United States General Accounting Office 131468

GAO

Briefing Report to the Honorable
Thomas A. Luken
House of Representatives

September 1986

ENERGY PRICES

Gasoline Price Increases in Early 1985 Interrupted Previous Trend

131468

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GAO/RCED-86-165BR

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United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-224102

September 25, 1986

The Honorable Thomas A. Luken
House of Representatives

Dear Mr. Luken:

As requested in your August 22, 1985, letter and subsequent discussions with your office, this briefing report provides information on the factors contributing to the rise in gasoline prices in the first half of 1985, including the effect of two mergers in 1984 and actions taken by the Federal Trade Commission (FTC) regarding these mergers. To do our analysis, we first compared gasoline prices with the price of crude oil, which is the largest variable cost in manufacturing gasoline. Because gasoline prices are also affected by many other supply and demand factors, however, we also did a regression analysis of the wholesale gasoline market to examine these other relationships. We focused on the wholesale gasoline market because more comprehensive data were available at that level and because trends in gasoline prices usually are observed first in the wholesale market. Details on our objectives, scope, and methodology are discussed in section 4, and technical details on the design and results of our regression analysis are presented in appendix I.

In 1985 the downward trend in wholesale gasoline prices since 1981 was interrupted despite a continuing gradual decline in crude oil prices. As a result, the spread between these two prices increased in 1985 but only to a level approximating that which existed in 1981 and 1982. (See section 1.) In early 1986, crude oil prices dropped significantly because of an oversupply of crude oil on the world markets. This drop was accompanied by a parallel drop in wholesale gasoline prices.

The two mergers that had the potential to increase market concentration during the first half of 1985 were Texaco, Inc.'s merger with Getty Oil Company and Chevron Corporation's merger with Gulf Corporation. FTC investigated both mergers and permitted them to proceed after entering into consent agreements with the companies that required divestiture of specified assets to remove

potential anticompetitive effects. For example, FTC required Chevron to sell all of Gulf's petroleum product marketing assets in seven southeastern states.

Using data provided by the Department of Energy's Energy Information Administration (EIA), we independently identified those states (four in the Texaco/Getty merger and two in the Chevron/Gulf merger) where it appeared that the mergers could have increased market concentration levels above the amounts permitted by the merger guidelines used by FTC in analyzing mergers. We found that the required divestitures covered all of these states except one. FTC officials indicated that they had determined no action was necessary in that one state because the merged companies could not have controlled the volume of gasoline being supplied to the state; ownership of the marine terminals, through which all of the state's gasoline supplies flowed, was not concentrated. (See section 2.)

Using regression analysis, we examined the effect of changes in market concentration levels in wholesale gasoline markets on prices. Estimates derived from that analysis suggest that in moderately and highly concentrated markets, increases in concentration at the level permitted by the merger guidelines were generally associated with increases in wholesale gasoline prices of about one-half cent per gallon or less. On the basis of these estimates, we believe that increases in concentration as a result of the two mergers would have had at most a very small effect on wholesale gasoline prices.

For our regression analysis we identified factors, including concentration levels, likely to influence the wholesale price of gasoline due to their effects on the quantity producers want to supply, the quantity consumers want to purchase, or both. The results of our analysis suggest that wholesale gasoline prices in 1985 were 4 to 6 percent higher than might have been expected on the basis of the 1985 values of these factors and their estimated relationship to prices. Our results do not provide strong evidence to identify a specific cause for this higher price, but they do suggest that supply factors are more likely to have been responsible than demand factors.

We found that a shift occurred in the sources of gasoline supplied in 1985 compared with the previous 4 years. A smaller percent of the gasoline supplied in the first few

months of 1985 came from domestic production, and more was provided from imports and inventory drawdowns.

Our analysis suggests that one explanation given by industry officials--reduced competition from cheaper imports when foreign production was reduced after settlement of the British coal strike--was probably not an important contributor to the 1985 price increase. However, some of the increase in price could be related to increased costs associated with the required reduction in the amount of lead in gasoline. Also, as noted by several government and industry officials, the refining industry experienced low profitability levels in 1984, and a reduction in domestic gasoline production would not be unexpected under those conditions. (See section 3.)

COMMENTS BY ENERGY AND FTC

We received comments on a draft of this report from the Department of Energy and FTC (see app. II and III). The Department of Energy commented that the EIA staff found the analysis underlying the report to be of high quality but noted several points. First, EIA noted that no explanation was given for the significantly lower demand than expected in 1984 and 1985. Our regression analysis controlled for the decreases in demand in deriving the results presented above. Also reduced demand would tend to cause downward pressure on prices, thus it would not have helped explain why 1985 prices were higher than expected. We, therefore, chose not to do the additional data collection and analysis that would have been necessary to determine which factors caused the demand to be lower than expected. The remaining points noted by EIA dealt with technical aspects of our analysis and are discussed in appendix II.

FTC expressed doubt that our finding of a small positive relationship (less than one-half cent per gallon) between concentration and price would be applicable in relatively unconcentrated markets. FTC noted that their merger guidelines assume that mergers in unconcentrated markets are unlikely to affect prices. For the limited purpose of our analysis, resolving this issue is relatively unimportant. Regardless of whether there is a small relationship between concentration and price in these markets or none at all, we believe that our conclusion that the 1985 price increases were not primarily the result of increases in concentration from recent mergers is sound. Nonetheless, in response to FTC's comments, we

performed additional statistical analysis using FTC's criterion for dividing unconcentrated markets from moderately and highly concentrated ones. The results of this analysis showed a similar relationship between concentration and price in both groups of markets. Other specifications, such as a different dividing point between unconcentrated and moderately and highly concentrated markets, might yield different results. FTC's technical points are discussed in appendixes I and III.

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As arranged with your office, we plan no further distribution of this report until 7 days after the issue date, unless you publically announce its contents earlier. At that time, we will send copies to the Secretary of Energy, the Chairman of FTC, and other interested parties. If we can be of further assistance, please contact me at (202) 275-8545.

Sincerely yours,

For Gerald H. Elsken

James Duffus III
Associate Director

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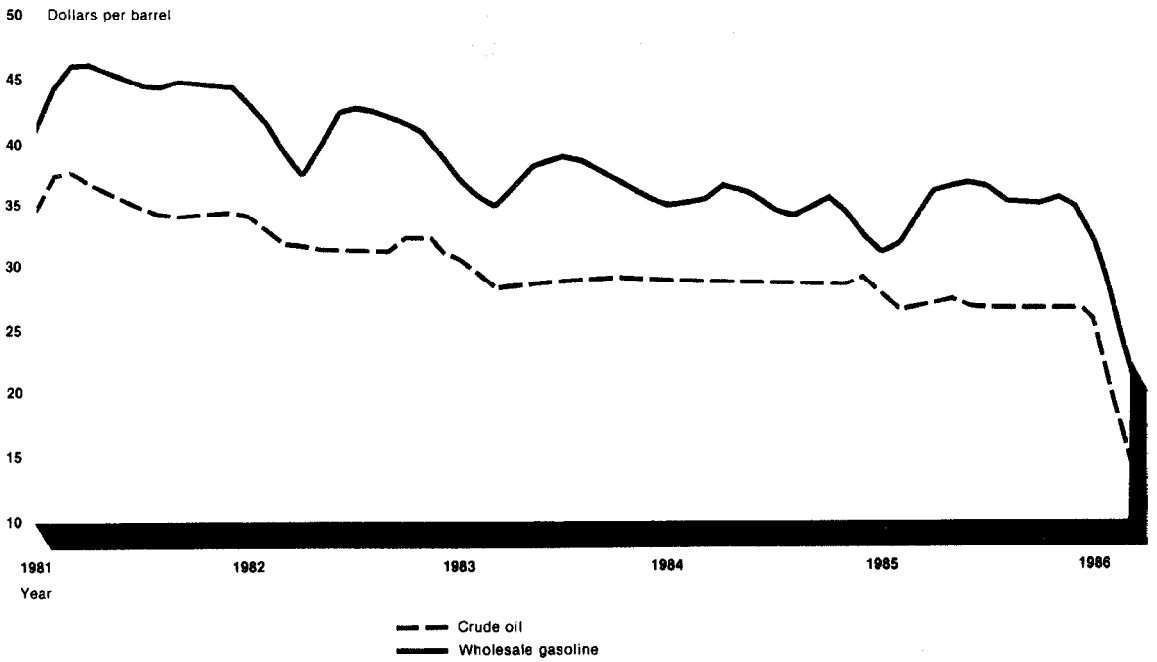
ABBREVIATIONS

EIA	Energy Information Administration
FTC	Federal Trade Commission
FRS	Financial Reporting System
GAO	General Accounting Office
HHI	Herfindahl-Hirschman Index
MC	Marginal cost
MR	Marginal revenue
O.L.S.	Ordinary Least Squares
RCED	Resources, Community, and Economic Development Division
2SLS	Two-stage Least Squares

SECTION 1

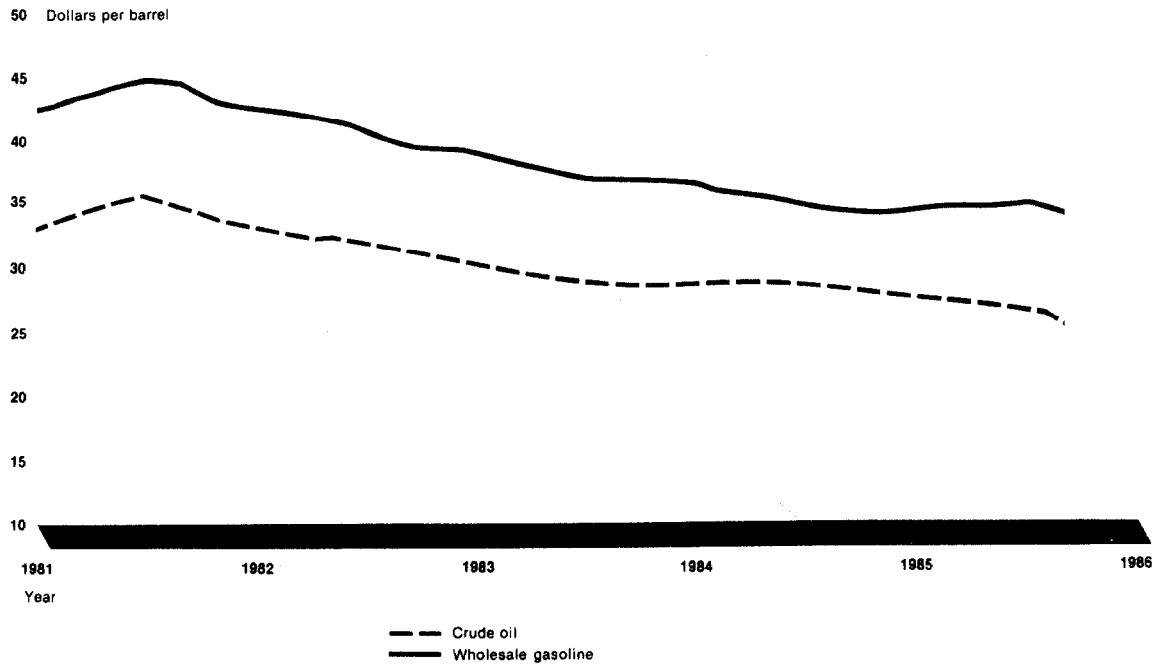
INCREASES IN GASOLINE PRICES DURING THE JANUARY TO JUNE 1985 PERIOD INTERRUPTED THE DOWNWARD TREND OF THE PRIOR 4 YEARS

Figure 1.1: Comparison of Crude Oil and Wholesale Gasoline Prices (1981-March 1986)



Source: EIA data.

Figure 1.2: Comparison of Seasonally Adjusted Crude Oil and Wholesale Gasoline Prices (1981-Sept. 1985)



Source: GAO calculations based on EIA data.

TRENDS IN GASOLINE AND CRUDE OIL PRICES

Figure 1.1 shows the relationship between crude oil prices (based on refiners' average acquisition cost) and wholesale gasoline prices.

--From 1981-84 crude oil and wholesale gasoline prices went steadily downward, but in the short term there does not appear to be a direct relationship between the two prices.

--Wholesale gasoline prices tend to have a stronger seasonal variation because the higher level of demand for gasoline during the summer driving season causes prices to go up.

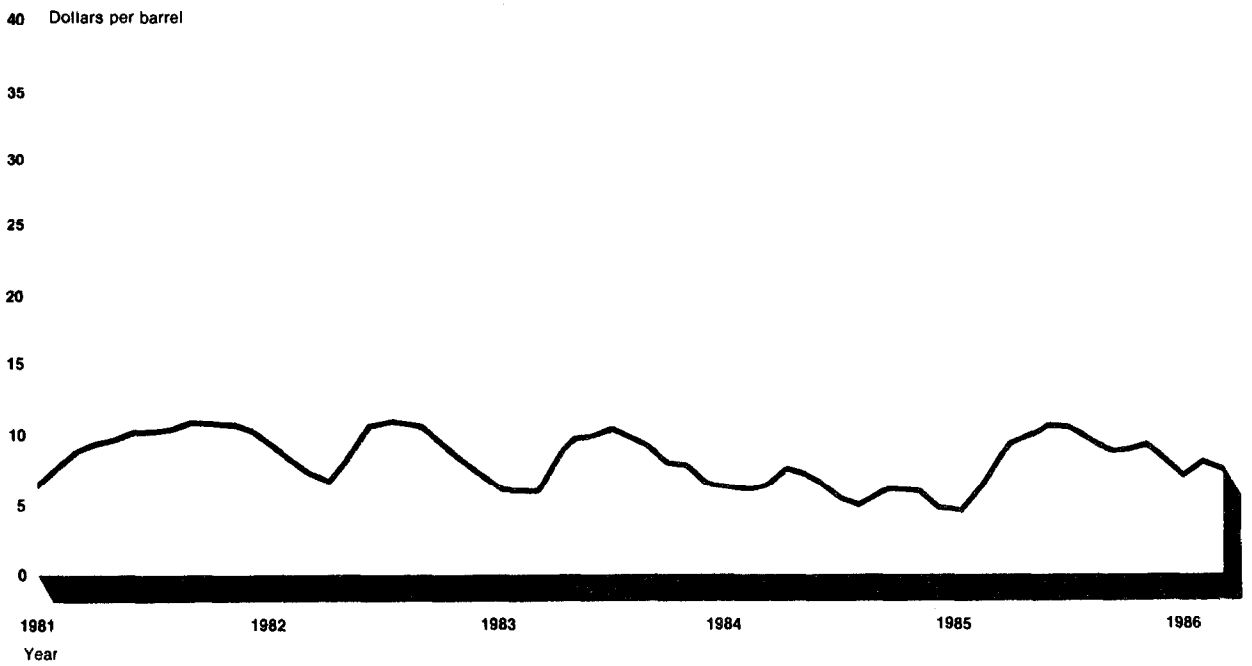
--Wholesale gasoline prices increased by $5.25 per barrel (about 16.6 percent) between January and June 1985 which exceeded the increase in any of the previous 4 years. In contrast, crude oil prices dropped about 50 cents a barrel between January and February and then rose slightly through May.

Figure 1.2 shows the crude oil and wholesale gasoline prices adjusted to remove the seasonal variation.

--Both prices still show a strong downward trend, but wholesale gasoline prices leveled off in early 1985 while in previous years they had declined.

--Crude oil prices continued to decline in 1985, so the gap between the two prices widened.

Figure 1.3: Difference Between Crude Oil and Wholesale Gasoline Prices (1981-March 1986)



Source: GAO calculations based on EIA data.

While the difference between crude oil and wholesale gasoline prices increased in 1985, it did not exceed the differences that existed in 1981 and 1982, as shown in figure 1.3.

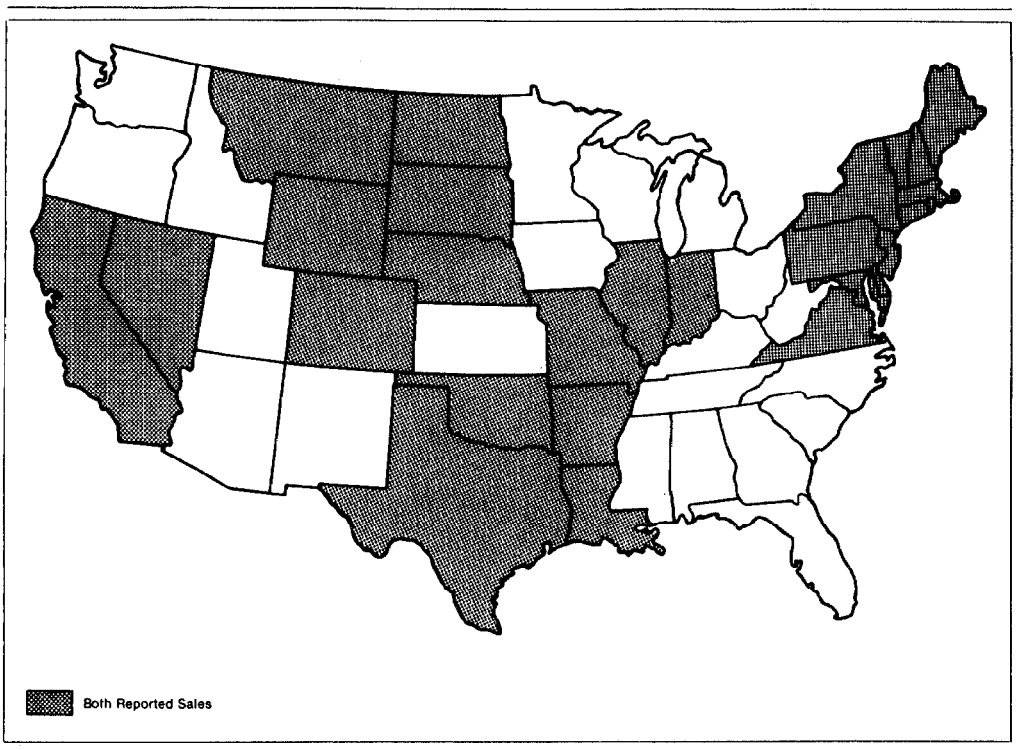
SUMMARY

In 1985, wholesale gasoline prices did not continue the downward trend begun in 1981 despite a continuing decline in crude oil prices. As a result, the spread between these two prices increased in 1985, but only to a level approximating what existed in 1981 and 1982.

SECTION 2

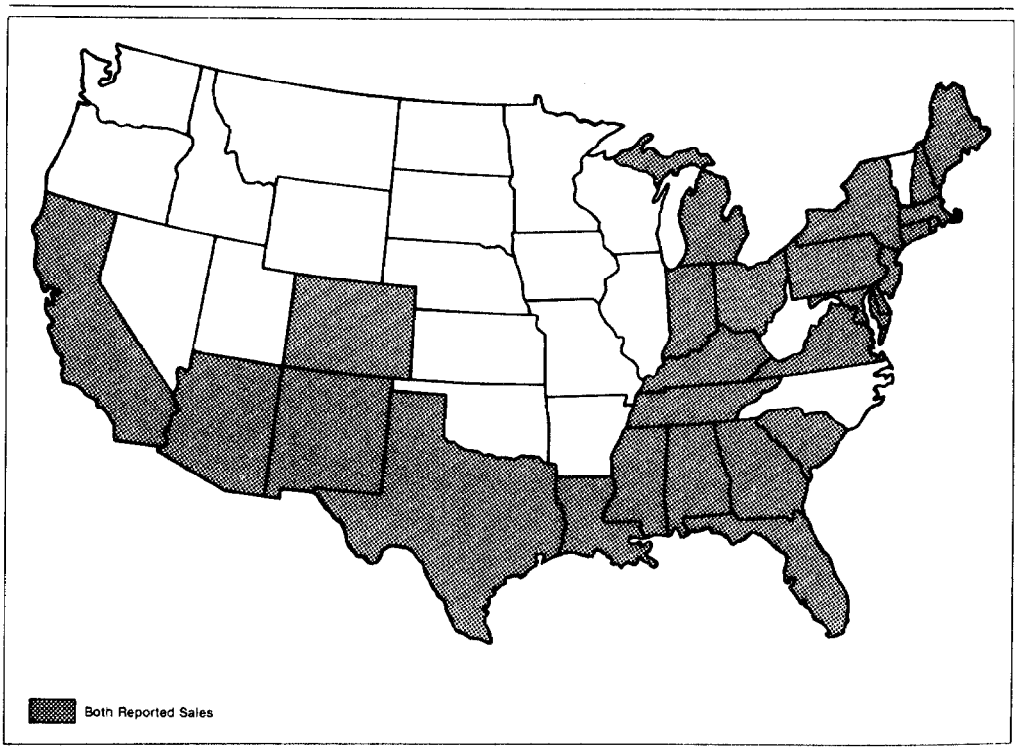
REQUIRED DIVESTITURES IN TWO MERGERS APPEAR TO HAVE ELIMINATED INCREASES IN CONCENTRATION THAT WOULD HAVE EXCEEDED THE MERGER GUIDELINES

Figure 2.1: States Where Texaco and Getty Both Reported Sales at the Wholesale Level in 1984



Source: EIA data.

Figure 2.2: States Where Chevron and Gulf Both Reported Sales at the Wholesale Level in 1984



Source: EIA data.

OIL COMPANY MERGERS

Two mergers in the oil industry in 1984 had the potential to increase market concentration and thereby affect prices in 1985:

--Texaco, Inc., acquired Getty Oil Company and

--Chevron Corporation acquired Gulf Corporation.

Figures 2.1 and 2.2 show those states (27 in each merger) where both of the merging companies reported sales at the wholesale level in 1984.

ENFORCEMENT OF ANTITRUST LAWS

The Department of Justice and the Federal Trade Commission (FTC) have overlapping responsibility for enforcing the antitrust laws. Since enactment of the Hart-Scott-Rodino Antitrust Improvements Act of 1976 (15 U.S.C. §18a), companies contemplating mergers valued at $15 million or more and meeting certain other conditions must formally notify these agencies and delay the merger for prescribed periods of time (15 days for cash tender offers such as the mergers discussed in this report). The Department of Justice and FTC decide which agency will investigate the merger. According to a FTC official, FTC generally handles mergers in the oil industry because of its expertise in the area.

The agencies will take issue with a merger if its effect may be to substantially lessen competition or tend to create a monopoly. The merger guidelines issued by the Department of Justice (and used by FTC in its analysis of a merger) outline when the government is likely to challenge a merger.[1] The guidelines indicate that mergers should not be permitted to create or enhance market power--the ability of one or more firms profitably to maintain prices above competitive levels for a significant period of time. For horizontal mergers (mergers between firms operating in the same market such as the Texaco/Getty and Chevron/Gulf mergers), the first area FTC examines is the market concentration. Market concentration is a function of the number of firms in a market and their respective market shares. Other things being equal, concentration affects the likelihood that one firm, or a small group of firms, could successfully exercise market power.

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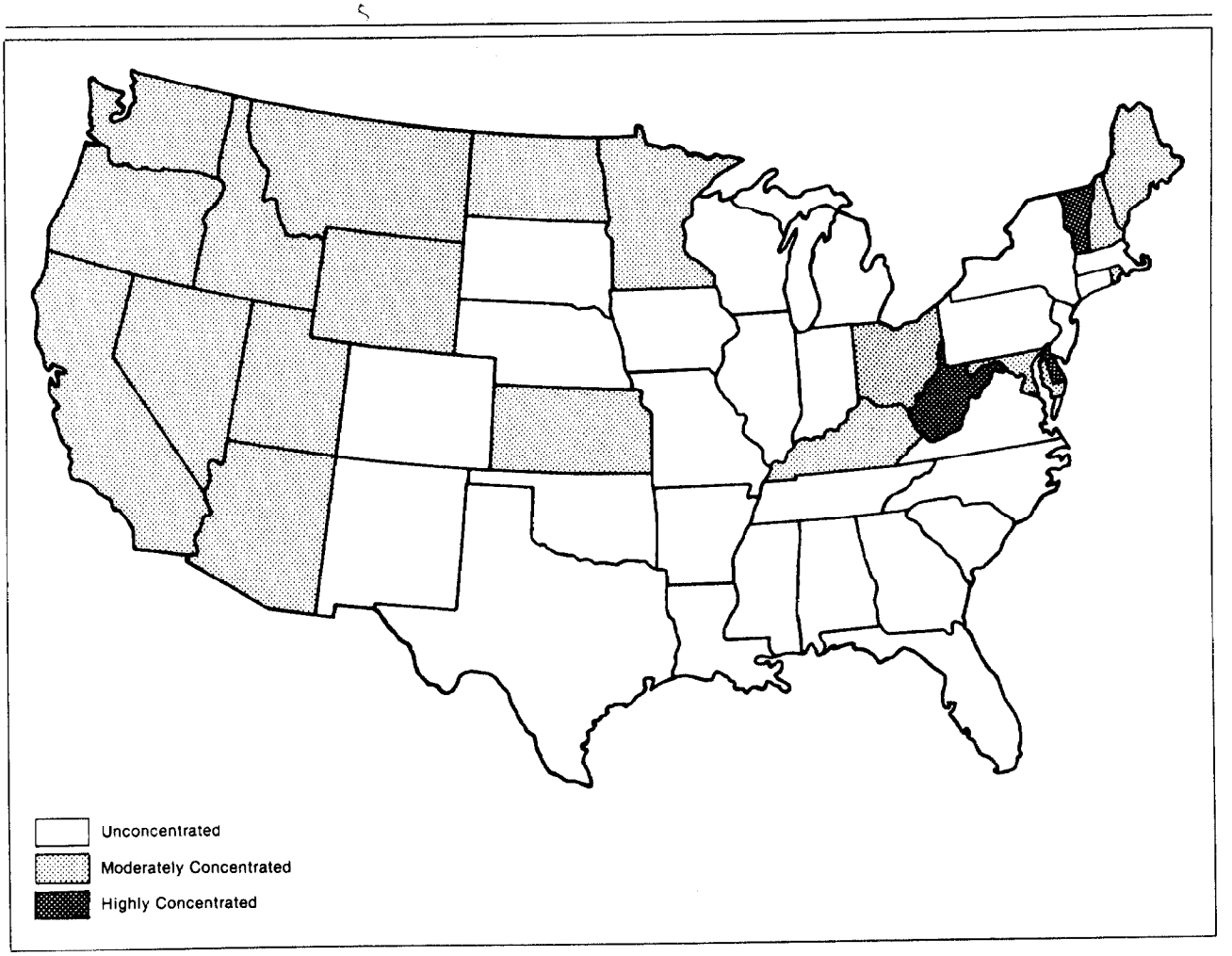
[1]U.S. Department of Justice Merger Guidelines, June 14, 1984. These guidelines were a revision of 1982 guidelines. They did not make extensive modifications but instead provided clarification of the policies established in 1982. The 1982 guidelines, however, were a major change from the original guidelines published in 1968.

Figure 2.3: Concentration in Gasoline Marketing at the Wholesale Level by State, 1984



Source: GAO calculation based on EIA data.

The merger guidelines identify the Herfindahl-Hirshman index (HHI) as the measure that will be used in evaluating market concentration. The HHI reflects the composition of a market while giving proportionately greater weight to the market shares of the larger firms. It is calculated by squaring the decimal market shares of each of the sellers in a market, summing these figures, and multiplying the total by 10,000. For example, 10 firms with equal market shares would result in an HHI of 1,000 for that market, and five firms with equal market shares would result in a HHI of 2,000.

The merger guidelines indicate that a merger generally will not be challenged in a market where

--the post-merger HHI is less than 1,000 points (an unconcentrated market);

--the post-merger HHI is from 1,000 to 1,800 points (a moderately concentrated market), and the HHI would be increased by less than 100 points by the merger; or

--the post-merger HHI is over 1,800 points (a highly concentrated market), and the merger would increase it by less than 50 points.

Mergers that increase the concentration above these levels will be examined further.

MARKET CONCENTRATION

At our request, the Department of Energy's Energy Information Administration (EIA) calculated the HHI for each state using the data it collects on the value of wholesale gasoline sales. The HHI showed that in 1984, 3 states were highly concentrated and 18 were moderately concentrated. (See fig. 2.3.) If the market shares of Texaco and Getty had been merged in 1984,[2] the increase in concentration would have exceeded the merger guidelines in four states. The increase in concentration from merging the market shares of Chevron and Gulf would have exceeded the guidelines in two states.

This information gives only an indication of the areas where market concentration may have exceeded the guidelines because

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[2]While both mergers were announced in 1984, the mergers were delayed while FTC investigated them, and the consent agreement provisions were agreed to by both FTC and the companies. Even after FTC accepted the consent agreements (July 1984 for the Texaco/Getty merger and October 1984 for Chevron/Gulf), Texaco was required to hold separate all Getty assets to be divested, and Chevron had to hold separate all of Gulf's domestic oil and gas assets until the required divestitures were completed.

state borders do not necessarily correspond with true markets. An actual market may be a subset of a state or overlap state lines. FTC regards a terminal cluster[3] as a market. Information at this level of the industry is not routinely collected by EIA,[4] so we could not calculate market concentration at that level. The state figures, however, were adequate to identify areas where the mergers could have affected competition under the merger guideline and served as our basis for examining actions FTC took to remove the potential anticompetitive effects of the mergers.

Both the merger guidelines and FTC emphasize that the HHI information on concentration is only the first step in examining the effects of a proposed merger. Other factors, such as ease of entry into a market, are considered in deciding whether to challenge a proposed merger.

If FTC determines that a merger has potential anticompetitive effects, it could file an injunction to stop the merger or proceed with an administrative complaint, but according to an FTC official, FTC generally prefers to develop a consent arrangement that allows the merger to proceed but requires the divestiture of assets to remedy the lessening of competition resulting from the merger.

TEXACO AND CHEVRON DIVESTITURE REQUIREMENTS

FTC required the merging companies to divest specified assets and take other actions to reduce the potential anticompetitive effects of the mergers.

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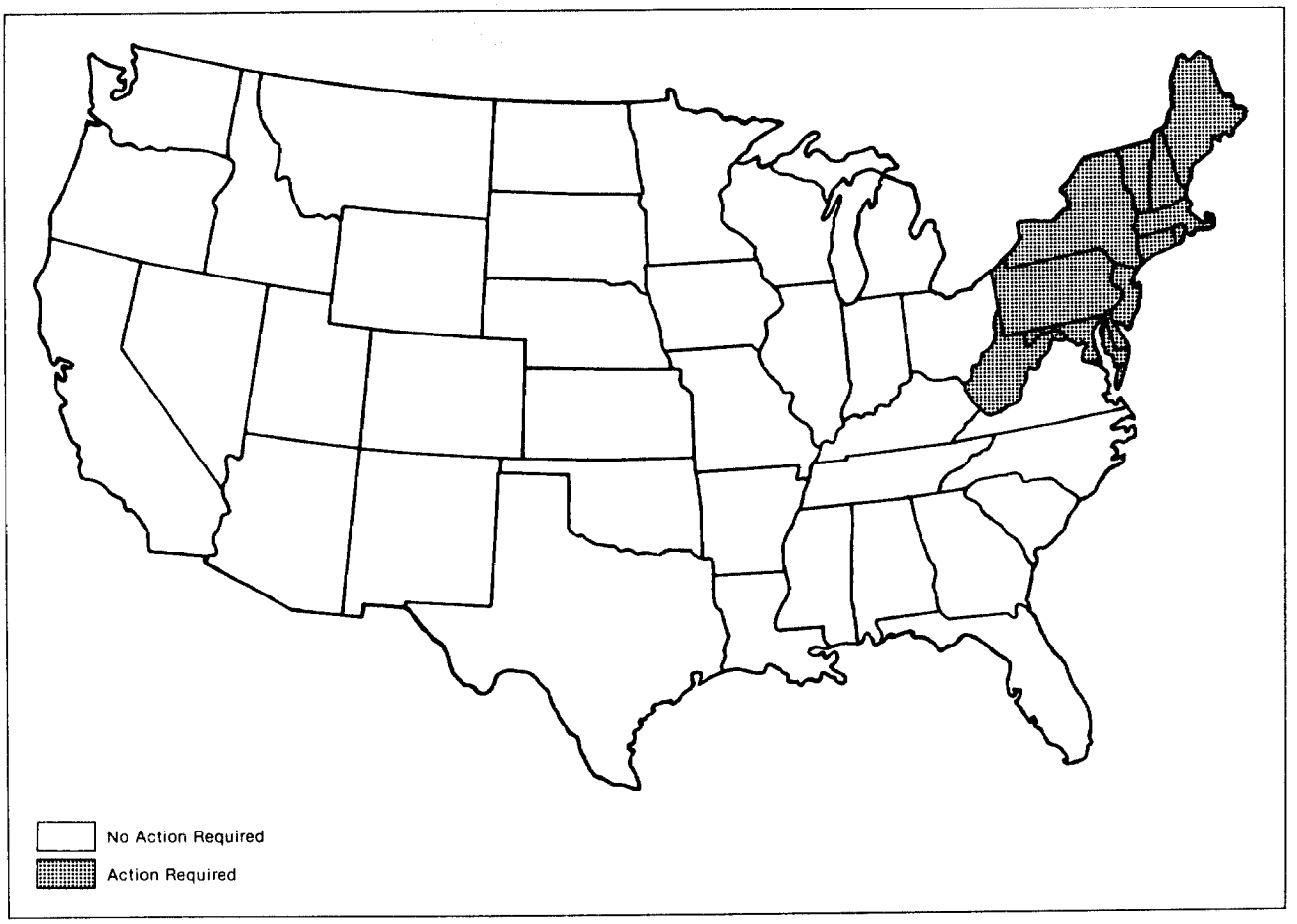
[3]Terminals, which are primary bulk storage facilities, get gasoline directly from refineries by vessel or pipeline. They usually are located in clusters near metropolitan areas.

[4]According to an FTC official, they obtain market share information at the terminal level directly from the merging companies.

Figure 2.4: Divestiture of Getty's Petroleum-related assets Required by FTC



Source: FTC data.

Texaco/Getty actions

The consent agreement concerning the Texaco/Getty merger, accepted by FTC in July 1984, required that:

1. Texaco divest the following assets within 12 months to FTC-approved purchasers:	FTC approved the proposed sale In	To
--All Getty petroleum-related assets in 12 northeastern states and the District of Columbia, except for 30 properties and a refinery in Delaware (see fig. 2.4);	1/85	Power Test Corp.
--Texaco's Salisbury, Maryland, terminal;	12/85	Cato Inc.
--Texaco's refinery in Westville, New Jersey; and	4/85	Coastal Corp.
--Either		
--Texaco's 40% interest in the Wyco Pipe Line, or	7/85	Mobil
--Getty's Kansas refinery, related pipelines and terminals, and marketing and transportation assets in 15 midwestern states.		

2. Texaco hold separate all Getty assets to be divested.

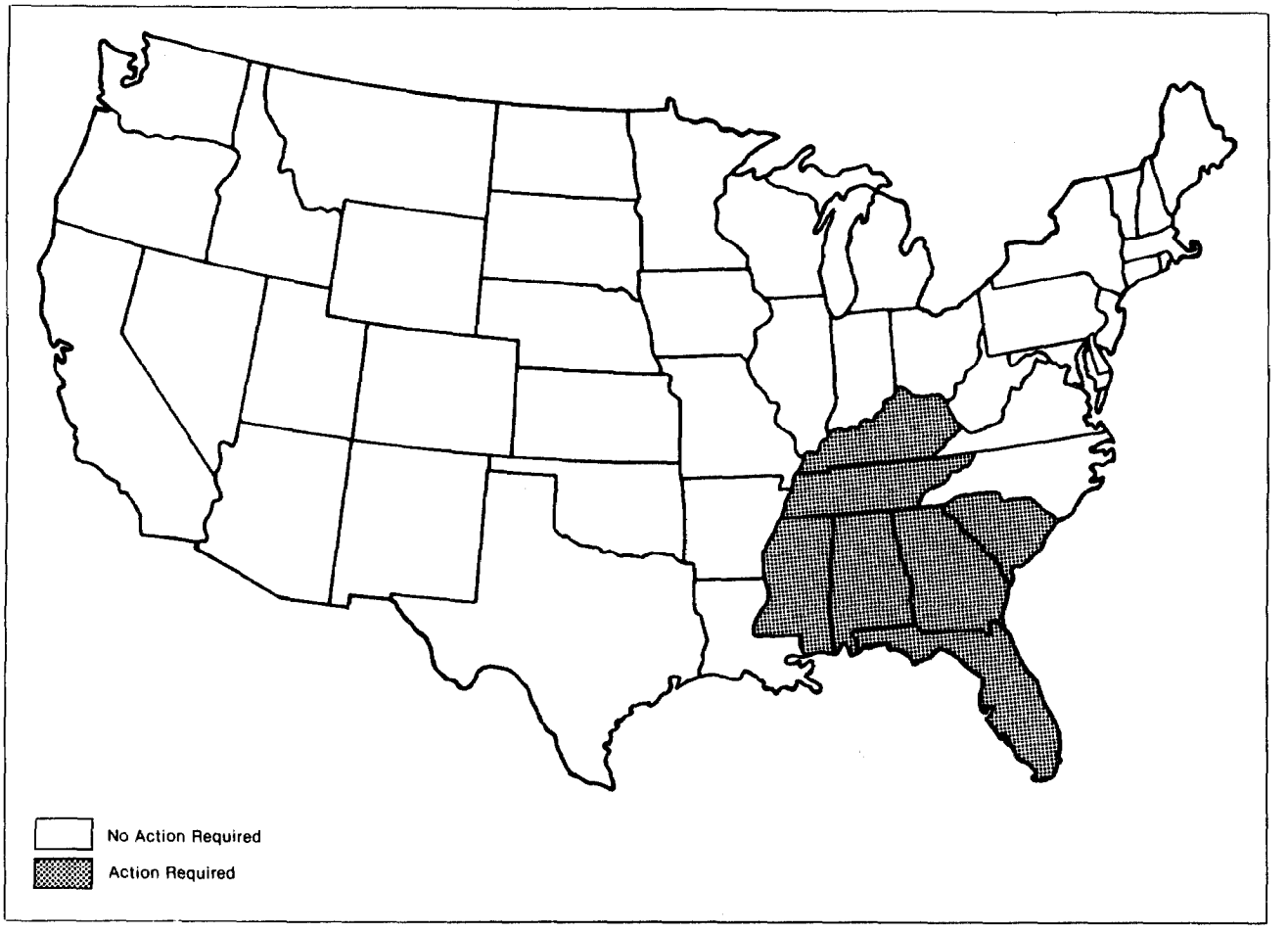
3. Texaco support any proposal to expand the capacity of the Colonial Pipeline north of Dorsey Junction, Maryland, for 10 years.

4. Texaco continue to sell crude oil for 5 years to the independent West Coast refiners who were purchasers of Getty's California crude oil in 1983.

5. Texaco continue to offer access to Getty's pipeline, used to transport residual fuel oil within Los Angeles, California, to Getty's customers for 10 years.

6. Texaco be prohibited from acquiring, without prior FTC approval, any interest in any concern engaged in refining or wholesale distribution of gasoline or middle distillate fuel oils in 12 eastern states and the District of Columbia and any petroleum product pipeline transportation into Colorado for 10 years.

Figure 2.5: Divestiture of Gulf's Petroleum Product Marketing Assets Required by FTC



Source: FTC data.

Chevron/Gulf actions

The consent agreement concerning the Chevron/Gulf merger, accepted by FTC in October 1984, required that:

1. Chevron divest the following assets within 6 months to FTC-approved purchasers:	FTC approved the proposed sale In	To
--Gulf's petroleum product marketing assets in seven southeastern states (see fig. 2.5);	2/85	Sohio
--Either		
--Gulf's Alliance, Louisiana, refinery along with 51% of Gulf's interest in the West Texas Gulf Pipeline;	2/85	Refinery--Sohio
	4/85	Pipeline--Union Oil of California (17%) Sohio (7%), and Sun Pipeline Company (5%) (Chevron retained 28%)
or		
--Gulf's Port Arthur, Texas, refinery along with 51% of Gulf's interest in the Mesa and West Texas Gulf Pipelines;		
--Gulf's 16.78% interest in the Colonial Pipeline.	3/85	Union Oil of California

2. Chevron hold separate all of Gulf's domestic oil and gas assets until all required divestitures are completed.

3. Chevron be prohibited from acquiring, without prior FTC approval, any interest in pipeline transportation, refining, or wholesale marketing assets in Tennessee, Kentucky, the East and Gulf Coasts, the Carribbean, and the Bahamas for 10 years.

Effect of divestitures

The areas covered by the divestitures in these mergers included all of the states that we had identified as potentially increasing concentration above the guideline levels except one. For this state, FTC officials told us that they had determined that no action was necessary after examining concentration at the terminal level because it was an isolated state, and all supplies had to move through marine terminals to enter the state. Since the merging companies did not have a controlling interest in the terminals, they could not have manipulated prices by controlling the amount of supplies entering the state.

By examining the market share information for 1985, we also determined that, as a result of the Chevron/Gulf divestiture, Sohio had gained about the same share of the market that Gulf had held in 1984 in the southeastern states. We were unable to make this assessment for the divested Getty assets. The purchaser of those assets--Power Test Corporation--does not operate a refinery. Therefore, the first sales into a state for consumption data, which was the basis for the HHI calculation, would not reflect Power Test's share of the market.

Under the 1968 merger guidelines, the market shares of the merging firms were a key factor in determining whether a merger might have anticompetitive effects. Market concentration was determined by the portion of the market held by the four largest firms. If the top four firms accounted for 75 percent or more of the market, it was considered to be highly concentrated. If they controlled less than 75 percent of the market, it was considered less highly concentrated. The guidelines indicated that proposed mergers between firms with specified market shares (such as a merger in a less highly concentrated market between two firms, each of which had 5 percent of the market) would likely be challenged.

Since the 1968 guidelines were stricter than the current ones, we identified (using the market share information provided by EIA for the HHI calculation) the states where the two mergers would have exceeded these guidelines. We found that FTC's required divestitures covered all of the additional states that we identified as potentially exceeding the 1968 guidelines.

SUMMARY

FTC investigated the two proposed mergers and required divestitures of specified assets to correct the potential anticompetitive effects that it had identified. The required divestitures, which took place in 1985, eliminated any increases in concentration that would have exceeded the merger guidelines.

SECTION 3

1985 PRICES WERE HIGHER THAN EXPECTED BUT CONCENTRATION WAS NOT PRIMARILY RESPONSIBLE

Table 3.1: Description of GAO's Regression Analysis of the Wholesale Gasoline Market

Our regression analysis examined the determination of wholesale gasoline prices and quantities by the interaction of the following supply and demand factors:

Supply factors	Demand factors
Refiners' margin on wholesale distillate sales	Population density
Refiners' average acquisition cost of crude oil	Per capita personal income
Level of concentration at the wholesale level by state	Seasonal fluctuations

Table 3.2: Other Explanations for the 1985 Price Increase That We Examined

--Reduced competition from imports of gasoline after settlement of the British coal strike.

--Increased costs of producing gasoline because of the lower limits placed on the use of lead additives to increase octane ratings.

--Recovery from the poor profitability levels the industry experienced in recent years.

ANALYSIS SUGGESTS THAT 1985 PRICES WERE HIGHER THAN EXPECTED BUT CONCENTRATION HAS ONLY A SMALL ASSOCIATION WITH PRICES

We performed a regression analysis of the wholesale gasoline market from January 1983 through September 1985 to

(1) test whether increases in market concentration levels tended to be associated with higher prices;

(2) determine whether 1985 prices were higher than would be expected on the basis of (1) their estimated relationship to the factors presumed to influence prices through their effects on supply or demand and (2) the 1985 values of these factors (see table 3.1); and

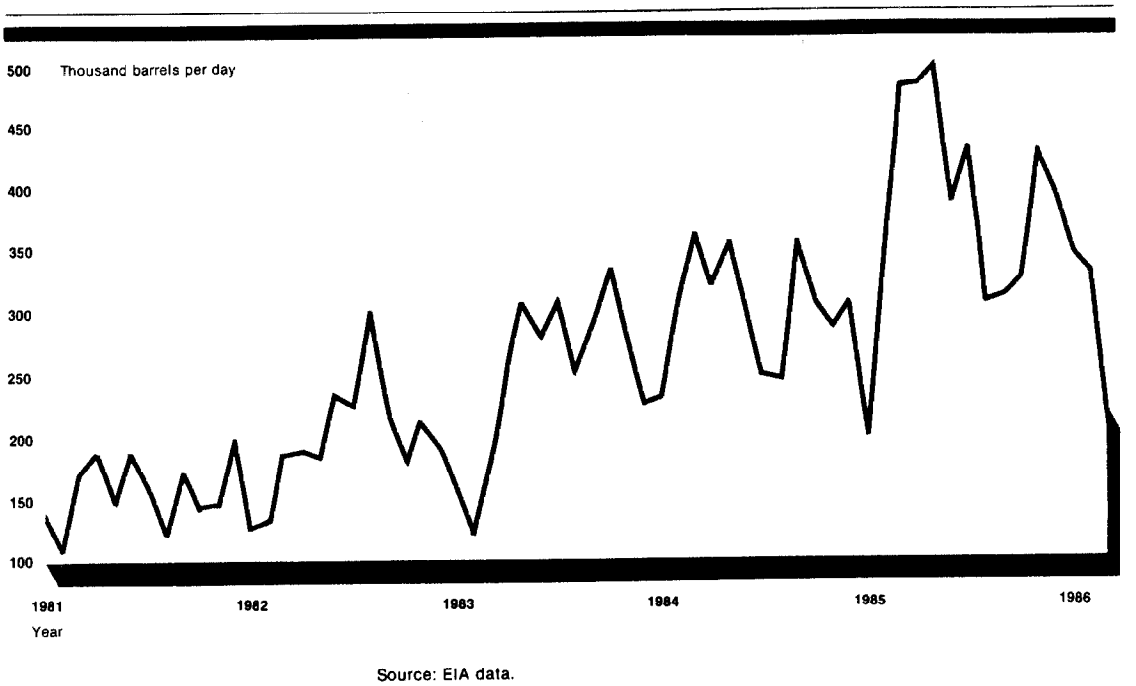
(3) identify the reason(s) for this result, if the prices were unexpectedly high.

Regression analysis allows us to estimate the effects of selected factors on price, while controlling for the effects of other factors. The results of this type of analysis are estimates, rather than exact measures, because they are subject to possible specification errors (for example, a significant factor may not be included in the analysis) or sampling errors. Different models, all plausible, could yield different estimates. We believe, however, that our model is reasonable and consistent with others we found while conducting a comprehensive survey of the economic literature on the gasoline industry. Also, we conducted a series of statistical tests to check the reliability of the estimates. As a result, we believe that these estimates provide credible evidence addressing the above issues. A full discussion of the methodology used in our analysis and the results obtained are presented in appendix I.

Concentration can increase in a market for many reasons, in addition to mergers. For example, if a company withdraws from a market and is not replaced by a new company, the market shares of the remaining companies would increase, and concentration would be higher. Increases in price due to increased concentration levels are likely to be similar regardless of the source of the increased concentration. Because only limited data from the post-merger period are available, we were unable to directly observe effects of the Texaco/Getty and Chevron/Gulf mergers on prices. However, we were able to estimate in general the effect of increases in concentration.

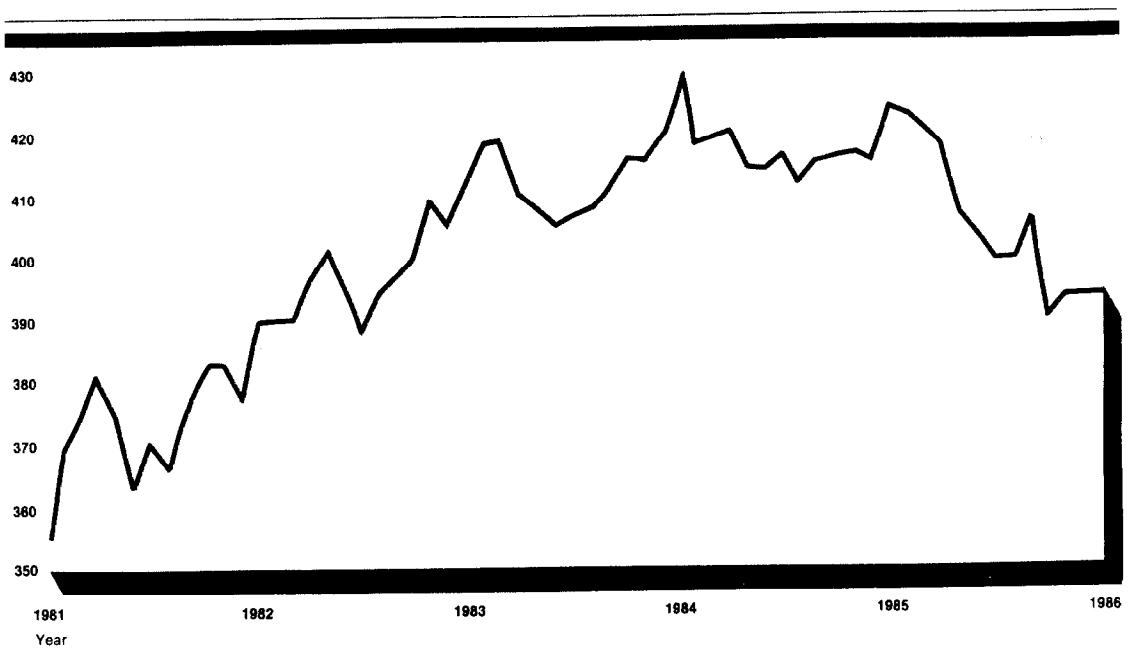
Our results for our first objective suggest that increases in concentration at the state level in moderately and highly concentrated markets have a positive, but small, association with prices. For example, a 100-point increase in a market that had a HHI of 1,000 points (the merger guidelines indicate that a merger that would increase concentration by this amount is likely to be

Figure 3.1: Imports of Finished Motor Gasoline (1981-March 1986)



Source: EIA data.

Figure 3.2: Nelson Index of Refinery Operating Costs (1981-Jan. 1986)



Source: Oil and Gas Journal.

questioned by the government) was associated with an increase in wholesale prices of about one-half cent per gallon or less. Because the association of increased concentration with prices appears small and the required divestitures in the two mergers eliminated increases in concentration exceeding the merger guidelines (see section 2), we believe the increases in concentration that resulted from the Texaco/Getty and Chevron/Gulf mergers would have had only a small effect on wholesale gasoline prices.

Our results for our second objective also suggest that wholesale gasoline prices in 1985 were 4 to 6 percent higher than might have been expected on the basis of their estimated relationship to the relevant supply and demand factors (including the concentration level) and the 1985 values of these factors. We were not able to identify a specific cause for this higher price to respond to our third objective, but these results suggest that supply factors are more likely to have been responsible than demand factors.

THE PRICE INCREASE IN 1985 DOES NOT APPEAR TO BE RELATED TO THE BRITISH COAL STRIKE

Some industry officials cited the British coal strike as a reason for the 1985 increase in wholesale gasoline prices. They believed U.S. prices had been held down by cheaper imports that resulted from the European refineries' increased production of distillate and residual oil (which produces gasoline as a by-product) to replace British coal. Thus, when the strike, which began in March 1984, ended in March 1985, imports declined, and prices were able to return to prior levels. Imports, however, did not increase significantly until March 1985 and did not drop to former levels until August 1985. (See fig. 3.1.)

THE INCREASE IN 1985 COULD BE RELATED TO COSTS OF REQUIRED LEAD PHASEDOWN

The lead phasedown required by the Environmental Protection Agency restricted the addition of lead from an average of 1.1 grams per gallon of gasoline to 0.5 grams per gallon by July 1, 1985, and 0.1 grams per gallon by January 1, 1986. Since lead is the cheapest way to increase the octane rating of gasoline, this phasedown should result in higher production costs according to the Regulatory Impact Analysis by the EPA. This assessment is shared by the analysts we talked to from the oil industry. The EPA's analysis estimates the costs of total lead phasedown to the January 1986 level at about 2 cents per gallon, or about 2.4 percent of the wholesale price. We examined the Nelson index of refinery operating costs[1] to see if the phasedown caused

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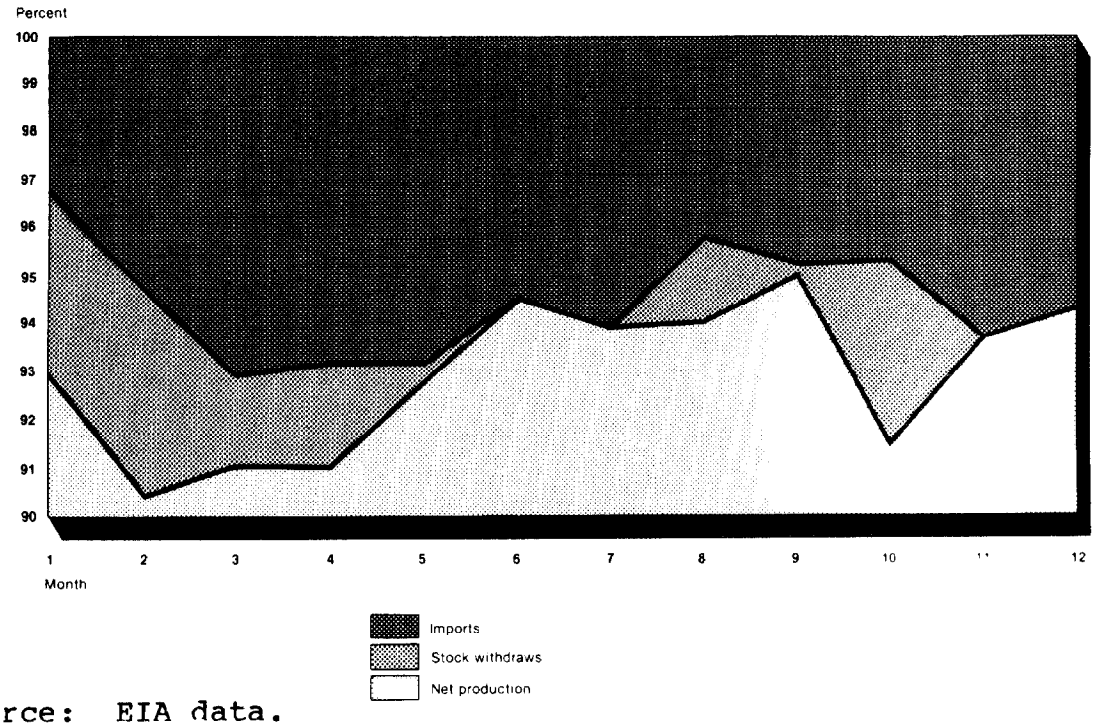
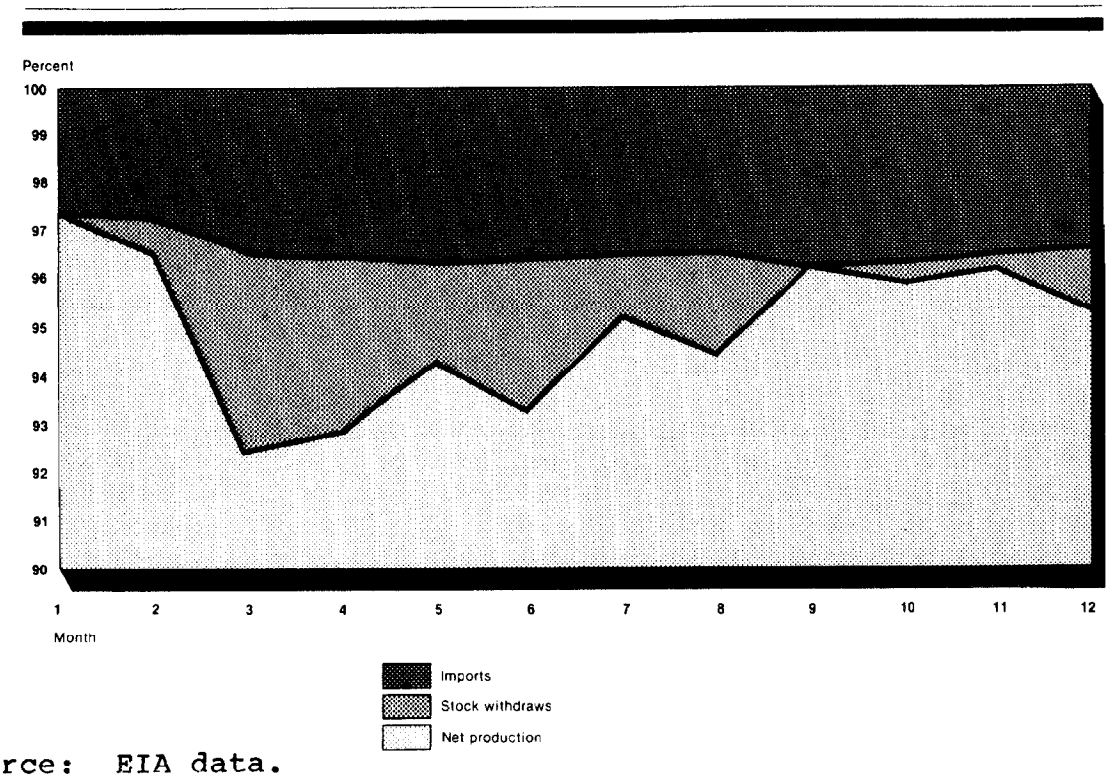
[1]The Nelson index of refinery operating costs, compiled by Gerald L. Farrar, Journal Contributing Editor, is published monthly in the Oil and Gas Journal.

Figure 3.3: Sources of Gasoline Supplied in 1985



Source: EIA data.

Figure 3.4: Monthly Average Sources of Gasoline Supplied from 1981 through 1984



Source: EIA data.

increases in the costs of refinery inputs. Figure 3.2 shows that the Nelson index fell substantially from January to July, increased somewhat from July to September, and then continued to decline even further from September to October. Thus, the costs of refinery inputs does not seem to have increased significantly during 1985. This is only a partial indication of possible impacts due to the phasedown, however, because refiners might have had to use more of the expensive components or more of some inputs per gallon of gas than formerly.

According to a spokesman for the American Petroleum Institute, refiners had already begun phasing out lead by early 1985 because they could earn lead credits that could be sold to other refiners. Given the timing of this regulatory change and the estimated cost associated with it, it seems possible this contributed to the 1985 increase in gasoline prices, but we could not find evidence of the extent of the impact.

DOMESTIC PRODUCTION ACCOUNTED FOR SMALLER SHARE OF GASOLINE SUPPLIED IN 1985

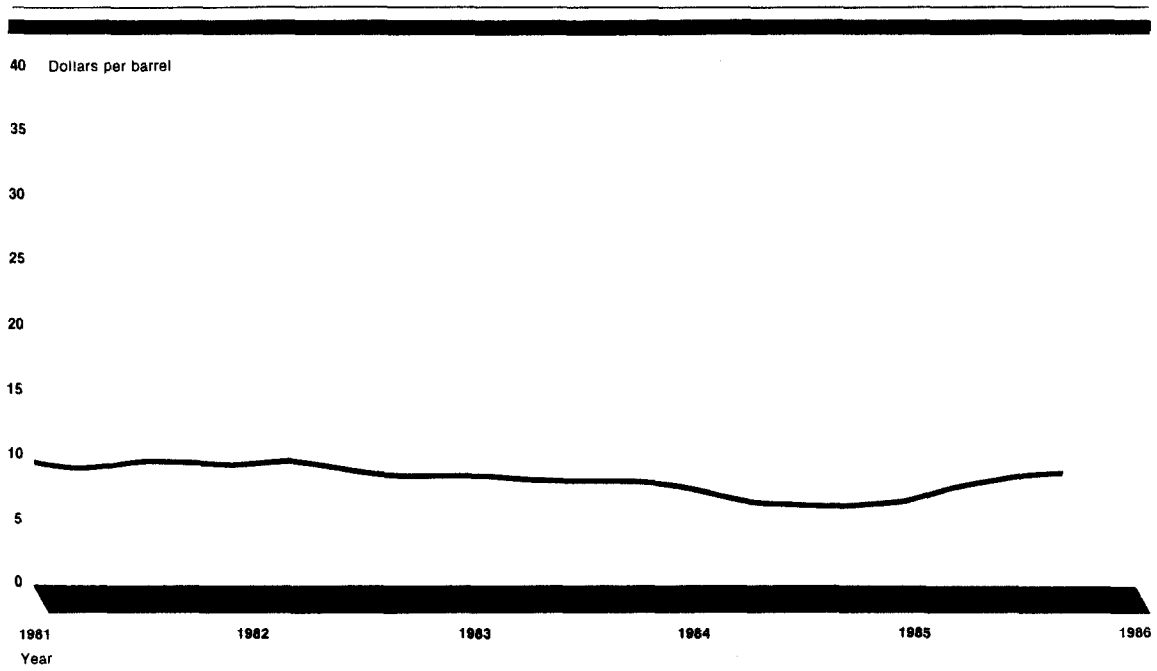
We found there was a shift in the sources of gasoline supplied in 1985 compared with the previous 4 years. Gasoline supplied is the amount of gasoline produced (net of any amount added to stock inventories or exported), drawdowns from inventories, and imports. A comparison of figures 3.3 and 3.4 shows that there was a shift in 1985 among the portion coming from each of these sources.

In general, during 1985 less of the gasoline supplied came from production and more came from imports. In addition, during January and February 1985, stock withdrawals were larger than the average for those months from 1981 through 1984. A recent GAO report, Petroleum Products: Effects of Imports on U.S. Oil Refineries and U.S. Energy Security (GAO/RCED-86-85, Apr. 15, 1986), cites several factors that contributed to the increased competitiveness of foreign refiners in the U.S. market and the resulting increase in imports. The factors included the end of U.S. oil price controls in 1981, which increased U.S. refineries' crude acquisition costs by removing the limitations placed on domestic crude oil prices, and increases in the value of the dollar (the basis for petroleum product prices in international trade) relative to other currencies, which made imports more expensive in some countries and led to reduced demand and downward pressure on prices in the world market.

Figure 3.5: Refiners' Margin (Difference Between Revenues and Costs) of 25 Major Energy Companies in Dollars per Barrel of Refined Product Sold (1977-84)

Source: EIA data.

Figure 3.6: Difference Between Seasonally Adjusted Crude and Wholesale Gasoline Prices (1981-Sept. 1986)



Source: GAO calculations based on EIA data.

1985 PRICES WERE A RETURN TO PREVIOUS PROFITABILITY LEVELS

Industry and government officials that we contacted indicated that they believe 1985 gasoline prices were not abnormally high, but that the 1985 price increase represented a return to previous profitability levels. The refining industry had experienced several bad years, with 1984 being the worst, when margins were squeezed to lower levels than in the past years.

--Figure 3.5 shows that refiners' margins (based on information from the 25 major energy companies reporting to the Financial Reporting System) dropped to $0.01 per barrel of refined product in 1984.[2] Comparable data for 1985 is not yet available.

--Figure 3.6 confirms this by showing that the difference between seasonally adjusted crude and wholesale gasoline prices started decreasing in mid-1982 and got much smaller in 1984. (See fig. 1.2.) The 1985 difference, while larger than the difference in 1984, did not exceed the levels that existed in 1981 and 1982.

SUMMARY

The results of our regression analysis suggest that increases in concentration at the state level have a positive, but small, association with gasoline prices. Because the required divestitures eliminated the increases in concentration exceeding the merger guidelines, we believe the two mergers examined would have had only a small effect on prices.

Our results also suggest that gasoline prices in 1985 were higher than might have been expected on the basis of the values of the supply and demand factors examined. While we were not able to identify a specific cause for these higher prices, the results suggest that supply factors are more likely to have been responsible than demand factors.

We found that a shift occurred in the sources of the gasoline supplied in 1985 compared with the previous 4 years. In 1985 a smaller percentage of the amount supplied came from domestic production while more was provided by imports and drawdowns of domestic inventories.

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[2]Pursuant to the Department of Energy Organization Act (42 U.S.C. 7135(h)(2)), EIA collects financial information and other measures of energy-related business efforts and results from major energy-producing companies.

Our analysis suggests that one explanation for the 1985 price increase given by industry officials--reduced competition from cheaper imports of gasoline when foreign production was decreased after settlement of the British coal strike--was probably not an important contributor to the 1985 price increase. However, some of the increase in price could be related to increased costs associated with the required reduction in the amount of lead in gasoline, and, as several government and industry officials noted, the refining industry experienced low profitability levels in 1984, and a reduction in domestic gasoline production would not be unexpected under those conditions.

SECTION 4

OBJECTIVES, SCOPE, AND METHODOLOGY

On August 22, 1985, Congressman Thomas A. Luken requested that we identify forces driving 1985 gasoline prices and investigate whether there is any plausible evidence that concentration in the oil industry may have been having an anticompetitive effect on market prices.

We met these objectives by focusing on three basic tasks. For the first tast, we obtained gasoline and crude oil prices from January 1981 to March 1986. We compared 1985 wholesale gasoline and crude oil prices with prices in the prior years (i.e., 1981-84) to see if 1985 seasonal and nonseasonal patterns differed from patterns in previous years. We did not include gasoline and crude oil pricing trends before 1981 because events such as the gasoline shortage and gasoline price controls would have affected these earlier prices.

All gasoline and crude price data came from the Department of Energy's EIA. Because EIA changed its data collection form at the end of 1982, monthly weighted average prices for wholesale gasoline were not available for 1981 and 1982. EIA calculated these price data on an annual basis for these years. We calculated monthly price data for 1981 and 1982 by taking the difference between annual retail and wholesale gasoline prices, and subtracting this difference from the monthly average retail price. We used the ratio-to-moving-average method to adjust prices for seasonality.[1]

For the second task, we identified, assessed, and compared forces cited as causes for the 1985 gasoline price increase. We reviewed government and industry literature to identify the factors that could have affected 1985 gasoline prices. We also developed a regression analysis designed to assess the effect of selected supply and demand factors on 1985 gasoline prices. The analysis and factors selected for the analysis are discussed in detail in appendix I.

Since the results of our analysis suggested that the increase was due to a change in the relationship between the supply factors and prices, we compared and analyzed trends in factors that comprise the supply of gasoline to determine whether they were normal or abnormal in 1985 relative to previous years (i.e., 1981-84) trends. In addition, we examined trends in factors suggested by leading industry officials as influencing 1985 gasoline prices to determine whether these explanations were substantiated by the data.

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[1]Each monthly observation is adjusted by a factor reflecting its seasonal divergence from the 24-month moving average. This is a simplified version of the X-11 method of seasonal analysis developed by the Census Bureau of the U.S. Department of Commerce.

For the third task, we identified and assessed recent merger activity to determine what impact these mergers have had on concentration levels in the gasoline market. To make this determination, we identified mergers that could have impacted 1985 gasoline prices by reviewing current literature.

We then identified those states in which concentration would have exceeded the merger guidelines as a result of these mergers. According to the guidelines, a merger is likely to be questioned if it increases the HHI for a market above specified levels that are established for high, moderate, and unconcentrated areas. For the two mergers, we reviewed the proposed and final consent order between FTC and the merging companies, which spelled out the actions FTC considered necessary to remove their anticompetitive effects. We discussed the area we had identified as potentially exceeding the guidelines where no action had been taken with FTC officials to determine why no actions were taken.

We also examined the files of public comments received on the orders and the proposed sales of the assets to be divested and verified that the required divestments had been completed. Finally, we examined state market share information for 1985 to determine the share of the market gained by the purchasers of the divested assets.

The basis for most of our analysis was statistical data collected by EIA and published in aggregate form in EIA's Petroleum Marketing Monthly and the Petroleum Supply Monthly publications. EIA also provided company wholesale market share data by state and related HHI calculations to allow us to examine the impact the two mergers could have had on concentration in each state. Finally, population and personal income data were obtained from the Department of Commerce's Bureau of Economic Analysis. We did not test the validity or reliability of the information provided by these agencies because of time limitations.

TECHNICAL DESCRIPTION OF THE REGRESSION ANALYSIS METHODOLOGY AND RESULTS

We performed a regression analysis of the wholesale gasoline market from February 1983 through September 1985 to

--test whether increases in concentration levels were associated with higher prices;

--determine whether 1985 prices were higher than would be expected on the basis of (1) their estimated relationship to the factors presumed to influence prices through their effects on supply or demand and (2) the 1985 values of these factors; and

--identify the reason(s) for this result, if the prices were unexpectedly high.

Regression analysis is the appropriate way to address these issues because of the need to control for the influence of various supply and demand factors while estimating the influence of any one of them.

The transaction that was the basis for the analysis was the first sale of gasoline in a state for consumption in that state. Data on the volume of these sales are collected and reported on a monthly basis by the EIA.[1] These transactions are typically between the company that refined the gasoline and the wholesale distributor, but some of the sales are by large volume resellers. While the data include sales at different levels of the gasoline industry, they were considered to be the most representative of wholesale market conditions by analysts.

Because the time period covered is February 1983 to September 1985, this is a short-run analysis of the gasoline market. Except where noted, the data used for the analysis are monthly observations at the state level for 48 states and the District of Columbia. We excluded Alaska and Hawaii because we believe the unusual conditions of supply in those two states may cause them to differ systematically from the rest of the states.

The data on wholesale gasoline sales and prices at the statewide level present a measurement error problem to the extent that states do not accurately reflect the geographic scale of

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[1]EIA-0380 Petroleum Marketing Monthly, Table 67.

wholesale gasoline markets. FTC regards a terminal cluster as the appropriate geographic scale, which usually corresponds to a metropolitan area. Data are not generally available at this level, however. The direction of bias, if any, associated with this error is unknown. In general, being at a larger level, the state data probably represent an averaging of the market-specific data. The estimated relationships are therefore averages of the true market relationships.

GENERAL FRAMEWORK

We estimated the influence of both supply and demand factors because they interact to determine simultaneously the quantity and price of gasoline sold in the wholesale market. The least restrictive way to do this is to make no specific assumption about the degree of competitive behavior in the market. If we do not assume "perfectly" competitive behavior, then economic theory implies that the output decision of the firm depends on factors influencing the demand for its product. This means the supply function of the firm (and the industry) cannot be identified separately from the demand function. Therefore, we derived a single equation model for the wholesale price of gasoline that we refer to here as a reduced form model. The reduced form estimates can provide information on the first two issues posed for our regression analysis, but they cannot be used to distinguish the separate effects of the factors on the supply and demand sides of the market. Thus, to address issue three, specifically whether changes in supply or demand caused changes in prices in 1985, we had to estimate structural equations that separately identify the supply and demand functions. To use this approach, we had to assume that the market is reasonably competitive because the supply function cannot be identified in a monopolized market. With this caveat in mind, we believe that the market is sufficiently competitive--and we are supported by the research of others who modeled the refinery industry in this way--to warrant using this approach to identify specific reasons that prices would have changed in 1985.

FACTORS AFFECTING SUPPLY

We identified several factors that economic theory suggests will influence the amount of wholesale gasoline refiners want to supply. The price of crude oil is one of the primary elements of gasoline costs and should therefore be negatively related to the quantity supplied. We treat the price of crude as independent of the current price and quantity of U.S. gasoline sold in the short run. We believe this is appropriate because it takes time for demanders to significantly alter their consumption patterns and, thereby, affect the world oil market. Such effects would be more relevant in a long-run model.

As a measure of the profitability of producing refined products other than gasoline, we calculated an approximate "margin" on distillate or home heating fuel by subtracting the price of crude oil from the price of distillate. We expect this variable to be negatively related to quantity supplied because a higher margin would encourage refiners to produce more distillate instead of gasoline. We expect the HHI, as a measure of seller concentration, to be negatively related to quantity supplied if firms are able to exert more monopoly power the greater the level of concentration. Such a relationship has been hypothesized in several theories of noncompetitive behavior.[2] Finally, we included the lagged value of gasoline sales as a determinant of supply because a previous econometric study found this to be a significant relationship. That study explained this by noting that refiners plan output to meet the expected needs of integrated market outlets as well as planned inventory accumulation, which is itself a function of previous sales.[3]

In addition to these variables, we considered including the stock of gasoline on the hypothesis that high stock levels might lead to higher supplies. We were not able to isolate the amount of stocks of gasoline available to suppliers in the transaction being modeled (the first sale for consumption) however, so we were not able to test this hypothesis. We do not think this presents a serious omitted variables problem for two reasons. One is that stock changes accounted for 6 percent or less of total gasoline supplied nationwide over this period. Second, the econometric study mentioned above found a "very slow" rate of adjustment of inventories over periods up to 1 year.[4] Since our data are collected monthly, the impact of inventory adjustments should be small.

Finally, we added dummy variables for the years 1984 and 1985 to allow us to identify shifts in supply during those years. Several industry observers have argued that gasoline supply was abnormally high in 1984 due to the British coal strike because excess supplies of gasoline were produced in producing additional distillate and residual to replace coal in Britain. So the coefficient on the 1984 dummy is expected to be positive. On the

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[2]F.M. Scherer, Industrial market structure and economic performance (Chicago: Rand McNally, 1980), p. 268.

[3]F.G. Adams and J.M. Griffin, "An Econometric Model of the U.S. Petroleum Refining Industry," in L. Klein, ed., Essays in Industrial Econometrics, Vol. I (Phila., University of Pennsylvania Press, 1969).

[4]Adams and Griffin, p. 114.

basis of an examination of the trends in prices over this period, we think the supply may have decreased in 1985. Therefore, we would expect the 1985 dummy variable to have a negative coefficient.

In the reduced form equation for price, the supply-side variables are expected to have opposite signs to those described above because the dependent variable in the supply equation is quantity supplied, and the quantity supplied is negatively related to the resulting equilibrium price of gas. That is, the greater the supply of gas, the lower the resulting equilibrium price.

FACTORS AFFECTING DEMAND

We modeled the wholesale demand for gasoline as a "derived" demand. Thus, the quantity of gasoline demanded by wholesale distributers is assumed to depend primarily on the quantity demanded by consumers at the retail level. In their study of the petroleum refining industry, Adams and Griffin also modeled demand as a function of total income and price as well as other variables affecting households demands.[5]

Several studies have modeled consumers' demand for gasoline as a "flow adjustment" process.[6] Within a given period, consumers' responses to changes in price and income are moderated by the difficulties of adjusting their driving habits and their stock of automobiles. The desired quantity demanded, Q^*, is, therefore, modeled as a function of price (p) and per capita income (Y):

(1) $$Q^* = Q(p,Y)$$

but the actual quantity demanded reflects a partial adjustment from the previous period's demand to the desired level, specified here in non-linear form:

(2) $$(Q_t/Q_{t-1}) = (Q^*_t/Q_{t-1})^{\delta} \qquad 0 < \delta < 1$$

where δ reflects the degree of adjustment to the desired level of demand within one period. Solving equation (2) for Q^*_t and substituting into equation (1) yields:

(3) $$Q_t = Q(P_t, Y_t, Q_{t-1})$$

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[5]Adams and Griffin, p. 114.

[6]H. Houthakker and L. D. Taylor, Consumer Demand in the United States, (Cambridge, Mass.: Harvard U. Press, 1970).

We introduced dummy variables into the demand equation to adjust for seasonality--demand is typically high during summer months and low during winter months. Finally, we introduced dummy variables for 1984 and 1985 into the demand equation to determine whether changes in the market during these periods could be due to changes in the relationship between these demand-side factors and price. The demand function we estimated is given by equation (4):

$$(4) \qquad Q_t = Q(P_t, Y_t, Q_{t-1}, S_t, D_{84}, D_{85})$$

where the S_t are the seasonal dummy variables, D_{84} and D_{85} are the dummy variables for 1984 and 1985, and the other variables are defined above.

REDUCED FORM EQUATION SPECIFICATION

In the most general model of gasoline price and quantity determination, we assume only that firms attempt to maximize profits, which, according to microeconomic theory, results when they set output at a level such that marginal revenue (MR) equals marginal cost (MC). Since we are making no assumption about the extent of competition, we know only that MR is some function of the demand for the output. Each state's demand is specified in inverse form as:

$$(5) \qquad p = d(Q, z)$$

where z are demand determinants other than price, p is the wholesale price, and Q the quantity of wholesale gasoline sold in a given month. Then MR of firm i can be written:

$$(6) \qquad MR_i = MR_i(Q_i, z)$$

The firm's marginal cost can be expressed generally as a function of Q_i and the supply determinants (w) described in the section, "Factors Affecting Supply":

$$(7) \qquad MC_i = MC_i(Q_i, w)$$

The assumption of profit maximizing behavior means firms will set their level of output such that:

$$(8) \qquad MR_i(Q_i, z) = MC_i(Q_i, w)$$

This expression models the determination of each firm's output, Q_i, which are totaled to determine the total quantity supplied to the market, Q. By substituting Q into the demand equation, we can

derive the reduced form expression for price as a function of both supply and demand determinants:[7]

(9) $$p = r(z,w)$$

This is the single equation model we estimated. The variables described by z and w are the same demand and supply factors described above. The equation was estimated in log-linear form for consistency with the specifications of the supply and demand equations as described in the next section.

STRUCTURAL EQUATIONS SPECIFICATION

In this section we make the assumption that the wholesale gasoline market is essentially competitive, so that we are able to identify the structural supply and demand equations that characterize the market, as described here.

If we assume that the number of firms in each market is large enough that each firm behaves as a price taker (i.e., perfectly competitive), then the MR of the firm is equal to the current market price, and each firm sets output at the level such that:

(10) $$p = MC_i(Q_i,w)$$

Since the supply decision is a function of price but not of other demand determinants, we can separately identify the supply function of firm i by solving the above expression for Q:

(11) $$Q_i = s_i(p,w)$$

The market supply function is the sum of the individual firm supplies,

(12) $$Q = s(p,w)$$

while the market demand is the same as described above, but expressed here with Q as the dependent variable:

(13) $$Q = d'(p,z)$$

Equations (12) and (13) were estimated using simultaneous equations methods. We specified the supply function in log-linear or multiplicative form because research on the short-run cost

[7]Ideally, we should have firm-specific data on the w variables, but since only market-level data were available, we are assuming that changes in the market level values reflect conditions affecting individual firms.

function in petroleum refining suggests that it is non-linear.[8] Also, other studies of gasoline supply have chosen the log-linear specification.[9] We estimated the demand equation in log-linear form because other research on gasoline demand has consistently found this specification to be the most appropriate.

We introduced the HHI into the supply function to test the hypothesis that higher concentration levels may lead to higher prices in some markets. Thus, where the concentration levels are low, we expect the market to function competitively, but where these levels are high, there may be deviation from the competitive supply levels due to the exercise of monopoly power. We realize that the exercise of monopoly power by firms is inconsistent with the competitive specification of the market, but we think this approach is nonetheless a useful way to test for divergence from competition due to high concentration levels in some markets.

RESULTS AND IMPLICATIONS

When using pooled cross-section and time series data in regression analysis, some analysts recommend the use of methods that adjust for unexplained differences between the cross section units.[10] In our study, for example, there may be differences in gasoline consumption or supply between states due to differences in climate, or in demographic patterns. By adjusting for these differences, even though we do not explain their specific causes, we can improve our estimates of those relationships we do want to explain. In the following discussion, we present two sets of results, one that included this adjustment, referred to as "error components," and another that does not. Because the error components correction influences some of the key estimates, we believe that both sets of results are of interest.

Reduced form

As described above, we estimated the reduced form equation with gasoline price as the dependent variable. The results are presented in table I.1.

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[8] J. M. Griffin, "The Process Analysis Alternative to Statistical Cost Functions: An Application to Petroleum Refining," American Economic Review, Vol. 64, (1974), p. 50.

[9] J. Ramsey, R. Rasche and B. Allen, "An Analysis of the Private and Commercial Demand for Gasoline," Rev. of Econ. and Stat., Vol. 57, (1975), p. 502. C.A. Dahl, "Consumer Adjustment to Gasoline Tax," Rev. of Econ. and Stat., Vol. 61, (1980), p. 427.

[10] G.S. Maddala, Econometrics, (New York: McGraw Hill, 1977), p. 326.

Table I.1: Summary of Reduced Form Equation Results
(Dependent variable: gasoline price)

Variable[a]	O.L.S.[b]	O.L.S. with error component
Constant	-3.30 [c]	.0004
	(.142)	(.001)
Lagged sales	- .002	.002
	(.001)	(.003)
Income per capita	.066[c]	.257[c]
	(.007)	(.017)
Crude oil price	1.82 [c]	1.84 [c]
	(.039)	(.03)
Distillate margin	.047[c]	.065[c]
	(.004)	(.006)
HHI	.013[c]	.041[c]
	(.003)	(.006)
Summer	.02 [c]	.006[c]
	(.002)	(.003)
Winter	- .025[c]	.006
	(.003)	(.004)
1984	- .021[c]	- .037[c]
	(.003)	(.003)
1985	.056[c]	.037[c]
	(.003)	(.005)
R^2	.81	.96

[a]Standard errors of the coefficient estimates are shown in parentheses.

[b]Ordinary Least Squares (O.L.S.).

[c]Indicates the coefficient is significantly different from zero at the 95-percent significance level or better.

The estimated coefficients of all the variables for which we could determine expected signs are as expected and significant: income, crude oil price, distillate margin, HHI, and the seasonal dummies (except winter in the error components regression, which appears insignificant). The dummy variable for 1984 was negative and significant in both equations, suggesting that the price was significantly lower in that year than in 1983, other things equal. The dummy variable for 1985 was positive and significant in both regressions, suggesting that price was between 4 and 6 percent higher in 1985, after controlling for the influence of the other variables we have introduced here.

The coefficient on the HHI was positive and significantly related to the price level. Its magnitude implies that a 1-percent increase in the index would be associated with an increase in the price level between .01 and .04 percent. Since we found that FTC's enforcement of the merger guidelines effectively prohibited any concentration increase over 10 percent in states considered to be moderately or highly concentrated as measured by the HHI, the maximum possible effect of the mergers on price in those states was less than .5 percent, or less than .5 cents per gallon.[11]

We detected some evidence of first order serial correlation in our results, but when we corrected for it using the 2 step procedure recommended by Hatanaka,[12] the magnitude of the coefficents did not change significantly. Therefore, this correction was not made in our final results.

Structural equations

We applied two-stage least squares (2SLS) to both the supply and demand equations described above. In the first stage estimation of each equation, wholesale gasoline price was regressed on the complete set of predetermined variables from both equations and an instrumental variable for price was created. In the second stage, we regressed gasoline sales on the instrumental variable and on the relevant predetermined variables in either the demand or supply function.

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[11] In response to a comment from FTC, we estimated an alternative specification of the reduced form equation. In this specification, the estimated relationship between the HHI and the price was allowed to vary according to the level of concentration (markets with an HHI of less than 1,000 versus markets with an HHI of 1,000 or more). The details of this specification and the results we obtained are discussed along with our responses to other FTC comments in app. III.

[12] M. Hatanaka, "An Efficient Two-Step Estimator for the Dynamic Adjustment Model with Autoregressive Errors," Journal of Econometrics 2(1974), pp. 199-220.

Table I.2: Structural equation results

Variable[a]	2SLS Supply	2SLS Demand	2SLS with error components Supply	2SLS with error components Demand
Constant	.124	.541	.00001	.001
	(.783)	(.222)	(.003)	(.003)
Price	.428[b]	-.108[b]	.662[b]	-.693[b]
	(.181)	(.056)	(.036)	(.099)
Lagged sales	.987[b]	.993[b]	.969[b]	.946[b]
	(.003)	(.003)	(.006)	(.006)
Income per capita	-	.004	-	1.16 [b]
		(.02)		(.076)
Crude oil price	-.328	-	-1.016[b]	-
	(.396)		(.057)	
Distillate margin	-.146[b]	-	-.181[b]	-
	(.013)		(.015)	
HHI	-.021[b]	-	-.051[b]	-
	(.01)		(.015)	
Summer	-	.012	-	.01
		(.007)		(.008)
Winter	-	-.068[b]	-	-.022[b]
		(.01)		(.01)
1984	.003	-.024[b]	-.001	-.144[b]
	(.008)	(.008)	(.009)	(.015)
1985	-.027	-.012	-.056[b]	-.185[b]
	(.016)	(.008)	(.008)	(.016)
R^2	.99	.99	.98	.98

[a]Standard errors of the coefficient estimates are shown in parentheses.

[b]Indicates the coefficient is significant at the 95-percent confidence level or better.

In the 2SLS results without error components, all the coefficients in the demand equation have the expected signs except that of income which is insignificant. Since the equation is in log-linear form, the coefficients can be interpreted as elasticities. The coefficient on the dummy variable for 1984 is negative and significant, but the coefficient on the 1985 dummy was insignificant.

The total demand for gasoline could vary from state to state for a number of reasons unrelated to the economic variables we have included in this regression. We used two methods to control for this state-to-state variation while estimating the demand

equation. The first is the error components adjustment described above. The results of this estimation are shown in table I.2. The income coefficient is positive and significant, as expected, and the dummy for 1985 is negative and significant. This implies that demand was lower in 1985 than in 1983, given the values of the demand factors we identified.

We also estimated the demand equation controlling for state-to-state variation by converting sales to per capita units. This approach has been used in several studies. Converting sales to per capita units adjusts the total demand for the size of the population, which might otherwise obscure the role of other factors. We added the state's population density on the hypothesis that people drive more the more spread apart they are. When we estimated this equation, the coefficient on population density was indeed negative and significant. The income coefficient was positive but not significant, while the dummy for 1985 was again insignificant.

The supply equation results were similar under both estimation procedures, except the price of crude was negative (as expected) and significant, and the 1985 dummy was negative and significant with the error components adjustment. The coefficient on the HHI was negative and significant under both procedures, implying that higher concentration levels are associated with lower supplies, or, other things being equal, higher prices. Again this effect is small, a 1-percent increase in the HHI is associated with a .02 to .05 percent decrease in supply or about a .04 percent increase in equilibrium price. This agrees with the reduced form equation results when estimated with the error components adjustment.

The structural equation estimates provide mixed evidence of changes that could have caused the change in prices in 1985. Neither supply nor demand appear to have shifted, when estimated by 2SLS without the error components correction. However, after making the adjustment for unexplained differences between states, both appear to have decreased. Since a decrease of demand by itself would cause lower prices, while a decrease of supply by itself would cause higher prices, this evidence suggests it was the latter that led to the increase in prices indicated by the reduced form results.

COMMENTS FROM THE DEPARTMENT OF ENERGY

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

Department of Energy
Washington, DC 20585

JUL 23 1986

Mr. J. Dexter Peach
Director, Resources, Community, and
Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

The Department of Energy (DOE) appreciates the opportunity to review and comment on the General Accounting Office (GAO) draft report entitled "Energy Prices: Gasoline Price Increases in Early 1985 Interrupted Previous Trends."

Energy Information Administration (EIA) staff found the analysis underlying GAO's report to be of high quality. The appendix provided an excellent description of the uses and limitations of regression analysis both in general and in addressing the questions at hand. Despite the overall positive view of the analysis, EIA's review found the following points worthy of note:

See comment 1.

- There is no theoretical reason given for significantly lower gasoline demand than expected in 1984 and 1985, and no explanation is offered.

See comment 2.

- The methodology used in "error component regression" is unaccountably vague, given the rigor of the appendix in general.

See comment 3.

- Using a 1985 supply dummy may have caused an underestimation of the impact of the Herfindahl-Hirschman concentration index. It is possible that some of the effects of the two 1985 mergers were captured by the dummy instead of the index.

DOE hopes that these comments will be helpful to you in your preparation of the final report.

Sincerely,

Martha O. Hesse
Assistant Secretary
Management and Administration

COMMENTS FROM THE DEPARTMENT OF ENERGY

GAO COMMENTS

The following are GAO's comments on the Department of Energy letter dated July 23, 1986.

1. DOE notes that we did not offer a theoretical explanation for the lower demand for gasoline than expected in 1984 and 1985. Our regression analysis controlled for the decreases in demand in deriving the results presented in the report. Also reduced demand would tend to cause downward pressure on prices, thus it would not have helped explain why 1985 prices were higher than expected. We, therefore, chose not to do the additional data collection and analysis that would have been necessary to determine which factors caused the demand to be lower than expected.

2. DOE states that our presentation of the error components methodology was unaccountably vague. The error components methodology is a technical procedure used when conducting regression analysis of pooled cross section/time series data. Although we did not believe it was necessary to include any additional description of this methodology for the purposes of this report, we did include a reference to an econometrics textbook where the procedure is described in more detail (see p. 45).

3. DOE noted that the 1985 supply dummy variable might have captured some of the effects of the mergers and therefore led to an underestimation of the impact of the HHI. This would occur if a statistical problem called collinearity arises between the HHI and the 1985 dummy variables. Collinearity refers to a close relationship between two variables in the regression analysis, for example, when one is a simple multiple of the other. In our model this could occur if the HHI were systematically higher during 1985 than during the previous time period. In performing various statistical tests to check the reliability of our results, we had measured the degree of relation between these two variables and found that it was small enough that the problem DOE refers to is not likely to be present.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

OFFICE OF THE CHAIRMAN

FEDERAL TRADE COMMISSION
WASHINGTON, D.C. 20580

August 7, 1986

Mr. Richard L. Fogel
Director
Human Resources Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Fogel:

Thank you for your letter of July 8, 1986, asking for comments on the draft report, Energy Prices: Gasoline Price Increases in Early 1985 Interrupted Previous Trend. I have asked the staffs of the Bureau of Competition and Bureau of Economics to review the report and to provide comments that would aid the GAO in analyzing gasoline pricing trends. The FTC staff analysis focuses on the methodology of the report that led the study to conclude that "increases in concentration at the level permitted by the merger guidelines were generally associated with less than a one-half cent per gallon increase in wholesale gasoline prices" and that "wholesale gasoline prices in 1985 were 4 to 6 percent higher than might have been expected on the basis of 1985" factors affecting gasoline prices.

The staff analysis is attached to my letter. The staff proposes a number of additional procedures that the GAO may wish to follow to test its conclusion that increased concentration is associated with increased price and that prices rose more than anticipated. GAO may find upon using the additional procedures suggested that the relationships predicted by the model disappear.

In this regard, I believe that there is reason to doubt the accuracy of the report's conclusion that there is a relationship between concentration and price at relatively low levels of concentration. A good deal of theoretical and empirical work suggests that there is no relationship between concentration and price in unconcentrated markets. The GAO model, however, assumes a linear relationship between concentration and price in all markets, irrespective of their level of concentration. Because this assumption is dubious, I recommend that the GAO test for critical levels of concentration before reaching conclusions

COMMENTS FROM THE FEDERAL TRADE COMMISSION

about the association between concentration and price.

I appreciate the opportunity to offer comments on the GAO study. If you have any questions regarding our analysis or if we can be of any further assistance, please contact my office or telephone Dr. Scott Harvey, a staff economist in the Bureau of Economics, at 634-4628.

Sincerely,

Daniel Oliver
Chairman

Attachment

COMMENTS FROM THE FEDERAL TRADE COMMISSION

Staff Analysis

I. General Observations

A. Presentation of Results

See comment 1.

See comment 2.

See comment 3.

The GAO estimate of a potential one-half cent per gallon increase appears to be an upper bound estimate for states where the HHI increased by 99 points or where the HHI was below 1000. To place this upper bound estimate in perspective, the report could list actual HHI increases that resulted from the acquisitions. It also would be helpful in interpreting and evaluating the implications of the coefficient estimates in the GAO regression analysis if the Tables on pages 47 and 48 reported the standard error of each coefficient estimate in addition to whether the coefficient estimate is significantly different from zero. For example, this information would permit a reader to calculate confidence intervals for the HHI coefficients in the various regressions. Finally, in numerous instances the report relies on the GAO model to predict the "effect" of increased concentration on price.[1] "Association" or "correlation" may be more appropriate terminology if the model continues to find such an association after adopting the suggested techniques.

B. The Price of Crude

See comment 4.

The GAO includes the price of crude oil in its model of wholesale gasoline prices. Although this may be appropriate, the study assumes that the price of crude is exogenous, i.e., the price of crude affects the price of gasoline but the price of gasoline does not affect the price of crude oil. In order to determine whether this assumption is correct, the GAO might wish to determine whether the results are sensitive to treatment of the price of crude oil as an endogenous variable.

See comment 5.

Second, some thought should be given to the implications of including the gasoline price and the crude price as separate variables in a log linear model.[2] The resulting coefficient estimate of 1.8 for the crude variable in the reduced form equations seems counter intuitive: it suggests that the margin between crude price and gasoline price increases substantially as the crude oil price increases. Because the crude oil price variable is probably correlated to some degree with other variables in the model, the distorted role of crude oil in the model could affect other coefficient estimates.

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1 GAO draft report at 5, 27, 29, 33.

2 The papers cited in the draft GAO report as examples of the use of log linear models to estimate gasoline demand do not use the price of crude oil as a variable.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

See comment 6.

Third, the use of current refiners' acquisition-cost data to measure the price of crude may not be the most desirable specification of the crude oil price variable. One might therefore explore whether the results are sensitive to the use of lagged rather than current crude price or to the use of spot price for a particular crude stream (such as Brent or West Texas Intermediate) instead of an aggregate average price.

II. Higher Gasoline Prices in 1985

See comment 7.

There are a number of possible explanations for the finding that gasoline prices were 4-6% higher in 1985 than predicted by the GAO model. First, the GAO analysis is based on the wholesale price of gasoline. The dependent variable is therefore the weighted average price of leaded regular, unleaded regular and premium gasoline. However, the proportion of unleaded regular and premium gasoline has been increasing over time. Leaded regular declined from 44.8% of gasoline sales for resale in January 1984, to 42.8% in July 1984, to 39.1% in January 1985, to 38.7% in July 1985. Because unleaded regular and premium grades command higher prices than leaded regular, the dependent variable has a built in tendency to rise over time. Thus, even if the price of leaded regular, unleaded regular and premium gasoline were unchanged from 1983 to 1985, the average price would rise because of the higher proportion of unleaded and premium gasoline sales in the later years.[3] Although this source of distortion probably accounts for only 10-20% of the unexplained price increase in 1985, the study would be improved if it either controlled for changes in gasoline mix or predicted the price of a single grade of gasoline.[4]

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3 In the two stage least squares analysis, the overstated price increase for the later years means that a given average price level does not induce as much output in 1985 as it does in 1984. This tends to cause the 1985 dummy variable in the supply equation to have a negative coefficient.

4 It should also be recognized that because the gasoline price variable is a wholesale price, the GAO study is an analysis of the supply of and demand for gasoline at the wholesale level, not the retail level. The demand side variables are nevertheless reasonable, because they presumably affect the derived demand for gasoline at the wholesale level.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

It might also be enlightening if the GAO study controlled for changes in refinery capacity.[5] Because the difference between the gasoline price and the crude price depends on the size of the refinery margin as well as the wholesale margin, the GAO finding that gasoline prices were higher than predicted in 1985 might be attributable to an increase in either the refinery margin or the wholesale margin. Because refinery capacity declined significantly from 1984 to 1985, refinery utilization rates were generally several percentage points higher in 1985 than in the corresponding month of 1984. It would not be surprising if tighter refinery capacity in 1985 resulted in somewhat higher refinery margins in 1985 than in 1984 and contributed to the GAO finding of higher prices than predicted in 1985.

See comment 8.

It might also strengthen the analysis if the GAO model controlled for changes in the use of lead as an octane enhancer. Two changes are important. First, EPA has ordered reductions in the quantity of tetraethyl lead that may be added to leaded gasoline.[6] Second, the proportion of leaded gasoline in total gasoline output declined throughout the period as noted above. Both changes reduced the ability of refiners to meet octane requirements through the addition of lead and required them to use either more expensive additives or increasingly valuable blending stocks to upgrade gasoline octanes. The GAO study concludes that lead phase down did not contribute to higher gasoline prices in 1985 because "the Nelson index of refinery operating costs, fell substantially from January to July, increased somewhat from July to September, and then continued to decline even further from September to October."[7] However, the Nelson index does not measure actual changes in the costs incurred by refiners to manufacture gasoline. It is an inflation index. Thus, it measures changes in the price of tetraethyl lead, other chemicals, electricity, and other inputs. The Nelson index does not rise if a lead phase down forces refiners to use more energy or more expensive chemicals in order to produce the

See comment 9.

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5 Because refinery markets are of different sizes, it would be necessary to use the ratio of current capacity to some base period value for each refinery market. Refinery capacity is also not entirely exogenous. While most of the changes in refinery capacity in this period are probably attributable to long-run considerations, it is likely that month to month variations in refinery margins had some impact on the level of operating capacity.

6 Although the lead limits were reduced effective July 1, 1985 and Jan. 1, 1986, the effects were spread through 1985 and 1986 because EPA rules permitted refiners to bank lead rights during 1985.

7 GAO draft report at p. 29.

Now on p. 31.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

same octane gasoline. If the GAO could obtain data on the sales price of lead rights, it might be able to control for the effects of lead phase down.

III. Gasoline Prices and Concentration

See comment 10.

The Department of Justice Merger Guidelines ("DOJ Guides") assume that mergers and acquisitions in unconcentrated markets are unlikely to reduce competition. The DOJ Guides do not assume a linear relationship between concentration and price. The assumptions set forth in the DOJ Guidelines are consistent with a large body of theoretical and empirical economic literature. The GAO study, however, assumes a linear relationship and does not test whether there are critical concentration values below which the relationship between concentration and price does not hold. Because this assumption is dubious, it would be important to test for such a critical value in order to determine whether the model can be used to assess the association between concentration and price in gasoline markets with HHIs below 1000, the level below which the DOJ Guides assume that market power is unlikely to exist.

It should also be noted that the error component procedure analyzes the relationship between changes in concentration and gasoline prices over time in a given market while the unadjusted OLS also takes account of any cross sectional relationships.[8] Because the error components analysis appears to find a considerably stronger relationship between concentration and price or output than does the unadjusted approach, it appears that it is the time series relationship that drives the results.

One reason that the error components methodology may find a stronger relationship between concentration and prices than does the OLS methodology is that the former approach controls for cross-sectional variations in gasoline prices attributable to differences in transportation costs[9] or differences in crude costs (between the West Coast and the Gulf Coast). Because the states with high concentration based on EIA data are not randomly distributed across the country but concentrated in the Western and Northern Tier states,[10] cross-sectional analysis may produce spurious relationships. The GAO methodology is therefore an

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8 The econometric technique used by GAO is not a variance component model but a model usually referred to as a fixed effects model. To avoid confusion we use the GAO terminology.

9 The difference in the price of gasoline sold in Illinois and in Texas includes the difference in the cost of transporting imported crude or gasoline into these states.

10 See the GAO draft report at p. 16.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

insightful approach to analysis of concentration in local gasoline markets.

See comment 11.

Since it is not apparent that there actually have been large changes in concentration in wholesale gasoline markets between 1983 and 1985, it is somewhat surprising that a statistically significant relationship between changes in prices and concentration over time is identified by the GAO study. If changes in the HHI variable from year to year are the result of quirks in the EIA data, rather than real changes in concentration, and the cause of the distortions is for some reason related to the price level, then the estimated relationship between concentration and prices may be spurious, in part. For example, it is our understanding that the explanatory variable in the GAO model is the average concentration in each state for each year. In our experience, when EIA aggregates data over time in this manner, the company code is used to derive total volumes for each company. However, changes in ownership during a year can cause a particular refiner to have more than one company code during the year. If this is not corrected, one can have significant swings from year to year in calculated concentration while actual concentration is unchanged.[11]

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[11] For example, suppose that Company A had 8% of the wholesale sales in a particular state in 1983, that these assets were sold to Company B on July 1, 1984, and that Company B had 1% of the market. The actual change in the HHI is from 65 (8^2 + 1) prior to July 1, 1984 to 81 after July 1, 1984. The EIA data might, however, lead to a 1983 HHI of 65, a 1984 HHI of 41 (4^2 + $(4+1)^2$), and a 1985 HHI of 81.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

GAO COMMENTS

The following are GAO's comments on the Federal Trade Commission letter dated July 23, 1986.

1. FTC commented that the actual HHI increases that resulted from the mergers could be listed to place the potential increase in gasoline prices of one-half cent per gallon in perspective. We do not believe that this is necessary because, as noted on p. 29, the required divestitures eliminated increases in concentration that would have exceeded the merger guidelines (increases of more than 100 points in a market where the HHI is 1,000 points).

2. As suggested by FTC, we have added the standard error of each coefficient estimates in the tables showing the regression results in app. I.

3. We agreed with FTC that "association" or "correlation" would be more appropriate than the term "effect" in describing the relationship between concentration levels and price and the report has been revised accordingly.

4. FTC suggested we might want to test whether the results of our study are sensitive to the treatment of the price of crude oil as an endogenous variable to check whether the price of crude oil is affected by the price of gasoline. The price of gasoline could influence the price of crude oil by influencing the demand for gasoline and, in turn, the demand for the crude oil to produce that gasoline. We believe, however, that this influence is likely to be very small in the short run because it takes time for purchasers to significantly alter their consumption patterns. Given the relative inelasticity of short-run demand for gasoline and the additional complexity of modeling the world oil market, we believe that the assumption that the price of crude oil is exogenous in our model is a reasonable one.

5. We do not believe that including the price of crude oil as a determinant of gasoline prices would lead to the problems mentioned by FTC. Since the gasoline price appears as a dependent variable and the crude oil price as an independent variable, the relationship between them is captured by the coefficient on the crude price and does not create problems of collinearity in the model. FTC commented that if the role of crude oil in the model is distorted, it could affect other coefficient estimates since it is probably correlated with them to some degree. We tested for correlation between the price of crude oil and the other independent variables in our model and found them to be relatively uncorrelated.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

FTC also commented that the coefficient on the crude price seems counter intuitive and that this might be due to correlation with other variables. While we agree that the coefficient appears large, we do not think it can be attributed to the problem FTC mentions, that is, collinearity.

6. FTC also suggested testing to see if our results were sensitive to the use of other measures for the crude price variable. On the basis of conversations with EIA and industry analysts, we believe the refiners' acquisition cost data were the best available measures of crude costs. We decided not to use a lagged value of crude price because other studies have related current gasoline prices to current crude prices in determining gasoline supply.

7. FTC suggested that the unexplained increase in gasoline prices in 1985 might be partly a result of the increasing share of unleaded gas (which is higher in price) in total sales. We had considered this change in designing our methodology and determined that the shift to unleaded gasoline (which is related to the replacement of older cars that used leaded gasoline with newer models that require unleaded gasoline) was a gradual change and as such did not appear to be related to the 1985 price increase. We tested this by calculating a weighted average price using the 1985 volume of total sales and the 1985 prices for each type of gasoline, but assumed that leaded, unleaded, and premium gasoline had accounted for the same percentage of the sales as they had in 1983. When we compared this with the 1985 weighted average price (as used in our model), we found that the shift to higher priced gasolines had caused a .8 percent increase in the average price. FTC is correct that this represents a partial explanation for the prices in 1985 being higher than expected, but the bulk of the increase remains unexplained.

8. FTC notes that refinery capacity decreased significantly from 1984 to 1985 and that this may have caused higher refinery margins, which could partially explain the higher than expected prices in 1985. We are aware of the decrease in refinery capacity during this period. The explanation given by EIA is that the industry was responding to a situation of excess capacity by closing down its unneeded refineries. On the basis of the information we collected, we were not able to determine whether refinery margins had increased due to these changes. For this reason, even though we believe that price increases in 1985 seemed to be due to supply-related factors, we do not think we have sufficient support to identify the specific changes that led to the higher prices.

COMMENTS FROM THE FEDERAL TRADE COMMISSION

9. FTC commented that the Nelson Index is an inflation index and does not measure actual changes in the costs incurred by refiners to manufacture gasoline. FTC indicated that the index would measure changes in the price of tetraethyl lead but would not show an increase if the lead phasedown forced refiners to use more energy or more expensive chemicals in order to produce the same octane gasoline. On the basis of further interviews with the publisher of the Nelson Index, we agree with the FTC's contention that it may not fully capture the impacts of the phasedown in 1985. However, as the FTC noted, the Index would capture the effects of the phasedown on the costs of refining inputs. For example, the price of an input might increase if refiners decide to use more of it to compensate for the reduction of lead. Thus, the Index does provide a partial indication of the impacts of the lead phasedown on refiners' costs. We modified our conclusion regarding the impact of the lead phasedown on the basis of this information.

10. FTC noted that their merger guidelines assume that mergers in unconcentrated markets (HHI below 1,000) are unlikely to affect prices and that GAO did not test for a critical concentration value below which the relationship between concentration and price does not hold. For the limited purpose of our analysis, resolving this issue is relatively unimportant. Regardless of whether there is a small relationship between concentration and price in these markets or none at all, we believe that our conclusion that the 1985 price increases were not primarily the result of increases in concentration from recent mergers is sound.

    Nonetheless, in response to FTC's comments, we performed additional statistical analysis using FTC's criterion for dividing unconcentrated markets from moderately and highly concentrated ones. In an alternate specification of the reduced form equation, we created a dummy variable equal to 1 when the HHI exceeded 1,000, and 0 otherwise. We then interacted that dummy with the HHI itself (that is, we multiplied the dummy times the HHI). By including both the new variable created this way and the HHI in one regression, we were able to test whether the relationship between the HHI and price was weaker (or nonexistent) in unconcentrated markets. Our results did not show this. Instead, they suggest (1) that there is a relationship between the HHI and price in unconcentrated markets and (2) that the relationship is nearly the same as in moderately and highly concentrated markets. Without the error components correction, the difference between the two types of markets in the effect of

COMMENTS FROM THE FEDERAL TRADE COMMISSION

correlation on prices was only about .002 percent. With the error components correction, the difference was .008 percent.

Other specifications, such as a different dividing point between unconcentrated and moderately and highly concentrated markets, might yield different results.

Because the alternate specification did not yield estimates showing differences of more than about .008 percent, we continued to base our numerical conclusion about the likely effect of allowed concentration level increases on gasoline prices in moderately and highly concentrated markets on the results presented in tables I.1 and I.2. The estimates from the alternate specification with the error component correction suggest that the effect may be slightly larger, but still less than 1 cent per gallon. Without that correction, the estimated effect is about the same as in the original specification.

11. The FTC commented that the EIA data might exaggerate year-to-year concentration changes due to the method of calculating the annual average HHI. In the course of our study, we decided to use the annual average HHI as the measure of market concentration because we believed that the monthly values would have reflected fluctuations in sales not related to the firms' typical market share. For example, a firm's sales could decrease due to temporary refinery closure for maintenance. Thus, we believe the annual average values gave a better indication of the prevailing market shares over a period of time (1 year). The FTC comments are correct in noting that this measure does not necessarily reflect the market shares of firms at a specific point in time. However, given the other factors causing changes in the monthly HHI values and that exerting market power within a market would probably require a concerted effort over time, we believe that the annual average values were a more appropriate measure of firms' abilities to exert market power.

(007063)

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