FEDERAL TRADE COMMISSION

Second Public Conference on Factors that Affect Prices of Refined Petroleum Products

Price Variability and Volatility in Wholesale and Retail Gasoline Markets

By

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May 8-9, 2002

MAIN POINTS

May 8: Price Variability/Volatility in Wholesale Gasoline Markets

-Bulk (Spot and Futures) Prices of Gasoline Are Notoriously Volatile, and Geographic Variability among Spot and Other Wholesale Prices Also Is Commonplace

-Proximate Causes of Variability/Volatility Include Accidents, New Fuel Mandates, Taxes, and Crude Oil Supply Disruptions, but the Underlying Problem Is Low Refining/Marketing Profit Rates That Limit Capacity Expansion

-Modest Increases in Refining/Marketing Price Margins Would Mitigate Wholesale Price Variability/Volatility

-Consolidation among Biggest Refiners and New Competition from Other Refiners Have Contributed to Lower, but Variable and Volatile Prices

May 9: Price Variability/Volatility in Retail Gasoline Markets

-Retail Gasoline Prices Exhibit Supranormal Volatility Due to Crude Oil Price Fluctuations, and Normal Spreads Among Retail Prices Sometimes Are Upset

-Compared to Other Goods and Services Sold at Retail, Gasoline Pump Prices Are Surprisingly Similar

-Competition Through New Distribution Methods Combined with Competition from Formerly Nonmajor Refiners Have Contributed to Lower, but More Variable and Volatile Prices

-Competition From New Distribution Methods May Be Constrained by Facility Siting Problems

MAY 8 REMARKS

BULK PRICES OF GASOLINE ARE NOTORIOUSLY VOLATILE AND GEOGRAPHICALLY VARIABLE

o NY Mercantile Exchange profits from buying & selling of **futures** contracts.

o In 1990 normal spreads among wholesale prices were **inverted**, with some spot prices for bulk supplies rising above tankwagon delivered prices.

o During the last 20 years, and especially the last 5 years, **spreads** between **dealer and marketer** buying prices tended to widen (Tables 1-2).

o A Comanor and Riddle study ("Branded Open Supply and Uniform Pricing of Gasoline", December 2001) found that **marketing terminal location** best explained variations in marketer buying prices.

PROXIMATE CAUSES OF VOLATILITY ARE NOT THE PROBLEM

o Accidents and fuel mandates have accounted for various **specific** instances of volatility, as have **crude oil price collapses and supply disruptions.**

o Low price elasticity of demand and supply explains why seasonal changes in demand and refinery maintenance shutdowns can have big impacts.

o The **underlying cause** of the of the 2000 Midwest price spikes was **chronically scarce refining capacity (**FTC, *Midwest Gasoline Price Investigation*, Executive Summary and press release). Energy Secretary Spencer Abraham and the API have identified high refinery utilization rates as a potentially key source of price spikes in the future.

o But, "the problem" is low profitability, which undermines incentives to invest. A typical annual rate of return in refining/marketing during the last two decades or so has been **approximately 5%.** Relative to almost any reasonable standard, this is **too low to justify the investment that would make severe price spikes unlikely.**

o Profits have been low because **refining capital expenditures** have tracked spending for **pollution abatement** (DOE FRS) and because upgrading, i.e., those **investments** designed to produce lighter and more valuable products like gasoline – or high octane gasoline – from heavier and less costly crude oil have been accompanied by **gyrating profits even as profits fall** (DOE, *Performance Profiles 1996* and *Petroleum 1996: Issues and Trends*). Fuel manufacturing requires very **costly** investments in long-lived equipment based on **hard-to-predict relative prices** for crude oil inputs and refined product outputs.

o Refiners face an **all-or-nothing choice**: upgrade facilities to abate pollution and produce cleaner-burning fuels or go out of business. This has led to what has been called **"debottlenecking"** and **"capacity creep"**, i.e., expansions of capacity beyond the minimum necessary for compliance with EPA rules. These investments, while rational for each refiner, have been detrimental to the industry.

o Increases in profitability, such as in the late 1980's and late 1990's, have been followed with a short lag by **increases in investment**, suggesting strong responsiveness to financial incentives. Thus, just as low profitability led to rising capacity utilization rates, increases in profitability likely would prevent further increases, and perhaps lead to capacity increases sufficient to make future price spikes much less likely.

MODEST INCREASES IN REFINING/MARKETING PRICE MARGINS WOULD MITIGATE WHOLESALE PRICE VOLATILITY, BUT MIGHT MAKE CONSUMERS WORSE OFF

o DOE has found a **close correlation** between the refining/marketing rate of return and the net refined product margin. The net refined product margin comprises revenues from wholesale or retail sale of refined products minus refining/marketing operating costs. I estimate that during 1977-2000 the net refined product margin averaged only about 74 cents per barrel (less than 2 cents per gallon). **Since the net margin is small in per gallon terms, and since it is correlated with rates of return, a big relative increase in the margin might have a small impact on consumers but a huge impact on investors in refining/marketing.**

o Based on data for 1977-2000, I estimate that a net margin of approximately **$3** per barrel – roughly quadruple the actual average margin during those years – would be accompanied by a rate of return in refining/marketing of about **15%.** Although four times greater, the implied net margin amounts to about 7-8 cents per

gallon for refined products generally, or **less than a dime per gallon of gasoline**. A **15%** rate of return for refining/marketing would be exceptionally high, and **probably would induce enough investment to keep capacity well above peak demands and thereby tend to stabilize prices.**

o In my August 2001 written presentation for the first FTC public conference, I argued that producers, in this case **refiners, would benefit** from more stable prices. Refinery investments to obtain higher-grade products from lower-grade crude oils could be made with greater predictability, leading to higher profits and less risk. This seems true especially since the unstable prices since decontrol in 1981 have been fluctuations around a downward trend, and falling prices commonly mean that producers have trouble passing any cost increases forward to consumers. However, I also argued that more stable prices would mean higher average prices, due to less innovation and less competition. **Hence, a modest increase in** refining margins and **the average price of gasoline that resulted in (nearly) stable prices might leave consumers worse off.**

CONSOLIDATION AMONG THE BIGGEST REFINERS AND NEW COMPETITION FROM OTHER REFINERS HAVE CONTRIBUTED TO LOWER, BUT MORE VOLATILE AND VARIABLE PRICES

o In the last decade **consolidation among the biggest** refiners has left the **successors** with **less** refining **capacity** than was held by the **predecessors**. Acquisition of refineries from majors has enabled rising **independent refiners** to dramatically increase their capacity, and become formidable competitors for the shrinking number of majors. Meanwhile, integrated companies like Citgo and Conoco continued to **expand in a shrinking market**.

o New competition in the form of **hypermarkets** becoming **distribution channels** for **merchant refiners** has given those refiners improved access to retail customers. This change may eventually convert refineries into "job shops" that manufacture gasoline according to major retailer needs, reversing the traditional subordination of marketing to manufacturing, and facilitating entry into refining.

o Lower costs through consolidation by majors and **added competition** from rising refiners may tend to shrink net refining margins and aggravate the volatility/variability of gasoline prices. **Spot/unbranded rack** prices may become **representative** of wholesale prices generally, displacing the traditionally more important branded rack/DTW prices. Such an outcome would mean **lower** average, but **more volatile/variable** prices.

MAY 9 REMARKS

RETAIL GASOLINE PRICES EXHIBIT SUPRANORMAL VOLATILITY MAINLY DUE TO CRUDE OIL PRICE FLUCTUATIONS, AND NORMAL SPREADS AMONG RETAIL PRICES SOMETIMES ARE UPSET, BUT VOLATILITY HAS BENEFITED CONSUMERS

o The Bureau of Labor Statistics finds it worthwhile to report a **CPI Special Index for Energy Commodities** mainly because gasoline prices fluctuate so much more than most other prices.

o Major brands of gasoline usually cost consumers a few more cents per gallon, but when **supplies** of bulk gasoline become **tight**, **unbranded** gasoline can cost as much or **more** than major brand gasoline.

o The 1999 price spike in California and the 2000-01 price spikes in Midwestern states **occurred after a nationwide collapse to all-time lows,** when prices are adjusted for inflation and changes in taxes. In general, API data show that the long-term trend of prices has been downward.

o Given a downward trend, **volatility benefits consumers.** The spikes induce **innovations** like self-service and **new competition,** like that from convenience stores in the recent past and from hypermarkets now. More generally, consumers gain more from price collapses than they lose from price spikes because they tend to buy more gasoline when and where it is cheaper, and because the surplus consumers gain beyond what they spend would be greater with unstable prices than with stable ones. **Innovation and competition in other industries also is enhanced by volatile gasoline prices.** As a result of the sharp spikes in gasoline prices in 1973-74 and 1979-80, foreign car manufacturers gained competitive advantage over domestic ones, forcing U.S. car manufacturers to improve the quality control of their production lines. The U.S. manufacturers also responded to the greater fuel efficiency of foreign cars by designing more vehicles to run on regular grade gasoline.

COMPARED TO OTHER GOODS AND SERVICES SOLD AT RETAIL, GASOLINE PUMP PRICES ARE SURPRISINGLY SIMILAR

o Articles in *USA Today* with titles such as "Why's gas less a block away?" and "Varying prices for gas leaves drivers fuming" show that "**gasoline prices vary all over the place"**. However, a 1997 study for API by Ron Johnson at Montana State found that **gasoline prices vary less among major metro areas than prices for nearly all other goods and services.** Johnson found that only mortgage interest rates varied less. Another 1997 study by Frank Adams in the *Review of Industrial Organization* found that prices for gasoline varied less than most other items commonly sold at convenience stores with gas pumps.

o The low variability of gasoline prices is surprising because taxes on gasoline vary so much. Cities like Chicago, Los Angeles, and New York impose much higher taxes on gasoline than do Atlanta, Newark, and St. Louis. Much of the observed difference is due to sales taxes which must be included in the prices posted by retail gasoline outlets.

o The low variability of gasoline prices is due to:

- The nearly universal practice of sign advertising of prices at retail outlets, and
- The practice of including all taxes in the posted price.

Thus, gasoline is the only product whose advertised price includes all taxes and is visible to passing motorists, permitting **drive-by shopping.**

o Consumers' familiarity with gasoline prices seemingly causes their concern with the variability that exists, while also keeping that variability relatively low.

COMPETITION THROUGH NEW DISTRIBUTION METHODS COMBINED WITH COMPETITION FROM FORMERLY NONMAJOR REFINERS HAVE CONTRIBUTED TO LOWER, BUT MORE VARIABLE AND VOLATILE PUMP PRICES

o Dealers operating full-service gas stations have lost out in competition with self-service stations, convenience stores, and most recently hypermarkets. Dealers were dominant in 1950, but have been losing share to marketers for 20-30 years, and now marketers are threatened by hypermarkets.

o Dealers sell high-quality gasoline at relatively high, but relatively stable prices. Hypermarkets sell average-quality gasoline at rock bottom, but relatively unstable prices. Marketers and their convenience stores are in-between.

o The growing shares of marketers at the expense of dealers has meant lower, but more volatile prices. The entry of hypermarkets intensifies this trend.

o Hypermarkets mean dramatically lower prices because: (1) they offer markets to merchant refiners selling unbranded gasoline; and (2) they have exploited economies of scale as never before in gasoline retailing.

o Experience with supply disruptions and interruptions shows that bargain hunting has a cost. To the extent that hypermarkets always seek to buy gasoline at the lowest wholesale price, **hypermarkets' purchase prices of gasoline will tend to be more volatile and variable.** The comparative **stability** offered by contract prices for major brand gasoline **may be sacrificed** by hypermarkets in return for lower, more volatile gasoline prices from independent and affiliated merchant refiners.

COMPETITION FROM NEW DISTRIBUTION METHODS MAY BE CONSTRAINED BY SITING PROBLEMS

o Consumers love to shop at hypermarkets and convenience stores, but don't want those favored stores in their neighborhoods. Consumers who can afford expensive SUVs save lots of money at Sam's Club or Costco gasoline pumps, but also support land zoning laws that impede siting of big-box retailers. Much the same applies to Citgo's 7-11 outlets, many of whose customers prefer neighborhood churches to convenience stores open 24/365.

o Zoning restrictions and rising land costs render retail gasoline outlets uneconomic in many places. Studies attribute higher prices in some areas to lower gas station density, which in turn is strongly influenced by cost of siting and construction. While some gasoline alleys remain, their days are numbered. When they go, area prices will become more uniform at higher levels.

o Facility siting problems are a big barrier to new competition in the manufacturing, storage, transportation, and marketing of gasoline. In some cases, such as the territorial restrictions embodied in Virginia's divorcement law, the siting problems have an anticompetitive basis.

I. Introduction

"Gasoline prices vary 'all the time' and "all over the place'" is the succinct statement leading Section VI of *Gasoline Marketing in the United States Today*, American Petroleum Institute Publication 1593, 3rd edition, May 1992. Confirmation of the first part of the API assertion came in the form of multiple Energy Information Administration studies, including "Spring '96 Gasoline Price Runup: An Example of Petroleum Market Dynamics" in *Petroleum 1996 – Issues and Trends*, September 1997, *Motor Gasoline Assessment, Spring 1997*, July 1997, *Asessment of Summer 1997Motor Gasoline Price Increase*, May 1998, and *Price Changes in the Gasoline Market*, June 1999. Confirmation of the second part was provided by a more recent series of newspaper articles, including "Why's gas less a block away?," *USA Today*, May 26, 2000, "Varying prices for gas leave drivers fuming," *USA Today*, August 14, 2001, "Paying Up at the Pump", *Washington Post Fairfax Extra*, May 17, 2001, "Bargain Hunters Hit the Road", *Washington Post*, October 17, 2001, and "At the Pump, a Profit Puzzle", *Washington Post*, February 24, 2002. Combining volatility with variability were the sharp price spikes in California and the Midwest at century's end, revealing that the nation had focused on the wrong Y2K problem. As noted by FTC General Counsel W. Kovacic ("Prepared Statement of the Federal Trade Commission", U.S. House Committee on Government Reform, April 23, 2002), gasoline price spikes also occurred in 2001 and pump prices nationwide rose sharply in March-April 2002.

A focus on the refining/marketing component of the pump price of gasoline is both important and timely. For one thing, refining/marketing costs comprised almost 37 percent of the retail price as of April 2001, approximately the same percentage as the cost of crude oil, and up from 27 percent in 1981 (American Petroleum Institute, *How Much We Pay for Gasoline*, May 2001). For another, this percentage may grow in the long run because environmentally driven manufacturing costs are likely to rise more than the finding costs of crude oil. Finally, media attention for 2-3 decades has educated the public about the importance of OPEC decisions to crude oil prices, but only in the last 2-3 years has comparable attention been paid to regulations and laws at all government levels that have notable impacts on gasoline prices. Finally, media attention devoted to federal energy legislation has focused on familiar topics like ANWR drilling and CAFÉ standards. The focus has been so intense that these seemingly obscure acronyms have become widely recognized. By contrast, the long-running absence of new refineries is not newsworthy, nor is possible scarcity of pipelines in rapidly growing regions. Yet, lack of adequate facility capacity throughout the

manufacturing/storage/distribution/marketing chain may be potentially more important to U.S. consumers in the long run than the world price of oil.

II. Supernormal Price Volatility and Price Variability

The Consumer Price Index's Special Index for Energy Commodities rose at about a 50 percent seasonally-adjusted-annual-rate in the first quarter of 2002, following a 25 percent fall during 2001. By comparison, the Special Index for Energy Services seemed stable, although it also tends to fluctuate sharply (Bureau of Labor Statistics, "Consumer Price Index Summary", **www.bls.gov**). The commodities index is much more volatile because gasoline prices fluctuate so much. Gasoline prices have been volatile ever since the elimination of allocation and price controls in January 1981. For the period 1981-89, the volatility reflected variation around a strong downward trend, as shown by the American Petroleum Institute's annual reports on gasoline pump prices adjusted for taxes and inflation.

The introduction of futures contracts for gasoline by the New York Mercantile Exchange in the early 1980's made the volatility of gasoline prices more visible, and stimulated expansion of spot markets in New York and Houston. Hence, changes in prices over time and among areas became more transparent.

The August 1990 invasion of Kuwait by Iraq marked the first worldwide crude oil disruption under a regime of uncontrolled gasoline prices and an active futures market for gasoline. Not surprisingly, this meant that gasoline prices might not track crude oil prices, at least not closely and not in all markets. Surprisingly, the crude oil market disruption upset normal price spreads among wholesale gasoline prices (e.g., dealer delivered prices suddenly were lower than marketing terminal prices in many areas), and even led to cases in which pump prices of some sellers were lower than wholesale prices paid by other sellers. As told by Stephen Sheetz, CEO of a major gasoline chain store corporation operating in mid-Atlantic states, to the U.S. Senate Subcommittee on Antitrust, Monopolies, and Business Rights in May 1992,

"The start of the price inversions we have witnessed for the past 2 years coincided with Iraq's August 2, 1990, invasion of Kuwait…Price inversions have continued, sometimes nationwide, sometimes regionally, sometimes only in a particular market throughout 1991 and 1992."

A month later Robert Phillips, Jr. told the U.S. House Subcommittee on Energy and Power of 7 examples of wholesale prices paid by marketers that were higher

than the retail price posted at a station operated by the refiner selling the gasoline to the marketer.

Although the instances of retail prices below wholesale prices hinted at predatory pricing, the preponderance of the inversions represented inverted spreads among wholesale prices. With the August 1990 disruption and its aftermath, spot prices for bulk gasoline supplies soared. Simultaneously, some major oil companies temporarily froze both contract prices to dealers and pump prices at their controlled outlets. One oil company went so far as to buy gasoline on the spot market and resell it at a loss to dealers. The temporary freezing and subsequently slow raising of contract prices was a response to a call for restraint by President Bush, but more importantly was a reflection of the companies' desire to protect branded dealers and some branded marketers from the vagaries of roller coaster prices. While contract customers of major oil companies and those companies' directly operated retail outlets were getting this price protection, independent marketers like Sheetz were buying supplies at unbranded terminal rack prices that tracked spot prices. What seemed like straightforward cases of retail prices below wholesale prices were cases of major brand contract prices rising less than spot and unbranded wholesale prices. (For discussion and empirical evidence, see P. Sorensen, et al., "An Economic Analysis of the Distributor-Dealer Wholesale Gasoline Price Inversion of 1990: The Effects of Different Contractual Relations", American Petroleum Institute, April 1991, and "Additional Evidence Relating to the Distributor-Dealer Wholesale Gasoline Price Inversions of 1990-1991: The Effects of Different Contractual Relations", September 1991. The 1990 crisis also was accompanied by allocations, e.g., limits on sales to marketer customers and cutoff of non-contract customers. Cutoffs to non-contract customers in response to rapidly rising spot prices, or temporary excess demand, recently were reported by Phillips Petroleum as part of an effort to assure supplies at reasonable prices to its branded dealers. (See "Putting Hopes of Recovery Over a Barrel", *Washington Post,* April 7, 2002, p. H2.)

Prior to the price inversions, the increased buying power of marketers relative to dealers had caused price spreads between these resellers to widen far beyond the historical "jobber discount". The historically high dealer-marketer spreads during the 1980's gradually returned, ending all but the most unusual cases of price inversions. However, the record of the early 1990's had clearly been one of volatile and geographically variable wholesale price differences, even with conventional gasoline.

The rising relative importance of marketers is evident in the sales of gasoline by "major energy producers" that account for 87 percent of U.S. refining capacity. During 1990-2000, gasoline sales of major energy producers through the marketer channel approximately doubled, while sales through the dealer channel rose a less impressive 50 percent. Since these large reported changes partly reflect an increase in the number of major energy producers from 23 to 33, a more accurate representation is provided by examination of the four largest (in terms of assets) among these major energy producers. For this subgroup of four major oil companies, sales through both the dealer and the marketer channels roughly doubled during 1990-2000, but the marketer volumes rose by 334 million barrels versus a rise of 300 million barrels for dealers. This modest relative increase is important because the four largest companies accounted for one-half of total gasoline sales through the dealer channel for the larger group of 33. Further, sales through dealers represented about one-third of total gasoline sales of the four largest. Thus, a mutual dependence exists between dealers and the largest oil companies.

Historically, dealers dominated gasoline retailing and the dealer tankwagon price (DTW) was the reference price for wholesale market sales (R. Cassady, Jr., *Price Making and Price Behavior in the Petroleum Industry*, 1954, p. 198). Marketers commonly affiliated with one brand, i.e., were not "independent", and paid wholesale prices discounted 3-4 cents per gallon from the DTW, a functional discount. Independent marketers paid an unbranded terminal rack price. Some refiners switched their emphasis to terminal rack prices with the growth of self-service retailing and independent marketers during the 1970's, and terminal rack pricing became prevalent during 1981-82 (Department of Energy, *Deregulated Gasoline Marketing*, pp. 39-46). Today, the terminal rack price is as important as was the DTW fifty years ago. Stated differently, independent marketers, typically selling both branded and unbranded gasoline, are as dominant today as were dealers fifty years ago.

A consequence of branded dealers and independent marketers trading places has been greater variability (volatility) of wholesale gasoline prices around a 20-year (and counting) downward trend. Table 1 reports average wholesale prices realized by the four largest energy producers, starting with 1981, the first full year of decontrolled gasoline prices. Wholesale prices are reported for marketers and dealers, and compared to retail prices realized at refiner-operated retail outlets and retail prices realized from sales to large accounts ("other"). Whereas in 1981 the spread between dealer and marketer prices was about $2/barrel, it had widened to almost $6/barrel by 2000, mainly due to a $5/barrel drop in the price realized from

sales to marketers. Similarly, average prices to large accounts had fallen by roughly $7/barrel of gasoline. The price variability (volatility) derives from the facts that retail prices at refiner-operated outlets are subject to refiners' control, and dealer prices are stabilized by long-term supply agreements. By contrast, prices realized from sales to marketers are subject to daily and weekly market pressures, and retail prices to the other category are similarly freer to fluctuate.

While price volatility and variability have been high with conventional gasoline, introduction of reformulated gasoline led to increased spreads between dealer and marketer buying prices. The spread that had been 7-8 cents per gallon with conventional fuel increased to 10-11 cents per gallon with the introduction of reformulated gasoline (Table 2). Yet, these average data understated the much greater disparity among specific markets and classes of trade. Table 3 compares three wholesale prices (dealer buying price, branded rack price, and unbranded rack price) in four cities with differing gasoline formulas ranging from conventional gasoline (simplest) to California Air Resources Board (CARB) reformulated gasoline (most complex) in a month of historically low gasoline prices. The three varieties of RFG exhibit remarkably diverse prices, with the most common – federal RFG with MTBE – costing substantially less than the locally tailored CARB and ethanol-based fuels. Dealer/marketer price differentials are clearly greater with the more complex, locally tailored blends of gasoline.

The adoption of cleaner-burning gasoline in major metro areas would be expected to widen average spreads between dealer and marketer buying prices because marketers are more prevalent in suburban/rural areas that use conventional gasoline and because dealers are affiliated with major oil companies, the principal sources of cleaner-burning gasoline. Perhaps most important, conventional gasoline remains the largest market in terms of volume and number of competing suppliers. In many areas it appears that dealers sell only cleaner-burning gasoline since price quotes for conventional gasoline are only for sales at terminal racks. Thus, dealers as a class of trade have become mainly purveyors of high quality gasoline at high prices in major urban areas.

Distribution channel differences also are now a prominent reason for local and submarket price differentials. The disparity in prices between hypermarkets and conventional, dealer outlets in local submarkets is striking.

During January 2001-February 2002 I informally tracked pump prices at some three dozen Northern Virginia outlets that arguably could be construed as part of a single gasoline submarket. Table 4 reports the median pump prices, and their

range, for regular grade at nine of these outlets. Although 7 of the 9 outlets have similar median prices, the Costco outlet and an Exxon dealer station three miles from Costco were outliers, each having typical prices that differed by a dime or more per gallon from the others in Table 4. A noteworthy finding of Table 4 is the huge disparity between prices at an Exxon outlet and a Mobil outlet, each a mile from the Costco hypermarket. Table 5 compares all the prices at these three outlets through five summary statistics.

In respect to regular grade, both mean and median prices at the Costco outlet are more than a dime per gallon lower than those at the competing Exxon and Mobil outlets. The ranges differ similarly, but the standard deviations are not far apart. The most notable finding is that Costco sells premium grade at a price substantially below the Exxon and Mobil midgrade prices, and that this sharply lower average price is associated with a wider range and greater standard deviation.

Clearly, Tables 4 and 5 show that prices at some locations can be outliers and that price variability among distribution channels is pretty big, and perhaps much larger than might be expected for a standardized product. This raises the question: compared to what?

III. Gasoline Prices Compared to Other Prices

Two studies show that the recent variability of gasoline prices among sellers is exceeded by the corresponding variability of other goods and services.

In a November 1997 report entitled "Variability in Retail Prices in Various Lines of Business" prepared for the American Petroleum Institute, Professor Ronald Johnson of Montana State University calculated coefficients of variation for 62 goods/services whose retail prices had been estimated by the American Chamber of Commerce Researchers Association (ACCRA). Based on first quarter of 1997 data, he found that the coefficient of variation was lower for gasoline than for all the others, except for mortgage rates. The ten least variable products and their coefficients of variation (in percent) were as follows:

30-year mortgage rate (including fees)	2.1
gasoline (regular, major brand)	6.7
parmesan cheese (Kraft, grated)	8.2
dishwasher detergent (Cascade, powder)	8.6
antibiotic ointment (Polysporin)	8.7
liquor (J&B scotch)	9.2

beer (Miller Lite or Budweiser)	9.9
sugar (lowest price brand)	10.1
pizza (Pizza Hut or Pizza Inn)	10.1
men's jeans (Levi's denim)	10.5

The ACCRA data comprised prices for 314 metro areas and thus Johnson's coefficients represented nationwide, interurban measures. Given that retail gasoline prices vary according to environmental standards (reformulated v. conventional) and taxes (state, local), the 6.7% coefficient of variation is remarkably low, especially in comparison to single brands like Kraft grated cheese and Cascades dishwasher detergent.

Johnson also compared statewide gasoline and milk prices, using Energy Information Administration net-of-taxes retail price estimates. He found that, averaged over 28 states with adequate data, the coefficient of variation was 3.3% for gasoline and 6.86% for milk.

Finally, Johnson used November 1997, Internet-reported survey estimates of pump prices at 305 San Diego County retail gasoline outlets subdivided into 6 geographic subdivisions. The coefficients of variation for regular grade for the 6 subdivisions ranged from 3.19% to 4.75%.

The second study, "Search Costs and Price Dispersion in a Localized, Homogeneous Product Market: Some Empirical Evidence", *Review of Industrial Organization*, 1997, by A. Frank Adams III, compared regular gasoline prices with prices for 22 other items such as aspirin, beer, candy, chips, and drinks at 20 convenience stores in Auburn/Opelika, Alabama during November 1994. Adams found that 20 of the 22 items exhibited more and statistically significant dispersion than gasoline.

Items surveyed by Adams included common purchases like Budweiser 12 oz. can six-packs, Frito-Lay 6 oz. bags of potato chips, and Bayer 24-count bottles of aspirin. Despite their popularity, price advertising for the convenience items amounted to no more than store window displays, and often less. By contrast, gas prices were displayed on signs visible to passing motorists. Half the stores surveyed were located in-town and half at Interstate interchanges, but differences between these two groups of stores were not statistically significant. A test for loss leadership – "get them in with low gas prices and overcharge them for in-stores items" – was not supported.

These two studies permit an important inference: the high variability of gasoline prices is low relative to the higher price variability for nearly all other products. The relatively low price variability probably is due to:

- the practice of sign advertising that is nearly universal among gasoline outlets; and,
- the practice of including all taxes in the posted prices, which probably compresses retail margins in high tax areas.

Gasoline is the only product whose advertised price includes all taxes and is visible to passing motorists. This price transparency can reasonably be credited for the observed low variability relative to goods with less transparent prices.

Consumers' familiarity with gasoline prices seemingly causes their concern with the variability that exists, while also keeping that variability relatively low.

Proximate Causes of Price Volatility and Variability

Numerous reports about and investigations of recent gasoline price spikes have identified the proximate causes. In the case of regional gasoline price spikes, these were determined to be damage to refineries and pipelines from fires and explosions, difficulties in manufacturing and distributing statewide/local gasoline blends, and relatively small amounts of spare capacity to meet peak season requirements. In California in 1999, fires shut down two major refineries in late winter, and an explosion and series of spills shut down a northwestern pipeline, causing prices for California's unique gasoline to rise sharply, in absolute terms and relative to prices in Houston and New York (American Petroleum Institute, "Will Consumer Fear of Y2K Computer Malfunctions Cause Panic Purchasing or Petroleum Product Distribution Problems?", August 1999). In the Midwest in 2000, spring refinery maintenance problems, spot damage from storms and fires, and pipeline disruptions combined to impede the supply of gasoline (Federal Trade Commission, Final Report of the Federal Trade Commission: Midwest Gasoline Price Investigation, March 29, 2001). Common to both cases were unique gasoline blends: California Air Resources Board reformulated gasoline and Chicago/Milwaukee reformulated gasoline stock for oxygenate blending (J. Shore, Supply of Chicago/Milwaukee Gasoline Spring 2000, **www.eia.doe.gov**). These experiences induced the Environmental Protection Agency to temporarily suspend gasoline regulations for one refiner in September 2001 to forestall another price spike (**www.OGJonline.com**, September 5, 2001).

Notwithstanding the temporary relaxation of standards by the EPA and other evidence of delays in implementing new standards, the trend has been to impose stricter environmental quality requirements on fuel manufacturing. This trend will continue for decades and will help preserve the current dominance of gasoline over alternative fuels (T. Hogarty, "Gasoline: Still Powering Cars in 2050?", *The Futurist*, March 1999). Indeed, local/state/regional differences in gasoline blends may increase gradually for the same reason that large disparities in local/state fuel taxes have become commonplace: differences in electorates' demands and competitive responses to those demands by elected officials.

Since manufacturing/distribution capacity increases are expected to follow the modest increases of recent decades, seasonal and daily peaks in gasoline demand will make price volatility and variability the norm, not an aberration (www. OGJonline.com., September 5 and December 5, 2001). However, while the proximate causes of price spikes are physical and regulatory, chronically scarce manufacturing capacity is the underlying cause (FTC, *Midwest Gasoline Price Investigation*, "Executive Summary" and accompanying press release). U.S. Department of Energy Secretary Spencer Abraham apparently concurs with the Commission assessment that the U.S. needs more refining capacity to limit the threat of price spikes (AP news bulletin, May 3, 2002). In turn, the chronically scarce refining capacity results from chronically low profitability.

Refining: an Especially Beleaguered Manufacturing Industry

During the 21-year period 1980-2000, U.S. refining/marketing's median rate of return was 4.8 percent. For the four five-year periods starting with 1981, the median rates of return were 4.8, 5.1, 2.0, and 6.6 percent, respectively. The mean profit rate for the refining/marketing sector was only 5.6 percent during 1987-2000, despite some good years at the beginning and end of this period. (Sources: author's calculations from data in Energy Information Administration, Financial Reporting System, *Performance Profiles, 1982*, p. 56, *Performance Profiles, 1984*, p. 216, *Performance Profiles, 1990,* p. 123, *Performance Profiles, 2000*, p. 22.)

An industry with this financial performance should be shrinking financially, surrendering capital to numerous more productive industries. Amazingly, billions of dollars of new investment have continued to flow into this line of business. As the most recently available example, in 2000 major energy producers increased capital expenditures – excluding the effects of mergers and increases in sample size – by 19 percent for U.S. refining relative to 1999, while holding constant capital expenditures for marketing at $2.3 billion. During 1987-2000, major

energy producers added to net property, plant, and equipment in U.S. refining at an average annual rate of approximately $3.7 billion while average annual depreciation charges amounted to about $2.2 billion and average annual net income for combined refining/marketing averaged less than $3.0 billion annually. In only two of the fourteen years comprising 1987-2000 were depreciation charges for refining greater than additions to plant, property, and equipment.

One reasonable inference permitted by these data is that the continued investment has contributed to the dismal profitability. Indeed, a striking illustration of this simple phenomenon is 1992, when $5.1 billion in additions to plant, property, and equipment were made and the rate of return was **negative**. In turn, this inference suggests the possibility of a principal/agent problem in which major energy producers' management is not fulfilling their duties to stockholders. However, the more prevalent and plausible explanation is that continued investment in refining has been driven by compliance with environmental/health/safety regulation, which has yielded social returns not discernible from companies' income statements. Regulations issued under the Clean Air Act Amendments and similar state laws have confronted refiners with an all-or-nothing choice: either invest large sums of money to manufacture cleaner-burning motor fuels or shut down. For most companies, investments yielding substandard profits have continued to mean smaller (opportunity) losses than a strategy of ceasing operations. Indeed, for years the industry trade literature has noted that compliance often means capacity enhancement through "debottlenecking", meaning that investments beyond those minimally necessary for compliance have been optimal in many cases. Consequently, as explained by the Financial Reporting System's analysts (e.g., *Performance Profiles 1996*, pp. 49-51), variations in refining capital expenditures during the 1990's have tracked spending for pollution abatement. Furthermore, the enhancement of capacity that accompanied compliance with environmental regulations has amounted recently to 1-2% per year (API, "Responses to U.S. Federal Trade Commission Questions", April 19, 2002, www.ftc.gov).

To an extent, refining/marketing net margins have been low because third party interests have determined gasoline manufacturing/blending practices to the exclusion of market participants' interests. Specifically, consumers' willingness to pay for cleaner-burning fuels has fallen well short of voters' demand for a better environment and refiners/marketers' need for full cost recovery. With the elimination of leaded gasoline and the subsequent introduction of reformulated fuels, it was clear that consumers' dollar votes did not comport with citizens' ballot choices: numerous instances of misfueling occurred during the lead phaseout, and consumers continue to prefer cheaper, conventional gasoline to reformulated.

Refineries are paid for each gallon of standard gasoline and must absorb some added regulatory costs just as pipelines are paid on a per barrel basis, and cannot readily recoup the costs of handling greater varieties of fuel (Association of Oil Pipelines, "Maintaining Flexibility in Refined Products Pipelines," comments for FTC first conference, September 14, 2001).

However, refiners' capital expenditures have yielded poor results for a more fundamental reason in recent decades. Fuel manufacturing requires big investments in long-lived equipment based on difficult-to-predict relative prices for crude oil inputs and refined product outputs, and investment in this equipment makes economic sense only at high capacity utilization rates. One case in point is capacity to profit from differences in the prices of heavy and light crude oil. Refiners that upgraded facilities often have failed to profit because heavy/light crude oil price spreads have not only fluctuated sharply, but also have trended downward. A second case in point is capacity to profit from spreads between prices of light products like gasoline and heavy products like industrial fuel oil, which also did not live up to expectations. Since the upgraded capacity entails fixed capital costs and virtually fixed labor costs, it tends to be run at high utilization even if marginally profitable. To the extent that refiners tend to react similarly to the same relative price information, the consequence is gyrating profits even as average profits fall. (For further discussion, see Energy Information Administration, Office of Oil and Gas, *Petroleum 1996: Issues and Trends*, September 1997, pp. 134-6.) A third case in point is industry experience with refining capacity to enhance gasoline octane. Refiners made substantial investments to replace the additive lead, the traditional and cheap octane enhancer. However, spreads between prices of high and low octane gasoline are substantially greater at the retail level than at the wholesale level, with the result that much of the potential profit accrues to retailers and marketers, rather than refiners. Furthermore, American car manufacturers have reacted to these large octane-related pump price spreads by designing the vast majority of their engines to require only low octane gasoline. To the extent that Asian and European car manufacturers follow this lead – and they appear to be doing so – yet another potential source of profits for motor fuel manufacturers will not be realized. (Comparison of fuel requirements in the 1996 and 2001 *Consumer Reports* annual auto issues shows that the percent of foreign makes/models requiring premium gasoline fell from about one-third to about one-fourth during the 5 years, while the preponderance of domestically produced cars required only regular.)

Meanwhile, sporadic gluts of refining capacity have continued worldwide even as foreign refining usually is more profitable than domestic (*Performance Profiles,*

2000, pp. 10, 21). It appears that on all continents and at most times in recent decades, investments that probably were rational for each refiner individually have been detrimental to the industry. A major consequence is that the U.S. is now served by refineries that were originally built a quarter century or more ago, and mostly were sited and constructed to suit national needs a half century ago. If one were to design from scratch a motor fuel manufacturing industry specifically designed to meet the demands of American motorists in the first decade of this century, it's unlikely that the sites and refinery configurations chosen would match those existing today. Hence, the "inherited" physical characteristics of American petroleum refining may severely impede or even preclude good economic performance.

On the other hand, the evident willingness of major energy producers to invest in refining despite low concurrent returns may be construed as confidence that those long-lived investments eventually will yield compensatory returns. The large investments in facilities able to use low grades of crude oil seemingly reflect such sentiments. Similarly, the roughly $5 billion per year invested in 1991-92 following the Clean Air Act Amendments of 1990 may have reflected not only a belief that cleaner-burning motor fuels some day would command price premiums sufficient to reward investments in their manufacture, but also a delayed response to relatively high rates of return in refining/marketing during 1988-89. The larger investments made in 2000 following improved rates of return in 1997-2000 appear to support the assumption of a delayed response.

How Much Would Price Stability Cost Consumers?

The question – how much must consumers pay to get gasoline price stability? – is too difficult to answer, but a partial, failing attempt is instructive, and I propose one here in that spirit.

The answer begins with the presumption that current rates of return are unsustainably low and that estimates of price increases required to reach sustainable rates of return can be made.

The Energy Information Administration has observed a close correlation between refining/marketing rates of return and the net refined product margin (*Performance Profiles 1999*, pp. 35, 49). The net refined product margin is the gross margin (revenues from wholesale/retail sale of refined products minus purchases of raw materials and of refined products) less refining/marketing operating expenses. Succinctly, the net refined product margin is the difference between refined

product revenues and refined product operating costs for firms' refining/marketing units. Based on data reported in the annual reports *Performance Profiles*, during 1977-2000, the net refined product margin averaged about 74 cents per barrel, ranging from a penny per barrel in 1984 to $2.23 per barrel (= 42 gallons) in 2000. Hence, at its peak, the net margin amounted to little more than a nickel per gallon. Since the net margin is small in per gallon terms and since it is highly correlated with rates of return, a big relative increase in the margin might have a modest impact on consumers but a huge impact on investors in refining/marketing. Furthermore, since the net margin is the residual factor claim for payment from refined product revenues, it is the perfect mechanism for stabilizing gasoline prices at a sustainable level, assuming that the stabilization resulted from competitive market forces, and assuming that the competitive market results were acceptable to American electorates.

Using Financial Reporting System data for 1977-2000, I estimated the following relation between the rate of return (%) and the net refining margin (cents per barrel):

Return = 0.77 + 0.05 Margin.

The coefficient of determination was .55, so that the margin by itself accounts for over half the variation in the rate of return. The intercept was statistically insignificant, so that the relation is approximately proportional. According to this calculation, a $1 per barrel increase in the net margin results in a 5-percentage-point increase in the refining/marketing rate of return. Assuming that a risk-adjusted compensatory return in refining/marketing is 15 percent, the appropriate margin is on the order of $3 per barrel, or roughly four times greater than the actual average for 1977-2000. Although four times greater, the implied net margin amounts to about 7-8 cents per gallon for refined products generally, suggesting an increase of less than a dime per gallon to stabilize gasoline prices.

The inference that a 15 % annual rate of return would tend to stabilize prices depends on a crucial assumption, that fluctuations in the margin would supplant fluctuations in pump prices. The notion is that major refiners especially would sell greater amounts of fuel at more stable contract prices, so that pump prices would fall less in winter and rise less in summer while averaging no more than a dime per gallon higher than under current conditions. This is a stringent requirement because the dampened price fluctuations could mean relatively higher summer peaks and lower winter lows in capacity utilization. The notion further presumes greatly enhanced willingness to invest in upgraded facilities. In turn, the 15% rate

of return might have to be earned on a larger capital base, implying average prices close to a dime per gallon higher.

The estimated equation must be taken as preliminary since it is simple, and since it is based on tentative estimates of the net margin, for which some conflicting values were given in the early issues of *Performance Profiles.* However, it is sufficiently accurate to sustain a qualitative conclusion.

The qualitative conclusion these rough and partial calculations yield is that a modest increase in the refining/marketing margin would produce a risk-adjusted rate of return sufficient to compensate investors for additional capital expenditures that (hopefully) are sufficient to prevent most price spikes due to excessively high capacity utilization. Admittedly, even this qualitative conclusion is subject to some doubt.

Ultimately, the 25+-year experiment in treating refining/marketing as a separate business unit - expected by itself to earn a compensatory return – might have to be re-evaluated. The traditional idea - that an integrated company would earn a compensatory return overall, but not each business unit - may warrant re-examination. However, no such re-evaluation or re-examination appears imminent. In fact, the trends of recent decades, and especially of recent years have been consolidation of old competitors and expansion of new ones.

Capacity Consolidation, 1991-2001

Table 6 lists the names and refining capacities of selected leading companies as of January 1991 and January 2001. The selected companies include the preponderance of the leading companies that manufactured gasoline in each year and, for 1991, the main predecessors of the leading companies in 2001. During 1991-2001, total capacity declined from approximately 15.9 million barrels per day (b/d) to about 15.6 million barrels per day.

While the four largest in 2001 had a greater share than the four largest in 1991, the seven largest companies in 2001 collectively controlled less capacity than their predecessors in 1991. Chevron, the largest refiner in 1991, shrunk its capacity by almost 500,000 b/d. Exxon Mobil was 200,000 b/d smaller in 2001 than its two predecessor companies in 1991. BP was roughly 400,000 b/d smaller in 2001 than its predecessors BP America, Amoco, and ARCO. Combined Shell, Star, and Texaco controlled over 500,000 b/d more capacity in 1991 than successor companies Motiva and Equilon in 2001. Concurrent with this shrinkage by the

seven largest of 1991, Tosco increased its capacity by a multiple of ten to become the third largest, Valero went from marginal merchant refiner with 25,000 b/d capacity to ninth largest with more than 600,000 b/d in capacity, closely followed by Ultramar/Diamond/Shamrock (UDS), whose predecessors Ultramar and Diamond/Shamrock had been comparatively small players. Petroleos de Venezuela (Citgo), Sun, Koch, Tesoro and Conoco recorded impressive growth in a slowly shrinking industry.

Neal Davis of the Energy Information Administration, Financial Reporting System estimates that a half dozen independent or non-vertically-integrated (NVI) refiners plus effectively integrated PDV approximately tripled their refining capacity predominantly through acquisitions, of which about two-thirds comprised properties formerly owned by major energy producers (EIA, "The U.S. Petroleum Refining and Gasoline Marketing Industry", January 2000, **neal.davis@eia.doe.gov**). Tosco and UDS also have been leaders in acquiring retail gasoline outlets as a result of the acquisitions of BP and Exxon, and the exit of Unocal from U.S. refining/marketing. In more recent work ("Understanding Historical Changes in the U.S. Refining Industry," May 2, 2002), Davis estimates that NVI refineries increased their share of capacity from 9 to 26 percent during 1982-2002.

The capacity consolidation is an ongoing process and future DOE data may show further growth of NVI refiners' market shares. In that event, a transformation of the refining sector not seen for decades, perhaps a century, will have occurred.

Evolving Competition in the Manufacturing and Marketing of Gasoline

Fifty years ago gasoline manufacturing and marketing mainly were subsidiary activities of major oil companies domiciled in the U.S., U.K., and Netherlands whose main activity was managing worldwide movement of crude oil from low cost oil fields, principally in the Middle East. Neither refining nor marketing were held accountable for their individual profitability, the focus being on the overall corporate rate of return. U.S. refineries were numerous and simple by today's standards, and deliveries of gasoline went to numerous terminals and bulk stations. Retail gasoline outlets were ubiquitous, the idea being that customer convenience in respect to close access during normal business hours was paramount. The outlets also sold volumes that were one-third or less today's levels, and thus depended on income from related services like auto repair. Hundreds of thousands of people worked as jobbers, dealers, marketing personnel, etc., the vast majority not as employees of major oil companies, but rather as affiliates or franchisees.

Indeed, the many franchise practices perfected by McDonald's, the fast food chain, were pioneered by major oil companies in the 1920's and 1930's and further developed in the 1950's (T. Hogarty, "The Origin and Evolution of Gasoline Marketing", API Research Paper, October 1981).

Much of the benefit of cheap crude oil was passed forward in the form of recruiting and maintaining this large network of labor and capital needed to manufacture./transport/store/distribute/market gasoline, which combined with the cheap crude and modest taxes to provide stable, reasonable pump prices of gasoline. Hence, these beneficiaries were among the biggest losers when crude oil went from cheap to outrageously expensive in the early 1970's.

Although only seven major companies had access to cheap crude oil before World War II, access gradually widened so that the number of major oil companies (= integrated oil companies with geographically wide brand recognition) grew to at least and perhaps as many as twenty. In addition, independent refiners and independent marketers encroached on the major brand system of marketing, offering lower prices through larger volumes and no frills (including no restrooms, no roadmaps, no credit, no spot mechanical checks) and, where allowed, self-service. The independent refiners provided standard gasoline with basic additives and fewer/lesser claims of quality assurance, and some were merchant refiners selling into bulk markets at prevailing prices, contrary to the majors' system of supply agreements with less volatile prices.

Independents realized large competitive gains in the 1970's due to skyrocketing world crude oil prices combined with allocation and price controls on gasoline and - for a time, many other domestic prices – with legalization of self-service and improvements in cars' tires/batteries/accessories. Independent refiners fared relatively well under controls, as did independent marketers. Previously affiliated marketers and dealers expanded their scope to several refiner suppliers and multiple sites, and many previously independent operators established relations with major refiners. The development of more active spot markets and then futures markets further aided independent refiners and marketers.

Self-service's popularity along with diminishing (later disappearing) need for frequent cars servicing both reduced marketing margins and income from affiliated services, forcing adoption of convenience stores or gas 'n go outlets – the preferred forms of independents – by majors' marketing units. Majors also had to confront competition from formerly exclusively affiliated marketers that now were combined independent marketers/chain retailers.

The increased transparency and freedom of prices begun twenty or so years ago spawned demand for more accountability from refining/marketing units, whose comparatively poor profitability became more visible, leading to demands for more accountability. Demands for performance followed and led to the many deactivations, reactivations, sales, mergers, and acquisitions, especially in recent years. Today, as noted above, competition in refining and marketing, now both separable, encompasses competition for capital and labor, as well as customers, without the protective corporate cover traditionally provided by traditional integrated companies.

The rising independent refiners now have not only the refining capacity to produce standard gasoline, but also brand(s) recognition and owned/affiliated marketing facilities. In combination, these enable the rising independents to recruit and maintain the large numbers of people, and to get the large amounts of money to finance major-scale gasoline manufacturing and marketing operations. Hence, rising independents now set the standard for good practice: keep costs low, run facilities at high utilization rates, and realize all available scale economies in manufacturing/distribution/retailing. Whereas the traditional concept of convenience was many outlets operated by locals serving local needs, the newer concept of convenience is 24/365 and fast service. Whereas the traditional notion of the retail gasoline outlet was a way station for travelers or a neighborhood store, the newer concept is the fuel stop for commuters and shoppers. No longer are pump prices are to be reasonable and stable, but rather the lowest possible each day.

As fate would have it, the triumph of the "business model" of rising independent refiners and now-well-established independent marketers created a competitive threat: the combination of the hypermarket and "truly independent" refiner, i.e., the merchant refiner or refiner with too few outlets.

Hypermarkets and Merchant Refiners

Economies of scale always have been paramount in the petroleum industry, as attested by the growth of oil tankers, crude oil storage tanks, and even tank trucks and gas stations. Some twenty years ago ARCO embarked on a flattering imitation of independent marketers by shrinking its marketing territory and ramping up throughput at its retail outlets. The result was a successful challenge of Chevron dominance in western states, especially Arizona, California, and Nevada. Now, the successors to these companies and other refiner-marketers face an

unprecedented economies-of-scale challenge from hypermarkets like Walmart and Costco. According to the *Lundberg Letter* (10/28/99), in the world's biggest retail gasoline market, Los Angeles, Costco outlets have a monthly thoughput that is approximately triple that of industry leader ARCO-branded outlets and more than quadruple the industry average. Such a differential in volume potentially permits pooled retail margins of a nickel or less, about one-half the typical dime per gallon. Over time, a nickel spread per gallon can translate into huge shifts in market share.

However, notwithstanding the focus of trade literature on economies of scale and the apparently low retail margins of hypermarkets, e.g., (*Oil and Gas Journal*, May 14, 2001 and *National Petroleum News*, November 2000 and May 2001), hypermarkets are more fundamentally a challenge to the primacy of refiner-directed gasoline marketing.

Most of the petroleum industry continues to follow the mid-twentieth century marketing strategy of trying to market profitably the fuel volumes that refinery managers manufacture. The industry also relies on specialized retail outlets that derive most revenues from gasoline sales, although this is changing as convenience store footage increases. In general, current industry practice mainly is to market what refineries produce, a sales versus a marketing orientation most prevalent during the 1920's and 1950's (W. Pride and O. Ferrell, *Marketing Concepts and* Strategies, 2000). The more modern practice is to manufacture those things in those volumes which consumers' purchases show to be in demand. The modern practice thus makes manufacturing subordinate to retailing, e.g., book publishing now often follows book retailing, and product specialization also provisionally depends on demand, e.g., supermarkets today devote far more floor space to fast foods like salad bar offerings and snacks like sodas and chips than previously.

Thus, the messages of hypermarkets' early successes is are that: (1) economies of scale in gasoline retailing do not require specialized retail outlets so long as market shares are sensitive to small pump price differentials; and, (2) refinery production may profitably respond to retailer orders rather than to wholesale prices. According to these messages, retailing of gasoline is returning in a way to its origins when the general store or local garage sold gasoline as a customer convenience. Furthermore, according to these messages, refineries are "job shops" that should stand ready to manufacture whatever fuels in whatever volumes that consumers currently favor, not pivotal manufacturing facilities governed by input/output prices and seasonal turnaround schedules. Finally, in conjunction with the "commodification" of gasoline wrought by EPA-regulated gasoline manufacturing, these messages mean that manufacturer trademarks may be

supplanted by retail ones. In future years, retail trademarks like Walmart, Circle K, On the Run, and Tiger Mart may become as important as Exxon, Mobil or Sunoco, if not more so.

Neither economies of scale nor retailer branding are new to gasoline marketing. Independent marketers used both forms of competition, but usually with specialized gasoline outlets and mostly in roles subordinate to (independent) refining. And, as noted, the precursors of convenience stores were general stores in rural areas. What is new is the evident willingness of previously independent refiners and merchant refiners to collaborate with dominant retailers, depending on those retailers to make markets for their products and to schedule their manufacturing operations accordingly.

For these refiners the hypermarkets offer an unprecedented opportunity to become bigger without having to worry about marketing. Heretofore, an ambitious, but relatively small refiner would face big barriers. It did not have the capital and brand name required to recruit dealers. It could not afford a costly program of building its own outlet network. It could not sell much to marketers, except at prices generally lower than those paid to major brands. Hypermarkets overcome these barriers for refiners willing to partner, and thus hypermarkets potentially enable major expansion by refiners previously lacking access to retail gasoline markets. The result ultimately could be a dramatic increase in competition.

The combined expansion of hypermarkets and merchant refiners means more competition through aggressively low prices, and thus more price volatility and variability. Controversy over so-called below-cost selling and zone pricing is one recent consequence of this new competition.

For their part, established sellers in retail gasoline markets will continue to have the advantages of convenience and better locations. Hypermarkets like Costco not only require membership to purchase gasoline, but also payment by credit card and tolerance for short queues at pump islands. Starting next month, the Sterling, VA Costco plans to limit the credit cards it will accept, thus further restricting its potential number of customers. Hypermarkets also need lots of space and increasingly will encounter difficulty in acquiring sites convenient for more than 200 million customers. These hypermarket limitations enable traditional competitors to employ a double zone defense: zone pricing to keep pump prices competitive in areas served by hypermarkets and participation in land zoning meetings to slow hypermarket entry. It's hard to see how consumers/citizens fail

to win in the coming competition. However, competitors may encounter problems gaining access to good sites for outlets.

Land Costs and Zoning Restrictions Are a Big Barrier to Competition

California pump prices are among the highest in the contiguous 48 states, and special gasoline requirements and limited imports from other regions are not the whole story. Within California, gasoline costs more in San Diego and in San Francisco than in Los Angeles because the costs of new retail outlets are higher. The cost differences amount to $200-400,000 in San Diego relative to Los Angeles and to about $1 million in San Francisco relative to Los Angeles (Kosmont & Associates, Inc., "Gasoline Station Development Issues in San Diego", November 1997, and "Gasoline Station Development Issues in San Francisco", January 1998, both reports prepared for Western States Petroleum Association). In San Francisco especially, retail gasoline outlets are not allowed in almost half the city's area and land parcels big enough and cheap enough to make a retail gasoline outlet economically viable are scarce. Overall, Kosmont found that more monitoring and fewer approvals for stations prevailed in San Francisco.

The higher costs of outlets in San Diego and San Francisco leads to fewer outlets in local areas. Professors John Barron and John Umbeck of Purdue University estimated that the geographic density of retail gasoline outlets was markedly greater in Los Angeles than in the other two major California cities ("An Empirical Study of the Link Between Seller Density, Price Elasticity, and Market Prices in Retail Gasoline Markets", July 1999). Within a 1.5 miles radius, they found an average of almost 14 outlets in Los Angeles versus fewer than 12 in San Diego and San Francisco. Indeed, the proportion of outlets having more than 15 competitors within a 1.5 miles radius was .43 in Los Angeles versus .23 in San Diego and .25 in San Francisco. They further found that low outlet density was associated with higher price-cost margins and higher pump prices. In combination, the Kosmont and Barron/Umbeck studies indicate that regional price differences are partly the result of locational factors, including land zoning requirements.

Similarly, location is a bigger cause of differences in wholesale prices of gasoline than is the identity of the supplying firm. UCLA Professors W. Comanor and J. Riddle found that the most significant factor in variation of marketing terminal rack prices was the location of the terminal, not the particular refiner whose product was being sold ("Branded Open Supply and Uniform Pricing of Gasoline", December 4, 2001). Assuming that facility siting is as difficult for terminals as for

retail outlets in California, the differences in rack prices in California may reflect entry barriers due to simple space limitations.

Generally, the key to competition in the manufacturing, distribution, and marketing of gasoline may be increased facility siting. More facilities mean lower prices, and appear more important than the number or market shares of sellers. Judging by relative prices of gasoline, susceptibility to price spikes, and by relative profitability of refining/marketing segments, western states appear to have an acute need for more manufacturing/transportation facilities.

Matters for Consideration in Law Enforcement and Public Reports

The prepared statement of the Federal Trade Commission for the U.S. House Committee on Government Reform (*Factors that May Affect Gasoline Prices*, April 23, 2002) briefly summarized the Commission's role in the structure, conduct, and performance of gasoline markets. Through its merger enforcement, such as in the recent combinations of Exxon and Mobil and BP and Amoco and Arco, and the more recent combinations of Chevron and Texaco and of Valero and Ultramar Diamond Shamrock, the Commission has markedly altered industry structure. Its monitoring of gasoline prices affects conduct, and its large – and growing – expertise will influence the Congress and state legislatures.

Suppose the Commission were to consent to more mergers and concentration in the petroleum refining industry were to rise sharply, would competition in retail gasoline markets be threatened?

My answer is no, principally for one reason: the largest refiner-marketer after even more mergers, e.g., a hypothetical Exxon/Mobil/BP/Amoco/Arco, would control prices in a small fraction of retail markets. Not only would the Commission surely insist on key facility divestitures and brand name sharing/surrender as conditions of its consent, but the combined firm in its own self interest would set retail prices at only a small fraction of the outlets affiliated with its brand(s). Most of its gasoline sales would be to resellers that themselves controlled pump prices. Simply stated, brand market shares vastly exaggerate control over pump prices.

At worst, the hypothetical Exxon/Mobil/BP/Amoco/Arco would become like the theoretical dominant firm whose self-interest leads it to produce amounts close to those forthcoming under perfect competition since FTC consent would imply divestitures sufficient to maintain limits on leading firms' market shares within regions. With low market shares of relevant markets, the dominant firm would

confront a price-elastic demand curve for its product, despite a low price elasticity of demand in the market and a correspondingly low elasticity of supply for other firms in the market. Self-interest also would limit the pricing power of any dominant firm. Indeed, managers of the hypothetical Exxon/Mobil/BP/Amoco/Arco would have so many profitable opportunities to make crude oil deals with sundry oil-producing countries that U.S. gasoline markets likely would be "off their radar screens." In circumstances where multimillion and profitable crude oil deals become "too small", the managerial tasks associated with pricing at company-operated retail gasoline outlets present unbearable opportunity costs.

Furthermore, the Commission's monitoring of gasoline prices at both the wholesale and retail level ("Prepared Statement", p. 1) means special scrutiny of any attempt by sellers to violate antitrust laws. Finally, the exceptional expertise in the gasoline business acquired by the Commission ensures that its surveillance will be exceptionally well informed and likely thorough as well.

Thus, I infer or hypothesize that the Commission could consent to more and bigger mergers without appreciable harm to competition in retail gasoline markets.

The principal benefit of more and bigger mergers would be further cost reductions that would enable higher rates of return together with competition-constrained increases in gasoline prices. In turn, the higher rates of return likely would facilitate industry adaptation to the evident desires of local/state/federal electorates for increased environmental quality. Mandates for cleaner-burning fuels are ongoing, e.g., Phase 3 gasoline is expected to be introduced in California next year, and so smooth adjustment to these requirements would seem to be the wisest course. Through its enforcement, monitoring, and public provision of expert advice, the Commission can make the adjustment smoother than otherwise, and do so – I believe – without harm to competition.

Finally, as noted in a letter from the Commission's Office of Policy Planning and Bureau of Competition to R. McDonnell of the Virginia House of Delegates (Letter in response to request for comments on SB 458, Below-Cost Sales of Motor Fuels, February 15,2002), the FTC is charged with preventing unfair methods of competition and has considerable expertise in assessing the competitive impacts of state laws affecting gasoline markets. This authority and expertise might be used more extensively and frequently in the future. Similarly, the Bureau of Economics might consider greater emphasis in its working paper series on topics of interest primarily to gasoline manufacturing and marketing. For example, consideration

might be given to expanding work on specialized issues such as retail market divorcement, which was examined intensively by M. Vita in the paper "Regulatory Restrictions on Vertical Integration and Control: The Competitive Impact of Gasoline Divorcement Policies", July 21, 1999. Such papers are important because several states continue to enforce divorcement laws so that Vita's estimate – that divorcement raises gasoline prices by 2.7 cents per gallon – has current relevance and importance. Like below-cost selling laws, divorcement is a significant barrier to entry because new/marginal brands cannot recruit enough dealers and therefore depend more on (1) marketing through company-operated outlets, and on (2) aggressive price-cutting. In Virginia, the divorcement law blatantly excludes competitors through a territorial restriction that, as a practical matter, prevents a company-operated station of firm X from competing against a dealer-operated station of company Y.

Table 1. Average Prices Per Barrel of Gasoline by Distribution Channel for Four Largest Energy Producers, 1981-2000
(dollars per barrel)

	Marketers	Dealers	Company Outlets	Other
1981	44.42	46.69	47.77	47.36
1985	34.72	36.47	38.05	35.80
1990	31.75	35.97	39.15	31.57
1995	24.83	30.76	34.08	29.71
2000	39.69	45.51	48.35	40.40

Source: Energy Information Administration, *Performance Profile of Major Energy Producers 2000, 1995, 1990, 1986, 1981*.

Table 2. Average Dealer and Marketer Buying Prices for Regular Grade, Conventional and Reformulated Gasoline1995-2001
(cents per gallon)

Conventional	Dealer Price	Marketer Price
1995	65.1	57.0
1997	71.9	64.9
1999	67.6	59.5
2001	91.4	83.6
Reformulated		
1995	70.7	60.5
1997	78.7	68.2
1999	75.2	64.2
2001	100.1	89.5

Source: Tables 8, 12, Energy Information Administration, *Petroleum Marketing Monthly* (eia.doe.gov)

Table 3. Average Dealer and Terminal Rack (Branded, Unbranded) Prices for Regular Gasoline in Chicago, Detroit, Houston, and Los Angeles During Early January, 1999
(cents per gallon)

Price	Chicago RFG, Ethanol	Detroit Conventional	Houston RFG, MTBE	Los Angeles CARB
Dealer	66.50	43.60	49.70	64.48
Branded Rack	47.03	42.66	40.85	53.25
Unbranded Rack	46.50	44.76	38.32	46.83

Source: Lundberg Survey, Inc. "Lundberg's Wholesale Diary", January 8, 1999.

Table 4. Pump Price Variation for 87-Octane Gasoline at Nine Northern Virginia Outlets, January 2001-February 2002

Outlet/Location	Type	Pump Price (cents per gallon) Median	Minimum/Maximum
Brand X/Vienna	Independent/Bays	150	110-170
Exxon/close to Brand X	Dealer/Mart	156	109-175
Mobil/close to Brand X	Dealer/Bays	152	109-172
Exxon/Tyson's/Vienna	Tiger Mart	156	110-173
Mobil/Tyson's/Vienna	Dealer/Mart/Bays	154	110-172
Costco/Sterling	Gas 'n Go/Credit	141	105-168
Exxon/1 mile Costco	"On the Run"	152	112-177
Mobil/1 mile Costco	Circle K	152	114-177
Exxon/3 miles Costco (Sterling)	Dealer/Mart	165	125-180
Mobil/3 miles Costco (Herndon)	Dealer/Bays	158	111-177

Note: Brand X outlet shut down in February 2002.

Source: author's survey data.

Table 5. Pump Price Statistics for Gasoline Grade Offerings at Costco Hypermarket and Two Competing Outlets Within Mile Radius (cents/gallon)

	Costco (n=30)		
Statistic	87-Octane	89-Octane	93-Octane
Mean	138.3		153.6
Median	140.9		154.9
Mode	139.9		154.9
Standard Deviation	18.5		20.6
Range	104.9-167.9		118.9-186.9

	Exxon (n=29)		
Statistic	87-Octane	89-Octane	93-Octane
Mean	150.4	161.1	170.1
Median	151.9	163.9	171.9
Mode	151.9	161.9	171.9
Standard Deviation	18.7	19.1	18.5
Range	111.9-176.9	121.9-188.9	131.9-197.9

	Mobil/Circle K (n=29)		
Statistic	87-Octane	89-Octane	93-Octane
Mean	150.2	161.2	170.8
Median	151.9	163.9	173.9
Mode	151.9	161.9	171.9
Standard Deviation	17.9	18.4	18.1
Range	113.9-176.9	124.9-188.9	134.9-197.9

Note: Costco offerings limited to 87-octane and 93-octane gasoline.

Source: author's survey data.

Table 6. Selected Leading Refiners and Their Capacities as of January 1991 and January 2001

Company	1991 Capacity (000 b/d)	Company	2001 Capacity (000 b/d)
Chevron	1,575	Exxon Mobil	1,772
Exxon	1,147	BP	1,662
Shell (S)	1,083	Tosco	1,303
Amoco	1,002	Chevron	1,049
Mobil	838	Marathon/Ashland	935
BP	734	Motiva (S/St)	860
Star (St)	615	Sun	724
Marathon	605	PDV (Citgo)	703
Sun	515	Valero	622
ARCO	416	UDS	597
Conoco	407	Premcor (Clark)	561
Ashland	347	Koch	556
Koch	325	Conoco	543
Texaco (T)	320	Equilon (S/T)	469
PDV (Citgo)	305	Phillips	396
Phillips	305	Tesoro	276
Coastal	275	Coastal	258
Total	198	Total/Fina/Elf	179
Fina	165	Crown Central	155
Dia.Sham.(DS)	161	Sinclair	152
Crown Central	155	Murphy	128
Tosco	132		
Murphy	128		
Sinclair	126		
Clark	122		
Tesoro	72		
Ultramar (U)	66		
Valero	25		

Sources: Energy Information Administration, *Petroleum Supply Annual 2000*, Volume 1, pp.105-6; *Petroleum Supply Annual 1990*, Volume 1, pp.120-3; and, National Petroleum News, *Market Facts "92*, June 1992, pp. 172-3.