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## Competition in the Petroleum Industry: The Situation in 2001<sup>1</sup>

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### INTRODUCTION

Competition in the petroleum industry is normally assessed using the traditional tools of antitrust analysis. The expectation is that markets will remain competitive, prices will stay relatively stable, and the exercise of market power will be blocked if proposed mergers are approved only when it can be shown that the merged firms will not gain excessive control. Divestitures are sometimes required to meet these conditions.

Thus, in evaluating the mergers of BP with Amoco, Exxon with Mobil, BP Amoco (now BP) with Arco, and Chevron and Texaco, as well as the formation of joint refining and marketing ventures created by Shell and Texaco (Motiva and Equilon) and Marathon Ashland, the Federal Trade Commission (FTC) has examined indices of competition in a number of activities. Ownership of critical facilities such as pipelines and terminals has been studied closely, and the competitive conditions in refining have been examined. In addition, the Commission has focused on the ownership of retail establishments by the merging parties, as well as their contracts with independent marketers. In some cases, the FTC has also examined the control merging firms may have over exploration and production of crude oil or natural gas.

In the five years since the merger wave in the oil industry began, the FTC's examinations have resulted in demands for altering specific transactions through divestitures. Asset sales have been required for the purported purpose of maintaining competition and preventing the merging parties from exercising market power to raise prices to consumers.

Some may assert that the Commission has failed because the merger wave has coincided with an increase in prices and price volatility. Certainly, politicians such as Senators Barbara Boxer (D. CA), Diane Feinstein (D. CA), Carl Levin (D. MI), and Ron Wyden (D. OR) believe the mergers

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have contributed to price volatility. Senator Wyden has gone so far as to accuse the oil industry of conspiring to limit production to raise prices.<sup>3</sup> Senator Wyden and others clearly believe that the mergers approved by the FTC are a cause of the increased volatility of petroleum product prices.

Republicans have complained as well, including Speaker of the House Dennis Hastert and the chairman of the Judiciary Committee, Henry Hyde. Both represent the state of Illinois, which has experienced substantial price volatility.

With the benefit of hindsight, one could conclude that the Commission's effort has failed. The volatility of retail gasoline, heating oil, jet fuel, and natural gas prices has increased noticeably since the first merger was announced. Furthermore, the increased volatility has been most noticeable in those regions where mergers occurred.

It will be suggested here that these criticisms of the FTC and of the oil industry are incorrect. In particular, accusations of conspiracy within the petroleum industry have been rejected at both the federal and state levels. The FTC itself found absolutely no evidence of a conspiracy on the part of any individuals in the industry to raise prices in its recent investigation of marketing practices in the Midwest during the spring of 2000.<sup>4</sup> The Commission also found no evidence of anticompetitive actions in its investigation of the California gasoline market.<sup>5</sup> Furthermore, the California Supreme Court dismissed a separate class action lawsuit alleging a conspiracy on the part of the oil industry to raise prices in 1996.<sup>6</sup> Lastly, investigations of the petroleum market's performance conducted by the FTC following the 1996 increase in prices revealed no violation of the law.<sup>7</sup>

However, findings of no antitrust violations do not absolve competition authorities of all responsibility for the upsurge in price volatility. To the contrary, actions taken by both the FTC and the Department of Justice (DOJ) have contributed to the increased price instability. Their acts — combined with those taken or not taken by the Department of Energy, the Department of State, the Environmental Protection Agency, competition authorities in the European Union, the International Energy Agency, and legislative bodies in the United States and Europe — are the primary cause of the rise in price volatility.

In this paper, I suggest that the FTC's application of a "one size fits all" theory of competition has been a principal source of the increase in prices and price volatility. Specifically, I suggest

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<sup>3</sup> Senator Ron Wyden, "The Oil Industry, Gas Supply and Refinery Capacity: More than Meets the Eye," Investigative Report, June 14, 2001. [<http://wyden.senate.gov/oilinvest.doc>]

<sup>4</sup> See "Midwest Gasoline Price Investigation," Final Report of the Federal Trade Commission, March 29, 2001. [<http://www.ftc.gov/os/2001/03/mwgasrpt.htm>]

<sup>5</sup> See "Western States Gasoline Pricing Investigation," Statement of Commissioners Sheila F. Anthony, Orson Swindle, and Thomas B. Lcary, File No. 981-0187, May 7, 2001. [<http://www.ftc.gov/os/2001/05/wsgniswindlc.htm>]

<sup>6</sup> See *Theresa Aguilar et al. v. Atlantic Richfield Company et al.*, California Supreme Court Opinion S086738, June 14, 2001. [<http://www.courtinfo.ca.gov/opinions/documents/S086738.PDF>]

<sup>7</sup> No report was issued following this investigation. However, the author was a member of the consulting task force.

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that the Commission has focused too much attention on retail marketing and too little on the costs of entry into and continued operation of refining. Rather than mandating divestitures of refining assets, the FTC should require merging firms to operate and expand existing refining capacity as a condition for the merger. Rather than mandating the sale of terminal facilities, the FTC should also require merging firms to expand existing terminal facilities, as well as open them to third parties.

Neither of these two proposals is among the remedies normally put forth by US or European competition authorities. However, implementing such steps would better serve the economic interests of consumers in the short and longer run. In the short run, instituting the steps would increase the supply of petroleum products and lower prices. In the longer run, it would increase the likelihood of the refining industry having the capacity to adapt to the demands imposed by consumers and environmental regulators.

In this paper, I will also argue that the leading anticompetitive force in energy markets is the Organization of Petroleum Exporting Countries. Competition authorities on both sides of the Atlantic should address the conspiracy among OPEC members, along with the governments of Norway and Mexico, to raise prices artificially. If action is not taken to address this conspiracy, I see no reason for government agencies to use their limited resources to investigate actions by refiners or others in the industry.

The fundamental theme of the paper, however, focuses on the role of commodity markets. Such markets represent a backwater of economic research. Few papers are published on the subject and much of the research is more than thirty years old. Academic institutions such as Stanford have closed research institutes that once focused on the subject and terminated professors despite their having tenure. Yet the techniques developed for assessing commodity markets explain the recent fluctuations observed in petroleum markets. Indeed, the rise in crude oil prices from March 1999 to the fall of 2000, the increase in heating oil prices in January and February 2000, the boost in gasoline prices in the spring of 1996, 1999, 2000, and 2001, the increase in natural gas prices during the fall and spring of 2000/2001, and perhaps even the recent surge in electricity prices can all be explained by one relatively old and simple theory.

Given the strength of the commodity market model, an improved understanding of the relationships it is based on would clearly help the Commission assess the effects of proposed mergers and predict the consequences. Furthermore, an improved understanding of the behavior of commodity markets would enable the FTC to advise other agencies — particularly the Environmental Protection Agency, the Department of Treasury, the Department of Energy, and the Department of State — regarding proposed policies and regulations.

**RECENT FTC ACTIONS IN PETROLEUM**

Neither the Federal Trade Commission nor the Department of Justice was asked to review even one merger in the petroleum industry over a ten-year period beginning in 1987. This situation changed in 1996. In the last five years, mergers have been proposed between

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- The refining and marketing entities of Shell and Texaco
- The refining and marketing entities of Ashland and Marathon
- Tosco and Unocal (through Tosco's acquisition of Unocal's petroleum marketing assets)
- Amoco and British Petroleum
- Mobil and Exxon
- Arco and BP
- Texaco and Chevron
- Tosco and Phillips
- UDS and Valero

Mergers have occurred in Europe as well. The French firm Total purchased the assets of the Belgian firm Fina. The combined firm then acquired the French firm Elf.

Each of these mergers was evaluated using the traditional tools of antitrust analysis. A Herfindahl-Hirschman Index (HHI) of competition was computed for refining, marketing, pipeline transportation and, on occasion, exploration and production. In addition, special analyses were made in certain cases to determine whether the merging firms would enjoy excessive control over critical facilities, such as crude production in Alaska.

The procedures followed were no different than those applied to other industries. Using the methodology set out in its *Horizontal Merger Guidelines*<sup>8</sup>, the Commission sought to define the "relevant geographic markets" and then determine whether the merging parties enjoyed significant market power in each of the markets.

**Shell and Texaco**

The merger of the refining and marketing assets of Shell and Texaco was the first petroleum merger assessed in the last five years. The two companies proposed to put all their refining, terminal, and marketing assets into two companies. Upon approval, the firms created Motiva Enterprises LLC and Equilon Enterprises LLC.<sup>9</sup> The FTC imposed certain conditions on the merging parties. Specifically, they were required to sell a specific number of service stations in San Diego and Hawaii, a terminal in Hawaii, and Shell's refinery in Anacortes, Washington.<sup>10</sup>

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<sup>8</sup> FTC, "1992 Horizontal Merger Guidelines (with April 8, 1997, revisions to Section 4 on Efficiencies)." [<http://www.ftc.gov/bc/docs/horizmer.htm>]

<sup>9</sup> The merging parties needed to create two firms because Texaco had previously formed a joint venture with Aramco, Saudi Arabia's national oil company, to own the refining and marketing assets previously owned by Texaco east of the Rocky Mountain States. Thus, Motiva had three shareholders (Shell, Texaco, and Saudi Arabia), while Equilon had two (Shell and Texaco).

<sup>10</sup> FTC, *In the Matter of Shell Oil Company and Texaco, Inc.*, Decision and Order, Docket Number C-3803, File No. 9710026, April 22, 1998. [<http://www.ftc.gov/os/1998/9804/100026.do.htm>]

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As I note below, the requirement to dispose of the Anacortes refinery was a mistake that has probably resulted in higher prices to consumers and greater price volatility.

**Tosco and Unocal**

Tosco followed the merger of Shell and Texaco's refining assets with its acquisition of Unocal's 76 refining and marketing company. The transaction was allowed to proceed without changes because, prior to the deal, Tosco had only minor involvement in refining and marketing in the western states where Unocal historically had been a large player.<sup>11</sup>

**Ashland and Marathon**

The merger of the refining and marketing assets of Ashland with Marathon was the second petroleum merger assessed by the FTC. The two companies proposed to put all their refining, terminal, and marketing assets into one company. The FTC approved this merger with no conditions. As a consequence, control of terminal facilities along the Ohio River fell into the hands of a single company. Some firms have complained privately that substantial competition was lost. The data suggest that retail prices paid by consumers in the areas affected by the merger did rise relative to prices in other areas for a time.

**BP and Amoco**

BP's purchase of Amoco was the first of the "mega mergers" that combined two integrated oil companies. The merger, announced in the fall of 1997, was consummated by the spring of 1998 with relatively few divestitures. The union occurred because the companies concluded they lacked sufficient scale to afford the capital expenditures to explore for oil in those areas thought to have large reserves.<sup>12</sup> The companies agreed to sell or release from contract 1,600 gasoline stations in thirty markets and sell nine product terminals.<sup>13</sup>

**Exxon and Mobil**

Exxon's acquisition of Mobil was announced in December 1998 and completed at the end of 1999. This merger was also dictated by the very high capital costs associated with exploration in those areas thought to hold the largest reserves. In this merger, the FTC required that the firms divest 2,431 service stations. The parties were required to sell three terminals and interests in one

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<sup>11</sup> Before the merger, Tosco owned refineries in Ferndale, Washington, and Martinez, California, and marketed products in the Northwest under the BP brand and in Arizona under the Exxon brand. The FTC apparently concluded that the acquisition would not adversely affect competition in any region.

<sup>12</sup> See Philip K. Verleger, Jr., "Prepared Statement before the Subcommittee on Antitrust, Business Rights, and Competition of the Senate Judiciary Committee," September 22, 1998. [<http://www.pkverlegerllc.com/BP-AMOCO.PDF>]

<sup>13</sup> FTC, In the Matter of The British Petroleum Company p.l.c., a Corporation, and Amoco Corporation, a Corporation, Agreement Containing Consent Order, File No. 981-0345, December 30, 1998. [<http://www.ftc.gov/os/1998/9812/consentord.htm>]

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of two competing pipelines. Lastly, the FTC also required that the merging companies dispose of ownership interests in some product pipelines and Exxon's Benicia (CA) refinery.<sup>14</sup>

**BP and Arco**

BP's acquisition of Arco was proposed in late 1999 and completed in the fall of 2000. This transaction created some unique circumstances for the FTC for two reasons. First, BP and Arco were two of the three principal producers of crude oil in Alaska. Second, BP owned a substantial portion of the crude oil terminaling facilities in Cushing, Oklahoma, the delivery point for most mid-continent crude, while Arco owned one of the two principal crude oil pipelines that could be used to bring imported crude to Cushing. BP was required to sell Arco's crude oil assets in Alaska and the pipeline from Houston to Cushing.

**Other Oil Industry Mergers**

The FTC is currently investigating the proposed mergers of Chevron and Texaco, Phillips and Tosco, and UDS and Valero and its response to these transactions is not known at this time.

**EVALUATING THE DIVESTITURES ORDERED BY THE FTC**

Table 1 (page 7) summarizes the divestitures required by the FTC in the major mergers noted above. From this table, one can observe that the principal actions required by the Commission have been sales of ownership interests in pipelines and terminals, sales of retail facilities (service stations), and sales of refineries.

*Sales of ownership interests in pipelines and terminals* can be and are justified by the need to maintain competitive access to critical facilities. Operations in the petroleum industry depend on access to storage facilities and to low-cost pipeline transportation. Firms that are unable to access pipelines to a specific city (say, Timbuktu) will be forced to bring product in by truck. These competitors will often choose to exit or not enter the Timbuktu market under those circumstances where the cost of truck transportation is significantly greater than the cost of shipping by pipeline to the market. By preventing existing marketers from gaining control of terminals or pipelines, the FTC ensures that competitors have access to facilities and a reasonable chance of success.<sup>15</sup>

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<sup>14</sup> FTC, In the Matter of Exxon Corporation, a Corporation, and Mobil Corporation, a Corporation, Decision and Order, Docket No. C-3907, File No. 991-0077, January 30, 2001. [<http://www.ftc.gov/os/2001/01/cxxondo.pdf>]

<sup>15</sup> There are apparently no precedents regarding mergers of firms that are strictly in the business of operating terminal facilities. However, it appears that the argument denying a marketer of petroleum products the right to control terminal facilities would not extend to a firm that was strictly in the business of operating terminals. Whereas the marketing firm would have an incentive to limit competitors' access to the terminal to raise its rivals' costs and thereby allow it to raise consumer prices, the operator of terminals would seem to have every incentive to run the terminal so as to maximize profits, which would presumably be done in a less discriminatory manner.

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Table 1. Divestitures Demanded by the FTC in Petroleum Company Mergers

<u>Merging Firms</u>	<u>Date</u>	<u>Refineries</u>	<u>Terminals</u>	<u>Retail Facilities</u>	<u>Exploration and Production</u>
Shell and Texaco Joint Venture	1998	Anacortes (WA)	Hawaii	Hawaii and California	
Tosco Purchase of Unocal Refining and Marketing	1998	None	None	None	
Ashland and Marathon Joint Venture	1998	None	None	None	
BP Purchase of Amoco	1998	None	9	1,600	
Exxon Acquisition of Mobil	1999	Benicia (CA)	2+	2,431	
BP Acquisition of Arco	2000	2 in Alaska	None	None	Arco's Alaskan assets

Source: PKVerleger LLC.

In the complaint filed by the Commission against the merger of Exxon and Mobil, it asserted that the merger would create concentration in terminaling in Boston and Washington, DC.<sup>16</sup> The merging parties agreed to dispose of terminals to realize the merger.

In a recent working paper issued from the POWR program on regulation at the University of California, Richard Gilbert and Justine Hastings analyze statistically the effect of certain mergers that lessen competition in terminaling.<sup>17</sup> The authors provide a dramatic quantification of the effect of such mergers on wholesale gasoline prices.

Gilbert and Hastings apply a model of "Raising Rivals' Costs" developed by Thomas Krattenmaker and Steven Salop.<sup>18</sup> Krattenmaker and Salop study a case in an industry involving two stages of production where the parties are initially not integrated. Their analysis asks whether the merger of an upstream and downstream firm to create an integrated company could raise the costs to a competitor that is not integrated. The model is applicable to petroleum, where some firms are integrated and others are not. Integrated companies operate refineries and retail distribution systems. Companies that are not integrated produce refined products or distribute products.

Gilbert and Hastings studied the case where a refiner (Tosco) purchased an integrated refining and marketing company (Unocal). Prior to the merger, Tosco was a supplier of petroleum

<sup>16</sup> FTC, *In the Matter of Exxon Corporation and Mobil Corporation*, Complaint, Docket No. C-3907, File No. 991-0077, p. 6. [<http://www.ftc.gov/os/1999/9911/exxonmobilcmp.pdf>]

<sup>17</sup> Richard Gilbert and Justine Hastings, "Vertical Integration in Gasoline Supply, An Empirical Test of Raising Rivals' Costs," *POWER Working Paper PWP-084*, University of California Energy Institute, July 2001. [<http://www.ucci.berkeley.edu/ucci/PDF/pwp084.pdf>]

<sup>18</sup> Thomas G. Krattenmaker and Steven C. Salop, "Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power over Price," *Yale Law Journal* 96 (1986), pp. 209-234.

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products to independent marketers at terminals in various locations. Following the merger, the availability of product to independent marketers was reduced. The authors concluded that the wholesale price of unbranded product was increased in some markets. For example, they noted that the wholesale price of unbranded product rose 2.94 cents per gallon in San Jose, California, as a result of the increase in Tosco's market share that occurred with the Unocal acquisition.<sup>19</sup> In Los Angeles, the authors found an increase of 3.7 cents per gallon.<sup>20</sup> They also noted that rivals' costs (costs incurred by unbranded marketers) were increased in other markets when Texaco and Shell merged and supplies were cut off at some locations.

The Gilbert and Hastings paper offers a quantitative basis to justify the Commission's past focus on terminal ownership. Possession of such facilities by a vertically integrated company that refines and distributes petroleum products at its own branded stations – whether company-owned or jobber-operated — can result in higher prices.

*Sales of ownership interests in retail petroleum marketing properties as well as requirements that companies permit jobbers to break long-term contracts* historically have been mandated to maintain a significant degree of competition among petroleum marketers. The Commission has sought to determine whether the merging parties enjoy excessive market power in specific geographic markets. Where concentration was found, the merging parties were required to dispose of service stations.

Exxon and Mobil, for example, had to sell large numbers of service stations on the East Coast, and Exxon was required to divest 2,431 stations, some in northern California. Furthermore, Exxon was prohibited from entering into a supply contract with the jobber operating Exxon gasoline stations in southern California (World Oil).

Shell and Texaco were also required to sell a number of gasoline stations in San Diego, California, because the Commission's analysis showed that the two firms would have had an excessively large market share had the sales not occurred.

This requirement may have made sense in 1997 or 1998. However, requiring merging parties to dispose of competing gasoline stations does not make sense today. The historical focus on retail market shares has become unimportant because competition in the retail distribution of petroleum products has been drastically altered by the entry of two new competitors. These competitors are hypermarkets and large independent, unbranded retailers.

The term "hypermarkets" may be new to some readers.<sup>21</sup> Hypermarkets originated in France, where entrepreneurs opened large supermarket-type stores on the outskirts of major cities. These establishments offered the French the opportunity to shop at a single location for all of their food

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<sup>19</sup> Gilbert and Hastings, p. 27.

<sup>20</sup> Gilbert and Hastings, p. 25.

<sup>21</sup> It is not found in most dictionaries.

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and clothing needs rather than traipsing from one shop to the next as they had for well over a century. These stores were an immediate success.

The success of hypermarkets stems from the fact that they offer lower prices and provide consumers with the convenience of shopping at a single location and during extended hours (that is, later in the day). Hypermarkets can offer reduced prices because they realize economies of scale and scope. Economies of scale are achieved as a result of the size of the individual location and because the ownership of a large number of stores allows the hypermarket operators to buy in quantity. Economies of scope are achieved by combining the activities of many traditional shops in a single institution.

French hypermarkets expanded their offerings to include gasoline in the mid-1980s. Again, the firms achieved economies of scale and scope. Economies of scale were achieved because the firms were able to buy in quantity and because the volumes sold at each hypermarket location were five to ten times those sold at traditional French gasoline stations. Within a few years, competition from hypermarkets had put all the traditional independent French gasoline marketers out of business. By 1990, hypermarkets accounted for more than 50 percent of all gasoline sold to French consumers. Stations owned and operated by the traditional integrated companies sold the remaining volumes.

Hypermarkets spread to the United Kingdom, where the grocery firms Tesco and Safeway have become major suppliers. Again, independent marketers have been unable to compete. Major firms such as Exxon (Esso in the UK), BP, and Shell have remained competitive by sharply reducing costs and margins.

The hypermarket phenomenon has now spread to the United States. Major retailers such as Walmart, Costco, Albertson's, and others have become large gasoline marketers. The effect of their appearance can be seen in San Diego, the market the FTC sought to protect when Shell and Texaco merged their refining and marketing enterprises. Historically, prices in San Diego have been higher than prices in Los Angeles. In the six years ending December 2000, the average retail price in San Diego had been 10 cents greater than in Los Angeles. The divergence between markets received substantial attention from politicians and the state's attorney general because the differentials could not be explained by transportation costs.<sup>22</sup>

Recently, though, the differential has vanished. One explanation for this occurrence can be found in the unexpected supply surplus that developed during 2001. However, a more convincing explanation is the fact that Costco opened seven gasoline outlets in San Diego.<sup>23</sup>

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<sup>22</sup> Attorney General Bill Lockyer, *Report on Gasoline Pricing in California*, Office of the Attorney General, State of California, Department of Justice, May 2000. [<http://caag.state.ca.us/antitrust/publications/gasstudy/gasstudy2.pdf>]

<sup>23</sup> It may be argued that the collapse in the differential between San Diego and Los Angeles cannot be related to the increased competition from hypermarkets. Instead, the decline in prices could be explained by the fall in all prices. I disagree. Historically, retail prices in San Francisco and San Diego have exceeded prices in Los Angeles by 10 and 15 cents, respectively. The differential between Los Angeles and San Francisco has not changed. However, the

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The seven gasoline stations owned by Costco account for 1 percent of all stations in San Diego. However, in the twelve months since the stations opened, Costco has captured more than 3 percent of the market. According to a joint study by the Oil Price Information Service (OPIS) and New Image Marketing<sup>24</sup>, the average Costco station sells 410,000 gallons per month, while the average volume distributed by the 678 other gasoline stations in San Diego is only 131,000 gallons per month. Furthermore, the OPIS/New Image report estimates that the 678 stations suffered an average loss of volume of 1 percent.

The manner in which Costco achieved its market share is well understood. Costco offered consumers gasoline at a much lower price. *Petroleum Intelligence Weekly* reported that the 1,230 US hypermarkets operating in 2000 (approximately one half of one percent of the national total) accounted for 3.3 percent of gasoline sold. *PIW* went on to note, "As in Europe, hypermarkets see cheap gasoline as a way to lure customer to their stores" "On average, US hypermarkets sell gasoline at 5¢ to 15¢ per gallon lower than major branded operators."<sup>25</sup>

Some of this competition will come from Wal-Mart. Over the last two years, Wal-Mart has entered into contracts with Murphy, Tesoro, and Sun to operate gasoline stations on Wal-Mart lots. These facilities are owned and operated by the refiner but incur lower costs because the investment in the facilities is lower and the volumes of gasoline sold are higher. The lower costs are passed on to consumers in the form of lower prices.<sup>26</sup>

Competition also comes from chains of aggressive, unbranded gasoline marketers that have spread across the country — for example, Race Track, Wawa, Sheets, and Kwik Trip. In the last five years, these firms have expanded their marketing and brought new competition to the marketplace. Table 2 shows the number of stations reported by some of these aggressive marketers in the *NPN Fact Book* for 1994 and 1999. A quick review of the data reveals that the market share of these firms has increased.

The increased competition from hypermarkets and these new unbranded entrants suggests that the FTC's historical focus on competition between major branded dealers can be

Table 2. Gasoline Stations Owned by a Group of Independent, Aggressive Gasoline Marketers in 1994 and 1999

Marketer	1994	1999
Casey's General Store	876	1,176
Pantry	374	947
EZ Market	331	487
Cumberland Farms	598	630
Race Track	325	441
Kwik Trip	243	275
Sheetz	163	212
Subtotal	2,910	4,168
Total Reported	202,878	180,567

Source: *NPN Fact Book*, 1995 and 2000 editions.

differential between Los Angeles and San Diego has recently declined. I attribute the decline to the competition from Costco.

<sup>24</sup> Oil Price Information Service and New Image Marketing, *Petroleum Market Evaluator*, San Diego, California, 2001. [<http://www.opisnet.com/retail/sandiego.pdf>]

<sup>25</sup> "US Hypermarkets Copy Europe's Retail Onslaught," *Petroleum Intelligence Weekly*, June 18, 2001, p. 3.

<sup>26</sup> See Keith Reid, "The Wal-Mart Approach," *National Petroleum News*, May 2001, p.20.

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reduced. The growth of hypermarkets and other unbranded firms makes it much harder — and in most regions impossible — for an integrated company or large refiner marketer to raise prices at all, let alone by 5 percent, or to sustain an increase for a year. The truth is that the independent marketers are being pushed out of business as they were in France and the United Kingdom.<sup>27</sup>

In introducing greater competition to gasoline marketing, the entry of hypermarkets and new unbranded chains may increase the volatility of retail gasoline prices. This increased volatility can occur because the retail prices charged by large gasoline vendors might track spot gasoline prices more closely than prices charged by branded dealers. Borenstein and Gilbert, for example, note that retail prices tend to increase rapidly when spot prices rise but fall more slowly when spot prices decline.<sup>28</sup> There is evidence that prices charged at hypermarkets have tended to decrease much more quickly. For example, spot prices of retail gasoline in Los Angeles rose sharply during the spring of 2001 and then dropped precipitously. Retail prices in San Diego followed the same cycle.

Further, the hypermarket effect has spread to Los Angeles. On July 24, 2001, the National Public Radio show *Market Place* reported that a Costco outlet was selling regular gasoline for \$1.42 per gallon in Los Angeles when other retailers were charging as much as \$2 for regular and the DOE reported that the average price charged for regular in Los Angeles was \$1.90.

*Requirements that firms sell refineries have also been a component of two mergers.* As noted above, both sales occurred on the West Coast. Shell had to sell its Anacortes refinery, a 110,000-barrel-per-day facility in Washington, while Exxon was required to sell its Benicia refinery, a 130,000-barrel-per-day facility near San Francisco Bay.

In its complaint, the FTC noted that the merger would increase concentration in refining in California:

The refining and marketing of CARB gasoline for sale in the State of California, and smaller areas contained therein, would be moderately concentrated as a result of the merger. The proposed merger would significantly increase concentration in each of these markets.<sup>29</sup>

The Commission's complaint regarding the formation of the Shell-Texaco refining and marketing joint venture contained identical language. In each instance, the divestiture of a refinery was ordered.

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<sup>27</sup> I have oversimplified the conclusion. In states such as Alabama, petroleum marketers have successfully lobbied the state legislatures to pass minimum selling price legislation. These laws seem to be similar to the Robinson Patman Act. Without exception, these laws do not seem to offer the consumer any benefit but do protect the entrenched marketers for a while.

<sup>28</sup> See Severin Borenstein and Richard, J. Gilbert, "Uncle Sam at the Gas Pump: Causes and Consequences of Regulating Gasoline Distribution," *Regulation* 16, No. 2 (Spring 1993), pp. 63–75.

<sup>29</sup> FTC complaint, Docket No. C-3907, p. 6.

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The economic theory on which the FTC's actions were taken is unimpeachable. There is overwhelming evidence from most markets that ownership of a high share of productive capacity results in higher prices to consumers.

However, in the case of refining, it can be argued that the divestitures may have led to higher, not lower consumer prices. Furthermore, similar orders in future mergers could also raise prices to consumers.

This apparently contrary result occurs because refining is extremely capital intensive. Furthermore, the divestitures have resulted in the transfer of refining assets from well-capitalized firms to firms that are arguably undercapitalized.

The potential problem is illustrated in Table 3, which shows refinery ownership by size of firm in 1990 and 2001. Here I have divided the industry into four categories: firms with market capitalization of more than \$100 billion in June 2001, firms with market capitalization of from \$10 to \$100 billion, firms with market capitalization of between \$1 and \$10 billion, and firms with market capitalization of less than \$1 billion. Estimates of market capitalization are taken from Value Line.

**Table 3. Distribution of US Refining Capacity by Market Capitalization of Firms — 1990 v. 2001**

<u>Type of Firm</u>	<u>Market Capitalization</u>	<u>Refining Capacity (bbl/day)</u>		<u>Market Share (%)</u>	
		<u>1990</u>	<u>2001</u>	<u>1990</u>	<u>2001</u>
Integrated Majors	> \$100 billion	7,786,240	5,970,670	49.7	36.7
Large Companies	\$10-100 billion	3,424,200	4,995,420	21.8	30.7
Medium Companies*	\$1-10 billion	1,434,500	2,373,400	9.2	14.6
Small Companies	< \$1 billion	3,030,687	2,921,800	19.3	18.0
Total		15,675,627	16,261,290		

\*Includes Citgo and Koch.

Source: DOE and Value Line.

In making the calculations, I assumed that the pending mergers of Tosco with Phillips, UDS with Valero, and Texaco with Chevron would be completed. I added the market capitalization of the merging companies in each case.

The analysis reveals that there has been a shift in refinery ownership between 1990 and 2001. In 1990, the largest companies owned almost half of all US refining capacity. In 2001, the ownership share has declined by 13 percentage points. At the same time, firms with market capitalization in excess of \$10 billion increased their ownership of capacity by 9 percentage points, while firms with market capitalization of less than \$10 billion increased their share of the market by 5 percentage points.

(It should be noted that the residual share of capacity — firms with market capitalization of less than \$10 billion — includes both very small firms and privately held firms such as Koch, Clark,

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and Citgo, for which no data on market capitalization are available. For the ten-year period examined, the share of the market held by these firms essentially did not change.)

The decline in refinery ownership by the largest firms occurred for two reasons. First, the largest companies concluded that refining did not offer the competitive returns they sought. Second, in two cases, the FTC forced divestitures. Table 4 lists the divestitures made by the largest companies. From this table, one can note that two companies, Equilon (the Shell-Texaco joint venture) and BP, have voluntarily sold more than 1.4 million barrels per day in refining capacity.

- The three companies that now form BP (Amoco, Arco, and Sohio) owned refining capacity with more than 2.2 MBD of atmospheric distillation capacity in 1990. With recent sales of refineries in Utah and North Dakota, BP will own capacity of 1.5 MBD.
- The two companies that formed Equilon and Motiva (Shell and Texaco) owned 2 MBD in refining capacity in 1990. Today, the total is approximately 1.3 MBD.

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**Table 4. Refinery Divestitures Made by Integrated Companies**


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<u>Company</u>	<u>Refinery</u>	<u>Capacity (bbl/day)</u>	<u>Buyer</u>	<u>Approximate Date of Sale</u>
BP	Alliance (LA)	250,000	Tosco	9/00
BP	Marcus Hook (PA)	172,000	Tosco	2/96
BP	Lima (OH)	161,500	Blackstone	8/98
BP	Ferndale (WA)	77,400	Tosco	
BP	Mandan (ND)	58,000	Tesoro	2001
BP	Salt Lake City (UT)	40,000	Tesoro	2001
BP	Savannah (GA)	28,000	Citgo	
BP	Prudhoe Bay (AK)	15,000	Phillips	1/00
BP	Kupanuk (AK)	14,000	Phillips	1/00
Equilon/Motiva	Wood River (IL)	288,300	Tosco	6/00
Equilon/Motiva	Deer Park (TX)	215,900	JV with Pemex	
Equilon/Motiva	Anacortes (WA)	89,300	Tesoro	
Equilon/Motiva	El Dorado (KS)	105,000	Frontier	11/99
ExxonMobil	Chalmette (LA)	160,000	Chalmette Ref.	1/98
ExxonMobil	Bayway (NJ)	130,000	Tosco	1993
ExxonMobil	Benicia (CA)	129,500	Valero	6/00
ExxonMobil	Paulsboro (NJ)	152,000	Valero	10/98
Chevron	Port Arthur (TX)	315,300	Clark	
Chevron	Philadelphia (PA)	175,000	Sun	

Source: US DOE *Petroleum Supply Annual*.

---

The transfer of assets from the largest firms to the smallest firms has potentially troubling implications for the nation's economy because the firms acquiring refining capacity may lack the funds to make the investments required to produce the products required later in the decade. The EPA has mandated that refiners remove sulfur from gasoline beginning in 2003 and sulfur from diesel fuel by 2006. These requirements will force refiners to make substantial capital

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expenditures to improve their facilities. The National Petroleum Council (NPC) estimates refiners will be required to spend in excess of \$12 billion to meet the new standards for gasoline.<sup>30</sup> The Department of Energy estimates that refiners may need to invest an additional \$8 to \$13 billion to produce the low-sulfur diesel required by the EPA.<sup>31</sup> Total investment to produce fuels required by EPA may exceed \$25 billion between 2001 and 2006.

The problem could be especially acute for firms with a market capitalization of between \$1 and \$10 billion. These companies account for almost 20 percent of US refining capacity and yet may not be able to obtain funding for upgrading refining capacity. Their problem is debt.

The financial weakness of these firms can be seen from Table 5 and Table 6 (page 15). These tables show the market capitalization of publicly owned refining firms, their short- and long-term debt, and the ratio of debt to market capitalization. Table 5 shows the distribution of refinery ownership by market capitalization of a group of firms in 1990. Using 1990 refinery ownership and today's market capitalization figures, one observes that over half of US refining capacity is owned by firms whose debt level is less than 10 percent. The conclusion is emphasized by Figure 1 (page 15) and Figure 2 (page 16), scatter diagrams that show 1990 and 2001 debt as a percentage of market capitalization. From Figure 1, one can note that the firms owning large amounts of refining capacity had little debt relative to their equity in 1990. The situation has changed in 2001. Today, one can observe that some of the firms owning very large amounts of capacity have high debt ratios.

Table 5. 1990 Distribution of Refinery Ownership: Market Capitalization, Debt, Debt as Percentage of Capitalization, and Refining Capacity for Major Oil Companies

	Market Capitalization (\$ Billion)	Debt (\$ Billion)	Debt as % of Capitalization	1990 Refining Capacity (Barrels/Day)
ExxonMobil	310.0	12.8	4.1	1,985,000
Shell (RD + Trans.)	210.0	14.2	6.8	2,017,900
BP	199.0	18.8	9.4	2,208,240
Chevron Texaco	122.5	13.6	11.1	1,575,100
Phillips Tosco	23.4	8.5	36.3	636,900
Conoco	18.6	4.4	23.7	406,500
Williams	17.8	8.9	50.0	232,800
Marathon Ashland	12.6	4.3	34.1	951,000
Unocal	9.0	2.7	30.0	226,000
Valero UDS	6.3	2.9	46.0	534,000
Sunoco	3.2	1.3	40.6	515,000
Tesoro	0.5	0.4	80.0	164,500

Source: US DOE and Value Line.

<sup>30</sup> National Petroleum Council, *US Petroleum Refining* (Washington, DC: National Petroleum Council, June 2000).

<sup>31</sup> US Department of Energy, *The Transition to Ultra-Low-Sulfur Diesel Fuel: Effects on Prices and Supply* (Washington: Department of Energy, May 2001), p. 67.

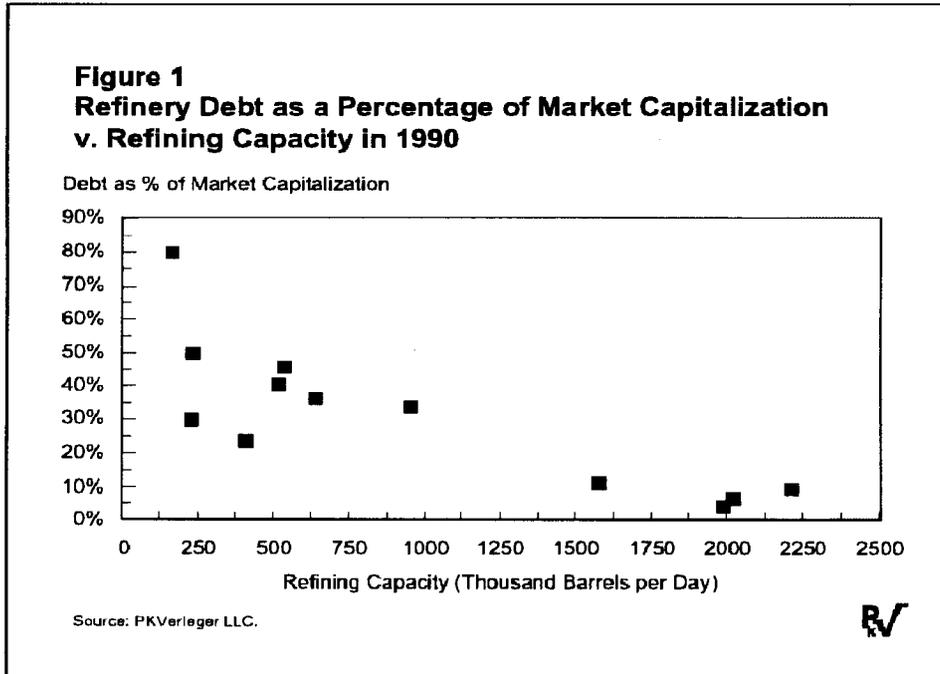
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Table 6. 2001 Distribution of Refinery Ownership: Market Capitalization, Debt, Debt as Percentage of Capitalization, and Refining Capacity for Major Oil Companies

	Market Capitalization (\$ Billion)	Debt (\$ Billion)	Debt as % of Capitalization	2001 Refining Capacity (Barrels/Day)
ExxonMobil	310.0	12.8	4.1	1,772,300
Shell (RD + Trans.)	210.0	14.2	6.8	1,602,950
BP	199.0	18.8	9.4	1,546,420
Chevron Texaco	122.5	13.6	11.1	1,049,000
Phillips Tosco	23.4	8.5	36.3	1,704,300
Conoco	18.6	4.4	23.7	542,500
Williams	17.8	8.9	50.0	366,700
Marathon Ashland	12.6	4.3	34.1	935,000
Valero UDS	6.3	2.9	46.0	1,361,900
Murphy	3.7	0.5	13.5	128,000
Sunoco	3.2	1.3	40.6	724,000

Source: US DOE and Value Line.



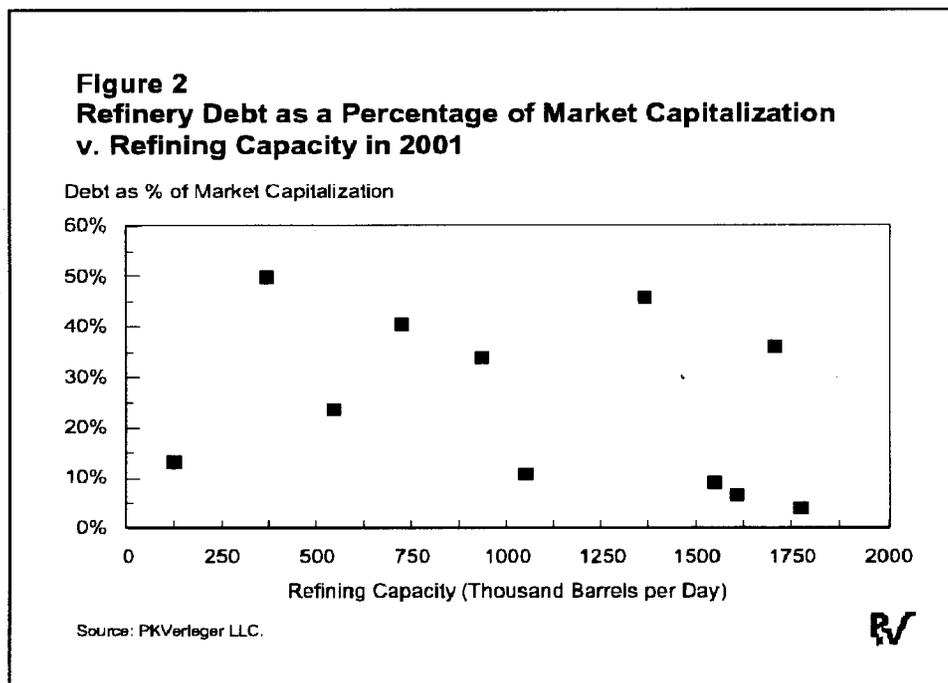
This shift in capital structure has possible implications for the future supply of petroleum products in the United States. It is possible that supply may be reduced when the new standards take effect because some of the undercapitalized refiners have not been able to upgrade all of their refineries. The consequence of such a failure would be to limit the supply of clean fuel.

Roughly speaking, the loss of 100 thousand barrels per day (kbd) of gasoline supply would require an increase of 3 to 10 cents per gallon in retail prices and cost consumers between \$2 and \$10 billion annually. The loss of 50 kbd of diesel supply would require a rise of 10 to 20 cents

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per gallon in retail prices and cost consumers between \$3 and \$5 billion.<sup>32</sup> Such economic impacts appear to be substantially higher than the possible consumer impact that would have occurred if firms had not been forced to sell refineries.



This threat of such a supply constraint is by no means a certainty. In fact, many companies and experts asserted that the nation would face a shortage of reformulated gasoline when the EPA requirements for that fuel took effect in 1993. At the time, the National Petroleum Council also warned that costs of producing the cleaner fuels might amount to 10 cents per gallon and could cause price increases of a similar magnitude.<sup>33</sup> The forecast was wrong. Prices of reformulated gasoline did not rise. Instead, refiners absorbed the increased costs and provided investors with very poor financial returns. The most recent NPC study notes, “The US refining and marketing industry in aggregate has been a 5% return business since the end of the price control period.”<sup>34</sup>

I would argue that the FTC could have achieved a greater benefit for consumers had it required that the merging firms agree (a) not to sell any refining capacity for five years, (b) to upgrade all refining capacity immediately to meet the new EPA standards before the requirements take effect, and (c) to expand refining capacity by 10 percent in markets identified by the FTC as being tight. I will add that this suggestion is totally inconsistent with antitrust economics theory.

<sup>32</sup> These calculations are based on a range of price elasticities of 0.1 to 0.4 for gasoline and diesel fuel.

<sup>33</sup> National Petroleum Council, *US Petroleum Refining – Meeting Requirements for Cleaner Fuels and Refineries* (Washington, DC: National Petroleum Council, 1993).

<sup>34</sup> National Petroleum Council, *US Petroleum Refining* (Washington, DC: National Petroleum Council, June 2000), p. 33.

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I will also add that had the Commission boldly followed such a plan, US product prices would have been much lower than they were this spring.

This proposal would have a greater probability of benefiting consumers than the approach taken by the Commission for three reasons. First, increased capacity mandated by the FTC would be used. Second, the firms have the capital to make the investment. Third, large refiners have a record of making more timely investments.

In summary, FTC actions requiring divestitures as a condition for approval of mergers have had a mixed effect. Requirements to open or divest terminals by vertically integrated companies have clearly benefited consumers. Orders requiring the sales of retail facilities have probably been ineffective, although the Commission could not anticipate this consequence. Entry of large retailers such as Wal-Mart and Costco into gasoline marketing has changed the market fundamentally, neutralizing much of the market power once enjoyed by the integrated refiner marketers. Lastly, requirements that large, well-capitalized majors such as Exxon Mobil, BP, Shell, and Chevron divest refining assets may have negative long-term consequences for the nation's economy because the undercapitalized buyers may be unable to expand capacity as needed to meet mandated environmental standards. Retail prices of gasoline, diesel fuel, and heating oil may be significantly higher in the future than they might otherwise have been had the FTC not mandated these divestitures.

**INVENTORIES AS THE CAUSES OF HIGH AND VOLATILE OIL PRICES**

Critics have asserted that mergers in the industry have caused higher prices and greater price volatility. The previous section of this paper has assessed the steps taken by the FTC in connection with the mergers of a number of oil companies. In seven major mergers, the firms were required to divest terminals, retail stations, and refineries. The divestitures of terminals promoted competition and resulted in lower prices, while the mandated divestitures of refineries may have reduced supply and caused prices to be slightly higher. In general though, mergers probably contributed little to the increased volatility of petroleum product prices. The cause of greater price volatility is something else: inventories.

This section examines the effect of inventory levels on oil prices. It will be shown that price levels perceived to be "very high" by consumers and politicians are associated with very low inventories. These low stocks, in turn, have resulted from the following causes:

- Environmental regulations that have increased the number of products, which unnecessarily complicates inventory management
- Efforts by oil-exporting countries to raise crude oil prices artificially above the competitive or mean return level by attempting to hold stocks down
- Efforts by companies to reduce inventories in order to improve investor returns

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This section begins with a detailed explanation of the relationship between inventories and commodity prices. The theoretical analysis will then be tied to energy markets. Finally, the effects of environmental regulation, efforts by oil-exporting countries, and the cost-saving steps taken by companies will be discussed.

**Why Firms Hold Stocks**

The business practice of holding inventories of physical commodities has created problems for economists for centuries. In theory, a profit-maximizing firm should not hold stocks. However, companies do maintain inventories. Often their behavior is explained by the need to ensure a continued flow of product and avoid disruptions. Difficulties in obtaining physical supplies of raw materials have created a need for inventories in many industries.

The commodity receiving the greatest attention has been cash. Theory suggests that no economic agent should keep deposits in a bank account if the bank charges the agent a significant amount to be the custodian. The rationality of this conclusion has strengthened as the speed at which funds can be transferred has increased. Yet, economic agents do hold bank deposits, even though this action costs them money. In fact, *Financial Times* recently reported that Japanese firms are depositing funds with banks that are charging them negative rates of interest.<sup>35</sup>

Sixty years ago, John Maynard Keynes<sup>36</sup> explained this phenomenon by defining three types of currency demand: transactional, precautionary, and speculative.<sup>37</sup> Jeffrey Williams extended this explanation to physical commodities, offering three specific explanations for holding inventories.<sup>38</sup>

Holbert Working<sup>39</sup> and Michael Brennen<sup>40</sup> created a method of quantifying the relationship. Referred to as the “supply-of-storage” curve, this relationship postulates a nonlinear linkage between inventories and price spreads (defined as futures prices less cash prices).

Figure 3 (page 19) shows the hypothesized relationship as an inverse relationship between inventories (shown on the horizontal axis) and the spread (futures prices less cash prices and costs) shown on the vertical axis. When done correctly, the spread is calculated as the price that would be received in a future period less the cash price of the commodity *plus* all the factors related to the activity of storing the commodity from one period to the next. These factors include the following:

- The time value of money (interest on the money invested in the inventory that could have been earned if the stocks had not been purchased)

<sup>35</sup> *Financial Times*, November 6, 1998, p. 1.

<sup>36</sup> John Maynard Keynes, *The General Theory on Employment, Interest, and Money* (1936). In Donald Moggridge (ed.), *The Collected Writings of John Maynard Keynes*, vol. 7 (Cambridge: The Cambridge University Press, 1982).

<sup>37</sup> Keynes, p. 195.

<sup>38</sup> Jeffrey Williams, *The Economic Function of Futures Markets* (Cambridge: Cambridge University Press, 1986).

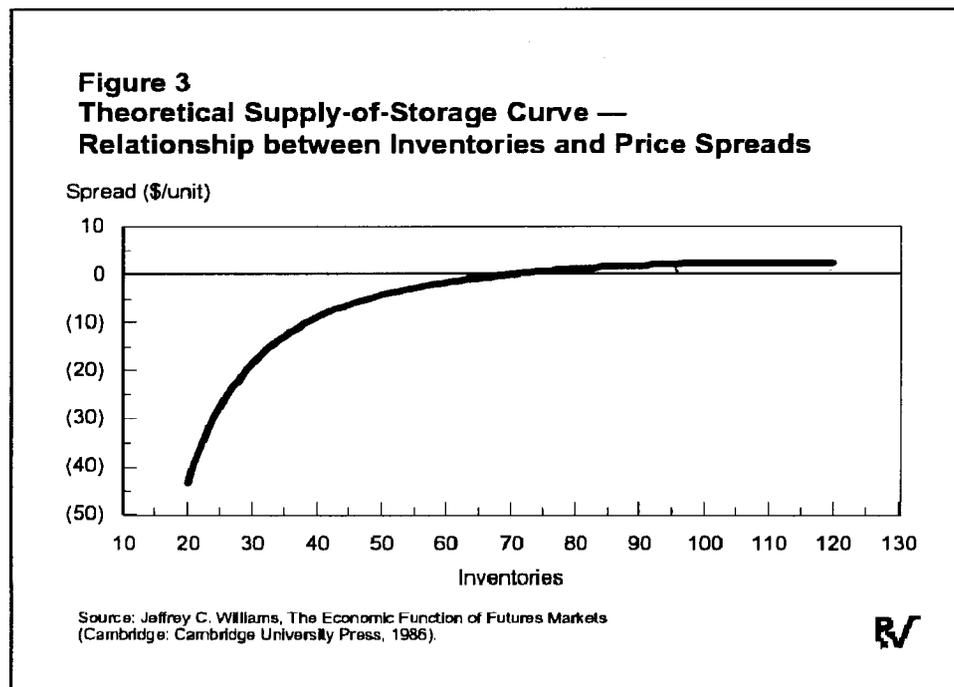
<sup>39</sup> Holbert Working, “The Theory of the Price of Storage,” *American Economic Review* 48 (1949), pp. 1254–1262.

<sup>40</sup> Michael J. Brennen, “The Supply of Storage,” *American Economic Review* 47, No. 1 (1958), pp. 50–72.

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- Storage costs (monies spent on physically holding the commodity, moving the commodity into and out of storage, insurance costs, and other out-of-pocket expenditures)
- Shrinkage (expected losses from deterioration, spoilage, or other factors affecting the quality of the commodity being held)



Working demonstrated the linkage for a few agricultural commodities. Brennen provided more evidence for a group of 15 commodities, mostly agricultural. Results published by Fama and French provide similar confirmation for a group of commodities.<sup>41</sup> Finally, Cho and McDougal<sup>42</sup> produced results for petroleum that confirm the existence of a supply of storage in this industry. The relationship is quantified here.<sup>43</sup>

<sup>41</sup> Eugene F. Fama, and Kenneth R. French, "Commodity Futures Prices: Some Evidence on Forecast Power, Premiums, and the Theory of Storage," *Journal of Business* (January 1987), pp. 55–73.

<sup>42</sup> Dong W. Cho and Gerald S. McDougal, "The Supply of Storage in Energy Futures Markets," *Journal of Futures Markets* 10, No. 6 (December 1990), pp. 611–621.

<sup>43</sup> It must be noted that the concept of the supply of storage is not uniformly accepted. In the last ten years, Williams and Wright published two papers that question the entire concept of convenience yields as an explanation for holding stocks at apparent financial losses. In a paper entitled "A Theory of the Negative Prices for Storage," they belittled the theory by noting the following: "Convenience yield as the explanation of storage at inverse carrying charges has not been analyzed beyond demonstration of its plausibility with brief examples related to the behavior of individual processors." The authors then demonstrated that it is rational for producers to hold stocks of intermediate goods such as crude oil under certain conditions. The basis of the Williams and Wright findings has to do with geographical aggregation. As they noted, "Observation of storage under backwardation is an aggregation phenomenon. As disaggregation proceeds, the expected rate of change of the price of each subaggregate with

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The first measure of quantification is simple observation. Figures 4 through 7 present scatter diagrams of inventories with spreads. Figure 4 shows the scatter diagram of inventories of crude oil compared to the twelve-month-forward spread (twelve-month forward future less cash). Here, inventories are measured in PADD II, the delivery market for crude oil under the NYMEX crude futures contract.<sup>44</sup> The plot reveals the relationship postulated by Working, Brennan, and others.

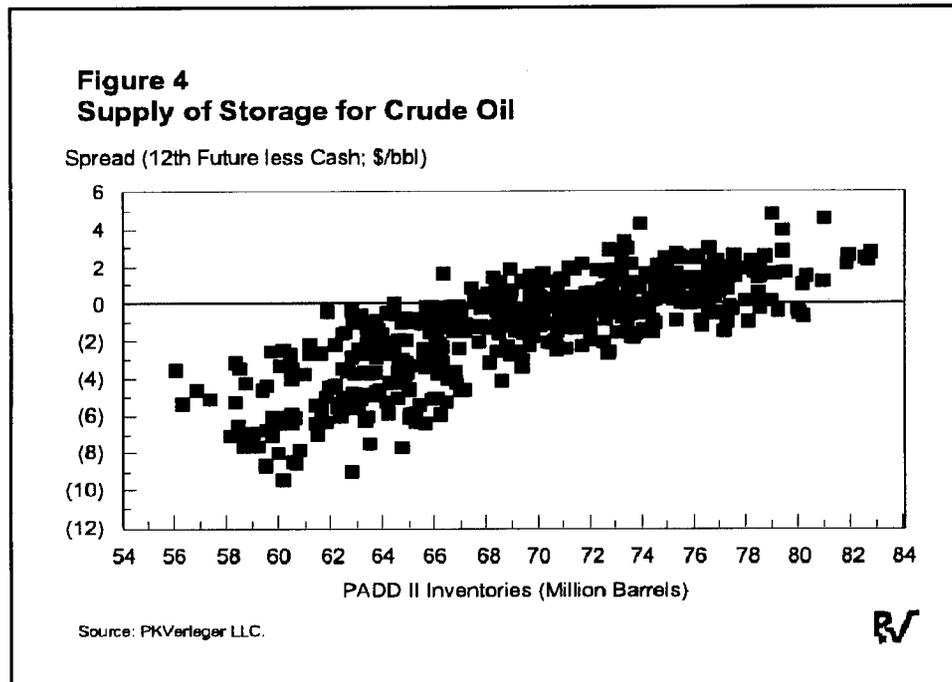


Figure 5 (page 21) compares the three-month-forward spread between futures and distillate prices with inventories of heating oil held in New York, the delivery market. In this case, observations are shown for only the last week in February rather than the entire year. This choice of a single week is dictated by the fact that heating oil inventories fluctuate seasonally with demand. To borrow from Williams, the levels of “transactional” and “precautionary” stocks will be higher in the fall and winter than the summer. Furthermore, storage capacity is reallocated from heating oil to gasoline as demand levels fluctuate. Thus, a scatter diagram of observations for an entire year does not reveal the expected relationship. On the other hand, scatter diagrams

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positive stocks tends towards full carrying charges.” See Brian D. Wright and Jeffrey C. Williams, “A Theory of the Negative Prices for Storage,” *Journal of Futures Markets* 9, No. 1 (February 1989), pp. 1–13.

<sup>44</sup> Analysis of relationships between futures to cash spreads and inventories requires the use of comparable data because price spreads measure the cost of holding the commodity or the price of scarcity in a particular geographic market. Thus in the case of crude oil the futures-to-cash spread measures the cost of holding crude oil in the mid-continent region of the United States. Data on crude inventories held in PADD II (Petroleum Administration for Defense District II) provide the best measure of comparable stocks. See Donna Brennan, Jeffrey C. Williams, and Brian D. Wright, “Convenience Yield without the Convenience: A Spatial-Temporal Interpretation of Storage under Backwardation,” *Economic Journal* 107, No. 443 (July 1997), pp. 1009–1022.

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drawn from observations taken at the same time of the year do display the expected relationship, as can be observed from Figure 5.

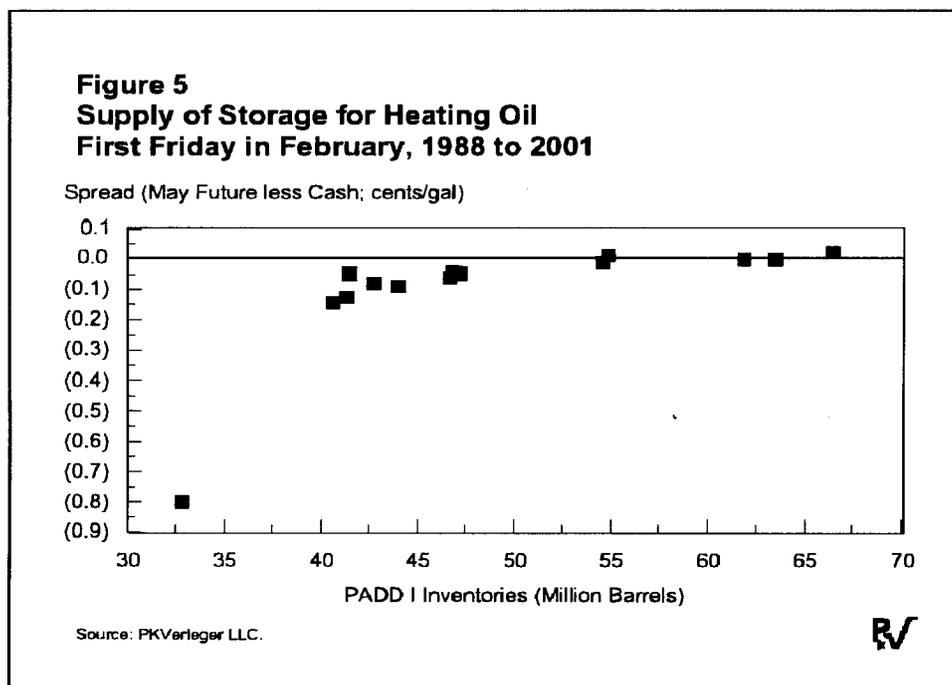


Figure 6 (page 22) compares the three-month-forward spread for natural gas with inventories of natural gas in the month of December.<sup>45</sup> Again, the expected relationship is observed.

Lastly, Figure 7 (page 23) compares the three-month-forward spread for reformulated gasoline with inventories of the product held in New York Harbor. Data are shown for the month of June. Again, the expected relationship is observed.

Empirical estimates of supply-of-storage relationships are presented in Table 7 (page 22). The calculations shown here were developed using the model originally proposed by Brennen more than forty years ago. The results from the estimation of this apparently reduced-form relationship show the correct signs and are statistically significant.

<sup>45</sup> Natural gas stocks, like heating oil stocks, follow a seasonal pattern necessitating the use of data for a single time of year.

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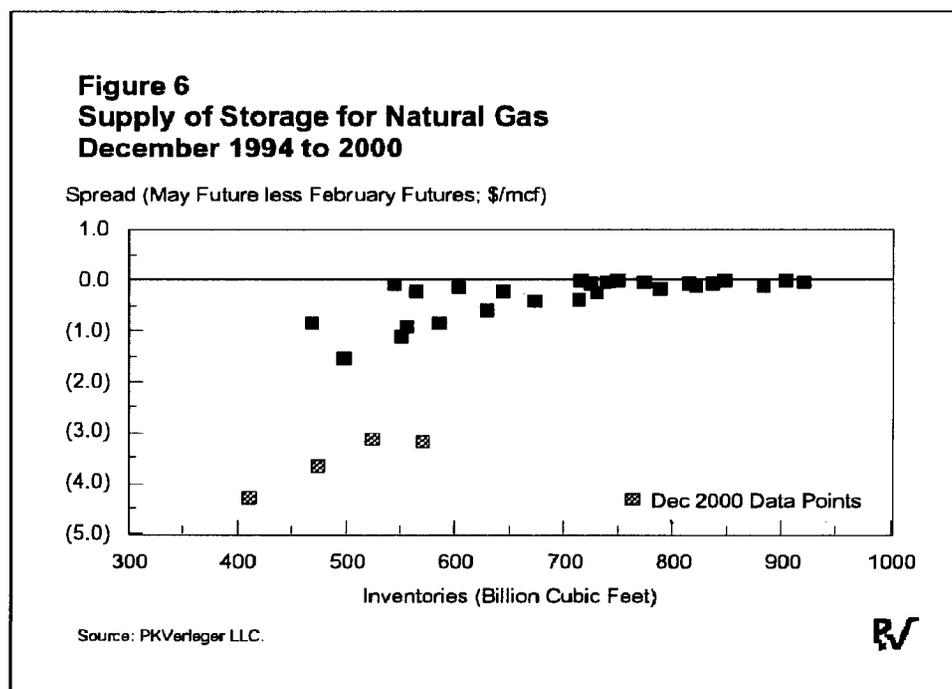


Table 7. Results of Econometric Estimation of Supply-of-Storage Relationship

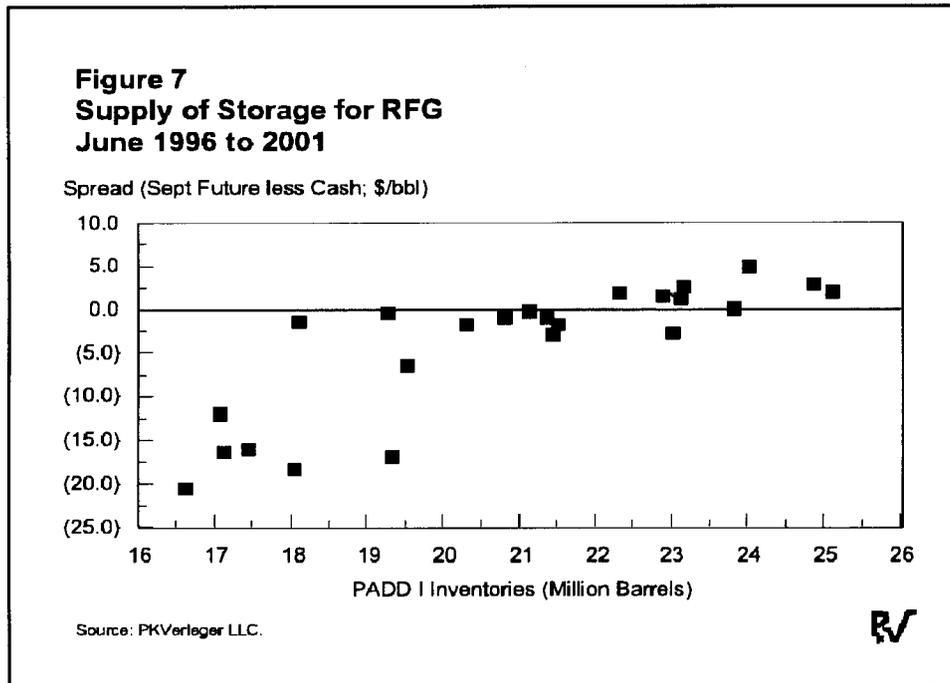
	<u>Inventory Variable</u>	<u>Coefficient of Multiple Correlation (R<sup>2</sup>)</u>	<u>Standard Error of Estimate</u>	<u>Notes</u>
<u>Crude Oil</u>				
Coefficient	9.96	0.644	0.643	Dummy variable included for Gulf War
Standard Error	0.5			
(t-stat)	19.9			
<u>Heating Oil</u>				
Coefficient	117,447	0.374	9,475	Certain extreme data points censored in data
Standard Error	6,009			
(t-stat)	19.5			
<u>Gasoline</u>				
Coefficient	-1,971	0.326	2.87	RFG period only; dependent variable is inverse of inventories
Standard Error	207			
(t-stat)	-9.5			

Source: PKVerleger LLC.

The findings from this analysis offer one explanation for sudden increases in petroleum product prices. Specifically, large rises can be anticipated when inventories of the commodity are suddenly drawn to very low levels. At those times, suppliers can be expected to husband stocks while buyers may panic, perhaps even offering huge premiums for product. Several episodes of low inventories have occurred in the United States in recent years. The Commission noted one

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such instance in its review of events in Midwest gasoline markets in May and June 2000.<sup>46</sup> High prices for spot supplies accompanied the low stocks. A second instance occurred in January 2000, when heating oil inventories were also drawn to unusually low levels during a period of unusually cold weather. Heating oil prices doubled at the time. (The decline in inventories is shown in Figure 8, page 24.)



### **THE EFFECTS OF MERGERS AND ENVIRONMENTAL REGULATIONS ON SUPPLY-OF-STORAGE RELATIONSHIPS**

Many economic relationships change over time. Change occurs, for example, because consumer tastes evolve, because manufacturing processes become more efficient, or because new laws and regulations require alterations in behavior.

Industry attitudes toward petroleum inventories have been transfigured by many of these factors. Increased efficiency in refinery operations allows refiners to boost the yield of heating oil produced from a barrel of oil in winter and gasoline yield in the summer. This gain in productivity makes it possible for refiners to build fewer inventories of products in advance of the peak period of demand.<sup>47</sup>

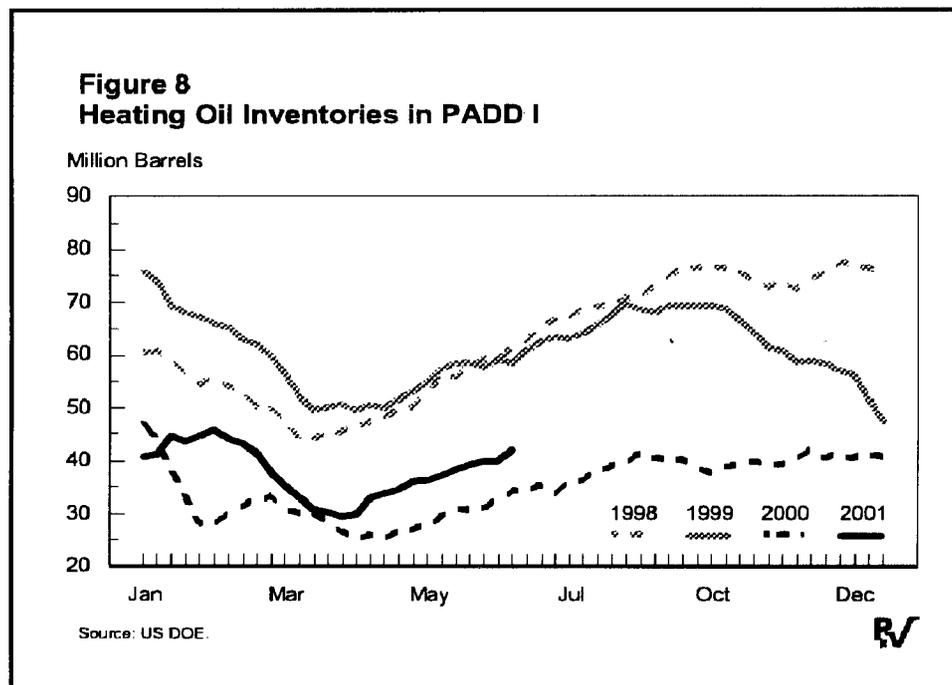
<sup>46</sup> FTC, *Midwest Gasoline Price Investigation*, p. 17.

<sup>47</sup> The change can be observed most clearly in heating oil. At the time of the Iranian crisis in 1979, the Department of Energy forced the petroleum industry to build a total of 240 million barrels of heating oil inventories in advance of winter. In 2000, industry inventories peaked at less than half that total despite the fact that consumption has increased by approximately 10 percent from 1979.

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Improvement in automation has also enabled firms to operate with lower stocks. Instantaneous monitoring of stock levels and distribution, combined with the introduction of integrated computer systems, makes it possible for firms to reduce precautionary stocks, which at one time were kept to compensate for reporting delays and clerical errors.



Technological changes in storage facilities also make it possible to alter stock management practices. In the past, some inventories in tank bottoms were inaccessible. Today, the introduction of “drain-dry” tanks has eliminated this problem.

These factors have changed the expected relationship between inventories and price spreads. Another factor that has altered the relationship has been the requirement that refiners provide a wider variety of gasoline to consumers. Twenty years ago, refiners provided basically a single type of gasoline — unleaded — to the market. The only essential difference in the product supplied was the Reid Vapor Pressure (RVP), where lower RVP product was supplied in regions with warmer temperatures. Today, refiners are required to supply a wide variety of gasoline blends, including conventional unleaded gasoline, Phase II reformulated gasoline, oxygenated gasoline, refining blendstock for ethanol blending (referred to as RBOB), and specialized blends for cities such as Atlanta. The proliferation of fuel types has complicated gasoline storage.

These changes have made the supply-of-storage curve less elastic over time. Figure 9 (page 25) shows two calculated supply-of-storage curves for reformulated gasoline. The more horizontal line covers the period from 1996 to 1998. The more vertical (less elastic) curve covers the period from 1999 to 2001.

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These two supply-of-storage curves were estimated using data for spring and summer months (April through August). The measure of fit  $R^2$  rises from .25 to .58. The coefficients in the equation are highly significant (see Table 8).

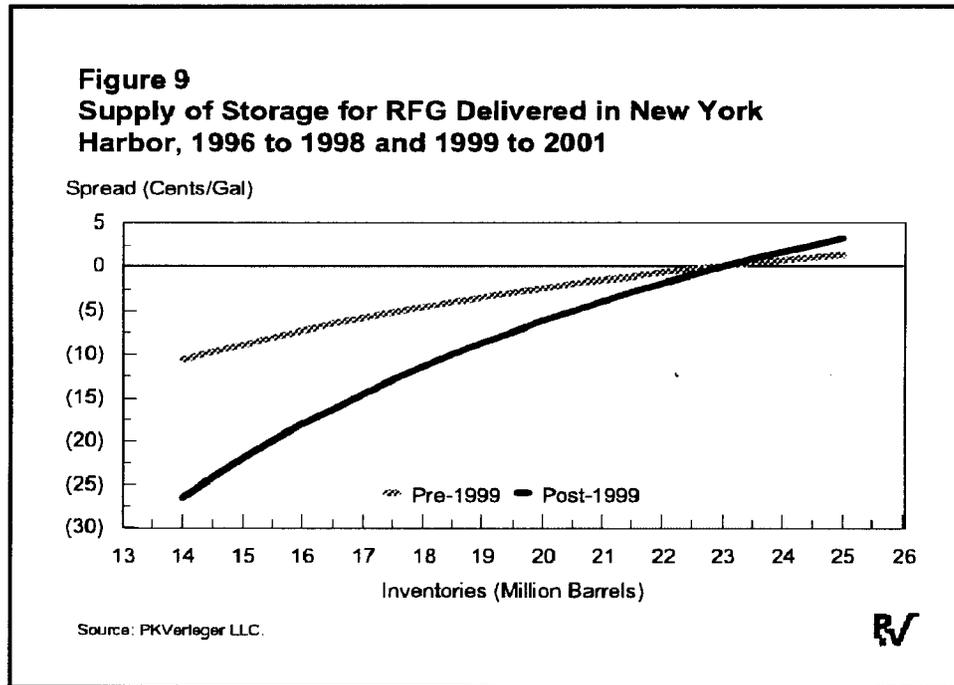


Table 8. Result of Estimates for Supply-of-Storage Curve for RFG in New York Harbor for Two Periods: 1996 to 1998 and 1999 to 2001, Spring and Summer Months Only

	Inventory Variable	$R^2$	Standard Error
<u>1996 to 1998</u>	-386153	0.255	4.71
Coefficient	82431		
Standard Error	-4.7		
t-statistic			
<u>1999 to 2001</u>	-951527	0.585	5.55
Coefficient	114505		
Standard Error	-8.3		
t-statistic			

This changed can be summarized as follows. In the past, small changes in inventories would cause relatively modest changes in spreads. A 1-million-barrel decline in stocks, for example, might cause spreads to increase by 1.5 cents per gallon. This increase would probably imply an increase of 2 cents per gallon in the spot price. With the introduction of more gasoline blends as mandated by the EPA, the change in spreads has more than doubled. Environmental regulations thus make prices more volatile.

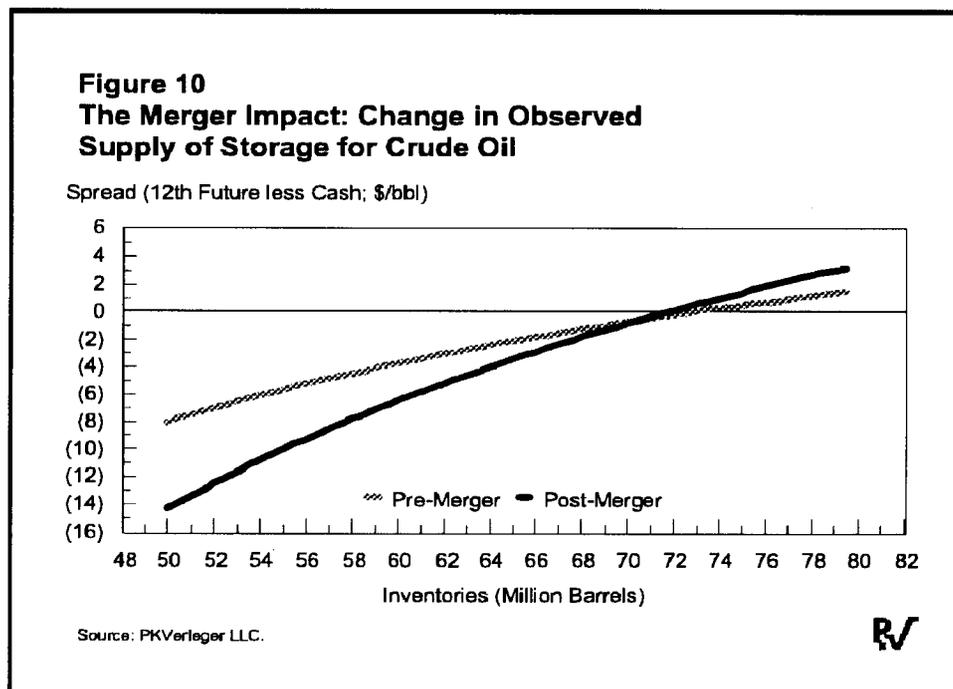
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Structural change in the petroleum industry also contributed to a change in the supply-of-storage relationship. These shifts have occurred as companies merged and as integrated companies sold refining assets to smaller firms.

- Merging companies have embarked on extensive efforts to reduce costs. For example, ExxonMobil sought to achieve several billion dollars in synergistic cost savings from the merger of the two companies. The firm's chairman reported that gains were achieved. One element of the cost savings was a substantial reduction in inventories.
- Integrated companies have sold refining assets to smaller firms with much higher debt-to-equity ratios. The firms buying refineries are often required to operate with lower inventories for financial reasons.

The impact of the structural change can be observed from Figure 10, which shows two estimated supply-of-storage relationships for crude oil. The first, labeled "Pre-Merger," is calculated for the period 1992 to 1997. The second curve, labeled "Post-Merger," is computed for the period 1998 to 2000. The post-merger supply-of-storage curve is much less elastic than the pre-merger curve. Both relationships are statistically significant and the statistics confirm that the relationships are different.



What does the decreased elasticity of the supply-of-storage curve mean? Basically, the steeper (less-elastic) curve implies that firms are willing to pay or insist on charging a higher rental rate for crude in 2000 than they did in 1997. The results suggest that prices would have been more volatile in 2000 due to structural change.

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The quantitative impact of the change can be seen from Table 9. The table indicates that markets will be more “backwardated” when inventories are low. In English, this means that the premium of spot crude prices over futures prices will be larger. For example, the structural change implies that the spot price of crude oil would be approximately \$3 greater after the mergers and other asset sales when inventories in PADD II fall to 60 million barrels, as they did this February. On average, structural changes including mergers have probably boosted the price of crude by between \$2 and \$3 per barrel.<sup>48</sup>

**OPEC’s Role**

The impact of structural changes in the petroleum industry that have altered the supply-of-storage relationship for crude and the government regulations that have made the curve for products less elastic pale in comparison to OPEC’s effect. OPEC nations met in March 1999 and announced a cut of 2 MBD. The cuts were sustained until late 2000 and caused prices to increase from \$10 to \$36 per barrel.

Table 9. Price Spreads for Crude Oil: Premium for Cash Supplies Relative to One-Year-Forward Crude Prices (Dollars per Barrel)

PADD II Stocks (000 Barrels)	Pre-Merger Supply-of- Storage Curve	Post-Merger Supply-of- Storage Curve
50,000	7.96	14.30
55,000	5.65	10.01
60,000	3.73	6.44
65,000	2.11	3.42
70,000	0.72	0.83
75,000	-0.49	-1.42
80,000	-1.55	-3.38
85,000	-2.48	-5.12
90,000	-3.31	-6.66

Source: PKVerleger LLC.

OPEC succeeded because producers cut output aggressively and caused a dramatic decline in stocks by the end of the first quarter of 2000. The effect of the action can be observed from Figure 11 (page 28), which shows usable days of supply of commercial stocks in OECD countries. The data are reported by the Energy Intelligence Group, a publishing company that produces *Petroleum Intelligence Weekly*. On this graph, I show the normal range for inventories. This represents the observed trend over the last thirteen years. The shaded area represents the one-standard-deviation range above and below trend.

One can observe that at the beginning of 1999 inventories were above the normal range. By the beginning of 2000, stocks had dropped to historical lows. The swing in stocks was associated with a move along the supply-of-storage curve. Spot prices went from a discount of \$3 per barrel to forward prices to a premium of \$10.

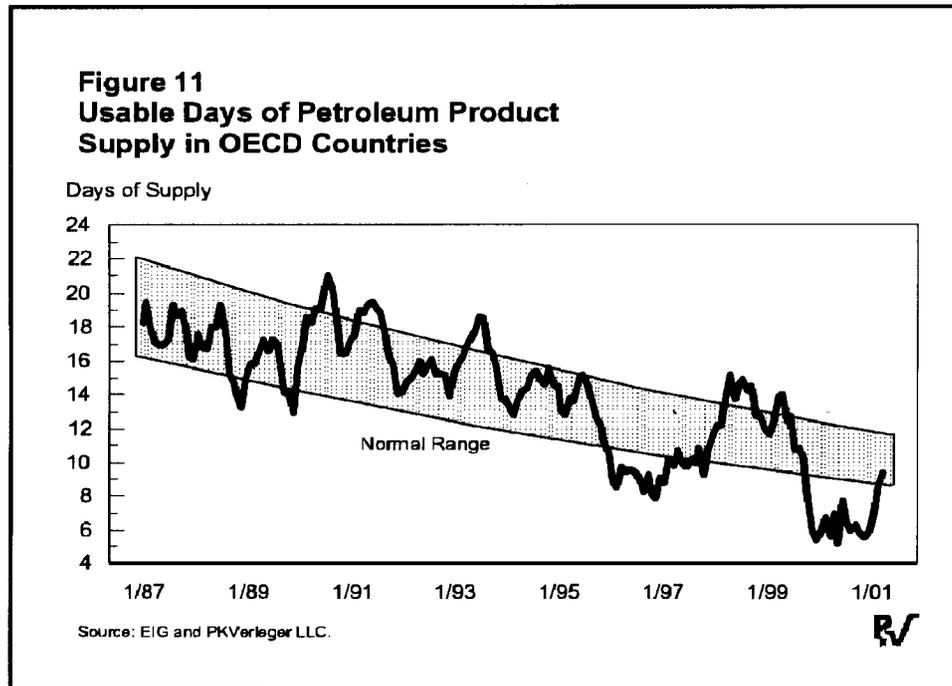
The decline in inventories was not accidental. OPEC members, along with Mexico and Norway, cut production to remove excess inventories from the market in the expectation that the coordinated, very public conspiracy would push up prices. *The Wall Street Journal* was the first to note rumors of the joint production cut. The *Journal* cites a joint statement by the oil ministers of Saudi Arabia, Kuwait, Qatar, and Oman in which the countries agreed to work with other

<sup>48</sup> This figure is calculated using the spread implied by average level of inventories observed since 1999 (65 million barrels) compared to the spread calculated using the average level of inventories observed from 1993 to 1998 (70 million barrels).

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exporters “to take all measures, most importantly, effective reduction of output, in order to withdraw excess supplies from the market and boost oil prices.”<sup>49</sup>



OPEC members met in September 1999 to review the market situation, by which time prices had more than doubled and consuming nations had begun pressuring OPEC to increase output. The members refused, citing high inventory levels. *Platts* reported that OPEC’s Economic Commission Board (ECB), which included marketing experts from each country, had expressed concerns that stocks were too high.

The ECB report [issued at the time] says that if OPEC continues to pump around 26.2 mil b/d through March next year, the first quarter could see global stocks reduced by 4 mil b/d. Nevertheless, the ECB discussions, which happened over three days, threw up concern that stocks remained on the high side. And while it was generally felt that stocks would eventually return to “normal” levels, it could not be predicted when this would happen because of a number of uncertainties.<sup>50</sup>

The ECB report went on to note that stocks were still too high. Other publications reported similar comments from OPEC members. In an interview with *Petroleum Argus*, OPEC Secretary General Lukman was asked about stocks. He responded, “I don’t want to get embroiled in

<sup>49</sup> “Oil Prices Surge as OPEC Weighs Cuts,” *The Wall Street Journal*, March 11, 1999, p. A2.

<sup>50</sup> “OPEC Sees Need for Further Stock Draw,” *Platts Oilgram News*, September 20, 1999, p.1.

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figures and statistics. What we're referring to is the general level of stocks, which is higher than would normally be considered reasonable."<sup>51</sup>

Through 1999 and 2000, oil-exporting countries maintained their focus on inventory levels. For example, in a detailed review of market behavior published a year after the March 1999 meeting, writers for *The Wall Street Journal* noted the ministers' perspective:

Oil ministers from the Mexico-Venezuela-Saudi Arabia troika got together in November in what many thought would be a first step to loosen restrictions on output. But the data the ministers had to guide them suggested that oil stocks were resilient, so they took no action on the cutbacks.<sup>52</sup>

This concern with inventory levels has continued. OPEC's March 2001 production cut was dictated by expectations of stock increases. *Financial Times* reported that OPEC made the cut to "give oil-consuming countries less leeway to build up stocks in periods of slack demand."<sup>53</sup> OPEC's most recent announcement (July 27, 2001) of a further cut in production continues this trend. Crude oil prices will remain well above their long-run equilibrium level of roughly \$19 per barrel as long as oil-exporting countries are allowed to conspire to limit production and as long as these countries abide by their arguably illegal agreement.

**The Market Impact of OPEC's Action**

OPEC's efforts to keep inventories tight have important asymmetric impacts on consumer prices due to the time lags between changes in demand and supply. The problem occurs for two reasons. First, up to two months are required for changes in OPEC production to be reflected in inventories. Second, the supply-of-storage function is nonlinear. Thus, a random and unexpected decrease in demand that causes inventories to increase temporarily will have a more modest effect on crude prices than an increase in demand that causes a drop in stocks of equal magnitude. The results presented here suggest that if an increase in stocks caused a \$1-per-barrel decline in crude prices, a decrease in stocks of equal magnitude would cause a price increase of \$1.50 per barrel. The price increases for gasoline and heating oil observed in 2000 and 2001 were clearly exaggerated by this factor.

**CONCLUSIONS**

This paper has examined the impact of the Federal Trade Commission's review of mergers in the oil industry in light of the increased volatility of gasoline and heating oil prices observed over the last two years. The conclusions are relatively straightforward.

First, the primary causes of higher and more volatile prices are lower inventory levels. The low stocks are explained primarily by OPEC's actions to keep them down. Higher prices and greater

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<sup>51</sup> "Lukman Sees No 'Danger' in High Prices," *Weekly Petroleum Argus*, September 27, 1999, p. 9.

<sup>52</sup> "Barrel Roll: Why Oil Price Tripled Even as Nations Strive to Limit its Gyration," *The Wall Street Journal*, March 27, 2000, p. A1.

<sup>53</sup> "Oil Production Cut Likely to Boost Oil Prices," *Financial Times*, March 19, 2001.

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price volatility can also be traced to structural change in the petroleum industry resulting from mergers and from the adoption of environmental regulations that affect gasoline.

Second, the Commission's focus on the ownership of retail establishments is of less importance than in the past. The entry of new, well-capitalized firms such as Wal-mart into gasoline retailing will provide greater protection to the consumer than any divestiture order.

Third, requiring well-capitalized integrated companies to divest refining capacity is probably a mistake. There is a real risk that the structural change that has occurred over the last few years may actually constrain the supply of petroleum products and boost prices. This risk will be aggravated as environmental regulators erect higher and higher barriers to importing foreign product.

Fourth, the FTC needs to maintain or even increase its review of terminal operation by integrated oil companies. The results offered by Gilbert and Hastings suggest that apparently trivial changes in ownership of terminals by integrated companies can have serious consequences for consumers.

Finally, other "Made in America" energy policies such as the oxygenated fuels mandate, prohibitions on the mingling of reformulated and conventional gasoline, and the Jones Act are all actions that raise consumer prices. Indeed, each of these policies has probably contributed more to the rise in prices than any of the mergers of major oil companies.

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## REFERENCES

- “Barrel Roll: Why Oil Price Tripled Even as Nations Strove to Limit its Gyration.” *The Wall Street Journal*, March 27, 2000, p. A1.
- Brennan, Donna, Jeffrey C. Williams, and Brian D. Wright. “Convenience Yield without the Convenience: A Spatial-Temporal Interpretation of Storage under Backwardation.” *Economic Journal* 107, No. 443 (July 1997), pp. 1009–1022.
- Brennen, Michael J. “The Supply of Storage.” *American Economic Review* 47, No. 1 (1958), pp. 50–72.
- Borenstein, Severin, and Richard, J. Gilbert. “Uncle Sam at the Gas Pump: Causes and Consequences of Regulating Gasoline Distribution.” *Regulation* 16, No. 2 (Spring 1993), pp. 63–75.
- Cho, Dong W., and Gerald S. McDougal. “The Supply of Storage in Energy Futures Markets.” *Journal of Futures Markets* 10, No. 6 (December 1990), pp. 611–621.
- Fama, Eugene. F., and Kenneth R. French. “Commodity Futures Prices: Some Evidence on Forecast Power, Premiums, and the Theory of Storage.” *Journal of Business* (January 1987), pp. 55–73.
- Financial Times*, November 6, 1998, p. 1.
- FTC. *1992 Horizontal Merger Guidelines* (with April 8, 1997, revisions to Section 4 on Efficiencies). Washington, DC: FTC.
- FTC. In the Matter of Exxon Corporation and Mobil Corporation, Complaint, Docket No. C-3907, File No. 991-0077.
- FTC. In the Matter of Exxon Corporation, a Corporation, and Mobil Corporation, a Corporation, Decision and Order, Docket No. C-3907, File No. 991-0077, January 30, 2001.
- FTC. In the Matter of Shell Oil Company and Texaco, Inc., Decision and Order, Docket Number C-3803, File No. 9710026, April 22, 1998.
- FTC. In the Matter of The British Petroleum Company p.l.c., a Corporation, and Amoco Corporation, a Corporation, Agreement Containing Consent Order, File No. 981-0345, December 30, 1998.
- FTC. *Midwest Gasoline Price Investigation*, Final Report of the Federal Trade Commission. Washington, DC: FTC, March 29, 2001.
- FTC, “Western States Gasoline Pricing Investigation,” Statement of Commissioners Sheila F. Anthony, Orson Swindle, and Thomas B. Leary, File No. 981-0187, May 7, 2001.
- Gilbert, Richard, and Justine Hastings. “Vertical Integration in Gasoline Supply, An Empirical Test of Raising Rivals’ Costs.” *POWER Working Paper PWP-084*, University of California Energy Institute, July 2001.

## Competition in the Petroleum Industry

DRAFT — Please Do Not Quote or Cite

- Keynes, John Maynard. *The General Theory on Employment, Interest, and Money* (1936). In Donald Moggridge (ed.), *The Collected Writings of John Maynard Keynes*, vol. 7. Cambridge: The Cambridge University Press, 1982.
- Krattenmaker, Thomas G., and Steven C. Salop. "Anticompetitive Exclusion: Raising Rivals' Costs to Achieve Power over Price." *Yale Law Journal* 96 (1986), pp. 209–234.
- Lockyer, William. *Report on Gasoline Pricing in California*. Sacramento, CA: Office of the Attorney General, State of California, Department of Justice, May 2000.
- "Lukman Sees No 'Danger' in High Prices." *Weekly Petroleum Argus*, September 27, 1999, p. 9.
- National Petroleum Council. *US Petroleum Refining — Meeting Requirements for Cleaner Fuels and Refineries*. Washington, DC: National Petroleum Council, 1993.
- National Petroleum Council. *US Petroleum Refining*. Washington, DC: National Petroleum Council, June 2000.
- "Oil Prices Surge as OPEC Weighs Cuts." *The Wall Street Journal*, March 11, 1999, p. A2.
- Oil Price Information Service and New Image Marketing, *Petroleum Market Evaluator, San Diego, California, 2001*.
- "Oil Production Cut Likely to Boost Oil Prices," *Financial Times*, March 19, 2001.
- "OPEC Sees Need for Further Stock Draw." *Platts Oilgram News*, September 20, 1999, p.1.
- Reid, Keith. "The Wal-Mart Approach." *National Petroleum News*, May 2001.
- Theresa Aguilar et al. v. Atlantic Richfield Company et al., California Supreme Court Opinion S086738, June 14, 2001.
- US Department of Energy. *The Transition to Ultra-Low-Sulfur Diesel Fuel: Effects on Prices and Supply*. Washington, DC: Department of Energy, May 2001.
- "US Hypermarkets Copy Europe's Retail Onslaught," *Petroleum Intelligence Weekly*, June 18, 2001.
- Williams, Jeffrey C. *The Economic Function of Futures Markets*. Cambridge: Cambridge University Press, 1986.
- Working, Holbert. "The Theory of the Price of Storage." *American Economic Review* 48 (1949), pp. 1254–1262.
- Wright, Brian D., and Jeffrey C. Williams. "A Theory of the Negative Prices for Storage." *Journal of Futures Markets* 9, No. 1 (February 1989), pp. 1–13.
- Wyden, Senator Ron. "The Oil Industry, Gas Supply and Refinery Capacity: More than Meets the Eye." Investigative Report, June 14, 2001.
- Verleger, Philip K. "Prepared Statement before the Subcommittee on Antitrust, Business Rights, and Competition of the Senate Judiciary Committee," September 22, 1998.