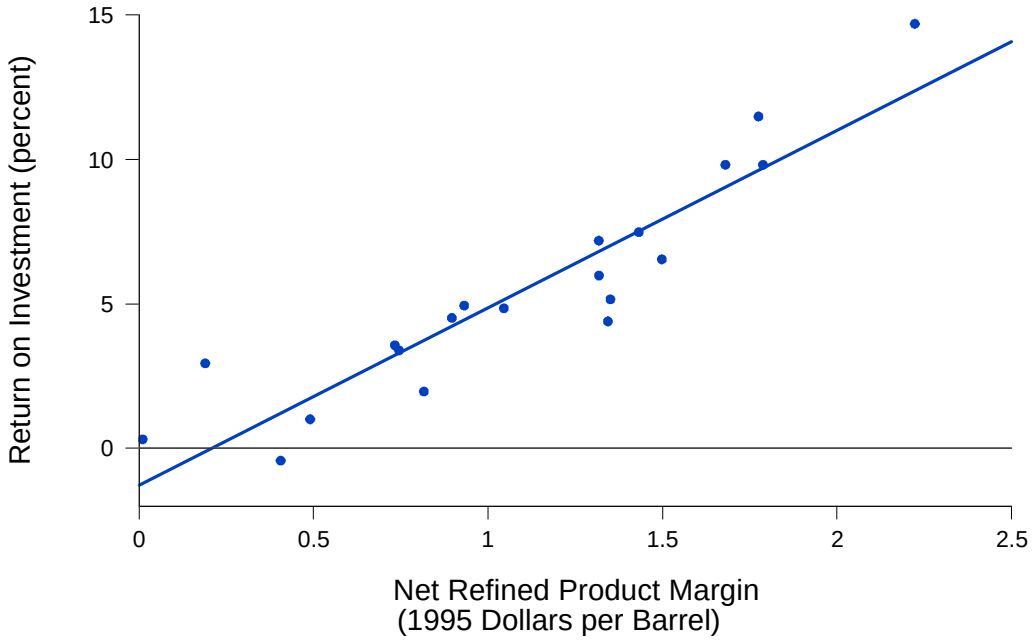

Note: Excludes effects of intra-FRS mergers in 1982 and 1984.
Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System). U.S. Department of Commerce, Bureau of the Census, *Pollution Abatement Costs and Expenditures* (various issues) (Washington, DC). American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997)

Figure 4. Expenditures for Pollution Abatement as a Share of U.S. Refining Capital Expenditures for FRS Companies



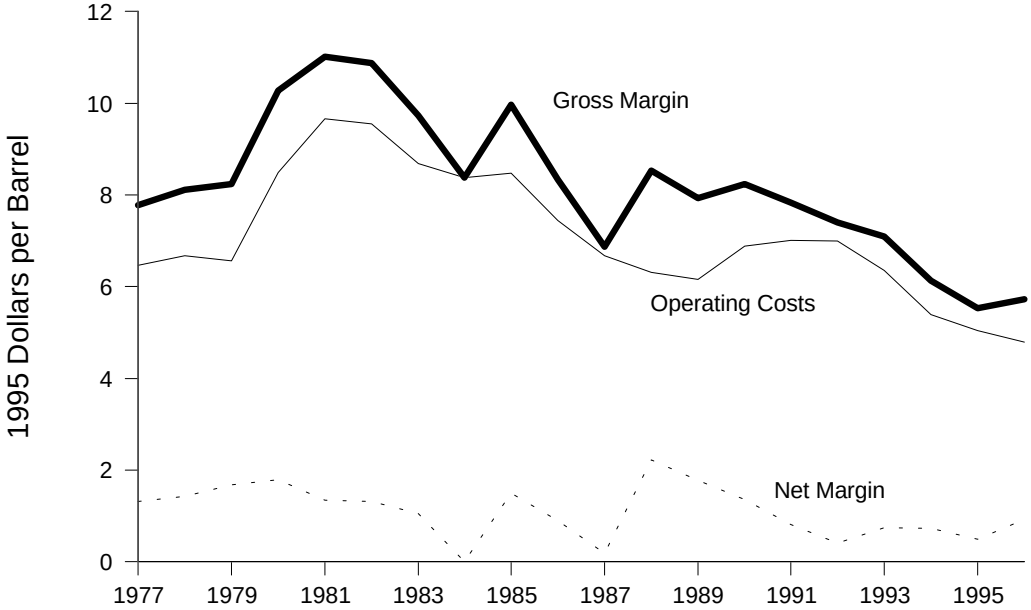

Note: Excludes effects of intra-FRS mergers in 1982 and 1984.
Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System). U.S. Department of Commerce, Bureau of the Census, Pollution Abatement Costs and Expenditures (various issues) (Washington, DC). American Petroleum Institute, Petroleum Industry Environmental Performance (Washington, DC, May 1997)

## Figure 5. U.S. Refining/Marketing Return on Investment and Net Refined Product Margin for FRS Companies, 1977-1996




Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

## Figure 6. Refining/Marketing Margins and Operating Costs for FRS Companies

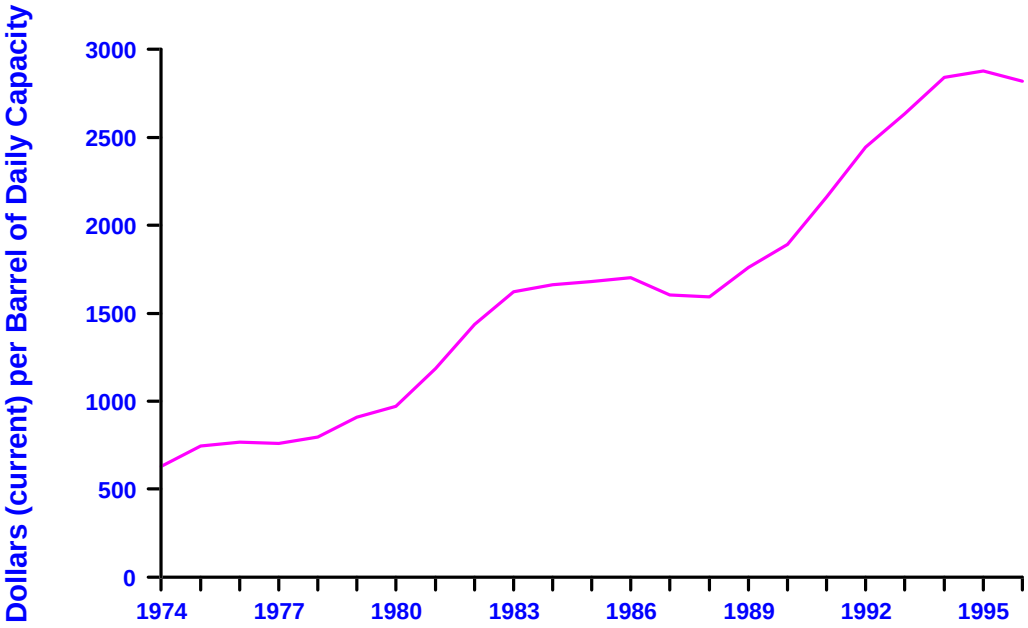



Note: Gross Margin= Refined product revenues less raw material and product purchases per barrel of refined product sold. Net margin=gross margin less operating costs.
Source; Energy Information Administration, Form EIA-28(Financial Reporting System)

## Figure 7. Light Minus Heavy Spot Crude Price Difference (Bonny Light - Arab Heavy)

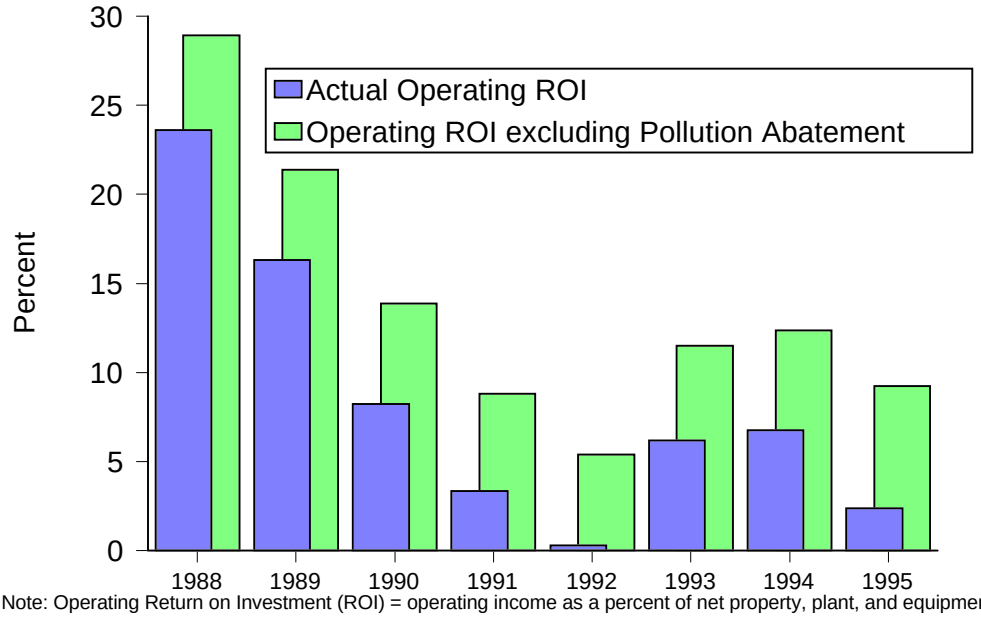

Source:Annual averages of quarterly data appearing in Energy Information Administration, *Petroleum 1996: Issues and Trends*, DOE/EIA-0615(97)(Washington, DC, September 1997)

## Figure 8. Net PP&E per Unit of U.S. Refinery Capacity for FRS Companies




Source: Energy Information Administration, Form EIA-28 (Financial Reporting System).

## Figure 9. Operating Return on Investment in U.S. Refining and Marketing for FRS Companies




Note: Operating Return on Investment (ROI) = operating income as a percent of net property, plant, and equipment (PP&E). Operating ROI excluding Pollution Abatement = operating income less pollution abatement operating costs and less estimated depreciation traceable to pollution abatement as a percent of net PP&E less estimated pollution abatement net PP&E.

Sources: Energy Information Administration, Form EIA-28 (Financial Reporting System). U.S. Department of Commerce, Bureau of the Census, *Pollution Abatement Costs and Expenditures* (various issues) (Washington, DC). American Petroleum Institute, *Petroleum Industry Environmental Performance* (Washington, DC, May 1997)