An Analysis of Heating Fuel Market Behavior in 1989-90

June 1990

**A Final Report to the
Senate Governmental Affairs Committee
and the
House Subcommittee on Energy and Power**

Energy Information Administration

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U.S. Department of Energy
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Contacts

The report, *An Analysis of Heating Fuel Market Behavior in 1989-90*, was prepared by the Energy Information Administration under the direction of Dr. John S. Cook. Contributing authors were:

Bruce Bawks
Michael H. Burdette
Lamar Gowland
Stacy R. MacIntyre
Jon Rasmussen
Charles P. Shirkey

Kendrick E. Brown, Jr.
Mindi Farber
T. Crawford Honeycutt
Kenneth I. Platto
Charles W. Riner
Robert W. Vagnetti

ADMINISTRATOR'S MESSAGE

This is the long-awaited follow-up report to EIA's interim study of the December heating oil crisis. This report differs from its predecessor in that it uses statistically more reliable data in addition to information on corporate profits that was unavailable earlier.

The report essentially confirms our earlier findings, which were that most of the price increase in December can be accounted for by the extraordinary cold snap early in the season. Transportation problems, refinery mishaps, and freezing pipes and gas wells exacerbated the situation.

The more than 50 percent increase in December heating oil bills experienced by residents in the Northeast was compensated in part by abnormally low bills in October and in February. For the season, October through February, the average monthly bill for Northeastern residents averaged out at \$14.00 per household above normal.

While propane and distillate prices rose significantly, this did not translate into a remarkable season for U. S. refineries. On balance, the net income of integrated U. S. refiners fell by over 60 percent from the previous heating season, while independent refiners registered a decline of 51 percent. The profitability of both groups remained below the U. S. industry average in the fourth Quarter of 1989 and the first Quarter of 1990.

Dr. H. A. Merklein

Administrator

Energy Information Administration

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Executive Summary

During December 1989, the prices of many refined petroleum products escalated rapidly throughout the Eastern two-thirds of the United States. The especially dramatic price increases shown by heating fuels prompted many questions concerning the reasons for these increases. Of particular importance was the issue of whether rising December prices were the result of collusive or anticompetitive behavior and whether the factors underlying the market surge generated sustainable rates of return in excess of competitive norms. In response to these concerns, as well as to reports of fuel oil and propane shortages, and as a follow-up to hearings before the House Subcommittee on Energy and Power and the Senate Committee on Governmental Affairs, the Energy Information Administration (EIA) agreed to conduct two analyses.

A short-term analysis dealing with prices, supplies, and margins, utilizing immediately available data either from public sources or EIA collections, was submitted to Congress on January 31, 1990. The purpose of that study was to provide information quickly on what happened, along with a preliminary interpretation of heating fuel market trends.

The purpose of this second report is to fully assess the heating fuel crisis from a broader and longer-term perspective. Using EIA final, monthly data, in conjunction with credible information from non-Government sources, the pricing phenomena exhibited by heating fuels in late December 1989 and early January 1990 are described and evaluated in more detail and more accurately than in the interim report. Additionally, data through February 1990 (and, in some cases, preliminary figures for March) make it possible to assess the market impact of movements in prices and supplies over the heating season as a whole. Finally, the longer time frame and the availability of quarterly reports filed with the Securities and Exchange Commission make it possible to weigh the impact of revenue gains in December and January on overall profits over the two winter quarters.

Some of the major, related issues raised during the House and Senate hearings in January concerned the structure of heating fuel markets and the degree to which changes in this structure over the last decade may have influenced the behavior and financial performance of market participants. Have these markets become more concentrated? Was collusion or market manipulation behind December's rising prices? Did these, or other, factors permit suppliers to realize excessive profits? What additional costs were incurred by consumers as a result of such forces? These questions, and others, are addressed in the course of this report.

Chapter 1 provides essential background information on the nature of, and interrelationships among, the markets in which heating fuels are bought and sold. An overview of the contract, spot, and futures markets is presented that explains the similarities and differences between the three, and the ways in which each influences and is influenced by supply and pricing phenomena. The relationships among the various markets are discussed, including the possible effects of futures market trading and speculation on prices in the cash markets.

Chapter 2 addresses the spikes and prevailing trends in prices over the heating season. The extremely cold weather in December 1989 initiated a dramatic surge in heating fuel prices. No. 2 distillate fuel (heating oil) and propane, the petroleum fuels that are of primary importance to residential consumers, were especially affected.

The coldest December in at least 60 years was followed by the warmest January in 57 years. Spot prices fell nearly as rapidly as they had risen. EIA's monthly average wholesale and residential prices, which tend to lag and smooth out rapid price changes, continued to rise somewhat in January, but then fell sharply in February. Distillate wholesale prices dropped to pre-December levels, while residential prices maintained a portion of the price rise. Propane prices also decreased in February, although at a slower pace than heating oil.

On average, consumers in the Northeast saw more than a 50-percent increase in their heating oil bills for December 1989, compared to December 1988, amounting to increased costs of nearly \$400 million for the region. The average monthly increase for October through February, however, amounted to a more modest \$14 per household.

Chapter 3 examines the fundamental forces of demand and supply that combined to push distillate prices upward in December 1989 by record amounts. Although many factors are influential in determining the level and movement of heating oil prices, the more important ones are the severity of cold weather, stock levels, and crude oil prices.

To assess the degree to which heating oil prices and demand diverged from expected patterns, regression analyses were performed. The analyses suggested that about 10 cents per gallon of the December price rise may have been due to factors other than weather and inventory levels, such as additional transport costs, local distribution problems, refinery outages, reduced imports, and market panic. The regression results indicated that of the December increase in demand of 708 thousand barrels per day (MBD), 415 MBD were unexpected. This unanticipated increase added to transportation and distribution problems and market panic, thereby accounting for some of the unexplained price increase.

An analysis of EIA data showed that the residential and electric utility sectors exerted a disproportionately large impact on distillate markets in December 1989. While commanding only 44 percent of the market, together these two sectors accounted for about 91 percent of the total increase in demand in December, and about 74 percent of the unanticipated surge.

The composition, as well as the magnitude, of the unexpected increase in distillate demand may well have been important in explaining the price increases in December. December 1989 differed notably from past years in that over 160 MBD of additional demand, much of it unanticipated, was generated by the industrial, commercial, and utility sectors. To the extent that these consumers were better able to absorb, or pass on, higher distillate prices, their substantial and unexpected presence in the December market may have significantly steepened the aggregate demand relationship. In other words, the presence of the non-residential sector was a surprise to December's markets, resulting in additional transportation and distribution problems, and possibly an acceleration in the bidding process for scarce supplies, thereby inducing an overreaction to the cold weather and tight market conditions.

The components of distillate supply also were analyzed with respect to their contribution to sharply higher December 1989 prices. Publicly, much was made of the observation that the national distillate inventory level was 7 million barrels (MMB) below the previous year's at the outset of the heating season. Nevertheless, initial stock levels in 1989 were about the same as those at the beginning of the heating season 2 years ago. Moreover, while stocks immediately available to meet excess demand on the East Coast were 5 MMB lower than the end-of-October levels in 1988, they were only 2 MMB lower than initial 1987 levels. An analysis of the declining long-term trend in initial stock levels showed that after adjustment for this trend, beginning-of-season days of supply in 1989 were near the levels of the previous 2 years.

Two factors that dampened beginning-of-season inventory levels in 1989 were strong diesel demand in the spring and summer, compared to 1988 levels, which raised the opportunity cost of holding inventories, and significantly lower import levels, beginning in August and lasting

throughout the fall. The lower import levels largely resulted from strong European demand for gasoil and relatively high prices, which discouraged shipments to the U.S. Moreover, weather forecasts as late as the end of October indicated warmer than normal weather was expected for November and December of 1989. This tended to confirm the widespread industry assessment that stocks were adequate to meet expected winter demand.

U.S. refiners responded to the surge in heating oil demand in December 1989 by increasing distillate production from 3.1 million barrels per day (MMBD) during the week prior to the onset of the cold snap to 3.5 MMBD for the week ending December 22. Distillate production averaged 3.3 MMBD in December 1989, a 6.5-percent increase over the previous December. Additionally, distillate yields reached near-record levels for the decade during December. This response was achieved despite weather-related and other production problems at numerous major refineries which caused a drop in output of over 300 MBD in late December and early January.

In tight markets, marginal sources of supply can significantly influence overall prices. In recent years, imports have served as such a source, and, in 1988, they accounted for (on a net basis) about 9 percent of December's distillate supplies. However, in 1989, the comparable share was only 4.9 percent which, given December's surge in heating oil demand, tended to push suppliers increasingly toward domestic spot markets to meet their customers' needs. Thus, spot market prices rose as slim supplies were confronted with substantially increased demands. Residential prices rose accordingly, as the additional costs were largely passed on to consumers in the context of shrinking inventory levels and heightened anxieties over the length of the cold spell.

In short, inventories seemed adequate as late as Thanksgiving, and distillate production reached 3.3 MMBD in December 1989, the highest level since at least 1982, despite numerous refinery problems that month. Hence, the bulk of the price increase can be explained by the enormous increase in demand in December 1989, with the remainder due to exacerbating factors including refinery and distribution problems and relatively low imports.

Chapter 4 reviews the ripple effect on the price and availability of other related fuels and energy sources. This winter's heating fuel crisis had some effect on other petroleum and natural gas markets. Other distillate fuels which can be blended into No. 2 heating oil, such as diesel and kerojet, were the most affected, as their prices were bid up while their supply was drawn down. Motor gasoline production and pre-season stock building were reduced, with potential impacts on price. The prices of naphthas and liquefied petroleum gases were bid up, in the absence of propane for petrochemical plants, and interruptible contracts for natural gas were invoked to assure supplies for home heating.

Chapter 5 evaluates the impact on margins and profits of major petroleum companies and marketers. The analysis of the underlying factors indicated that heating oil prices reflected the workings of competitive demand and supply fundamentals, given the unanticipated cold snap. Further, the structure of distillate markets appeared to be consistent with competitive

behavior; these markets are neither highly concentrated, nor have their concentration levels tended to increase in recent years.

Of course, the unanticipated December runup in heating oil prices had a positive impact on the financial performance of refiners and marketers, as would be the case in any market experiencing an unanticipated surge in demand. However, apart from the December price spike, which carried over into early January, most developments in the 1989-90 heating season worked against higher refining profits. These developments included product prices which mainly tended to lag crude oil cost increases, higher costs due to weather-related operating problems and refinery outages, additional costs stemming from rapid changes in refinery output slates, and sharply reduced sales volumes in the first quarter of 1990, in part reflecting a turnaround in weather patterns in January and February.

On balance, the U.S. refining sector fared poorly in terms of financial results during the 1989-90 heating season, compared with the same period in 1988-89. Income from major petroleum companies' U.S. refining/marketing operations fell 70 percent in the fourth quarter of 1989 and 48 percent in the first quarter of 1990, compared with the same quarters of the previous year. Independent U.S. refiners registered comparable declines in net income of 57 percent and 32 percent, respectively. As a result, the profitability of the majors and other refiners, as measured by return on equity, remained below that of the rest of U.S. industry.

The preliminary findings of the short-term analysis indicated that, ". . . in the face of extraordinary and unexpected increases in demand, petroleum markets performed as might have been expected. The distribution system responded to temporary imbalances in supply and demand through higher prices, which were quickly followed by increased supplies and declining prices, approaching those of last November."

The analysis conducted for this report substantiates that conclusion. While there may have been isolated cases in which margins and profits were unusually high and consumers paid very high prices, the market as a whole functioned well under extremely difficult circumstances. In the context of the entire 1989-90 heating season, the industry and the consumer shared the extra costs.

In response to immediate data needs during the December-January crisis, EIA supplemented its routine data collections with bi-weekly emergency surveys of heating oil and propane producers and distributors, as well as selected price data provided by the Bureau of Labor Statistics, State Energy Offices, and leading trade journals/news services. To maximize the frequency of data collection, EIA coordinated its emergency collections with those of the various State Energy Offices participating in the EIA/State Heating Oil Program.

In order to expand and improve its emergency monitoring capabilities for propane, EIA developed for Office of Management and Budget approval a weekly propane supply and price program that was initiated in early February 1990. Through weekly telephone surveys, timely data on propane stocks, production, imports, and wholesale and retail prices were tabulated

for key East Coast and Midwest regions. These reports were disseminated to Congress, State and Federal agencies, industry, and the public. This program will be maintained for operation in subsequent years whenever emergency conditions warrant its use.

Chapter 1

Structure and Behavior Of Heating Fuel Markets

In analyzing the unusual events and trends of the 1989-90 heating season, many observers have raised the question of whether, and to what degree, the problems of supply and price experienced were caused by the structure of the markets themselves, as well as by the behavior of the participants. In this chapter, we will examine the workings of the petroleum product markets, specifically as they relate to the phenomena which occurred during the past winter. Those desiring or requiring a more thorough discussion of the general structure of these markets are referred to Appendix D, "Mechanics of Heating Fuel Markets."

The three major types of markets for petroleum products are generally referred to as the contract, spot, and futures markets. The first two of these, contract and spot, make up what is commonly called the cash market, in contrast to futures, which is sometimes referred to as a paper market. None of the three markets functions in isolation from the other two, and each currently has a significant influence on the availability and price of the products involved. We will examine each in turn, and then consider their interactions and combined effects on product supply and pricing.

Contract Market

The use of long-term contractual arrangements for wholesale petroleum product transactions was for many years the traditional means of doing business in the industry. Until the oil supply shocks of the 1970s, petroleum was a commodity with low, generally stable prices, set by a relative handful of integrated producer/refiner/marketers which dominated trade. The 1970s and 1980s saw a distinct movement away from contracts, and towards the more flexible, if more volatile, spot and futures markets. This trend coincided with the market entry of a much broader cast of buyers and sellers, including independent refiners and/or marketers, domestic and international trading companies, and speculators. However, despite the emergence of other markets, contracts are still the most stable, and therefore most desirable, type of arrangement for certain purposes and participants. Included among these are purchases by smaller resellers and end users whose available storage and/or inventory turnover are insufficient to merit participation in the riskier spot and futures markets. Contract purchases also are often attractive to end users such as government agencies and utilities, which, for financial reasons, are averse to the more volatile prices of the other markets.

The term "contract" as it is commonly used in the petroleum industry refers primarily to a supply agreement, with little reference to price except for the requirements for notification of a price change. However, during the routine seasonal fluctuations of the heating fuel markets, contract prices tend to remain relatively stable, beginning the season low as suppliers compete for early filling of storage, moving gradually upward in response to growing tightness of supply, and retreating slowly as the weather turns warmer. Although spot prices, reacting to various forces, may move significantly up or down on a daily basis, contract prices generally ignore these daily swings, and only respond to longer-term trends in the spot markets. Nonetheless, because the spot markets represent the source or destination for incremental volumes bought or sold by contract market participants, the discrepancy between the two markets cannot grow beyond a certain point before products will begin to move from one to the other.

Despite the extraordinary price fluctuations which occurred over the course of the most recent heating season, the pattern described above essentially held true. During the phenomenal increases in spot market prices for heating oil and propane, the contract markets lagged behind, reaching their peaks later and at a lower level in comparison to their pre-runup positions. However, as product purchased in the spot markets at near-peak prices worked its way into contract transactions, the contract markets remained at elevated levels for some time after spot prices began to recede.

Spot Market

In contrast to the contract market as defined above, the spot market represents transactions unconstrained by any preexisting relationships, and theoretically executed "on the spot." As

is the case with contract sales, however, this distinction may be misleading, because spot prices may be used directly, or as a basis, for pricing recurring sales between the same two parties over time. Spot sales can occur at any location and in any amount, but are most commonly consummated at major supply points such as refineries or pipeline junctions, allowing maximum transportation flexibility for both buyer and seller.

Because these transactions represent incremental supply available or needed, depending upon the perspective of the participant involved, prices in the spot market can rise and fall very rapidly. While contract prices may be held steady in temporary disregard of external phenomena, spot prices will usually reflect the complete range of hopes, fears, rumors, and forecasts known to the collective consciousness of the market participants. Accordingly, the spot market can, and often does, reverse direction from one day to the next, or even within a day's trading.

During the winter of 1989-90, the spot markets for both heating oil and propane moved in accordance with established patterns, with only the magnitude of the price changes being out of the ordinary. As surplus product, as well as shipping space, became increasingly scarce, its value in the marketplace rose dramatically. Unbound by artificial restrictions, prices rose to the highest levels that purchasers were willing to pay, based upon either their expected ability to sell the product for an even higher price, or their own need for additional supplies to cover projected consumption or previous sales commitments. The rise in spot prices was short-lived, as market participants stepped up supplies to take advantage of increased market value, and changes in the weather enabled the supply system to recover relatively quickly.

Futures Market

The development of a successful futures market in crude oil, petroleum products, and most recently natural gas has been by far the most fundamental change to occur in energy markets in recent years. The availability of futures trading not only provides a means of managing risk for traditional participants in markets for these commodities, but it enables entry into the marketplace of entire new groups of players, without the high barriers to entry that have significantly restricted participation in the past.

The futures market is a paper market dealing in contracts for future delivery of a specified commodity. Unlike contract and spot markets, all trading is executed on an exchange, in a strictly prescribed manner, under government regulation. The standardization of futures contracts facilitates their exchange, and all bidding focuses on price, thereby maximizing market liquidity and minimizing transaction cost. Contractual periods are usually specified by month, for up to 18 months into the future.

Participants in futures markets typically open and close positions repeatedly in response to their own changing needs and perceptions of market opportunity. The commodity volume traded in open futures contracts for a given month usually greatly exceeds the physical

volume of the commodity that ultimately changes hands that month. The New York Mercantile Exchange (NYMEX) traded heating oil contracts in 1989 representing 5,243 MMB, roughly five times the 1,151 MMB of distillate calculated by EIA as product supplied. However, because the vast majority of futures contracts are closed out prior to delivery, the percentage of product supplied that is actually delivered on the futures markets is usually small.

Futures markets have arisen and proven successful for their abilities to serve two specific needs:

- risk transfer - futures trading provides a means for transfer of the risk inherent in price volatility from the producers and consumers of a commodity, for whom price may determine profitability, to those parties most willing to bear risk as a financial strategy.
- price discovery - because of the free flow of information across the broad spectrum of energy suppliers, consumers, traders, and speculators involved, as well as the sheer number of participants, futures markets provide a very efficient means of determining the free-market value of a commodity. Additionally, because of the regulated and observable nature of trading activity, reported prices are objective and verifiable.

Though execution of all futures market strategies involves buying and selling of contracts, market participation can be grouped into two types, according to the participant's physical market position (ownership of product):

- "hedging" - where a futures position is taken to offset an existing or anticipated physical position, locking in cost or margin, and
- "position-taking" - where no corresponding physical position exists, and the trader will incur profit or loss on any price movement.

Based on the functions and available actions described (and greatly simplified) above, futures markets attract four general classes of participants, with some overlaps:

- suppliers - have or will have product (in futures terms, are "long" physicals), and need to protect from price drops. They can accomplish this by implementing a "short hedge"; i.e. selling futures contracts to lock in the current futures price.
- end users - will need to purchase product in the future (are "short" physicals), and may fear price increases. They may take a "long hedge," buying futures roughly equal to their expected needs.

- resellers - will continually buy and sell product to make a profit. Depending on their inventory position, existing contracts, and other factors, they may use the futures market to hedge in either direction, or to procure or sell physical product.
- speculators - may have no desire to handle physical product, but can profit simply by buying and selling futures contracts.

A major factor underlying NYMEX's credibility is the concept of "cash convergence." As a futures contract approaches its expiration date, the futures price and cash prompt or spot price converge. This is because of arbitrage, in this case the simultaneous buying of spot product and selling of futures contracts, or vice versa, to take advantage of the price differential. In actual practice, the end-of-month NYMEX prices have consistently converged to within a fraction of a cent of the spot New York Harbor price. However, one notable exception occurred during the unexpected cold snap this winter for No. 2 fuel oil, as the January NYMEX futures contract neared expiration at the end of December.

During the second week of December, the spot/futures price differential began to signal an increasingly tight supply/demand balance, a situation that was expected to be temporary. The spot price rose faster than the January futures price, reaching an unusually high premium over futures during the final 2 weeks of trading. At the same time, the January futures price rose faster than February futures. This substantial premium for prompt product, known as "backwardation," reflected the extreme urgency of demand for heating oil in late December.

One possible contributing factor to the market movements in December was an increase in the number of physical deliveries of heating oil futures contracts, including long positions taken during the summer. As NYMEX is not required by law to reveal specifics regarding each futures transaction, and the use of agents obscures the identity of the actual parties holding the contracts, it is impossible to determine when the long positions were assumed by marketers requiring winter heating oil supplies. Anecdotally, however, it is known that many marketers and large end users utilize the futures markets, not only for now-traditional hedging purposes, but sometimes to "lock in" prices for their winter season purchases well in advance, at a time when prices are presumed to be at their lowest. One Northeast utility was reported to have purchased, through a futures-linked arrangement with a supplier, No. 2 fuel oil for delivery in January 1990 at a price some 30 cents below the market at the time of delivery, by committing for the purchase in the spring of 1989.

Interrelationships and Combined Effects of Markets

Because of the complex interrelationships of the various markets for petroleum products, it is impossible to directly ascribe any aspect of product pricing or supply to the actions observed in any single market. As a result of changes in both the behavior of participants and the technology available for instant communication of market movements, direct or indirect relationships now exist between markets of different types, in different countries, and for

different products and their raw materials. In contrast to a time less than 20 years ago when changes in the U.S. heating fuel markets might have been attributed to local and identifiable causes, the global "commoditization" of petroleum now makes it necessary to look worldwide for causal factors, and renders it nearly impossible to fix responsibility on any one influence.

Limiting discussion to the domestic markets, the influences of contract, spot, and futures prices on each other can be grossly discerned by observing the leading and lagging indicators of price trends. Between November 1, 1989 and January 2, 1990, the spot price of No. 2 heating oil in New York Harbor jumped approximately 46 cents per gallon. Much of this increase came in an 8-day period in the middle of December, during which heating oil futures hit the record volume traded on a single day—57,930 contracts—on December 18, 1989. Futures spreads were minimal into early December. That is, futures prices for delivery in December and out months closely matched spot prices in November. However, by mid-December, futures prices began to trail spot prices, especially during the periods with the biggest price spikes. These price differentials can be largely explained by differences in the timing of delivery, since the greatest demand existed for prompt or immediate heating oil. Thus, reports of temporary outages and shortages in supply would have had the greatest impact on spot markets.

Much of the research on the relationship between spot and futures prices has been inconclusive. What has been more or less agreed upon is that futures markets may increase the volatility of market prices in the very short run. Because futures markets promote frequent revisions of expectations, this can lead to an over-buying or over-selling of a paper commodity that does not physically exist. However, this phenomenon is usually short-lived, not lasting more than a few days. In the long run, the increased trading of crude oil and petroleum products in commodity markets has probably redistributed risk and uncertainty to the consumer's benefit.

The fact that spot outpaced futures prices over the relatively long period of time during which the price swings occurred is, in this case, evidence that futures markets did not trigger the runup in market prices in December 1989. The major causal factors were supply and demand fundamentals, not trading or speculation on futures or spot markets. The Commodity Futures Trading Commission (CFTC) shares this opinion, finding no evidence of manipulation of the futures market during the December price runup. CFTC Chairman Gramm has responded to inquiries from New York Governor Cuomo and six U.S. Senators. CFTC recently received a petition from three State Attorneys General to open an investigation of this matter, although no action has been taken to date. The CFTC position is that they consider none of the market movements sufficiently peculiar to warrant their taking the lead in an investigation, although they are willing to cooperate with efforts undertaken by other agencies.

Chapter 2

Heating Fuel Prices

Heating Oil

The 1989-90 heating season for retail and wholesale No. 2 distillate markets was characterized by gradually increasing prices early in the season, followed by a dramatic surge in December and subsequent downturn offsetting much of the increase. This section will examine prices at various points along the distribution chain, namely, spot prices for No. 2 heating oil in New York Harbor (Table E.14), wholesale No. 2 distillate fuel prices, as published in the *Petroleum Marketing Monthly (PMM)*, and residential and non-residential distillate prices, also included in the *PMM*. The category of non-residential distillate sales to end users includes commercial and industrial establishments, utilities, and farmers. Such sales often occur in bulk quantities sufficiently large to yield prices similar to wholesale transactions.

Spot Market

The New York Harbor spot price for No. 2 heating oil increased gradually from 48 to 58 cents per gallon over the period August 1 through September 29. Prices remained at about the 58-cent level until mid-November, when they again began to climb, reaching 70 cents by mid-December. During the last 2 weeks of December, prices on the New York spot market

rose 45 cents, from 70 cents (on December 13) to \$1.15 (on December 27). After peaking at \$1.15 per gallon, prices plummeted over the next 2 weeks, completely offsetting the late December surge. In one month, from mid-December to mid-January, prices rose and fell by equal amounts, again reaching the 70-cent level on January 16, 1990. For the rest of the month they drifted downward, returning to the early November level of 58 cents by January 31. Prices then remained near the 58-cent level through May 1, 1990.

Wholesale Market

Data reported in the *PMM* show that monthly average wholesale No. 2 distillate prices rose sharply in December, increased by a smaller amount in January, then dropped to pre-season levels in February (Figure 2.1).

Figure 2.1 U.S. Wholesale No. 2 Distillate Prices, 1986-90

Wholesale prices in October and November averaged 61 cents per gallon, within 3 cents of spot market levels, before increasing by 11 cents and 2 cents in December and January, respectively, to the 74-cent level (Table 2.1 below). Prices then declined 15 cents in February, completely offsetting the increases of the prior 2 months. The price levels reached

in the 1989-90 heating season were the highest since the 1984-85 and 1985-86 heating seasons, when crude oil costs were much higher.

Because wholesale prices published in the *PMM* include all types of transactions, contract as well as spot market, the magnitude of the changes observed was dampened. Daily spot market prices approximate the cost of the marginal gallon, and can be relatively volatile, particularly when markets are thin. *PMM* prices are volume-weighted averages of all transactions occurring at various price levels during the month. Thus, they generally smooth the trend and lag rapidly changing spot prices.

Table 2.1 Wholesale No. 2 Distillate Prices, 1989-90

(Cents per Gallon)					
	Oct	Nov	Dec	Jan	Feb
U.S.	61.3	61.5	72.1	74.0	59.0
PADD I*	60.5	60.9	76.1	80.1	60.7
PADD IA	60.8	61.2	79.3	83.7	62.5
PADD IB	60.1	60.9	75.3	79.4	60.1
PADD II	62.5	62.8	70.5	68.8	57.5
PADD III	57.8	58.3	66.3	68.4	57.2

* includes PADD IC

PMM regional price data (Table 2.1) show that the sharpest increases and highest prices occurred in the New England and Mid-Atlantic States (PADDs IA and IB, respectively), while upward movements were less severe in the Midwest (PADD II) (Figure 2.2). Like the national-level data, regional price increases in December and January were largely or completely offset by decreases in February. Wholesale prices increased in the New England States by 23 cents during December and January, reaching 84 cents per gallon. Price trends in this region most closely correspond to the behavior of the New York spot market. The Mid-Atlantic States experienced a 19-cent increase in December and January as prices rose to 79 cents per gallon, while prices in the Midwest were more moderate at 69 cents per gallon, up only 6 cents for the months of December and January.

Figure 2.2 Wholesale No. 2 Distillate Prices by PADD, 1989-90

Residential Market

Residential price trends were similar to those of the wholesale sector, with an initial gradual increase, followed by a dramatic surge in December. Prices continued upward in January, reaching the highest levels experienced since the last major spike during the 1983-84 heating season. However, prices collapsed in February, largely offsetting the increases of the prior 2 months.

Figure 2.3 U.S. Residential Heating Oil Prices, 1986-90

According to the *PMM*, the 1989-90 heating season began in October with prices exceeding year-earlier levels by about 10 cents per gallon (Figure 2.3), largely as a result of an increase in crude oil prices of around 12 cents per gallon. Residential prices then increased 28 cents, peaking in January at \$1.14, the highest level since the 1983-84 heating season when prices reached \$1.16 per gallon and crude costs were near \$29 per barrel. Compared to January of last year, prices were 29 cents higher.

The 1989-90 heating season was not typical either in terms of the suddenness of the price increases or their subsequent decline. February prices dropped 18 cents per gallon, averaging for the month about 11 cents more than last year, but less than 2 cents higher after allowing for increased crude oil costs.

Table 2.2 Residential No. 2 Heating Oil Prices, 1989-90

(Cents per Gallon)					
	Oct	Nov	Dec	Jan	Feb
U.S.	85.6	88.3	107.6	114.0	96.3
PADD I*	86.5	89.3	110.1	117.9	98.8
PADD IA	87.2	89.6	112.7	118.3	97.5
PADD IB	86.6	89.6	109.4	118.9	99.6
PADD II	81.2	83.3	96.8	96.1	85.5

* Includes PADD IC.

As with wholesale prices, the highest levels and sharpest increases occurred in the New England and Mid-Atlantic States, followed by the Midwest (Table 2.2 and Figure 2.4).

Figure 2.4 Residential Heating Oil Prices by PADD, 1989-90

Non-Residential End-Use Market

Distillate fuel prices for the other retail or end-use sectors followed the residential trend. In each of the major distillate-consuming regions, these customers tend to buy in bulk and generally pay prices below residential. Average non-residential end-use prices increased 30 cents per gallon from October through January in New England (Table 2.3 and Figure 2.5). This compares with a wholesale increase of 23 cents and 31 cents for residential. The average non-residential end-use price in January, the peak month, reached \$1.01 per gallon, as opposed to \$1.18 for residential and 84 cents for wholesale. During February, prices fell 24 cents to 76 cents per gallon.

Table 2.3 Non-Residential Retail No. 2 Heating Oil Prices, 1989-90

(Cents per Gallon)					
	Oct	Nov	Dec	Jan	Feb
U.S.	68.0	68.3	78.4	82.0	67.6
PADD I*	66.5	67.7	83.3	90.5	71.1
PADD IA	70.9	72.4	91.1	100.8	76.3
PADD IB	66.8	67.7	83.7	92.1	72.4
PADD II	68.4	68.1	77.8	79.2	65.3
* includes PADD IC					

Non-residential price increases in the Mid-Atlantic States were only slightly less severe than in New England. In this region, prices increased 25 cents from October through January, reaching 92 cents per gallon. Wholesale and residential prices rose 19 cents and 32 cents, respectively. During February, non-residential retail prices decreased 20 cents, matching the declines in the wholesale and residential sectors.

In the Midwest, where increases were even more moderate, non-residential end users paid 11 cents per gallon more than at the beginning of the heating season. Prices reached 79 cents in January, well below the levels seen on the East Coast. This was the only region of the three where February prices actually fell below October levels.

Figure 2.5 Total Non-Residential Retail Prices by PADD, 1989-90

Average Household Fuel Costs

The cost of residential fuel oil for the average U.S. household¹ for the October-February portion of the 1989-90 heating season rose \$71 over the same period in 1988-89. This brought the average expenditure for the 1989-90 heating season to \$445, compared to \$374 last year. Consumers in the Northeast, the hardest hit by higher fuel costs, paid, on average, an additional \$72 to heat their homes this year. Table 2.4 shows the monthly heating oil costs per household in the U.S. and the Northeast. The factors affecting the size of the monthly fuel bill were prices and quantities purchased. Prices in 1989 were higher at the beginning of the

¹ Household data were derived from Tables 13 and 17 of EIA publication DOE/EIA-0314(87), *Housing Characteristics 1987*, EIA publication DOE/EIA-0380(90/02), *Petroleum Marketing Monthly*, and unpublished data from survey Form EIA-782A and B. The number of households using fuel oil from the *Housing Characteristics 1987* was combined with sales prices and volumes from the *Petroleum Marketing Monthly* and the EIA-782A and B to derive the average monthly expenditures. Residential volumes, as measured by the EIA-782A and B, do not include sales to apartments. The number of households consuming fuel oil in the Northeast, as well as the United States as a whole, was adjusted to account for the absence of apartment sales. Two to four family dwellings were included and may have made the household counts too high if these were indeed billed as commercial apartments. The result would be that the per household costs shown may be low.

heating season, primarily due to higher crude oil costs this year. However, with the exception of December, consumers purchased less heating oil in 1989 than in 1988, which lessened the impact of higher prices, and in October and February actually caused the average bill to be lower than the prior year. When the severe cold weather occurred in December, sales and prices of heating oil soared. The average December bill for consumers in the Northeast surged to \$163, up 55 percent from the \$105 average bill in December 1988. This translates into a nearly \$400 million increase in total expenditures, to \$1.1 billion for the region. The warm January that followed helped to lower consumption, but by then prices were at a peak. Households in the Northeast paid \$23 more in January 1990 than the prior year, but that was considerably less than the \$57 increase experienced in December. By February, receding fuel oil prices and substantially lower consumption pushed the monthly average fuel oil bill \$8 below the prior year. A small increase in November, along with lower expenditures in October and February, combined to hold the average monthly increase to \$14 above the prior year. Similarly, on a national basis, the average monthly fuel bill increased \$14. (Although March data were not finalized by June 1, preliminary figures suggest that continuing warm weather and sliding prices combined in March to push U.S. and Northeast monthly bills, and the full heating season differential, even lower.)

Table 2.4 Average Household Heating Oil Expenditures, 1988-89 and 1989-90

Heating Seasons Fuel Oil Prices (Cents per Gallon)			Typical Household Monthly Fuel Oil Expenditures (Dollars)			
Average Consumer in the United States						
	1988	1989		1988	1989	Difference
Oct	75.5	85.6		38.99	38.51	(0.48)
Nov	77.2	88.3		55.67	59.56	3.89
Dec	81.4	107.6		94.24	148.91	54.67
Jan	85.0	114.0		94.32	115.34	21.03
Feb	85.5	96.3		90.47	82.68	(7.78)
Season Total	--	--		373.69	445.00	71.31
Average Consumer in the Northeast						
Oct	77.0	86.8		39.85	38.25	(1.60)
Nov	78.6	89.6		60.88	62.64	1.76
Dec	83.4	110.7		105.28	162.68	57.41
Jan	87.4	118.7		104.72	127.64	22.92
Feb	88.0	98.8		99.44	91.16	(8.28)
Season Total	--	--		410.17	482.37	72.20

Propane

Propane prices proved to be even more volatile than those of heating oil during the winter of 1989-90. This was particularly unusual since, historically, propane has shown less seasonality in pricing than such major petroleum products as gasoline and distillate.

Figure 2.6 U.S. Wholesale Propane Prices, 1987-90

Before reviewing the price trends exhibited by propane over the recent heating season, it may be useful to elaborate on the nature of the prices discussed in this analysis. These prices are referred to here as spot, terminal, and residential. While some assumptions can be made about the type of purchaser typically involved in each transaction (Chapter 1, "Structure and Behavior of Heating Fuel Markets"), these prices do not necessarily infer any particular class of trade or the existence or lack of a contract. Spot prices are quoted here for two major propane supply points, Mont Belvieu, Texas, and Conway, Kansas, through which a majority of the U.S. domestic supply is marketed and distributed. Terminal prices are cited as reported for representative pipeline terminals throughout the affected area. Both of the above are collected and published by a number of commercial publications and price reporting services. Residential prices are derived from a telephone survey of selected respondents conducted by EIA on various dates during the season, because of the unusual interest in these data and the

lack of previously available sources. Monthly data from the EIA-782A survey of refiner and gas plant operator sales of propane are presented as appropriate. Due to the limited class of sellers represented (the majority of retail sales of propane are made by non-refiners/gas plant operators) and the mixture of sectors included in retail sales, these data are less precise than those reflecting heating oil trends.

At the beginning of the 1989-90 heating season, propane prices were near those of the previous season (Figure 2.6). National average prices for wholesale sales of consumer-grade propane by refiners in October 1989 were approximately 2 cents per gallon higher than in October 1988. Average refiner retail prices (adjusted for a change in the refiner/gas plant operator population used in generating these statistics²), were at virtually identical levels with 1988. Spot market prices at the beginning of October 1989 at Mont Belvieu were 1 cent above 1988, while those for Conway were 5 cents above the previous year. In general, propane prices had been fairly stable for more than 3 years.

Throughout October and November 1989, propane prices remained relatively flat, showing only the beginnings of the usual seasonal increases which occur as demand rises. The average spot market price at Mont Belvieu on December 1 was 23 cents per gallon, less than 1 cent higher than at the beginning of October, while the price at Conway rose about one and one-half cents to 24 cents per gallon (Figure 2.7). Terminal prices were up 1 to 4 cents in the East and upper Midwest, generally reflecting the typical seasonal pattern of greater increases at the consuming end of the supply system.

Starting about the first of December, propane prices began to rise steadily, though at different rates in each market. In spot markets, average prices increased 12 cents at Mont Belvieu and 20 cents at Conway between December 1 and December 15. Reported increases in terminal prices in PADDs I and II ranged up to 4 cents during the same period. Residential price movements for the States surveyed ranged from no change (in Ohio and Tennessee) to 19 cents (in Massachusetts), but the majority of the reported State increases were less than 8 cents.

²EIA-782A data, as referenced here, are collected from all refiners and gas plant operators in the United States. Effective with January 1989 data, a major seller of retail propane was removed from the survey frame, due to its parent company selling its interests in gas plants. This change resulted in a downward adjustment of approximately 9 cents per gallon in the national average retail propane price series.

Figure 2.7 Spot, Terminal, and Residential Propane Prices, 1989-90

During the last half of December, the pace of propane price increases reached historic proportions (Table E.25). Between December 15 and their peak on January 2, 1990, spot prices rose 36 cents at Mont Belvieu to 70 cents per gallon and 52 cents at Conway to 96 cents per gallon. Overall spot price increases at these points from December 1 were 211 percent and 305 percent, respectively. After lagging the spot markets in the first half of December, terminal prices began to more nearly keep pace, rising 29 to 37 cents during the same period. Residential prices climbed at a similar rate over the latter half of December, increasing from 19 to 40 cents at the State level, with the largest increases occurring in PADDs IA and IB.

After spot prices peaked on January 2, the three price series began to diverge. Prices in the spot markets began to fall nearly as quickly as they had risen. By January 23, Mont Belvieu spot prices had receded by 38 cents from their peak, and Conway by 64 cents, each returning to mid-December levels. Though both rebounded briefly and moderately in late January, they declined throughout February, essentially reaching December 1 levels. Spot prices have remained stable since that time.

For weeks following January 2, however, terminal prices continued to rise and/or flatten at high levels, increasing by another 2 to 10 cents before beginning to drop off in late January.

The return to pre-season levels was much more gradual than in spot markets, and in some cases, terminal prices had not yet returned to pre-December positions by May 1.

Residential prices also continued upward after the peak in spot prices, gaining another 6 to 8 cents in PADDs IA, IB, and II. Paradoxically, however, they began to decline before terminal prices. Propane prices to residential customers peaked in mid-January, up 30 to 47 cents from December 1, and have declined ever since, albeit at a slower rate than either spot or terminal prices. As of May 1, residential prices in PADDs I and II stood 6 to 8 cents above their levels on December 1.

Chapter 3

Underlying Factors

In this chapter, we examine in detail the underlying demand and supply factors which combined to push prices upward by record amounts in December 1989. Heating oil prices, like those of all petroleum products, are affected by the dynamic interplay of national and international forces. For heating oil, some of the more important factors are: the severity of cold weather, stock levels, and crude oil prices. Cold weather and low stock levels were both publicly blamed for the price runup. In an attempt to provide insight into the question of whether the increase in heating oil prices was within expectations (that is, could be explained by these variables), a regression analysis was performed, and is described in more detail in Appendix B, "Actual and Forecasted Heating Oil Prices." This analysis quantifies the historical relationship between residential heating oil prices and crude oil costs, weather (a proxy for demand), and stock levels. Prices were then forecasted for the 1989-90 heating season, using the regression results.

Briefly summarizing the analysis, an equation was estimated using data from October 1984 through November 1989, a period of relatively stable weather and marketing patterns. The equation predicted prices quite well, as forecasted prices throughout this relatively normal period, on average, differed from actual prices by less than 2 cents per gallon. As expected, however, the forecasted prices for periods of severe market strain fell somewhat short of the

actual levels (spikes) that occurred. For example, during the 1983-84 heating season (the most recent period in which heating oil markets "overreacted" to temporary tight conditions), a very cold December followed by a cold January resulted in prices rising about 6 cents more than expected. In December 1989, prices also rose more sharply than the severity of the weather or the drain on stocks would indicate, according to the regression analysis. This suggests that other problems as well (possibly related to the weather or stock levels indirectly) were responsible for some portion of the price increases. Such factors as additional transportation costs, local distribution problems and shortages, refinery shutdowns, downward shifts in import patterns, speculative activity, and market panic may have contributed to additional pressure on prices. Because such unusual factors tend to cause shifts in the supply and demand functions generating the underlying data, regression models tend to underestimate price spikes. All together, these factors added about 10 cents per gallon to the December price, not explained by the regression equation. Because monthly average prices tend to lag and smooth out rapidly changing prices, January's actual price was also well above the expected. By February, the actual price had returned to the forecasted or expected range. We now examine in depth the various components of demand and supply responsible for December's price movements.

Demand

Unanticipated Demand

U.S. demand for No. 2 distillate, as measured by EIA¹, rose 708 thousand barrels per day (MBD), or 21 percent, between November and December 1989, to 4.0 million barrels per day (MMBD). This contrasts with a 293 MBD, or 9 percent, increase in December of 1988 which some observers have characterized as more representative of "typical," or "normal" seasonal patterns. If the 1988-89 heating season is accepted as a baseline seasonal demand pattern, then the 415 MBD differential between the December increases of each of the past 2 years can be interpreted as the "unanticipated" increase in demand for December 1989.

An analysis was conducted in order to provide some insight into the sources and impacts of unanticipated demand. The premise here was that if sales were greater than expected, they may have contributed to transportation and distribution problems and thereby added an element to upward price pressures beyond that of their impact on demand alone. This analysis centered on forecasts of distillate fuel sales, which were derived from the historical relationship between sales and weather. (The methodology is described in detail in the Appendix C, "Expected Distillate Sales Based on Weather Conditions.")

The study showed that actual sales in December did not differ greatly from forecasted sales, given the severity of December's cold weather. However, actual sales turned out to be 17 to

¹These data are derived from the EIA-782C, "Monthly Report of Petroleum Products Sold Into States for Consumption." For further details, see the *Petroleum Marketing Monthly*.

18 percent higher than forecasted, based on normal weather. Since no one predicted the record cold weather in December, actual sales were considerably higher than anticipated, although not outside the expected range given the extreme low temperatures. Thus, some of the unexplained price increase may be due to the large amount of unanticipated demand in December which complicated problems in the transportation and distribution sector and possibly induced panic reactions by market participants at all levels. Despite the severe cold snap in December, overall 1989-90 heating season (October through February) demand roughly matched that of the previous year.

End-Use Sector Analysis of Demand for No. 2 Distillate

Table 3.1 shows U.S. sales of No. 2 distillate by end use for each of the heating season months since 1987. All data except that of the electric utility sector were derived from the EIA-782A and EIA-782B, a combination of monthly surveys of petroleum product prices and volumes submitted by refiners, gas plant operators, resellers, and retailers. Utility data were derived from EIA's *Electric Power Monthly* by adding consumption data and changes in stock levels for light oil (mostly No. 2 distillate).

Tables 3.1 and 3.2 and Figure E.7 show that the residential sector was the major contributor to the increase in demand from November to December 1989, making up almost 80 percent of the 665 MBD retail increase, while maintaining about the same 39 percent share of December's market as in 1988. Furthermore, residential sales accounted for 58 percent of the unexpected increase in demand this past December. The residential sector also was exceptional in the magnitude of its sales swings during the 1989-90 heating season. While exhibiting a very large December volume, it was the only sector which showed October, November, and January sales volumes significantly below the levels of the previous year (Figure E.8). Although data on residential inventories were not available, the sales trend may suggest that residential users were relatively less prepared for the severe cold weather spell.

Like residential users, the impact of electric utilities on the No. 2 distillate market in December was disproportionately large, compared to their relative size in the market. While utility purchases made up only 5 percent of the retail total, they accounted for 12 percent of the increase in December's retail sales, and 16 percent of the unanticipated change in December. Taken in this context, the surge in utility demand was even steeper than the increase in residential demand. While sales to the residential sector increased almost 100 percent in December, sales to utilities jumped 138 percent from already high November levels (Table 3.1, Figures E.8 and E.9). Moreover, while residential users may have fallen victim to relatively low November inventories, stocks held by electric utility companies in November 1989 were at the same level as the previous year (Table 3.3).

Table 3.1 U.S. No. 2 Distillate Heating Season Sales, 1987-90

(Thousands of Barrels per Day)

Year	Month	Residential	Commercial/ Institution	Industrial	Retail Outlets	Electric Utilities	Total End Use
87	Oct	384.6	731.9	268.0	340.3	30.4	1,755.2
87	Nov	519.4	681.6	229.5	318.2	31.0	1,779.7
87	Dec	750.4	703.0	227.7	313.5	40.7	2,035.3
88	Jan	968.5	715.5	217.8	298.6	54.3	2,254.7
88	Feb	866.8	771.6	222.9	342.4	45.0	2,248.6
88	Mar	654.0	792.1	246.9	372.1	31.9	2,097.0
88	Oct	396.7	745.9	250.3	379.5	29.6	1,802.0
88	Nov	572.3	787.9	234.3	366.5	39.7	2,000.7
88	Dec	889.2	789.5	231.5	330.3	62.6	2,303.1
89	Jan	853.1	796.8	200.4	311.6	56.9	2,218.8
89	Feb	899.7	817.8	202.0	332.2	57.0	2,308.7
89	Mar	724.7	846.1	212.0	340.5	67.1	2,190.4
89	Oct	345.5	778.3	280.0	354.6	46.6	1,805.0
89	Nov	535.3	829.3	280.1	337.7	57.6	2,040.0
89	Dec	1062.9	898.9	292.3	312.7	137.8	2,704.6
90	Jan	777.1	841.7	239.4	318.6	92.5	2,269.3
90	Feb	731.6	830.4	243.5	332.0	40.6	2,178.1

Note: The data in Table 3.1 are presented primarily to depict trends. The calculation of market shares will result in overestimates for some sectors due to the absence of the agricultural sector and underestimates of the retail outlet component resulting from incomplete sampling coverage of this sector. The retail outlet sector reflects diesel fuel sales for highway use and are collected from refiners and a sample of distillate resellers.

Table 3.2 Changes in U.S. Sales of No. 2 Distillate, 1988-89

(Thousands of Barrels per Day)

	Nov-Dec	Nov-Dec	Incremental	% of Total
End-Use	1988	1989	Change	Incremental
Sector	(a)	(b)	(b-a)	Change
Residential	316.9	527.6	210.7	58.1
Commercial/Inst	1.6	69.6	68.0	18.8
Industrial	-2.8	12.3	15.1	4.2
Utilities	22.9	80.3	57.4	15.8
Outlets	-36.2	-25.0	11.2	3.1
Total Retail	302.4	664.8	362.4	100.0

Table 3.3 U.S. Stocks of Light Oil Held by Electric Utility Companies, 1987-90

(Thousands of Barrels)

Years	Oct	Nov	Dec	Jan	Feb
1987-88	16,081	15,704	15,759	15,142	15,311
1988-89	15,344	15,332	15,099	14,809	13,980
1989-90	15,090	15,332	13,824	15,458	15,622

In contrast, the commercial/institutional and industrial sectors had relatively smaller impacts on the No. 2 distillate market, particularly given their absolute sizes (Figures E.11 and E.12). Together, they shared about 44 percent of retail demand in December, and yet, they accounted for only 12 percent of the November to December increase.

Another indication of the electric utility sector's impact on the market in December is evident in comparing each sector's share of total retail sales over time (Figure E.14). The shares held by the residential, commercial/institutional, and industrial sectors in December 1989 were in

line with their respective shares for the previous 2 years. However, the share representing utility use in December, about 5 percent, was well above the market shares seen for the previous 2 years of under 3 percent. In fact, utility shares for the first 4 months of the 1989-90 heating season were unusually high, and did not fall to normal levels until February. The fact that utility demand captured a greater than normal share of the retail market for much of the 1989-90 heating season, and especially in December, suggests that this sector had a disproportionate influence on the market during the late-December price spike.

Table 3.4 breaks down the residential sector by region (only the significant ones are shown) so that the relative importance of each can be compared. It is clear that each PADD had an unexpected change from November to December, 1989 (column b) and, hence, an impact on the unanticipated demand in December (last column) roughly equal to its relative size in the national market (first column). Also, all the regions shown had percentage increases in November-December 1989 sales similar to their relative importance. Moreover, these regions maintained these relationships over the entire course of the heating season (Figure E.15). This suggests that, in relative terms, the East Coast and the Midwest residential markets reacted similarly to the extreme cold weather in late 1989.

Table 3.4 No. 2 Distillate Residential Sales, 1989

(Changes in Thousands of Barrels per Day)

Region	Dec 89 Percent of U.S.	Nov-Dec 89 Change (a)	Nov-Dec Unexpected Change (b)	Col (a) Percent of U.S. Total	Col (b) Percent of U.S. Total
PADD I	82.4	450.6	177.8	85.4	84.3
PADD IA	29.3	160.1	70.0	30.3	33.2
PADD IB	45.4	246.6	86.8	46.7	41.2
PADD IC	7.6	43.9	21.0	8.3	10.0
PADD II	15.4	72.0	34.8	13.6	16.5
U.S.	100.0	527.6	210.7	100.0	100.0

Note: PADD I includes PADDs IA, IB, and IC. Regions do not add up to U.S. total due to the exclusion of PADDs III, IV, and V.

Table 3.5 examines the regional distribution of light oil (mostly distillate) purchases by electric utilities and shows the relative impact on the U.S. market. The East Coast, the largest consuming region of light oil within the sector, accounted for about three-quarters of the total U.S. increase in December 1989, and about two-thirds of the unexpected increase in December's total. However, PADD III, and to a lesser extent PADD II, had a relatively large impact on December's unexpected increase, given their market size (compare the first and last columns of Table 3.5).

In summary, the residential and electric utility sectors exerted a disproportionately large impact on distillate markets in December 1989. While commanding only 44 percent of the market, together they accounted for about 91 percent of the increase in demand in December, and about 74 percent of the unanticipated surge.

Table 3.5 Light Oil Purchases by Electric Utilities, 1989

(Changes in Thousands of Barrels per Day)

Region	Dec 89 Percent of U.S.	Nov-Dec 89 Change (a)	Nov-Dec Unexpected Change (b)	Col (a) Percent of U.S. Total	Col (b) Percent of U.S. Total
PADD I	65.9	61.4	38.2	76.5	66.6
PADD IA	8.4	8.7	3.9	10.8	6.8
PADD IB	39.7	35.8	25.6	44.6	44.6
PADD IC	17.8	16.9	8.7	21.0	15.2
PADD II	13.7	13.0	10.2	16.2	17.8
PADD III	18.8	15.4	15.3	19.2	33.4
U.S.	100.0	80.3	57.4	100.0	100.0

Note: Regions do not add up to U.S. total due to the exclusion of PADDs IV and V.

While relatively smaller, the impact on December markets of the commercial and industrial sectors was significant. Together, these sectors accounted for 23 percent, or 83 MBD, of unexpected December distillate demand. Adding the electric utility sector, 141 MBD, or 39

percent, of the unanticipated surge of 362 MBD in total retail sales can be conservatively traced to these major, non-residential, bulk end-user groups (Table 3.2).

These observations suggest that the composition, as well as the magnitude, of the unexpected increase in distillate demand may well have been important in fully explaining the price increases in December. In recent, more typical heating seasons, such as the winter of 1988-89, December's increased demand was almost entirely derived from the residential sector. December 1989 differed notably from past years in that, while residential consumers again accounted for the majority of the increase, a significant and unanticipated portion, over 160 MBD, was generated by the industrial, commercial, and utility sectors. To the extent that these consumers were better able to absorb or pass on higher distillate prices, their substantial and unexpected presence in the December market may have significantly steepened the aggregate demand relationship between prices and total end-use sales in a manner not readily captured in the model's specification. In other words, the substantial presence of the non-residential sector was a surprise to December's markets, resulting in additional transportation and distribution problems, and possibly an acceleration in the bidding process for scarce supplies, thereby inducing price overreaction to the cold weather and tight market conditions.

Impact of Interruptible Gas Contracts

There is widespread concern that interruptible gas contracts contributed to the increased distillate demand by electric utilities and industry. This section addresses the impact these contracts may have had on overall demand and, hence, prices for heating oil and related fuels.

Given the current constraints of pipeline throughput capacity, demand exceeds the deliverable supply of marketable natural gas in some regions during the peak of the heating season. For a combination of reasons—physical, regulatory, and economic—most of the customers in the high-priority residential and commercial sectors cannot switch from natural gas to alternate fuels, particularly in the short run. Hence, a portion of the demand for natural gas in the electric utility and industrial sectors that can switch has been redirected into other fuel markets, namely, petroleum. Interruptible gas contracts are the primary means in the natural gas industry to assure that demand does not exceed available supply. Figure 3.1 shows the seasonal variation in deliveries, after the application of so-called interruptible contracts which alter the fuel options available to selected customers.

The industrial and electric utility sectors have a high incidence of interruptible contracts. These contracts assure the customer access to natural gas at a reduced price in the summer on the condition that delivery of natural gas above a given volume will be cut off in the winter months. Interruptible contracts are executed in a variety of forms, for sales or transportation service, but basically provide for service subject to interruption during periods when the servicing company requires the gas supply or system capacity to serve its "firm" customers. Interruptible service agreements may be between pipeline companies, pipeline

companies and end users, pipeline companies and distribution companies, or distribution companies and end users.

Figure 3.1 U.S. Seasonal Demand for Natural Gas, 1986-90

In the summer months, interruptible customers benefit by a more favorable pricing structure and/or access to gas supplies and/or service not otherwise available. Large end users, particularly boiler fuel users with alternate fuel burning capabilities, can make cost-effective use of any excess gas during slack periods, whether or not gas is the primary or secondary fuel for the facility. Such users may also purchase gas under firm contracts for usage (such as process gas) not easily shifted to alternate fuels. For the pipeline or distribution company providing the service, interruptible contracts in the winter level out the large seasonal variation in deliveries to the designated "firm" (gas-on-demand, temperature-sensitive) consumers, particularly in the residential and commercial sectors.

In any year, residential and commercial consumption of natural gas during the peak winter months may be five to six times consumption during the summer low month. This difference may be much greater on a daily or weekly basis. Underground storage, liquefied natural gas storage, and other peak shaving facilities help smooth out such variations but are costly. The demand and supply of natural gas during the heating fuel crisis is addressed in Chapter 4.

Since December 1989, there has been considerable concern over the role of electric utilities and their interruptible gas contracts in the runup of No. 2 distillate and other petroleum prices during the peak of the heating fuel crisis. In the winter of 1989-90, the residential, electric utility and, to a lesser extent, commercial sectors most directly responded to the sharp rise in demand for space heating. While the delivery of natural gas to electric utilities increased slightly this past December-January, No. 2 distillate sales rose 55.4 MBD over the same period, compared with 1988-89. Table 3.3 shows that utilities drew down stocks of light oil in December 1989 at a rate of almost 49 MBD, 42 MBD faster than in December 1988, leaving utilities little option but to compete for petroleum fuels at high prices. Moreover, most electric utilities have fuel adjustment provisions permitting them to "pass through" most, if not all, of the higher cost of purchased fuel to the consumer.

Natural gas consumption and price data are collected on a billing-month basis and thus overlap calendar months. In order to focus on sectoral impacts in the New England and Mid-Atlantic States, the combined consumption and prices reported for December 1989 and January 1990 were compared with corresponding data from a year earlier. Residential consumption was 14 percent greater in New England and 16 percent greater in the Mid-Atlantic. Commercial consumption was 9 percent greater in New England and 13 percent higher in the Mid-Atlantic States. These sectors are characterized primarily by firm contracts not subject to interruption.

As is shown in Table 3.6, volumes of natural gas deliveries in the Mid-Atlantic States were much higher than in New England. The bulk of winter gas deliveries was used primarily for space heating in the residential and commercial sectors. Relatively small amounts of gas were used by the industrial and electric utility sectors. Industrial consumption was 2 percent greater in New England and 3 percent higher in the Mid-Atlantic States. In the electric utility sector, consumption in New England dropped 81 percent while rising 64 percent in the Mid-Atlantic States.

In summary, the impact of interruptible gas contracts on the December 1989 heating oil market was at most 141 MBD, but probably less, based on the total unanticipated demand for the electric utility, commercial/institutional, and industrial sectors (see section above). There currently exist insufficient data to estimate the proportion of this unanticipated demand attributable to interrupted natural gas, as opposed to weather-related petroleum requirements per se. It should be noted that normally these interruptible contracts generally tend to reduce petroleum demand overall, thereby usually lowering distillate prices for all classes of end-use customers.

Table 3.6 Natural Gas Consumption, 1988-90

(Million Cubic Feet)

End-Use Sector	NEW ENGLAND ^a			MID-ATLANTIC ^b		
	Dec 88- Jan 89	Dec 89- Jan 90	Percent Change	Dec 88- Jan 89	Dec 89- Jan 90	Percent Change
Residential	50,314	57,133	14	232,526	269,157	16
Commercial	24,766	27,022	9	111,205	125,199	13
Industrial	9,917	10,112	2	74,660	76,741	3
Elec Utility	387	73	-81	6,152	10,062	64

^aConnecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.

^bNew Jersey, New York, Pennsylvania.

Supply

In response to sharply increased space heating demand, U.S. supplies of distillate rose substantially in December 1989. Compared with December 1988, total distillate supplied rose 10 percent (Table 3.7). Heating oil accounted for nearly two-thirds of the increased supply of distillate. For the United States, No. 2 fuel oil supplies were up 12.5 percent. The East Coast was particularly hard hit by frigid weather and, among U.S. regions, it depends the most on heating oil for space heating. Supplies of heating oil for this region rose 18 percent.

The bulk of the additional distillate supplies came from drawdowns of primary inventories. Refiner production of distillate rose, but was constrained by short-term refining flexibility and refinery outages. Imports of distillate had been at a reduced level since August, and in December 1989 played a lesser role in meeting demand than was customary in recent Decembers.

Table 3.7 Components of Distillate Fuel Oil Supply, 1988-90

(Thousands of Barrels per Day)

Heating Season	Month	Refinery Production	Net Stock Withdrawal	Net Imports	Total Distillate Supplied	First Sales of No.2 Fuel Oil	
						U.S.	PADD I
1988-89	Nov	2,909	-19	293	3,183	1,615	968
	Dec	3,068	171	322	3,560	1,959	1,317
	Jan	2,973	103	221	3,296	1,943	1,310
	Feb	2,798	455	158	3,411	1,920	1,292
1989-90	Nov	3,076	67	175	3,318	1,540	928
	Dec	3,266	446	193	3,905	2,204	1,552
	Jan	3,136	-398	439	3,177	1,715	1,173
	Feb	2,753	204	292	3,250	1,725	1,187
Change	Dec 89/ Dec 88	198	275	-129	345	245	235
Percent Change	Dec 89/ Dec 88	6.5	160.8	-40.1	9.7	12.5	17.8

Note: Negative number indicates an increase in stocks.

Distillate Stocks

Distillate inventories were drawn down sharply during the December cold snap. Nationally, distillate was supplied from existing primary inventory at an average rate of 446 MBD during December. In PADD I, supplies were made available out of inventories at an average rate of 471 MBD. In December 1987 and 1988, national distillate stock levels were reduced at an average daily rate of only 209 MBD and 171 MBD, respectively. On the East Coast, distillate stocks were drawn down at the rate of 170 MBD during December 1988. During the same month of 1987, East Coast distillate stocks actually increased.

Figure 3.2 Beginning and Ending Heating Season U.S. Distillate Stocks, 1978-90

The level of distillate stocks has trended downward during the 1980s. Nationally, distillate stocks at the beginning of the 1989-90 heating season stood at 121 MMB, or 7 MMB lower than in 1988. However, that level was about the same as stock levels at the beginning of the heating season 2 years ago (Figure 3.2). Similarly, distillate stocks immediately available to meet excess demand on the East Coast were 5 MMB lower than at the beginning of the 1988 heating season, but only 2 MMB lower than at the beginning of the 1987 heating season.

In a historical context, distillate stock levels in November 1989 do not appear to have been particularly low. The incentive to build stocks derives from three functions: transactional, precautionary, and speculative. Transactional purposes are the normal commercial activities undertaken by enterprises. Sufficient stocks should be available to supply customers without experiencing outages. The precautionary element of stock building usually serves to increase stocks over the normal transactional level "just in case." The third element of stock building is speculative in nature. This element reveals itself when enterprises change their stock levels based on their expectations about future price changes.

In the United States, distillate stocks typically are accumulated in the non-heating season for very practical reasons. First, there normally is not sufficient demand for distillate produced as a by-product during the months of high gasoline production. Thus, the opportunity cost of storing distillate as opposed to selling it in a depressed market is relatively small at that time of the year. However, strong growth of diesel fuel consumption during the first half of

1989 provided a ready market for some distillate that might otherwise have gone into inventory. Growth of diesel fuel consumption may reduce the seasonal swings in total distillate consumption and thereby reduce the incentive to maintain distillate stocks. Second, daily demand during the heating season exceeds the daily production capacity. Thus, stocks must be accumulated in advance to meet normal demand.

Figure 3.3 U.S. Distillate Days Supply, 1974-90

Distillate stocks, measured by days supply, fell during the 1980s. Figure 3.3 shows this in two complementary ways. The monthly level of stocks (divided by the average daily consumption for that month) reveals substantial month-to-month and year-to-year variation but a general downward trend during the 1980s. From 1973 through 1980, stock levels routinely fluctuated much more substantially from year to year than they did at any time after 1980. For example, from the spring of 1976 to the spring of 1977, stocks first increased by almost 90 days supply and then fell by almost 100 days supply. After 1980, the amplitude fell to the 20- to 40-days supply range.

The 12-month moving average (MAVG) of days supply smooths some of the seasonal fluctuation from the time series and clearly indicates that stocks fell during the 1980s. Using the 12-month moving average, the average fall in stocks was 3.9 days supply per year over the decade of the 1980s.

Figure 3.4 Ratio of U.S. November Distillate Days Supply to 12-Month
Moving Average, 1974-89

The only year-to-year material increase occurred in 1985-86 when days supply increased from 43 in October 1985 to 52 in October 1986. In October 1989, there were 39 days supply of distillate in storage, roughly the same as the previous 2 years. After accounting for the long-term downward trend in stock levels, the October and November 1989 stock levels were near the previous 2 years. Figure 3.4 shows the November stock level relative to the 12-month moving average.

Figure 3.5 U.S. Manufacturing Inventory/Sales, 1980-89

The ratio of inventory to sales also has tended to fall for manufacturing in general over the past decade (Figure 3.5). Although part of the decline is related to the continued economic expansion, improved inventory management techniques are a major factor in the fall.

Several factors contributed to the declining beginning-of-season distillate stock levels characteristic of the 1980s. Primary stocks are those possessed by refiners, pipelines, and large terminal operators. It is likely that some portion of the stocks previously held by primary suppliers is now held at secondary or tertiary levels. Building excessive stock is a costly exercise that competitive enterprises will seek to minimize. Improved measuring, monitoring, and distribution techniques may reduce the level of stock necessary to meet a given level of demand. When interest rates increase, the cost of stock holding also increases. It may not be a coincidence that stock levels have been falling since the historically high real short-term interest rates and prices that prevailed in the early 1980s.

The development of futures markets attenuates the speculative incentive for stock building since the same speculative objectives can be more effectively (i.e., less expensively) accommodated by futures trading than by building excessive wet-barrel inventories. As noted above, growing demand for diesel fuel effectively increases the opportunity cost of building fuel oil stocks and thereby reduces the incentive to do so.

Furthermore, the movement away from producer pricing to market-related pricing (referred to as the "commoditization" of oil) has tended to increase both the competitiveness and volatility of petroleum markets. The current price-determining process involves many more market participants, with varying expectations, including traders, brokers, speculators, retailers, wholesalers, and refiners, while many more transactions are now directly or indirectly linked to spot or futures market prices. This encourages sellers to "follow the market," which can rise or fall relatively quickly on either technical factors, or on changing near-term perceptions of market fundamentals.

In this environment of increased carrying costs, competition, and volatility, rational heating oil sellers will build inventories above what they perceive is required to meet immediate demand (that is, to cover transactions needs), only if it is profitable to do so. At a minimum, they must cover their investment, including carrying costs. Suppliers can do this by hedging their physical inventory through short positions in the futures market whenever futures prices are higher than cash prices plus operating and carrying costs. Given higher carrying costs, this is often not the case. In fact, heating oil cash prices are often higher, particularly during the peak season when demand is high.

Another reason for the somewhat lower inventories at the beginning of the heating season seems apparent: the spread throughout August and September between cash and futures prices was rarely as high as 2 cents, averaging around 1.5 cents in August and even less in September. This was probably insufficient to cover carrying costs.

Strong diesel demand last spring and summer, compared to 1988 levels, not only dampened stocks directly, but also indirectly by supporting cash prices during the summer and early fall to the point where August and September futures spreads were too small to promote preseason stock building.

Relatively low distillate imports, compared to 1988, beginning in August and lasting throughout the fall, also depressed stock levels. The lower import levels largely resulted from strong European demand for gasoil and relatively high prices, stemming from delayed consumer stock building, which acted as disincentives to trans-Atlantic shipments to the United States.

Still another factor affecting distillate stocks was that National Oceanic and Atmospheric Administration forecasts as late as the end of October indicated warmer-than-normal weather was expected for November and December 1989. This, coupled with the falling supply/demand trends, tended to confirm the widespread industry assessment that distillate stocks were adequate to meet expected winter demand.

Finally, even though beginning-of-season distillate inventories have trended downward over recent years, end-of-season inventories (end of April) have been remarkably stable over the same period, as shown in Figure 3.2. They fluctuated from a high of 108 MMB in April 1982 to 95 MMB in April 1988, compared with the minimum operating inventory level, as

determined by the National Petroleum Council, of 85 MMB. Despite last December's cold weather and historic stock draw, inventories finished the season at 97 MMB in April 1990, comfortably within this range.

Distillate Production

U.S. refiners responded to the surge in heating oil demand by increasing the production of distillate. Based on EIA weekly statistics, distillate production rose from 3.1 million barrels per day (MMBD) in the week prior to the onset of the cold spell to a rate of 3.5 MMBD for the week ending December 22. In spite of production problems at numerous major refineries (discussed below), monthly distillate production averaged 3.3 MMBD in December 1989, a 6.5-percent increase from December 1988 (Table 3.7).

In the historical context of the 1980s, the step-up in distillate production in December 1989 appears to have pressed the limits of short-term refinery flexibility, particularly in light of a 1.6-percent drop in overall finished petroleum product output between November and December. Distillate production represented 21.6 percent of refinery production in December 1989, a share exceeded only in November-December 1985 (Figure 3.6). The 1-month swing in the product slate toward distillate, of 1.6 percentage points, between November and December 1989, was exceeded only in October 1985.

Figure 3.6 Distillate Share of U.S. Refinery Output, 1980-90

The emphasis of refiners on distillate production carried over to January. January production of distillate in 1990, 3.1 MMBD, was a January high for the decade. However, the cold spell, which was largely over by the second week of January, was followed by temperatures considerably in excess of normal. January's level of distillate production, together with a surge in imports (see below), greatly exceeded January's demand for distillate. As a result, distillate stocks increased in January, an uncharacteristic pattern compared to past heating seasons.

Distillate Imports

Net imports of distillate were down 40 percent in December 1989, or by 129 MBD, compared with December 1988. A reduced level of distillate imports became apparent in August. In the August through November period, net imports of distillate were down a similar 41 percent (Table 3.8). The reduced level of imports reflected a higher price for gasoil abroad relative to the U.S. price. The level of U.S. imports of distillate was strongly influenced not only by U.S. developments, but also by developments abroad, particularly in Europe.

Table 3.8 U.S. Net Imports of Distillate Fuel Oil, 1988-90

(Thousands of Barrels per Day)				
Heating Season	Aug-Nov	Dec	Jan	Feb
1988-89	256	322	221	158
1989-90	151	193	439	292
Change	-105	-129	218	134
Percent Change	-41.0	-40.1	98.6	84.8

Figure 3.7 Ratio of European Gasoil to U.S. No. 2 Fuel Oil Prices, 1988-89

Shortly after European gasoil (distillate) stocks were built for the heating season, cold weather hit Northern Europe in November. Although the cold spell turned out to be short lived, it exerted upward pressures on European gasoil prices. November gasoil prices in Europe were near or above gasoline prices. One broad indicator of the relative price of distillate between Europe and the United States is shown in Figure 3.7. The relatively high price of European gasoil in the August through November period tended to reduce exports to the United States in favor of European destinations. Consequently, gasoil imports into the United States were discouraged by relatively high prices in Europe and, in late November and early December, by uncertainties about the duration of the U.S. cold spell. As the cold spell lengthened and the U.S. demand for heating oil soared, U.S. suppliers sharply stepped up their orders for imports. However, because of transport lags, the surge in import demand did not result in increased supplies until after the cold spell had largely ended. Table 3.8 shows that net imports of gasoil in January 1990 were about double the level of the previous year.

The lessened role of imports in meeting December 1989 heating demand also contributed to the sharp rise in residential heating oil prices in that month. In tight market situations, marginal sources of supply can strongly influence overall prices. In recent years, imports have served as a primary marginal source of additional supplies in December. In 1988, net imports accounted for 9 percent of December's distillate supplies. In contrast, in 1989, the comparable share was a considerably lesser 5 percent. As noted above, additional orders for imports were placed in mid-to-late December, but, due to transport lags, were not received

until January. The surge in December 1989 space heating demand turned heating oil suppliers increasingly toward domestic spot markets to meet customers' needs.

Table 3.9 Monthly Fuel Oil Prices, 1989-90

(Dollars per Barrel)

		Oct	Nov	Dec	Jan	Feb
Refiners' Sales						
of Fuel Oil	Resale	25.24	25.37	30.58	31.00	24.23
	Residential	35.95	37.09	45.28	47.88	40.40
Spot Fuel Oil	New York	24.60	24.78	33.07	31.37	24.24
	Rotterdam FOB Plus Freight	25.67	25.71	30.80	29.92	24.55

In late December, the U.S. spot market was placed in the uncustomary position of serving as a significant source of additional heating oil supplies. Spot market prices rose sharply as slim supplies were confronted with urgent, substantially increased demands. New York weekly spot heating oil prices reflected these unusual pressures, rising \$7.60 per barrel in the third week in December and an additional \$7.56 in the last week in December. On a monthly basis, the New York spot heating oil price was \$8.29 per barrel higher than the November average (Table 3.9). Similarly, the rise in residential heating oil prices was \$8.19 per barrel between November and December, as the additional costs of heating oil suppliers were largely passed along to consumers in the context of dwindling tank levels and heightened anxieties concerning the duration of the cold spell.

In January, as heating oil imports rose sharply, the importance of spot markets as a source of supply receded. The New York heating oil spot price for the last week in January was over \$19 per barrel below the level of the last week in December.

In summary, since inventories seemed adequate as late as Thanksgiving, and monthly distillate production reached 3.3 MMBD in December 1989 (the highest level since at least 1982, despite numerous refinery problems that month), the bulk of the price increases can be explained by the enormous increase in demand in December 1989, with the remainder due to exacerbating factors including refinery and distribution problems (see the last section below) and relatively low imports.

Propane Supply

The amount of propane supplied in December 1989 increased 28 percent compared with December 1988 and was up 42 percent over the November level (Table 3.10). Drawdown of primary stocks accounted for the increased supplies. Field and refinery production were impaired by weather-related operational problems leading to a 4-percent drop in output compared with December 1988. Prior to the heating season in late September, primary propane stocks were 60.5 MMB. While this was about 4 percent below stock levels at the same time last year, it was 3.7 MMB more than in 1987 and 3.3 MMB more than the level in 1985. In less than 3 months, this national inventory dropped to 33 MMB, which was the lowest point in 20 years (according to industry sources). The December drawdown alone was over 19 MMB. This was the fourth time since 1969 that December's drop in propane stocks was greater than 9 MMB.

A significant factor in the reduced availability of propane in the Northeast was a markedly lower level of imports, particularly in December (Table 3.11). In PADD IA, beyond the reach of pipelines from the Gulf Coast and other domestic production areas, imports normally make up a substantial portion of the available supply. While imports in the fall were among the lowest in recent years, it was the severe drop in December that most notably contributed to the shortage. Several forces appear to have combined to create this situation. First, severe cold weather in Europe, earlier than in the United States, both drew exports from, and reduced available imports to, the United States. Second, production and transportation problems in Europe—including reduced production in the North Sea and explosion damage to a major natural gas liquids (NGL) pipeline in the Soviet Union—decreased supply there. Finally, rough weather in the North Atlantic delayed at least one major cargo from off-loading during the critical period in late December.

Table 3.10 Components of U.S. Propane Supply, 1988-90

(Thousands of Barrels per Day)

Heating Season	Month	Plant & Refinery Production	Net Stock Withdrawal	Net Imports	Total Propane Supplied
1988-89	Nov	869	85	66	1,019
	Dec	866	284	42	1,192
	Jan	892	166	140	1,198
	Feb	847	312	116	1,275
1989-90	Nov	840	146	87	1,074
	Dec	807	628	90	1,525
	Jan	867	5	140	1,012
	Feb	905	29	115	1,048
Change	Dec 89/ Dec 88	-59	344	48	333
	Percent Change				
Percent Change	Dec 89/ Dec 88	-6.8	121.1	114.3	27.9

Table 3.11 Imports of Propane to the East Coast, 1986-90

(Thousands of Barrels per Day)

	Oct	Nov	Dec	Jan	Feb	Mar
1986-87	15	24	37	31	28	26
1987-88	12	45	32	22	48	24
1988-89	13	29	29	41	37	22
1989-90	9	22	12	64	49	--

In contrast to the distillate market, where prices escalated but physical shortages failed to materialize, outages did occur in the propane market. By December 21, many propane suppliers were experiencing outages, especially in the Northeast, the upper Midwest, and as far south as Kansas and Tennessee. Propane supplies were being drained faster than they could be replenished. December product was reported to be unavailable on spot markets, while virtually all suppliers began to limit sales to contract customers at minimum allowable volumes. To assure continued supply for residential accounts, it was reported that lower-priority customers in commercial or industrial categories were cut off selectively.

Refinery and Distribution Problems

Domestic Problems

The increased demand on primary supplies of distillate fuel oil brought on by the unanticipated early cold weather resulted in short-term transportation bottlenecks. No consistent terminal outages were confirmed. However, particularly in New England, some terminals ran out for a day or two. Typically, suppliers limited sales to contract customers, prorated to "normal" levels, thereby increasing the demand on spot markets. This, in turn, put additional upward pressure on spot heating oil prices.

During the last 2 weeks of December, a number of refineries were completely shut down or had reduced operations, primarily due to the cold weather and/or fires and explosions. During the December cold snap, 24 major distillate-producing refineries were monitored on a daily basis by EIA. As of December 5, these refineries accounted for 33 percent of the total U.S. distillate production. By December 29, their combined production had dropped 33 percent, from 1,117 MBD to 750 MBD. Spot markets jumped 22 cents per gallon in just 2 trading

days on news of these refinery problems. As the weather improved, production was brought back on line, and reached typical seasonal levels by the second week in January.

Over the last two decades, at least 20 proposed refineries along the East Coast have been rejected by State and local jurisdictions for environmental reasons. Eleven of these, with a combined production capacity of 2.5 MMBD, were to be constructed in New England. If some of these refineries had been built, the additional capacity might have helped alleviate last winter's supply problems in the Northeast.

Jones Act Waiver Requests

Table 3.12 Jones Act Waiver Requests, 1989-90

(Barrels except where shown)

Fuel Type	No. of Ships	Volume Requested	Volume Approved	Actual Delivery
Heating Oil	2	315,000 ^a	0	Unknown
Propane	4	250,000	150,000	50,000
Residual Fuel	Blanket	230,000	0	Unknown

^aIncludes 275,000 barrels of Jet-A fuel for blending with No. 2 Heating Oil.

The Jones Act received a lot of attention as a factor contributing to the heating fuel shortage. This act, aimed at protecting the domestic shipping industry, prohibits foreign vessels from delivering cargoes from one U.S. port to another. The Jones Act can be waived on a case-by-case basis at the discretion of the U.S. Customs Service when requested by any other Federal agency. Between December 22, 1989 and January 8, 1990, requests for Jones Act waivers were submitted by six different companies. The exact number of waiver requests is somewhat confused by the fact that two companies modified their original requests to reflect changes in vessel availability. If modified and rescinded requests are included, there may have been as many as ten requests for Jones Act waivers. On four occasions the foreign vessels originally named in the requests had already sailed or entered into other agreements while the requests were being processed. It is worth noting that two sets of waiver requests named the same foreign vessel. In other words, at times waiver requests may have been in competition for the same vessels. The outcome of these requests is summarized in Table 3.12.

The three waiver requests dealing with heating oil and residual fuel transport were all denied on the basis that the Maritime Administration found that domestic transportation was available for these fuels. Of the heating oil and residual fuel supplies denied transport by foreign flag vessels, it is not known how much may have reached the desired destination through domestic means. On the other hand, investigation by the Maritime Administration revealed that there were no U.S. flag propane carriers available, therefore, none of these requests were denied. Timing was the key problem with obtaining waivers for the propane-carrying vessels. Only two requests were actually approved, as companies were unable to hold a commitment with foreign ships while waiting for waivers to come through. Of the two waiver requests that were granted, only one actually resulted in a delivery to the East Coast. The Norwegian vessel, Norgas Voyager, capable of holding 50,000 barrels of propane, was scheduled for delivery in Chesapeake, Virginia on January 22. The other vessel, representing approximately 100,000 barrels of propane, had already set sail for foreign ports by the time the waiver was obtained.

Other Affected Markets

Most, if not all, petroleum markets were affected by the enormous demand surge for heating oil and propane (Figures 4.1 and 4.2). This chapter discusses the ripple effect of December's frigid weather and refinery problems on other refined product markets.

No. 2 Diesel

No. 2 diesel fuel differs from No. 2 heating oil primarily in its cetane level specification (suggested industry standard calls for a minimum of 40 cetane for diesel engines). For the most part, refiners produce either a fully marketable — "dual purpose" — No. 2 distillate, or a sub-grade distillate suitable for home heating. Diesel-grade fuel can be burned in home furnaces, but sub-grade distillate cannot be used in diesel engines, without further blending to meet cetane specifications.

Figure 4.1 U.S. Wholesale Product Price Comparisons, 1989-90

Figure 4.2 U.S. Retail Product Price Comparisons, 1989-90

The enormous increase in demand for residential heating oil in December, coupled with increased demand from the other end-use sectors, including natural gas users, pushed wholesale and retail heating oil prices sharply upward. Since diesel fuel can be used for heating purposes, i.e., is fungible with No. 2 heating oil, diesel fuel prices experienced similar price increases. Moreover, when demand for heating oil peaked in December, some suppliers limited the supply available to non-residential customers, including on- and off-highway diesel, adding additional upward pressure to prices. Table 4.1 shows prices for No. 2 distillate in PADD I at various wholesale and retail levels.

Table 4.1 Wholesale and Retail No. 2 Distillate Prices in PADD I, 1989-90

(Cents per Gallon)					
	WHOLESALE			RETAIL	
	No. 2 Fuel Oil	No. 2 Diesel		Residential Fuel Oil	Non-Residential No. 2 Distillate Diesel Fuel Retail Outlets
Oct 89	60.1	61.5	86.5	66.5	69.9
Nov 89	60.5	62.1	89.3	67.7	71.7
Dec 89	76.1	76.1	110.1	83.3	85.7
Jan 90	80.6	78.2	117.9	90.5	97.7
Feb 90	60.7	61.0	98.8	71.1	81.5

Kerojet/Kerosene

No. 2 distillate and kerojet are not strictly interchangeable, but the distillation (temperature) ranges do overlap. Hence, an increase in the production of No. 2 distillate is, in part, at the expense of kerojet. This occurred when, in late December, refiners' No. 2 distillate production increased 3 percent to a high of 3.5 MMBD. At the same time, kerojet production fell 4 percent, or, as a percentage of distillate production, kerojet production fell from 39 to 36 percent. In the last week of December, in the wake of the refinery shutdowns and operational problems, kerojet production fell even further, to 32 percent of distillate production.

Blending of lighter products (e.g., kerosene, No. 1 distillate, and at times even kerojet) into No. 2 distillate, to produce a winter-grade heating fuel or to improve the quality of a sub-grade distillate, is also a common practice. Seasonal demand increases, due to holiday air travel, and increased blending resulted in an increase of almost 12 percent in kerojet demand during the week ending December 22. In the face of output reductions and low imports, demand could only be met by a large daily stock withdrawal of 457 MBD. The following week, kerojet production fell to 993 MBD, a drop of 22 percent from the previous week.

Stock withdrawals, equal to the previous week's level, were again required to meet increased demand for kerojet.

Normally, kerojet trades about 5 cents above No. 2 heating oil (Table E.30 displays spot kerojet prices in New York Harbor and the Gulf Coast). However, on December 15, New York Harbor spot heating oil surpassed kerojet. Prices rose sharply in the following 2 weeks, and on December 27 prices for both products peaked at \$1.15 and \$1.06 per gallon for No. 2 heating oil and kerojet, respectively. By January 3, spot kerojet had again risen above No. 2 heating oil. In the following week, heating oil prices fell sharply (26 cents), and by the 10th, New York Harbor spot kerojet exceeded heating oil by 19 cents. This occurred as a result of increased imports (exceeding 500 MBD in January) of sub-grade distillate arriving on the East Coast, which led to increased demand for lighter products for blending purposes.

Naphtha and Liquefied Petroleum Gases (LPGs)

Increases in demand relative to supply for propane enhance the attractiveness of naphtha, ethane, and other LPGs, putting upward pressure on their prices. This is particularly true of petrochemical plants, which have the discretion of using any one of these products as petrochemical feedstock.

Naphtha demand also increased in December, as a consequence of increased distillate production. Increased distillate production requires additional refinery cracking of petroleum feedstocks. Cracking processes require hydrogen, which can be produced at the refinery or purchased. Many refiners ran additional feedstock naphtha through reformers (a hydrogen yielding process unit), thereby adding demand and upward pressure on naphtha prices.

Motor Gasoline

Distillate competes directly with motor gasoline in refinery processing. During the fall and early winter, refinery processing units are set to maximize distillate production. Prior to the onset of the driving season, refiners begin to increase gasoline production as distillate demand slackens, to replenish stocks and provide a cushion for upcoming refinery turnarounds. The surge in distillate yields in December was at the direct expense of motor gasoline. As a result, gasoline stocks were drawn down at the very time they normally begin building for spring. (Gasoline production also was down at this time due to refinery accidents and fires, which cut utilization of refinery distillation capacity by more than 12 percent.) The drawdown in gasoline stocks led to unseasonable spot gasoline price increases.

From November 1 to January 2, spot regular unleaded rose 17 cents before peaking at 69 cents per gallon. In contrast, the sales price for total motor gasoline, as reflected by EIA data, was virtually unchanged during this time period. In January, U.S. wholesale and retail prices increased 7 and 5 cents, respectively. February wholesale and retail prices decreased 2 cents,

while spot prices fell by the end of February to 54 cents per gallon, largely as a result of a 17-percent increase in gasoline stocks over first-of-the-year levels.

Natural Gas

The natural gas industry was also impacted by the record cold temperatures. December 1989 consumption was almost 20 percent higher than in December 1988, which had experienced near-normal weather. This increased demand was met primarily by withdrawals from underground storage. Domestic production and imports were both slightly higher in December 1989 compared to December 1988; however, storage withdrawals were the highest on record, reaching 735 billion cubic feet.

Underground storage levels at the end of October 1989 were at a record high. The December withdrawals taxed the system to the limit, however. Informal contacts with storage operators serving pipelines servicing the Northeastern States indicated that working gas was nearly depleted in some fields at the end of the cold snap. The warm weather in the following months resulted in storage rebounding to normal levels by the end of February 1990.

Despite some well freeze-up problems in the producing areas, high-priority residential customers in New England and the Mid-Atlantic States were not curtailed (i.e., deliveries delayed or suspended due to supply problems) as the natural gas industry met the increased demand through traditional procedures, facilities, and contractual arrangements. Total U.S. deliveries to residential consumers increased more than 25 percent from December 1988, and deliveries to commercial and industrial consumers were up almost 15 percent (Table E.31). Electric utilities consumed 24 percent more natural gas in December 1989 than in the previous December. However, consumption was down about 12 percent from the previous month.

Natural gas wellhead prices for December 1989 were approximately the same as those of December 1988. However, the early January 1990 price offerings indicate increases of 15 to 25 percent. These prices represent primarily gas entering the interstate pipeline system in Louisiana, Oklahoma, and Texas. Residential natural gas prices for the last quarter of 1989, as published in the *Natural Gas Monthly*, showed the traditional seasonal decline to residential consumers. This was due to high volume and State public utility jurisdictional rulings. Residential consumers paid \$5.30 per thousand cubic feet in December 1989, 9 cents below December 1988 prices. This contrasted with price increases for natural gas delivered to the commercial and electric utility sectors, as well as the sharp increase in prices for residential heating oil customers.

Table 4.2 Natural Gas Prices, 1988-90

(Dollars per Thousand Cubic Feet)

	NEW ENGLAND ^a			MID-ATLANTIC ^b		
	Dec 88 and Jan 89	Dec 89 and Jan 90	Percent Change	Dec 88 and Jan 89	Dec 89 and Jan 90	Percent Change
Residential	7.10	7.37	4	6.24	6.34	2
Commercial	6.25	6.52	4	5.48	5.73	5
Industrial	5.16	5.66	10	4.24	4.62	9
Electric Utility	4.51	4.54	1	3.09	3.34	8

^aConnecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.^bNew Jersey, New York, and Pennsylvania.

Electric Utilities

During December 1989, peak electricity demand was experienced in several areas across the United States. While U.S. electrical demand rose 7 percent in December 1989, compared to December 1988, the largest consumer was the residential sector with 37 percent of the market and sales that were 11-percent higher than December 1988. Commercial sales were 7-percent higher while the industrial sector followed more of the trends of the economy with sales 3-percent higher.

Total U.S. net generation of electricity was 259 thousand gigawatthours, 11 percent higher than the amount reported during the same month in 1988 and 18 percent over the November 1989 level. Although all energy sources reported higher levels of generation in December, compared to the corresponding period in the previous year, natural gas deliveries to some utilities were interrupted, based on negotiated contracts, in order to ensure adequate supplies to residential customers. This was particularly true in New England where the natural gas consumption of electric utilities fell to 8 million cubic feet (MCF) for the month of December. This was in sharp contrast to November's level of 1,646 MCF and the previous December's level of 286 MCF.

Electric utilities in the Mid-Atlantic States also consumed less natural gas in December 1989 compared to November (63.3 percent less); however, compared to the previous year, consumption was up 85 percent for the same month. Consequently, utilities found it necessary to increase their petroleum consumption. In some areas of the country where record peak demands were experienced, many utilities relied on their peak load plants (i.e.,

gas turbines and diesels) and even had to use old steam units that are generally on standby status. The increased consumption of light petroleum fuel reflected the use of these units.

Residual Fuel Oil

Residual fuel oil competes with natural gas, coal, and other fuel oils as boiler fuel in steam-electric plants. Due to strong electricity demand caused by December's cold weather, U.S. heavy fuel oil (mostly No. 6) consumption by electric utilities increased 71 percent from November to December 1989, reaching 31.4 million barrels, a level 11 percent higher than the previous December (Table E.32).

In New England, heavy fuel oil consumption by electric utilities increased 29 percent in December 1989, compared to November, while rising 13 percent in December over the same month in 1988. Electric utilities in the Mid-Atlantic States consumed almost 82 percent more heavy fuel oil in December 1989, and 11 percent more than the previous December. Increased demand for residual fuel was primarily met through stock withdrawals averaging about 230 MBD during the month of December.

Increased demand for residual fuel oils, particularly those with low sulfur content, caused upward pressure on prices. Spot cargoes of 0.3 percent sulfur residual fuel in New York Harbor sold for \$35.13 per barrel on December 31, an increase of \$15.88 from the beginning of the month (Table E.33). EIA sales data for PADD I indicated that between November 1989 and January 1990, prices for residual fuel with greater than 1 percent sulfur content rose \$7.73 and \$6.76 per barrel at the retail and wholesale levels, respectively.

Crude Oil Costs

Spot markets for crude oil and products are linked. Increases in the cost of crude oil are eventually passed on to customers downstream. Conversely, demand for the marginal crude barrel on the spot market is influenced by the netback value of the hypothetical refined barrel, often based on product spot prices. Although the netback value helped support prices in December, spot crude markets were influenced primarily by worldwide factors other than U.S. heating fuel demand and supply. Figure 4.3 shows the relationship between West Texas Intermediate's (WTI) netback value and spot price (at Cushing, Oklahoma). During the month of December, the spot price increased only \$3.36 per barrel, compared to an increase of \$10.08 in its netback value. The larger increase in netback value reflected the dramatic rise in product spot prices, in particular, the rise in spot No. 2 distillate at New York Harbor over the same period.

Changes in the price of the marginal barrel of spot crude oil are reflected in the refiner acquisition cost (RAC) of crude data collected by the EIA. Since the RAC data cover all crude purchases, only a portion of which are spot deals, the RAC domestic, imported and

composite prices tend to lag spot price swings and are less volatile. The monthly RAC data are reported at the national level as displayed in Table E.34.

Figure 4.3 WTI Spot Crude and Product Netback Comparison, 1989-90

Refining and Marketing Profitability

It is axiomatic that an unanticipated, steep runup in a commodity's price will financially benefit those who produce the commodity or who held inventories of the commodity prior to the price rise. Undoubtedly, refiners and wholesalers who held substantial stocks of heating oil at the beginning of December realized greater financial returns due to the sharp rise in heating oil prices than if the unanticipated price rise had not occurred.

An important issue is whether the price rise was the result of anticompetitive behavior and whether the factors that produced the price rise yielded sustainable rates of return in excess of competitive norms. As is clear from the analysis in the preceding chapters, the heating oil market behaved in accordance with supply and demand fundamentals, given the historic cold snap. In this chapter, we examine the structure of the relevant markets and the profitability of the U.S. refining and marketing sector in order to assess the degree to which financial performance reflected competitive markets.

Structure of Distillate Markets

A rapid runup in prices often leads to questions concerning the degree of competition in an industry. In particular, has concentration, a frequently used indicator of potential market power, increased significantly? If so, to what extent did this structural change contribute to

the price increases? Since diesel and heating oil are fungible, it is most appropriate to examine patterns of concentration for distillate fuel oil, the sum of both products.

Distillate markets are not highly concentrated at the four-firm level. Further, using the concentration measure preferred by the Antitrust Division of the Department of Justice (Herfindahl-Hirschman Index or HHI), none of the regions examined are highly concentrated.¹ The Antitrust Division characterizes markets as unconcentrated (HHI below 1000), moderately concentrated (HHI between 1000 and 1800), and highly concentrated (HHI above 1800). Assuming that the PADDs define a geographic market appropriate for antitrust purposes, all but PADDs IA and V are unconcentrated (Table 5.1). PADD IA falls in the lower third of the moderate range and PADD V is at the bottom edge of the moderately concentrated range.

Table 5.1 Concentration in No. 2 Distillate Sales, 1985 and 1989

	(Concentration Ratios)					
	Four-Firm		Eight-Firm		Herfindahl-Hirschman	
	1985	1989	1985	1989	1985	1989
U.S.	26	23	42	39	339	321
PADD IA	73	61	90	91	1,568	1,263
PADD IB	48	47	67	77	772	844
PADD IC	32	37	54	60	557	628
PADD II	31	33	51	53	491	487
PADD III	25	28	43	51	364	438
PADD IV	46	49	75	75	819	860
PADD V	55	55	76	78	1,057	1,020

At the national level, total No. 2 distillate market concentration has declined over the past 5 years. The four-firm concentration ratio (share of sales by the four largest sellers) fell 3 percentage points, while the share of sales for the next four largest companies remained unchanged (Table 5.1). The New England States (PADD IA) show the highest levels of market concentration, particularly for the eight-firm concentration ratio. PADD III is the least concentrated.

A number of trends are apparent at the PADD level. The share of the market held by the largest sellers in PADD IA has declined since 1985. The four-firm concentration ratio fell by 12 percentage points. One reason for this decline was the exit of the largest reseller (31 percent market share) of distillate due to bankruptcy. Currently, the company with the largest share of that market has 23 percent. PADD IA also exhibited the largest fall in the HHI from 1985 to 1989. PADD IB showed a percentage point decline in the four-firm concentration

¹The Antitrust Division prefers the HHI because it reflects the distribution of the market shares of the largest four or eight companies and the composition of the market outside the largest companies. The HHI also gives more weight to the market shares of the larger companies, which is consistent with their likely role in any collusive activities. The HHI is calculated by squaring every company's individual market share and adding them together. Thus, a market with only one seller, a monopoly, would have an HHI of 10,000. A market in which all sellers had negligible market shares would have an HHI approaching zero. U.S. Department of Justice, *U.S. Department of Justice, Merger Guidelines*, June 14, 1984, pp. 19-20.

ratio and PADD V registered no change between 1985 and 1989. The greatest increase in concentration occurred in PADD IC, where the four-firm concentration ratio gained 5 percentage points. Although the four-firm concentration ratio decreased in PADDs IA and IB, increases of over 10 percentage points in the share accounted for by the companies ranked 5 through 8 occurred in those regions.

During the period of generally increasing prices in December and January, there was significant disparity in price changes among companies. Price patterns, as measured by posted terminal prices, for the four and eight largest companies over the period December 1, 1989 to January 11, 1990, differed very little from the rest of the market represented by 37 other companies. Within these groups, however, the company-specific prices varied considerably around the market average. On the East Coast, one of the four largest sellers was well above the average, while another was well below the average. The average price for the eight largest sellers was slightly higher than the regional average, with the gap widening a bit at the peak of the price rise, mostly as a result of three companies. In the Midwest, the regional average remained very close to the average for the four and eight largest companies throughout the period. The same result held true for monthly average prices. While the average prices for the four and eight largest companies in PADDs IA and IB were 1 to 2 cents higher than the average of all refiners, individually, the companies' prices ranged from below the average of all refiners to a few cents above. These data show that the largest companies pursued different price strategies and were not always the most aggressive in increasing prices.

The four-firm concentration ratio for distillate inventories ranged from 29 in PADD III to 54 in PADD IV in 1989. These levels reflect low to moderate concentration levels. (Note that a few large custody-only entities, such as Colonial Pipeline, are excluded from these calculations.) At such low concentration levels, collusive endeavors are difficult to establish and maintain.

Parallel behavior by potential competitors is consistent with, but not proof of, collusive endeavor. On the other hand, the contrary observation is a fairly strong indicator of the absence of collusion. The inventory changes of the 20 largest holders of distillate stock were examined for the August through October period over the past 4 years. During August 1988, 13 of the 20 increased their distillate stocks and 7 reduced their stocks. During August 1989, only 8 companies increased their stocks while 12 reduced them. (This is consistent with falling inventory levels discussed in Chapter 3.) However, the patterns of change for September and October were the reverse. In September 1989, 15 of the 20 increased their stocks; in October, 12 companies increased their stock levels. In the same months of 1988, 12 and 10 companies increased their stock levels. Thus, during the 1989 stockbuild season, more leading companies increased their stocks than did so in 1988.

An alternative approach for examining parallel behavior yielded ambiguous results. For each month from January 1986 through February 1990, a statistical measure of dispersion (coefficient of variation, which is the ratio of the standard deviation to the average value) of

stock changes was calculated for all primary stock holders. Higher values of this statistic indicate that companies have wider differences in their stocking behavior. As shown in Figure 5.1, this statistic has tended to fall since 1986. This result is neither a necessary nor a sufficient condition to infer collusion. It is, however, a logical result of companies responding to changing conditions in a transparent market in a generally similar fashion.

Figure 5.1 Coefficient of Variation, Distillate Inventory, 1986-90

In summary, the structure of the distillate market is not concentrated, nor has concentration generally increased over the last few years. More leading companies increased their stock levels during the 1989-90 stock-building season than in the previous year. Further, the lack of price uniformity across companies, noted above, is indicative of the competitive process at work rather than the result of collusion.

Perspective on U.S. Refining/Marketing Profitability

Despite the often positive relationship between short-term refining/marketing profitability and margins, other factors also influence swings in profitability. For most years since the decontrol of oil prices in early 1981, the profitability of U.S. refining/marketing has been below that of the rest of U.S. industry² (Figure 5.2). Refining/marketing profitability remained low until 1988, when crude oil prices fell sharply and refining margins rose noticeably from the prior year. In 1989, the gross refiners' margin, on an annual basis, was slightly above the prior-year's level while the volume of product supplied was nearly unchanged. Return on equity for independent refiners rose a bit in 1989 and matched that of the majors but was still below the overall profitability of U.S. industry.

Figure 5.2 Annual Return on Equity, 1981-89

²The S&P 400 shown in Figure 5.2 is based on 400 large U.S. industrial companies compiled by Standard & Poor's Compustat Services. Energy companies have been excluded from this group. In this section, the major energy companies are the Financial Reporting System (FRS) companies that report on Form EIA-28.

Throughout most of the 1980s, U.S. refiners and marketers have adjusted to significant changes in product market demand and composition of crude oil supply. Between 1981 and 1986, U.S. crude oil distillation capacity fell by 3 MMBD and the number of refineries declined from 324 to 218.³ Over the same period, the capability of U.S. refiners to produce higher-octane, unleaded gasoline rose from 61 percent of crude oil distillation capacity to 70 percent while capacity directed toward processing heavier, higher-sulfur crude oils rose from 24 percent to 34 percent.⁴ During this period of substantial adjustment, profits from U.S. refining/marketing operations were generally low.

The profitability of major petroleum companies has been below the profitability of U.S. industry for most of the 1980s. However, the majors' profitability generally exceeded the profitability of the more specialized U.S. refiners because the majors are vertically integrated, have large foreign operations, and are diversified into businesses outside petroleum. These characteristics have insulated them somewhat from the lesser financial returns to U.S. refining/marketing. Within the majors' operations, U.S. refining/marketing has been less profitable than the balance of their other businesses. Figure 5.3 shows that the annual return on investment⁵ for their U.S. refining/marketing operations exceeded their overall profitability only in 1988 and 1989.

Unlike the independent refiner/marketers, which generally reported an increase in annual income from refining/marketing operations between 1988 and 1989, the major petroleum companies shown in Figure 5.3 reported a decline of over 30 percent in their income from U.S. refining/marketing operations over the period. Higher operating costs in 1989 were reported by most of the majors. In addition to higher costs associated with refinery outages and cold weather in December, the increased costs stemmed from more stringent environmental protection measures, higher refinery maintenance costs in the first quarter of 1989, a continued shift in the refinery product slate toward higher-octane, unleaded gasoline which entails higher processing costs, and the additional costs of meeting gasoline vapor regulations which began in 1989.

In summary, the profitability of U.S. refining and marketing has only recently moved toward parity with the rest of U.S. industry. The improvement was achieved after a wrenching adjustment to changing market conditions and in the context of higher refiners' margins in recent years.

³Energy Information Administration, *Petroleum Supply Annual 1988*, DOE/EIA-0340(88)/1 (Washington, DC, May 1989), p. 63. The Hawaiian Independent Refinery was excluded from the results presented in the text.

⁴Energy Information Administration, *Performance Profiles of Major Energy Producers 1987*, DOE/EIA-0206(87) (Washington, DC, January 1989), p. 42.

⁵Since stockholders' equity is not allocated to component lines of business, an alternative measure of profitability, return on investment, is shown in Figure 5.3. Return on investment is measured as the ratio of operating income to net property, plant, and equipment.

Figure 5.3 Major Energy Companies' Operating Return on Investment, 1981-89

Refining Profits in the 1989-90 Heating Season

Based on quarterly financial information required by the Securities and Exchange Commission Form 10Q, the U.S. refining sector fared poorly during the 1989-90 heating season compared with the prior heating season. For major petroleum companies separately reporting income for U.S. downstream petroleum operations, these operations registered a 70-percent decline in the fourth quarter of 1989 (Q489) compared with the fourth quarter of 1988 (Q488) (Table 5.2). For eight independent refiner/marketers, the decline in net income over the same period was 57 percent. For the first quarter of 1990, financial results for the two groups were again significantly below the prior-year's level. The majors registered a 48-percent decline in their U.S. downstream petroleum income from Q189 and the reduction in the independent refiner/marketers' net income was 32 percent.

Table 5.2 Quarterly Financial Results for U.S. Refiners, 1989-90

(Millions of Dollars)				
		Percent Change		Percent Change
Income from US Refining/ Marketing for 10 Major Petroleum Companies ^a	Q489	From Q488	Q190	From Q189
	388	-70	231	-48
Net Income for 8 Independent Refiner/Marketers ^b	90	-57	41	-32

^aArco, Chevron, Exxon, Kerr-McGee, Mobil, Murphy Oil, Phillips Petroleum, Shell, Sun, and Texaco.

^bAshland Oil, Crown Central, Diamond Shamrock, MAPCO, Quaker State, TOSCO Refining, Total Petroleum (North America), and Witco.

Given the heating oil price increases in December, one might have expected an increase in refining profits. However, this view ignores all but one of the factors affecting profits. One factor that has been found to be an important influence on quarterly refining/marketing profitability is the gross refining margin. The gross refining margin is calculated as the average wholesale price of refinery sales volume less the refiner acquisition cost of crude oil. For example, over the 1982 through 1989 period, the correlation coefficient between quarterly return on equity for refiner/marketers and the quarterly gross refining margin was 0.6 (a value of 1.0 represents perfect positive correlation, 0.0 represents no correlation at all, and a value of -1.0 represents perfect negative correlation).

As shown in Figure 5.4, the refining margin in Q489 was about \$1.20 per barrel lower than in Q488. The source of the margin squeeze was a lesser rise in overall wholesale product prices compared with the rise in crude oil costs. In recent years, changes in product prices have tended to lag changes in crude oil costs. In periods of rising crude oil prices, as occurred in the last 4 months of 1989, refining margins tend to fall due to the lag effects. Other factors contributed to the decline in income for the U.S. refining sector in Q489. Compared with the previous year's fourth quarter, overall refined product supplied was down 0.5 percent, as increased demand for distillate was offset by reduced output of chemical feedstocks. Refinery outages due to fires and explosions in late December adversely affected bottom-line financial results due to lost revenue and insurance deductibles.

Figure 5.4 Quarterly Gross Refining Margins, 1982-90

Operating costs also were increased by developments related to the December cold spell. As was noted in Chapter 3, the shift toward distillate production in December was of near-record magnitude. Unplanned, rapid changes in the product slate generally result in additional costs. Also, some companies noted in their quarterly reports that purchases of distillate at the relatively high spot prices that prevailed in December were necessary to meet their customers' demands. Thus, apart from the December rise in heating oil prices, most developments in Q489 worked against higher U.S. refining profits.

The sharp rise in distillate prices in December clearly contributed positively to refiners' margins in Q489. Figure 5.5 shows the margins for distillate (resale price less the refiner acquisition cost of crude oil) and for other refined products. The distillate margin rose sharply in December 1989 and remained at a high level in January 1990. However, warmer weather arrived after early January, and heating oil demand and prices began to tumble. February temperatures also were considerably above the norm. In February, the distillate margin fell sharply from the January level while the margin for other products was slightly less.

Figure 5.5 Distillate Margins and Refining Margins Excluding Distillate, 1989-90

Regionally, during the recent heating season, refiner distillate margins rose sharply as wholesale price movements far outpaced crude cost increases. Refiner margins were 16-17 cents per gallon in October and November in New England and the Mid-Atlantic States and 19 cents in the Midwest. By January, these margins jumped to 35 cents in New England and 30 cents in the Mid-Atlantic States, but declined as quickly as they had increased, dropping below the October and November levels by February. In the Midwest, wholesale margins rose briefly to 24 cents in December, but moved back to 20 cents in January, then fell to 9 cents in February.

Ascertaining the effects of the cold spell and subsequent weather-related developments on refining margins is problematic. Not only were weather patterns unusual in 1989-90, but other elements of petroleum demand, the state of international petroleum markets, the level of crude oil prices, and operable refinery capacity differed from a typical heating season. Weather patterns of the 1988-89 heating season were more typical of those experienced in recent years. One simplified comparison that might show the effect of the unusual weather patterns on the margin for distillate is to assume the same path of relative monthly price changes for petroleum products that prevailed between November and February of the last heating season and the same composition of refined product supply. The hypothetical margin

for distillate computed in this way emulates the patterns of demand of the last heating season. The hypothetical refiners' margin for distillate computed under these assumptions and the actual margin are shown in Figure 5.6. The cold spell appeared to raise the actual distillate margin in December and January, but warmer weather reduced it sharply in February. Over the entire period, the hypothetical distillate margin exceeded the actual value by somewhat over a dollar per barrel due to the plunge in distillate prices in February. These computations suggest that the unusual weather patterns, on balance, had a negative effect on overall refiner distillate margins for the heating season.

Figure 5.6 Actual and Hypothetical Distillate Margins, 1989-90

Based on January and February data, the gross refiners' margin rose slightly in Q190 from the Q189 level (Figure 5.4). Between the two periods, distillate and residual fuel oil prices outpaced the rise in crude oil prices by about 80 cents per barrel. Despite the slight rise in margins, income reported by U.S. refiners for Q190 registered a large decline from Q189 (Table 5.2). However, the 10 major petroleum companies included in Table 5.2 generally reported lower margins on U.S. refined product sales in Q190 than in the first quarter of 1989. Only two companies unequivocally reported higher margins, while six of the companies reported lower margins in the United States. A steep drop in demand for

petroleum products of nearly 500 MBD, or over 2 percent, also contributed to a reduction in operating profits.

The large accumulation of distillate stocks in January appears to have adversely affected the bottom-line financial results of U.S. refiners in the first quarter of 1990. Generally, distillate stocks are drawn down, rather than accumulated, in January. In January 1990, primary distillate stocks rose by 12 MMB in the context of the highest wholesale distillate prices in 4 years. In February, these inventories were drawn down by 6 MMB, but the resale price of distillate averaged \$6 per barrel less than in January.

Marketing

The effect of the heating oil price patterns in 1989-90 on the financial performance of marketers is much more difficult to assess than for refiners. The refiners included in Table 5.2 account for 51 percent of U.S. refining capacity. Thus, their financial results can be taken as reasonably representative of the U.S. refining sector. However, most of the companies that are specialized marketers of petroleum products are not publicly traded corporations and are not required to publicly provide quarterly financial information. The Compustat Industrial File was scanned for companies with the primary Standard Industrial Classification code of 5172, Petroleum Wholesalers. The Compustat file contains financial information for over 7,100 publicly traded companies. The scan produced 17 companies. After reviewing the latest company annual reports, seven of the companies were in fact primarily involved in some phase of the marketing of refined petroleum products. Of these seven companies, three were primarily involved in the sale and distribution of only aviation fuel. Consequently, using these few financial reports would necessarily present an unrepresentative picture of the financial performance of petroleum marketers overall. Thus, only margins can be examined as indicators of profit movements.

The apparent residential margin for fuel oil in November 1989 was below the level observed in November 1988 (Figure 5.7). However, during December the residential margin increased by 32 percent to 36 cents per gallon. During January, the margin increased by another 13 percent to 40 cents per gallon. This was followed by a slight fall in the residential margin in February. These increases did not necessarily translate into increased profits for heating oil dealers. Of course, any fuel oil dealers with the good fortune to have a large inventory of lower-cost product would have profited by reselling at the prices that prevailed during the cold spell. Drawing down inventory in this manner, rather than hoarding stocks, served to reduce the severity of the price spike. Residential margins began to fall in February but remained above the annual average for recent years. Overall, for the 1989-90 heating season (through February), the residential heating oil margin rose 3 cents per gallon from the previous heating season (Figure 5.8), following increases of 2 cents per gallon in each of the two prior heating seasons.

Regionally, residential prices exceeded the wholesale prices at the start of the heating season in October, by about 26 cents per gallon in PADDs IA and IB and by nearly 19 cents per

gallon in PADD II (Table 5.3). When prices peaked in January, residential prices exceeded the wholesale prices by 35 cents in PADD IA, 40 cents in PADD IB, and 27 cents in PADD II. This shows that residential consumers paid an additional 8 cents over the wholesale price increases in New England, 13 cents in the Mid-Atlantic States, and 9 cents in the Midwest. However, the increases in residential margins were not as large as the rise in refiner margins. In February, when prices turned downward, the wholesale price decreases were generally matched by comparably lower residential prices, so the higher level of margins (residential-wholesale) were maintained. This contrasts with refiner margins which dropped significantly in February.

Table 5.3 Residential No. 2 Heating Oil Margins, 1989-90

(Cents per Gallon)					
	Oct	Nov	Dec	Jan	Feb
U.S.	24.3	26.8	35.5	40.0	37.3
PADD I	26.0	28.4	34.0	37.8	38.1
PADD IA	26.4	28.4	33.4	34.6	35.0
PADD IB	26.5	28.7	34.1	39.5	39.8
PADD II	18.7	20.5	26.3	27.3	28.0

Figure 5.7 U.S. Fuel Oil Prices and Retail Margins, 1988-90

Figure 5.8 U.S. Residential Heating Oil Margins for the Heating Season, 1983-90

The above analysis, together with the supply responses of refiners, appears to indicate neither excessive profits for U.S. refining during the 1989-90 heating season nor restriction of heating oil supplies.

Propane

A review of the financial performance of propane distributors is also limited by the small number of companies required to publicly disclose financial information. A search of companies required to file Securities and Exchange Commission Forms 10K and 10Q yielded only five companies whose primary line of business is propane distribution. Consequently, the financial results for so few companies cannot be taken as representative of propane distributors overall.

Although propane prices normally are not collected for the residential sector, retail margins shown in Figure 5.9 are computed as the difference between the refiner price of propane (consumer grade) to end users and the refiner price for resale. Refiner volumes of propane to end users accounted for only 10 percent of their total propane sales in 1989. These propane volumes are largely sold to bulk end users, such as utilities and industrial customers.

The propane margins shown in Figure 5.9 and Table 5.4 apply to these classes of trade rather than to residential consumers.

Figure 5.9 U.S. Propane End-User Prices and Margins, 1988-90

As shown in Figure 5.9, the end-user margin increased during the 1989-90 heating season, starting in December. The end-user price rose sharply in December and again in January, by a total of 36 cents, while the end-user margin rose by only 6 cents. When the end-user price fell in February, the end-user margin increased by 7 cents to 47 cents.

Patterns of change in the end-user margin varied considerably across PAD Districts (Table 5.4). Margins fell in December from the November level on the East Coast (PADD I) but rose sharply in February, by 19 cents. In the Midwest (PADD II), the largest increase in the end-user margin, 11 cents, occurred in January followed by an 8-cent rise in February. A 16-cent rise in December's end-user margin was evident in the South (excluding Atlantic seaboard States) followed by a substantial drop in January.

Table 5.4 End-User Propane Margins, 1989-90

(Cents per Gallon)					
	Oct	Nov	Dec	Jan	Feb
U.S.	35.5	34.0	38.2	40.0	46.9
PADD I	45.4	47.3	42.0	42.1	60.9
PADD II	34.4	37.7	35.7	47.0	55.2
PADD III	12.9	8.6	24.5	11.3	13.6

Appendix A

Summary of State and Attorneys General Reports

In response to December's rapid increases in both heating oil and propane prices, many State and Federal agencies were moved to conduct special investigations into the price issue. To date EIA has reviewed reports from five agencies:

- National Association of Attorneys General - *Attorneys General Task Force Reports on Winter Heating Oil Crisis* (Attorneys General)
- Maine - *Interim Report of the Governor's Task Force on Home Heating Oil Prices* (Maine)
- New Hampshire - *Governor's Energy Supply Crisis Review Board Report* (New Hampshire)
- New Jersey - *An Analysis of December 1989 Heating Oil Price Increases* (New Jersey)
- Pennsylvania - *Interim Report on Heating Oil / Propane Survey* (Pennsylvania)

The five reports were written because many people felt that the price spikes were not only the result of increased demand from the severe weather, but were contributed to by a number of other factors. The reports attempt to identify other contributing factors and come up with suggestions. On a number of occasions the reports included facts that contradicted EIA data, as well as unsubstantiated judgements. Although the accuracy of such information may be

In question, discussion of this information will be included in this summary in order to give a full range of information. In addition to looking at the causes of the supply shortage, two reports, New Jersey and Pennsylvania, included an analysis of gross margins.

While each had a variety of unique insights, the reports touched on many of the same factors which may have contributed to the price runup. For instance, all five reports discussed low inventories and the failure to waive the Jones Act (see Chapter 3 for definition) as key problems compounding the fuel crisis. The following tables show factors identified by each study which may have created upward pressure on prices. Further insights into the causes of the price crisis will be discussed in greater detail.

Additional Demand

All of the reports assumed that the catalyst for the rapid price increases was the high level of demand created by extremely cold weather. Various reports looked at sources of additional demand that may have helped to drive prices up: secondary demand from electric utilities and from fuel switching by interruptible natural gas customers, increased international demand, and hoarding. Of the three reports that addressed the secondary demand issue (New Hampshire, New Jersey, and Pennsylvania), only the Pennsylvania study indicated that electric utilities and switching from interruptible customers were factors in the crisis. However, this conclusion was not part of the analysis section of the Pennsylvania report, but was included in the attached testimony by Lieutenant Governor Mark S. Singel. Both the New Hampshire and New Jersey reports indicated that although demand for heating oil and propane by electric utilities did increase, the additional demand was not significant, since the utilities in both States were well prepared. Apparently, companies in both States had replenished inventories during the summer and did not need to make spot purchases during the crisis. The New Hampshire study did point out, however, that gas utilities may have put some additional pressure on the overall propane supply, since natural gas supplies were reduced (due to well freeze-offs in the Gulf of Mexico) at a time when electricity demand remained very high. Similarly, the New Jersey study mentioned that, while New Jersey companies did not require additional supplies, some pressure on prices may have occurred if utilities outside the State were forced to make spot purchases. While both the New Hampshire and New Jersey reports agreed that switching by interruptible natural gas customers would increase heating oil and propane demand, neither believed this demand significantly impacted the price crisis. The New Hampshire report stated that all interruptible customers in the State had already switched to alternative fuels prior to December 2, and therefore had little impact on the price runup which took place later in the month. The New Jersey report estimated that in December as much as 13 million gallons of fuel oil were consumed by consumers that had switched away from natural gas. A conclusion of this report, however, was that the level of additional consumption resulting from fuel switching was probably not significant.

The issue of potential U.S. imports being diverted to Europe and other countries was explicitly mentioned in the Attorneys General, the New Hampshire, and the New Jersey reports. The idea was that increased demand in other countries tightened supplies throughout

Table A.1 Summary of Factors for Heating Oil

Factors Identified In Reports	Possible Factors Influencing Heating Oil Prices				
	Source Report				
	Attorneys General	Maine	New Hampshire	New Jersey	Pennsylvania
Increased Demand:					
Primary	Y	Y	Y	Y	Y
Electric Utilities			N	P	Y
Switching			N	N	Y
Imports diverted	Y		P	Y	
Panic/hoarding			P		
Supply Problems:					
Refinery capacity/Outages	Y		Y	Y	Y
Low inventories	Y	Y	Y	Y	Y
Storage retired					P
Transportation Problems:					
Various Bottlenecks		Y	Y	Y	
Jones Act Waiver Process	Y	Y	Y	Y	Y
Oil Spill/NY Harbor			N		
Economic Factors:					
OPEC ceiling/WOP				Y	
Spot market			Y		
Futures trading	Y	P	P		
Market concentration	Y				
Anticompetitive Behavior	P	N	N		
Y = yes, significant N = not significant P = potential					

Table A.2 Summary of Factors for Propane

Factors Identified in Reports	Possible Factors Influencing Propane Prices			
	Source Reports			
	Attorneys General	New Hampshire	New Jersey	Pennsylvania
Increased Demand:				
Primary	Y	Y	Y	Y
Electric Utilities		P	P	
Switching		N	N	Y
Imports diverted		Y		
Panic/hoarding		N		
Supply Problems:				
Refinery capacity/Outages		Y		
Low inventories	Y	Y	Y	P
Storage used for Butane			Y	
Transportation Problems:				
Various Bottlenecks		Y	Y	
Failure of Shipments		Y		
Jones Act Waiver Process	Y	Y	Y	
Economic Factors:				
Reliance on Spot Market		Y		
Captive Consumers			Y	Y
Y = yes, significant N = not significant P = potential				

the international petroleum market, thus lessening the availability of products for import to the U.S. A number of different reasons for the additional international demand were given: cold weather in Europe, a coal miners' strike in Russia, and the closing of a Russian liquids pipeline. The New Hampshire report emphasized the loss of the Russian liquids pipeline, since it resulted in unmet energy demand in Europe. Some of the excess European demand was met with supplies of Algerian propane which would have ordinarily gone to the East Coast. As a result of these diverted supplies, seaborne propane imports to the East Coast were down an estimated 40 percent from November to December. Another issue addressed

by the New Hampshire study was panic buying and hoarding. The report indicated that this type of behavior may have had some influence on distillate demand.

Supply and Distribution Problems

With the exception of the Maine report, all identified limited refinery capacity and outages as a major problem. The explosion at Exxon's Baton Rouge refinery, numerous weather-related outages, as well as a panic psychology were believed to have driven prices upward. On the other hand, the Maine report suggests that the accident and other weather-related curtailments did not take place until the week of December 29, indicating that, while this may have aggravated the supply situation, it was not a major cause of the price spike. This report deduces that it was the low level of pre-season stocks, combined with the inability to quickly transport the product, that was behind the supply crisis rather than inadequate production.

The historically low level of pre-heating season inventories was a key theme shared by all of the reports. However, there seemed to be no consensus as to why the inventories were low. One possible reason, given that stocks may not have been built up to historical levels, was that high European demand and downed production units (such as Amerada Hess) may have made supplies tight prior to the heating season. Another reason suggested for the downward trend in inventory levels is increased reliance on the spot market. A third possibility is "supply manipulation," which is the idea that inventories may have been purposefully left at low levels to create a supply shortage. While supply manipulation was mentioned as a possibility in several of the reports, no evidence of this activity was given. Two other interesting storage issues were brought out in the discussion of inventories. In the Pennsylvania report, testimony given by the State's Lieutenant Governor mentioned that a number of storage tanks may have been retired as the result of tougher environmental laws. With regard to propane storage, the New Jersey report discussed that some propane storage was unavailable as it was used to store a butane surplus resulting from summer gasoline Reid Vapor Pressure standards.

All reports agreed that transportation bottlenecks were a major supply problem. They described problems such as the unavailability of ships, barges, railcars, and pipeline space; icy roads and waterways; and the inability of trucks and ships to get required permits. In addition to these individual problems, all of the reports cited the failure to get timely Jones Act waivers as a compounding problem. The New Jersey and New Hampshire reports both described a particular circumstance where failure of Federal officials to waive the Jones Act prevented much-needed propane supplies from reaching the Northeast. Apparently a foreign flag ship carrying propane was turned away from the United States when it was unable to get a waiver. The two reports claim that when officials were unable to get a Jones Act waiver, the region was left without propane while supplies of propane on foreign flag ships were turned away. (The source and accuracy of this account is unknown.) Apparently, transportation of propane into the region is reliant on ships, and the regularly scheduled delivery into the region was held up by two weeks when a ship, the Hesperus, was delayed due to storm damage.

A number of economic factors were discussed that made the Northeast more vulnerable to supply shortages: trend toward spot market contracts, use of futures market, more concentrated market, and anticompetitive behavior. The New Hampshire report indicated a belief that the growing reliance on spot purchases rather than long-term contracts heightened the problem. This analysis is based on the idea that companies may have avoided replenishing inventories while prices were high, due to the risk that prices may fall. Mobil and Agway (New Jersey) officials reported that they were forced to make spot purchases when prices were high. These prices would have presumably been passed on. Three reports pointed to futures trading on the NYMEX as a compounding factor to the price crisis (Attorneys General, Maine, New Hampshire). The New Jersey report concluded that the region was more susceptible to supply problems at present as the number of suppliers had declined. The Maine, New Hampshire and Attorneys General reports mentioned the possibility of anticompetitive behavior, although the idea was not pursued in these reports. The New Jersey report suggested an investigation into the possibility of supply and price manipulation at the wholesale level.

Two specific types of anticompetitive behavior related to propane distribution were described in the New Jersey and Pennsylvania reports, although there was no indication of how widespread these activities may have been. First, both reports mentioned accounts where customers had been prevented from buying propane from any dealer besides the one providing the tank because of some legally binding relationship. As a result, propane consumers may have been taken advantage of in some instances. Another account of propane dealers taking advantage of customers was described in the testimony given by the Lieutenant Governor of Pennsylvania. Apparently, customers may have been billed in some units that they were not familiar with and were later shocked to learn how much they really owed.

Margin Analysis

Two reports, those of New Jersey and Pennsylvania, included an analysis of gross refiner margins. The New Jersey report looked at crude oil prices as well as wholesale and retail heating oil prices. The report pointed out that part of the increase in heating oil prices was tied to the price of crude oil, and attributed at least 9 cents of the increase in retail prices through November and December to increased crude oil costs. Another key point of the New Jersey analysis is that throughout December retail margins stayed at average levels. Between November 20 and January 2, retail prices increased 43 cents per gallon, while wholesale prices increased 45 cents per gallon. These figures indicate that, during December, increases in retail merely reflected increased wholesale costs, and in fact, retailers may have absorbed 2 cents of wholesale costs. The analysis acknowledged the fact that not all of the increase in wholesale prices was profit and attempted to estimate the increase in transportation costs incurred over the time period. According to the New Jersey report an estimated 7 cents of the rise in wholesale prices may have resulted from increased transportation costs. One additional fact pointed out in this report was that the differential between the Gulf Coast and New York Harbor terminal prices was 26 cents at the peak, which should have been ample incentive to move the product. Based on this fact and the large apparent wholesale margins,

the study recommended further investigation into possible wholesale price and supply manipulation.

The gross margin analysis included in the Pennsylvania report was based on a State survey of prime suppliers and distributors of both heating oil and propane. The wholesale gross margins of the prime supplier were estimated as the difference between terminal prices and crude oil price. Gross margins for distributors, retail margins, were estimated as the difference between retail and terminal prices. The analysis brought two interesting points to light regarding heating oil margins that seem to support the New Jersey report analysis. First, the wholesale margins increased more than the retail margins during December. The gross wholesale margins increased from 14 cents on December 1 to a high of 48 cents per gallon on December 29. Retail margins, however, remained between 20 cents and 25 cents per gallon throughout November and December. In January, retail margins began to rise at the same time wholesale margins were on the decline. One explanation given by a distributor was that the January retail increases were an attempt to recover some of the higher wholesale costs as well as operating costs not passed on during December.

The results of the Pennsylvania survey of propane prime suppliers and distributors were not consistent, although a summary of the responses was. First, the respondents indicated that both retail and wholesale prices were tied to increased costs. Second, there did not appear to be a significant change in gross margins. Some modest increases were seen due to additional operating costs and some dealer margins may have actually declined.

Recommendations

Each of the five studies reviewed contained a number of recommendations for avoiding a possible recurrence of the December price and supply problems. These recommendations can be classified into the following proposals for government action:

- 1) Legislate or provide incentives for industry to maintain some minimum level of inventory (Attorneys General, New Hampshire, New Jersey, and Pennsylvania).
- 2) Develop a regional petroleum products reserve (all five).
- 3) Amend the Jones Act to permit transportation of fuel between domestic ports by foreign flag ships during a fuel shortage (all five).
- 4) Amend the Low Income Home Energy Assistance Program to provide more funds when they are required (New Hampshire), provide for a systematic increase in allowances (Maine), or restructure payments to encourage people to fill tanks during the summer (New Jersey).
- 5) Amend State laws to provide for waivers of vehicle weight requirements during a crisis (Pennsylvania).

- 6) Organize/reorganize State programs for energy emergencies and redefine role of State agencies (all five).
- 7) Promote energy conservation programs.
- 8) Develop regulations requiring fuel distributors to provide clear price and quantity information (New Jersey).
- 9) Unbundle propane tank services. This would allow propane customers to purchase supplies from any dealer, not just from the dealer providing the tank.
- 10) Study the following: growing market concentration (Attorneys General), interdependence of the energy sectors (New Hampshire), effects of new environmental regulations on energy supplies (New Hampshire), and impact of futures market on supplies and pricing (Attorneys General).

Summary

The purpose of the five reports reviewed by EIA was to identify the reasons behind the rapid escalation of heating oil and propane prices and to recommend actions for alleviating the problems identified. While there was much disagreement among the reports about which specific factors played a significant role in the price runup, there was a general consensus as to the problems of concern. The reports point to the fact that the crisis occurred in the face of high levels of domestic and international demand. At the same time, the supply picture included relatively low pre-heating season inventory levels, as well as numerous production and distribution problems. In addition, the reports brought out a number of other problems that were likely to exacerbate the price runup further, such as a trend toward reliance on spot purchases, speculation at the NYMEX, greater market concentration, and increased reliance of the New England States on external sources of heating oil and propane, as well as the possibilities of suppliers taking advantage of the situation. Certain government regulations such as the Jones Act, State vehicle permit processes, and a law requiring propane consumers to purchase supplies from the dealer providing the tank may have actually exacerbated the situation.

One key concern of these studies was the issue of the possible existence of price or supply manipulation. While both the Maine and New Hampshire reports addressed this issue, neither report found evidence of manipulation. Two other reports, New Jersey and Pennsylvania, included analysis of gross margins which had similar results. Both studies revealed that in December, wholesale margins increased greatly while retail margins remained fairly constant. While the wholesale margin would include increases in operating and transportation costs, the New Jersey study estimated that the cost of transportation during that period increased an approximately 7 cents while wholesale margins increased in the 45 to 50 cent range. Both analyses left the origin of the additional wholesale markup unanswered. The New Jersey report suggested that further investigation into wholesale prices was necessary. One additional observation made in the Pennsylvania report was that in January, when wholesale margins were

going down, retail margins were increasing. The report suggests that retailers were trying to make up for the higher wholesale and operating costs incurred during December.

While the reasons behind the price runup are not conclusive, the five reports each proposed a number of actions to deal with the problems that had been identified. All of the reports suggested developing a regional petroleum product reserve, amending the Jones Act, and creating or restructuring State programs for energy emergencies. All of the reports (excluding Maine) discussed possible legislation or incentives for maintaining some minimum level of inventories. The New Hampshire, Maine, and New Jersey reports discussed amendments to the Low Income Home Energy Assistance Program which would make funds more accessible. The New Jersey and Pennsylvania reports discussed unbundling propane tank services to allow consumers the freedom to purchase propane from sources other than the dealer providing the tank. The Pennsylvania report suggested that States coordinate waiving of vehicle weight requirements during a crisis. The New Jersey report suggested regulations requiring distributors to provide bills in familiar units. In addition to these regulatory suggestions, a few reports proposed to promote energy conservation programs, and a number of topics for further studies were suggested.

Appendix B

Actual and Forecasted Heating Oil Prices

The rapid escalation of heating oil prices that occurred in December 1989 has been attributed to a wide range of factors, including the extremely cold weather, refinery shutdowns, additional transportation costs, local distribution problems and shortages, low stock levels, downward shifts in import patterns, speculative activity, and market panic. Although data on most of these factors are not readily available, price behavior relative to changes in stock levels and weather conditions can be empirically examined. This analysis attempts to quantify the historical relationship between residential heating oil prices and crude oil costs, weather, and stock levels. Forecasts of prices for the 1989-90 heating season can then be estimated, based on this relationship, and predicted prices can be compared to the actual ones.

The regression analysis used national, monthly data for the period October 1984 through November 1989. A basic model was specified with heating oil prices expressed as a function of crude oil costs, a lagged stock variable, and heating degree-days (HDD). The basic model was refined by discounting the summer months, accounting for structural market changes, and correcting for autocorrelation.

Figure B.1 shows the values predicted by the model alongside the actual price. The actual prices for both December 1989 and January 1990 were above the 95 percent confidence range for the forecast by about 10 cents and 14 cents, respectively. The higher January figure

results from the calculation of monthly average prices, which tend to lag and smooth out rapidly changing prices. By February, the actual price returned to the expected range. The winter of 1983-84, which also had an extremely cold spell in December and January, was the only other time when actual prices rose above the confidence interval. While actual prices differed, on average, by less than 2 cents from predicted ones throughout the relatively normal period, heating oil prices in February 1984 exceeded the expected level by 6 cents.

Figure B.1 Actual versus Forecasted Heating Oil Prices, 1983-90

From the regression analysis, it appears that the somewhat larger than expected price increases in December 1989 and January 1990 were due to other factors, such as refinery shutdowns, transportation and distribution problems, relatively low imports, the magnitude and

composition of unanticipated demand, and market panic. In other words, these factors were responsible for shifts in the underlying supply and demand functions which resulted in 10-to-14 cent price increases not explained by the relatively cold weather and low stock levels.

A supplemental analysis was performed similarly on fuel oil prices at the wholesale level. The wholesale equation predicted prices 3 to 5 cents below actual prices for December and January, but were within the 95 percent confidence interval. The fact that the unexplained portions of the wholesale increases were of lesser magnitude than the residential ones may suggest that the greatest impact of the other factors occurred at the residential level. That is, given the severity of cold weather and relatively low stock levels, wholesale price increases were a few cents more than would be expected based on the regression equation.

In summary, the regression analysis indicated that, historically, residential and wholesale heating oil prices have been closely related to crude oil prices, weather, and stock levels. Based on this relationship, the actual heating oil prices were somewhat higher than expected for December 1989 and January 1990. It appears that the unexplained portions of the December and January price increases were the result of factors other than cold weather or low stock levels directly. The impact of these factors was short-lived, however, as prices returned to the expected range by February.

Model Specification

The final form of the equation used to forecast heating oil prices was as follows:

$$\text{PRICE} = (A1 + B1\text{DUM1} + C1\text{CHOW1}) + (A5\text{RAC} + B5\text{DUM5} + C5\text{CHOW5}) \\ + (A3\text{LSTKVAR} + B3\text{DUM3} + C3\text{CHOW3}) + (A4\text{HDD} + B4\text{DUM4} + C4\text{CHOW4})$$

where:

PRICE = residential heating oil prices calculated from EIA-782 A&B data, in 1989 dollars

RAC = composite refiner's acquisition prices taken from EIA-14 data, in 1989 dollars.

LSTKVAR = lag of a normalized stock term estimated as the quotient of the absolute monthly stock level over an historical average stock level for that month. Stock levels are taken from the *Petroleum Supply Monthly* and the average monthly levels were estimated from the ranges published in the *Weekly Petroleum Status Report*.

HDD = heating degree-days taken from National Oceanic and Atmospheric Administration data.

When the equation was originally estimated using the SAS Reg procedure, the resulting Durbin-Watson statistic of .89 indicated that the model specification suffered from auto regressivity (the errors were biased upward). Therefore, the model was estimated using the SAS Autoreg procedure which corrects for autocorrelation. The resulting coefficients were as follows:

Coefficients	t-statistics
A1 = 60.82	8.18
B1 = -12.81	-1.83
C1 = 14.56	1.53
A5 = 0.55	5.73
B5 = 0.08	1.73
C5 = 0.17	1.72
A3 = -0.94	-0.15
B3 = 8.44	1.38
C3 = -13.51	-1.77
A4 = .0058	2.97
B4 = .0065	2.04
C4 = .0034	1.39

where: the **A** coefficients are associated with non-summer months after June 1986,
the **B** coefficients are associated with the change from the non-summer coefficients by including the summer months,
the **C** coefficients are associated with the change from the post-1986 coefficients by including the previous period (A + C= coefficient for the pre-June 1986 non-summer period).

ADJ RSQUARED: .99
STANDARD ERROR OF THE REGRESSION: 1.76
CONFIDENCE INTERVAL: +/- 4.5

Some dummy variables were added to the equation in order to separate the effects of the data from the summer months. These dummies were defined as 0 for the months October through March and as follows for April through September:

DUM1 = 1
DUM5 = RAC
DUM3 = LSTKVAR
DUM4 = HDD

In testing for the stability of the variables, there seemed to be a change in the coefficients when post 1986 data were used rather than data starting in 1983. For this reason, the "Chow" dummies were added to the equation. These dummies represent the change in the post-86 coefficients (the A's) that would occur by including the pre-86 time period.

CHOW1: associated with the intercept term
CHOW5: associated with the RAC variable
CHOW3: associated with the LSTKVAR variable
CHOW4: associated with the HDD variable

The Chow Test was used to compare the equation containing the "Chow" dummies with an equation without them. The results of this test indicated that the two equations were significantly different from each other, that is, the Chow dummies should be included in the forecast model. One interesting result was that while the stock variable strongly influenced prices from October 1984 through May 1986, the effect of this variable was weaker over the period from June 1986 forward. This may be due to the greater variability and influence of crude prices in the later period.

Appendix C

Expected Distillate Sales Based on Weather Conditions

Regression analysis was used to provide an indication of whether December distillate sales were within expectations, given the severe weather conditions. The analysis also attempted to predict what December sales would have been under normal weather conditions.

Since this analysis required expected values for December sales based on different weather conditions, the goal of the regression equation's specification was to create a model that forecasted as accurately as possible, rather than explained the determinants of demand. The model ultimately chosen estimated distillate sales (per day) as a function of heating degree-days (HDD) converted to daily units, and a number of dummy variables. The following equation was specified using monthly data from October 1984 through November 1989:

$$\begin{aligned} \text{SALES} = & 13,589.62 + 710.17\text{HDDDAY} + 4,636.69\text{SUMMER} - 467.73\text{DUMHDD} \\ & \text{tstat}(9.98) \quad (13.95) \quad (3.32) \quad (-5.47) \\ & + 1,219.42\text{CHOW1} + 315.16\text{CHOW2} \\ & (1.39) \quad (7.43) \end{aligned}$$

ADJ RSQUARED: .95
DURBIN WATSON: 1.91

where:

SALES = New England and Mid-Atlantic States monthly sales of distillate fuel calculated from EIA-782A data on a per-day basis.

HDDDAY = heating degree-days for New England and the Mid-Atlantic States taken from National Oceanic and Atmospheric Administration (NOAA) data converted to a per-day basis.

The following are dummy variables used to remove the impact of the summer months:

SUMMER = dummy associated with the intercept term.

DUMHDD = dummy associated with the HDDDAY variable.

In the process of specifying the model, the residuals indicated a structural change occurred before the 1986-87 heating season. The following dummy variables were incorporated into the model to reflect the difference in behavior before and after October 1986:

CHOW1 = dummy associated with the intercept term

CHOW2 = dummy associated with the HDDDAY variable

Once the regression model was specified, December estimates based on the actual heating degree-days and normal heating degree-days could be compared. These predicted values were obtained by plugging the level of heating degree-days, either actual or normal, into the equation. The estimate assuming "normal weather" utilized the normal December level calculated from NOAA data as an estimated historical average. The expected December sales level, given actual heating degree-days, was 3 percent higher than actual sales. The estimate for December sales, assuming normal weather, was considerably lower than the actual level. Actual sales in December were 6,333 thousand gallons per day, 17 percent higher than expected or predicted under normal weather conditions.

Actual Sales (thou. gal/day)	Expected Sales Given Actual Weather (thou. gal/day)	Expected Sales Assuming Normal Weather (thou. gal/day)
43,198	44,535	36,865

Appendix D

Mechanics of Heating Fuel Markets

In the United States today, heating fuels reach the ultimate consumer through a wide variety of means, both in terms of the physical movement of the products, and the various market participants who play a part. The purpose of this Appendix is to outline the mechanics of both the distribution system and the markets themselves. In keeping with the problems experienced during the 1989-90 heating season, and with the emphasis of this report, we will concentrate here on No. 2 heating oil and propane.

As discussed elsewhere in this report, although they often compete for the same customers, heating oil and propane are distributed and marketed through entirely separate channels. This is primarily due to the different physical requirements for the handling and storage of the two products. No. 2 heating oil, which is typically fungible with No. 2 diesel fuel, is available at most refineries and terminals, and is shipped and stored at atmospheric pressure. Propane, like other liquefied petroleum gases (LPGs) such as butane, must be kept under pressure to remain liquid, and thus is stored and transported in pressurized containers. The notable exception to the separate distribution of these two products occurs in some pipeline systems. Due to the pipelines being kept under pressure to maintain the flow of products, propane may be shipped in batches like gasoline and distillates, but is kept in pressurized storage at point of origin and destination.

Heating Fuel Distribution Networks

Petroleum products enter the U.S. distribution system either at the refinery gate (for domestically refined products) or at the port of entry (for imports). They are then shipped, typically via pipeline, barge, or tanker, to a terminal, which may be adjacent to the refinery or port, or hundreds of miles away. A terminal is a storage and loading area, typically close to a large population center. From the terminal, products are transported by truck or rail to bulk plants (smaller storage facilities) or directly to service stations or large end users. Most terminals have several truck loading devices, commonly called racks. The rack may be equipped to load the truck compartments with several products simultaneously. Generally only accounts which can accept a full truckload of product (about 8,000 to 10,000 gallons), or at least a full compartment (1,000 gallons or more) are serviced directly from the terminal. In the case of propane, truckloads are of similar size, but in a single, non-compartmentalized tank.

Delivery of heating oil and propane to residential and small commercial accounts is usually made from a local bulk plant, using smaller trucks, commonly called tankwagons or bobtails. These vehicles can deliver the exact quantity needed by each account, and are equipped with meters to measure the amount of each delivery. Accounts may be serviced on a regular schedule, or on a "will call" basis. Heating oil tanks are generally owned by the consumer, while propane tanks are more often provided and maintained by the supplier, who usually retains exclusive rights to fill them.

Sales to end users may be made directly by refiners or importers, but in the case of residential heating fuels, are more often made by local distributors. These distributors, also called jobbers, are independent middlemen, who may contract with a refiner or large marketer as the agent to sell a specific brand of products in a given trade area. The distributor usually obtains his product at a terminal, and thus is subject to supply proration or interruption if supplies to the terminal are insufficient. Because of this, distributors often secure and maintain backup supply arrangements, such as access to other terminals, for use during local supply outages.

Table D.1 Sources of Distillate Fuel Oil Supply to PADDs I and II, 1989

	PADD I		PADD II	
	MBD	Percent	MBD	Percent
Net Production	362	29.6	684	78.1
Net Imports	282	23.1	7	0.8
Net Pipeline	444	36.3	167	19.1
Net Tanker/Barge	95	7.8	17	2.0
Stock Drawdown	39	3.2	1	0.1
Product Supplied	1,221	100.0	876	100.0

Note: Totals may not add due to independent rounding.

For many years the Northeast has been supplied with domestically-refined products by Mid-Atlantic and Gulf Coast refineries. The products are transported by pipelines and, to a lesser extent, tankers. Since the major product pipelines do not extend beyond the New York City area, further movement is accomplished by barge and truck. Table D.1 presents the sources of distillate fuel oil supplied to the East Coast (PADD I) and Midwest (PADD II) markets in 1989. Note the predominance of pipelines, which supply half of the distillate fuel oil to the East Coast. Almost all of this volume originates in Texas and Louisiana, States situated at the origins of major pipelines. The Midwest appears less dependent upon the pipelines for its heating oil. Refineries are the chief source of supply in PADD II, primarily because of the inclusion of the States of Oklahoma, Indiana and Illinois.

In the propane market, as shown in Table D.2, pipelines from the Gulf Coast carry nearly half of the product supplied to the East Coast. The Midwest is a much more important market for propane, with its extensive rural areas heavily dependent upon LPGs. Its most important supply sources are its refinery and gas plant production in the three States identified above, although pipelines distribute propane within the PADD.

Table D.2 Sources of LPG Supply to PADDs I and II, 1989

	PADD I		PADD II	
	MBD	Percent	MBD	Percent
Net Production	74	37.6	247	66.8
Net Imports	25	12.7	82	22.1
Net Pipeline	84	42.7	14	3.9
Net Tanker/Barge	7	3.6	0	0.1
Stock Drawdown	6	3.0	26	7.0
Product Supplied	197	100.0	370	100.0

Note: Totals may not add due to independent rounding.

Pipelines have implemented a number of allocation procedures to ensure equal access to limited supplies by all parties authorized to ship product, i.e., shippers. During times of peak demand, Colonial Pipeline prorates the amount each shipper is permitted to request to be moved to the average of that company's 13-month history of pipeline use. Any additional pipeline capacity that remains after all requests have been tabulated is usually allocated among the shippers in proportion to these proration factors. Williams Pipe Line implements an "In-Transit" policy whenever shortage conditions become apparent. Normally, shippers on Williams have immediate access to the product they move up the pipeline by following Williams' prescription for maintaining its inventories full at all times. In-transit means that the shippers must wait the full transit time required to move product to its delivery point. As an example, it takes over 3 weeks to move distillate from Tulsa, Oklahoma, to Chicago, Illinois.

Market Structures

Both heating oil and propane are bought and sold in contract, spot, and futures markets. The players in these markets often include the same refiners and marketers responsible for delivering the heating fuel to the end-use markets. Only in the case of the futures market do a large number of participants outside the distribution network become involved in trading heating oil and propane contracts.

In discussions of petroleum industry activities at all levels, the distinction is often drawn between "contract" and "spot" markets, sales, and prices. These two categories are generally presumed to include between them all cash market (as opposed to futures or "paper") transactions. While strict definitions of the two terms could exclude a considerable portion

of market activity, conventional industry usage of the terms allows for a large degree of flexibility. Additionally, it is important to realize that reference to certain types of sales transactions as a "market" does not imply that the participants are formally organized or bound together in any way, or that their activities are sanctioned by any particular entity. Contract and spot markets in the petroleum industry simply consist of transactions of a similar nature, the prices for which are communicated by word-of-mouth, publication, or electronic means. As such, any prices quoted or published are only as reliable as the sample of participants from which they are gathered, as no official agency exists to enforce collection of this type of data. Futures markets, on the other hand, are regulated exchanges, for which reliable prices and other statistics are updated and available instantaneously.

Contract Market

The term "contract," when used to refer to petroleum product markets or prices, has a somewhat different connotation than might be expected by those unfamiliar with the industry. While contracts, from a legal standpoint, are widely used in the petroleum industry, they most typically represent ongoing supply agreements, without specification either of actual prices, or even of the mechanism for setting them. In effect, the typical supply contract merely signifies the seller's intent to make available, and the buyer's intent to purchase, a given amount of product over a certain period of time. Prices are usually set by the seller, and may be changed as often as daily. Buyers are generally not forced to pay the seller's price if they find it unacceptable; however, they may find their contracts terminated if minimum amounts are not purchased. Contracts involving the buyer's use of the supplier's trade name in reselling the product are more complex. Some contracts, particularly those with government agencies, may involve a fixed price, or one linked to an independently verifiable index (such as published reports of spot prices). At the other extreme, there are often participants in the so-called contract market who are bound by no contract at all, but simply by mutual agreement continue to do business until one or the other chooses to end the arrangement.

References to contract markets or prices, therefore, simply indicate that class of transactions based on ongoing relationships, rather than one-time, or spot, deals. While sellers in these markets may have near-total flexibility to change prices, the continuing relationships involved tend to dampen price volatility. Traditional suppliers, such as refiners and gas plant operators, generally look upon the contract market as the outlet for the greater part of their production, and may take a more long-term view of the issues involved in maximizing profitability.

In the No. 2 fuel oil market, as discussed previously, product enters the U.S. distribution system via refiners or importers, and is typically sold to the end user by local distributors, with possible intermediary participation by other parties, generically referred to here as traders. Because of the multiple roles often played by single companies, these functions may overlap to various degrees. Any of these parties may sell to large commercial or industrial end users, and some refiners and importers sell directly to residential customers, effectively capturing the margins available at each level of the distribution chain. Contract-type sales are

most prevalent in the relationships between refiners and distributors, and between all suppliers and small end users, including residential and many commercial accounts. In a physical sense, the term contract, when applied to prices, is often synonymous with terminal or "rack" prices, because this is the distribution level at which many contract sales are made. By default, most buyers fall under the category of contract purchasers unless they have access to sufficient storage and/or can accept a degree of supply risk adequate to enable them to "play" the spot market for price advantage.

The nature of the contract market for propane is essentially very similar to that for heating oil, with a few relevant exceptions. The specialized handling required for propane, as opposed to products such as gasoline and distillates which are liquid at atmospheric pressure, provides it significantly less flexibility in transportation and storage. Fewer pipelines and marine vessels are available to transport propane, and fewer storage facilities exist; consequently the number of suppliers and marketers able to participate in the propane market is considerably smaller than for other fuels. Because there is relatively little overlap between producers and retail marketers of propane (see discussion of spot markets, below), the greatest concentration of contract sales is at the destination end of the pipelines. At this point in the supply system, local distributors are dependent on their wholesale suppliers for delivery of product as needed, with relatively few options if arrangements fall through.

Spot Market

The so-called spot market, as discussed previously, could be defined to include all "wet-barrel" (as opposed to paper) sales not transacted under contract. As such, these sales may be executed in any place or manner mutually acceptable to the participants. In practice, however, industry custom has come to dictate typical delivery points and terms of sale. This situation makes for relative comparability of prices, to a point where unofficial data is collected from and disseminated to participants throughout the market, accomplished today by electronic means.

The spot market for No. 2 fuel oil is most active between refiners, importers, and traders, although large distributors and commercial or industrial end users also participate to a lesser degree. The supply points most commonly quoted are the Gulf Coast, encompassing a large number of refineries and pipeline connections, with Houston as the point of reference, and New York Harbor, which can be accessed either by pipeline or ship.

Propane has an equally active spot market, but with a substantially different group of players. Over half of the U.S. propane supply is derived from natural gas processing, with the remainder coming from refinery production and net imports. The ownership of the gas processing plants is often shared by various gas producers, who typically sell their share of gas liquids to the plant operator. The operator in turn may sell to a trading company, which arranges transportation and sells to the propane distributor at the consuming end of the pipeline. As is the case with heating oil, the most likely candidates for spot transactions are

the sales at the origin end of the pipelines, between producers, refiners, and traders, but sometimes including large distributors. The supply points at which the greatest propane spot market activity occurs are Mont Belvieu, Texas and Conway, Kansas, each a point where production from various sources is gathered and stored for further transportation via pipeline.

Futures Market

The futures market is a relatively new development in the petroleum industry, patterned after those established for other commodities over 100 years ago. A futures contract represents a commitment to buy or sell a defined quantity and quality of a commodity or financial instrument at a price and future period agreed upon in advance. These contracts are traded on organized, highly regulated exchanges. Because of the large number and diversity of the participants and the free flow of information being communicated, futures prices can fluctuate rapidly in response to new market information about supply and demand for the commodity being traded. Commodity-based futures may experience wide and unpredictable price movements in response to adverse weather conditions, as was the case for heating oil and propane during the past winter.

After unsuccessful attempts to trade petroleum futures in 1974, the New York Mercantile Exchange (NYMEX) established the heating oil futures market in November 1978. Propane futures were introduced in August 1987, but that market has remained relatively small. The NYMEX heating oil futures market has become an integral part of the heating oil production and distribution system.

Trading is conducted on the floor of the exchange by open outcry auction. Each contract represents 1,000 barrels (42,000 gallons) of No. 2 fuel oil delivered in the New York Harbor. The standardization of quantity and quality of the items covered by futures contracts is intended to facilitate their exchange and to ensure that bidding is focused on price, thereby maximizing market liquidity and minimizing transaction cost. Contractual periods are usually specified by month, for up to 18 months into the future. Participants do not purchase contracts per se, but rather establish market positions using members of the exchange to act as their agent to buy and sell contracts on the exchange floor. Generally, one-half to two-thirds of all open futures contracts are held by commercial traders with reportable positions, while less than 20 percent are held by large speculators. Small, non-reportable traders hold the remaining positions.¹

Futures transactions follow specified rules enforced by NYMEX and overseen by the Commodity Futures Trading Commission (CFTC). Both NYMEX and CFTC conduct affirmative market surveillance programs to detect and prevent potential price manipulation

¹Testimony of John Meilke, Director of Market Surveillance, Commodity Futures Trading Commission, before a Joint Hearing of the New York State Attorney General, Consumer Protection Board, and State Energy Office, January 23, 1990.

before markets are distorted. Financial performance on futures contracts is guaranteed by NYMEX and its clearing members.

Every day, at the close of business, NYMEX "clears" all contracts traded that day; that is, it ensures that all transactions executed on the floor are settled, using a process of matching purchases and sales. Over 99 percent of heating oil contracts are liquidated prior to delivery because the standard terms are not likely to meet the exact needs of most industry transactions, particularly with regard to timing and location of delivery. Positions may be liquidated in three ways. Most commonly, an identical but opposite position is purchased and the matched positions are presented to the exchange for liquidation.

With NYMEX's approval, a participant liquidating his position may select either an Alternate Delivery Procedure (ADP) or an Exchange of Futures for Physicals (EFP). ADP allows the buyer and seller matched for delivery at the end of each trading month by NYMEX to agree mutually to settle their futures delivery obligations under terms and conditions that differ from those specified in the contract rules. An EFP allows delivery of physical product (which need not conform to contract specifications) from a futures participant to another participant, and a concomitant assumption of equal and opposite futures positions by the latter participant. EFPs offer enormous flexibility with regard to choice of trading partner, delivery location and timing, and price.

Futures prices not only articulate expectations of future price paths, but also are more precisely defined than spot composite prices published in trade journals and are far more widely and rapidly disseminated. These qualities in the past have favored the use of futures prices as reference prices in markets for virtually all commodities for which futures are traded. An established reference price alerts bidders and sellers in the heating oil market, almost instantly, to perceived shifts in the basic forces of supply and demand, resulting in a tightening of price relationships between regions, time periods, and closely-related energy commodities. A critical concept in futures market transactions is the "basis," the relationship at any time between the price of a futures contract and the current cash price of the same commodity.

One of the most fundamental uses of the futures market is for "hedging." Hedging is an important, relatively efficient, market-oriented mechanism for transferring certain kinds of price risk from participants in physicals markets to participants in the futures markets who are more willing to bear risk. Hedging has been described as speculating in basis risk. The successful hedger must consider the established basis relationships and the influences related to supply and demand patterns, known as "fundamentals," and "technical" influences from temporary market conditions. It has been suggested that fundamental influences primarily affect decisions of whether or not to hedge particular commercial positions, whereas technical influences primarily affect the timing and magnitude of positions taken.

Exposure to risk of unexpected price changes can arise in a variety of commercial situations. To offset this risk, two basic types of hedges are available:

- "Long Hedge" - participant has or anticipates a need to purchase product in the future, and fears increasing prices. By purchasing futures contracts at their current price, he can "lock-in" his product cost.
- "Short Hedge" - participant has or will have product to sell, and wishes to protect against falling prices. He may sell futures contracts, thus assuring maintenance of the current value.

Futures hedging helps to reduce price exposure both above and below a given price. While unexpected losses may thus be averted, so may unexpected gains. More elaborate hedging strategies can modify this consequence by locking in various advantageous spreads between markets, time periods and commodities as they occur. However, the use of such strategies begins to move the objective of hedging away from strictly reducing unexpected price risk, toward speculating for financial advantage. In actual practice, the purpose of most hedges may lie somewhere between these two goals.

Appendix E

Supplementary Charts and Tables

***Note: The listing of Appendix E tables and figures
in Appendix F can be used as an index.***

Figure E.1 Residential and Spot No. 2 Fuel Oil Prices, 1989-90

Figure E.2 Spot No. 2 Fuel Oil Prices and Product Supplied, 1989-90

Figure E.3 National Average Residential No. 2 Fuel Oil Prices, 1970-90

Figure E.4 Spot No. 2 Fuel Oil Price Differentials (New York
Less Rotterdam) and U.S. Imports, 1989-90

Table E.1 U.S. Distillate Stocks, 1982-90

(Millions of Barrels)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
82	164.4	147.4	126.3	108.0	113.6	123.7	148.2	158.7	161.2	170.1	185.6	178.6
83	167.6	148.2	118.1	103.1	108.9	113.7	130.7	142.4	154.0	162.6	161.2	140.3
84	119.3	132.2	109.6	97.7	98.1	112.8	124.4	133.3	142.9	152.2	161.0	161.1
85	142.4	121.4	99.3	96.8	104.4	109.7	115.7	113.8	117.4	123.4	139.7	143.7
86	136.5	112.4	98.8	95.9	98.9	107.9	118.9	137.7	152.4	151.6	158.3	155.1
87	141.3	123.7	109.3	100.3	101.3	104.4	114.6	124.7	126.8	121.0	128.0	134.5
88	128.1	110.3	89.8	95.0	104.9	110.4	120.0	125.7	131.5	128.2	128.8	123.5
89	120.3	107.5	96.6	98.4	99.3	99.4	115.0	116.1	122.2	121.4	119.4	105.6
90	117.9	112.2	99.7									

Table E.2 U.S. Distillate Refinery Production, 1982-90

(Thousands of Barrels per Day)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
82	2,591	2,427	2,288	2,358	2,618	2,729	2,734	2,507	2,656	2,838	2,860	2,655	2,606
83	2,321	2,135	1,993	2,171	2,444	2,546	2,604	2,615	2,739	2,581	2,680	2,522	2,454
84	2,590	2,866	2,477	2,341	2,623	2,879	2,718	2,660	2,705	2,690	2,825	2,796	2,681
85	2,630	2,502	2,265	2,488	2,684	2,645	2,644	2,591	2,592	2,900	3,101	3,174	2,685
86	2,897	2,561	2,642	2,786	2,857	2,728	2,709	2,921	2,864	2,716	2,915	2,941	2,795
87	2,758	2,554	2,420	2,551	2,561	2,687	2,699	2,704	2,747	2,779	3,034	3,240	2,728
88	3,008	2,666	2,705	2,865	2,935	2,891	2,783	2,847	2,777	2,826	2,908	3,067	2,857
89	2,973	2,798	2,714	2,788	2,748	2,808	2,846	2,905	2,950	2,906	3,076	3,266	2,899
90	3,136	2,753	2,655										

Table E.3 U.S. Distillate Imports, 1982-90

(Thousands of Barrels per Day)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
82	97	132	48	59	74	102	125	80	61	91	145	109	93
83	68	59	42	73	147	179	267	301	259	260	203	221	174
84	299	454	115	220	253	256	199	259	291	421	316	190	272
85	272	143	156	253	197	152	95	81	222	262	280	287	200
86	325	169	217	147	\$x9	169	313	370	262	243	254	339	247
87	222	253	297	192	203	265	381	222	222	237	187	378	255
88	424	383	247	210	253	222	222	279	307	336	327	409	302
89	331	322	439	299	290	233	335	254	243	254	298	323	302
90	501	357	280										

Table E.4 U.S. Distillate Product Supplied, 1982-90

	(Thousands of Barrels per Day)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
82	3,484	3,085	2,945	2,978	2,444	2,452	2,058	2,218	2,507	2,581	2,475	2,855	2,671
83	2,797	2,780	2,947	2,697	2,354	2,524	2,270	2,495	2,575	2,611	2,874	3,365	2,690
84	3,525	2,834	3,259	2,926	2,814	2,593	2,504	2,559	2,654	2,765	2,827	2,865	2,845
85	3,465	3,330	3,093	2,798	2,607	2,594	2,436	2,636	2,575	2,901	2,747	3,254	2,868
86	3,330	3,416	3,168	2,904	2,762	2,544	2,592	2,621	2,540	2,912	2,877	3,329	2,914
87	3,310	3,345	3,116	2,991	2,684	2,790	2,713	2,553	2,838	3,151	2,932	3,318	2,976
88	3,558	3,557	3,539	2,864	2,795	2,854	2,640	2,873	2,821	3,218	3,183	3,560	3,122
89	3,296	3,411	3,429	2,973	2,957	2,998	2,592	2,970	2,906	3,096	3,318	3,905	3,153
90	3,177	3,250	3,265										

Table E.5 U.S. Distillate Fuel Oil Weekly Product Supplied, 1987-90

(Thousands of Barrels per Day)					
1987-88		1988-89		1989-90	
10/02/87	2,981	10/07/88	3,160	10/06/89	3,373
10/09/87	3,145	10/14/88	3,157	10/13/89	3,344
10/16/87	3,334	10/21/88	3,693	10/20/89	2,925
10/23/87	3,311	10/28/88	2,823	10/27/89	3,118
10/30/87	2,937	11/04/88	3,244	11/03/89	3,040
11/06/87	3,387	11/11/88	3,307	11/10/89	2,759
11/13/87	2,521	11/18/88	3,074	11/17/89	3,538
11/20/87	3,283	11/25/88	3,156	11/24/89	2,906
11/27/87	3,258	12/02/88	3,142	12/01/89	3,374
12/04/87	2,691	12/09/88	3,666	12/08/89	3,977
12/11/87	3,484	12/16/88	3,424	12/15/89	3,945
12/18/87	3,376	12/23/88	3,801	12/22/89	4,414
12/25/87	3,555	12/30/88	3,317	12/29/89	4,096
01/01/88	2,702	01/06/89	3,189	01/05/90	3,076
01/08/88	3,474	01/13/89	3,823	01/12/90	3,682
01/15/88	3,904	01/20/89	3,955	01/19/90	2,892
01/22/88	3,815	01/27/89	3,331	01/26/90	2,654
01/29/88	3,587	02/03/89	3,661	02/02/90	2,971
02/05/88	3,550	02/10/89	3,405	02/09/90	3,229
02/12/88	3,832	02/17/89	3,837	02/16/90	3,156
02/19/88	3,380	02/24/89	3,452	02/23/90	3,192
02/26/88	2,936	03/03/89	3,213	03/02/90	3,257
03/04/88	3,349	03/10/89	3,627	03/09/90	3,640
03/11/88	3,558	03/17/89	3,141	03/16/90	3,248
03/18/88	3,295	03/24/89	3,718	03/23/90	3,389
03/25/88	3,436	03/31/89	3,043	03/30/90	3,193
04/01/88	3,507	04/07/89	3,183	04/06/90	3,201
04/08/88	2,758	04/14/89	2,926	04/13/90	2,973
04/15/88	2,680	04/21/89	3,132	04/20/90	3,554
04/22/88	3,189	04/28/89	3,120	04/27/90	3,042
04/29/88	2,834				

Table E.6 PADD I Distillate Stocks, 1982-90

(Millions of Barrels)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
82	68.3	60.3	44.7	35.0	39.1	44.2	57.4	63.9	68.0	75.7	88.7	80.6
83	71.1	55.5	38.0	31.8	36.9	41.0	50.9	61.7	67.5	74.6	70.7	57.7
84	43.3	54.4	37.3	29.8	32.7	40.0	45.3	49.1	57.5	71.7	74.9	72.9
85	56.3	43.4	32.8	31.3	33.5	34.3	38.8	41.0	47.1	52.4	61.4	58.6
86	55.3	38.0	36.1	30.1	30.7	35.2	46.3	59.4	68.9	73.3	74.1	75.3
87	65.3	48.8	41.5	36.1	34.6	37.0	44.8	50.5	52.4	53.4	52.1	53.8
88	48.1	44.4	33.0	30.0	34.9	37.4	44.7	52.3	57.0	56.7	54.6	49.2
89	46.3	37.2	33.3	33.2	32.9	35.6	44.5	48.4	50.2	51.7	49.7	35.1
90	44.3	39.5	30.9									

Table E.7 PADD I Distillate Imports, 1982-90

(Thousands of Barrels per Day)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
82	91	111	37	50	66	89	111	72	56	68	125	105	82
83	59	38	34	65	117	150	234	275	232	250	177	204	153
84	277	447	106	174	230	234	171	236	271	401	301	177	252
85	264	131	125	226	162	132	79	67	184	241	253	258	177
86	308	144	198	125	121	151	300	354	235	210	233	318	225
87	200	237	260	172	180	244	343	199	200	223	175	352	232
88	414	372	232	198	227	201	201	267	283	324	315	397	286
89	316	310	414	291	272	225	310	225	218	238	273	311	284
90	484	353	274										

Table E.8 PADD I Distillate Product Supplied, 1982-90

(Thousands of Barrels per Day)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
82	1,744	1,326	1,327	1,093	725	725	542	622	766	787	794	1,276	976
83	1,319	1,354	1,241	980	722	727	611	737	765	816	1,081	1,507	982
84	1,728	1,124	1,447	1,075	861	717	655	805	734	904	1,112	1,229	1,033
85	1,745	1,580	1,190	977	741	817	638	743	757	920	918	1,464	1,041
86	1,636	1,748	1,212	1,121	878	795	727	814	847	1,011	1,137	1,509	1,120
87	1,605	1,749	1,285	1,110	876	875	835	822	909	1,106	1,237	1,505	1,164
88	1,766	1,719	1,469	1,024	857	920	754	972	972	1,142	1,233	1,669	1,209
89	1,532	1,644	1,479	1,082	983	918	797	976	945	1,093	1,269	1,947	1,222
90	1,404	1,518	1,355										

Table E.9 U.S. Distillate Stocks, Beginning and
End of Season, 1978-90

(Millions of Barrels)

	Oct	Apr		Oct	Apr
78/79	233	115	84/85	152	97
79/80	230	177	85/86	123	96
80/81	226	165	86/87	152	100
81/82	201	108	87/88	121	95
82/83	170	103	88/89	128	98
83/84	163	98	89/90	121	100

Note: Minimum operating inventory is 85 million barrels.

Figure E.5 U.S. Distillate Stocks, Beginning and End of Season, 1978-90

Table E.10 PADD I Distillate Stocks, Beginning
and End of Season, 1978-90

(Millions of Barrels)					
	Oct	Apr		Oct	Apr
78/79	105	44	84/85	72	31
79/80	109	71	85/86	51	30
80/81	106	64	86/87	73	36
81/82	95	35	87/88	53	30
82/83	76	32	88/89	57	33
83/84	75	30	89/90	52	31

Figure E.6 PADD I Distillate Stocks, Beginning and End of Season, 1978-90

Table E.11 Real U.S. Residential Heating Oil Prices, 1982-90

	(Cents per Gallon, 1989 Dollars)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
82	164.9	163.5	158.5	151.8	151.4	152.6	152.6	151.6	150.9	153.4	156.5	156.1
83	151.3	147.0	139.3	134.5	136.2	135.4	134.4	133.9	133.8	133.7	133.1	132.8
84	136.5	147.8	140.0	136.7	135.9	134.7	132.1	129.2	127.7	128.5	128.3	127.7
85	126.7	127.0	126.0	126.1	125.1	122.5	119.7	117.7	118.8	121.9	127.2	129.6
86	127.4	114.7	106.8	99.9	94.4	91.3	85.1	82.6	82.8	82.3	82.3	84.1
87	91.0	94.6	93.2	92.7	92.0	91.8	91.7	92.2	91.8	92.9	95.3	95.6
88	95.3	94.9	93.8	92.7	92.2	90.6	87.1	85.6	84.6	81.4	82.2	85.1
89	90.4	90.6	90.4	91.2	88.9	86.6	85.4	84.3	84.3	87.5	89.9	96.1
90	122.5	99.1	95.0	93.0								

Table E.12 Nominal U.S. Residential Heating Oil Prices, 1982-90

	(Cents per Gallon)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
82	125.4	124.8	120.8	116.2	117.1	119.4	120.0	119.5	119.1	121.4	123.7	122.9
83	119.4	116.0	110.1	107.0	108.9	108.7	108.3	108.3	108.7	108.9	108.6	108.5
84	112.2	122.0	115.8	113.7	113.4	112.7	110.9	108.8	108.1	109.1	108.9	108.5
85	107.8	108.5	108.1	108.7	108.2	106.3	104.0	102.5	103.8	106.8	111.9	114.3
86	112.6	101.1	93.7	87.5	83.0	80.6	75.1	72.6	73.6	73.3	73.3	75.0
87	81.7	85.1	84.3	84.3	83.9	84.1	83.2	85.0	85.2	86.3	88.8	88.9
88	89.0	88.8	88.1	87.6	87.4	86.2	83.2	82.2	81.7	79.0	79.8	82.6
89	88.3	88.8	89.1	90.4	88.7	86.7	85.7	84.6	85.0	88.7	91.3	97.8
90	125.9	102.3	98.7	96.8								

Table E.13 Residential Heating Oil Prices, 1989-90

(Cents per Gallon)				
	PAD District			
	I A	I B	II	
Oct 2	89.3	90.3	82.5	
Oct 16	92.4	95.0	83.5	
Nov 6	94.7	93.7	85.1	
Nov 20	95.0	93.9	86.6	
Dec 4	96.7	96.4	87.4	
Dec 18	110.2	105.2	91.8	
Jan 2	146.5	137.3	113.4	
Jan 11	129.5	128.4	103.8	
Jan 16	129.5	125.1	107.5	
Jan 23	111.3	115.9	91.9	
Feb 5	109.0	108.0	94.2	
Feb 20	101.3	103.2	90.2	
Mar 5	101.3	102.6	89.5	
Mar 19	100.2	101.4	88.9	

Table E.14 New York Harbor Spot No. 2 Distillate Prices, 1989-90

(Cents per Gallon)									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	48.0	53.3		59.9	63.7		58.1	55.3	
2	48.6		58.9	59.4		105.6	59.4	56.7	59.0
3	48.2		58.9	59.5		101.2			58.8
4	48.3		58.3		64.8	96.7			57.9
5		53.9	57.2		64.5	87.4	57.1	60.3	56.6
6		55.6	57.5	59.0	65.3		56.8	59.7	58.6
7	47.5	54.8		58.9	66.3		56.8	59.1	
8	47.0	56.1		58.0	67.2	80.9	55.4	57.6	
9	48.2		58.3	58.6		74.6	55.1	56.2	59.6
10	48.8		59.0	57.9		74.9			59.7
11	48.7	55.3	59.5		68.0	77.3			59.2
12		54.4	60.5		69.1	78.4	55.7	56.1	60.4
13		54.4	60.2	57.3	70.0		56.2	56.6	
14	48.6	54.0		57.0	69.9		57.6	56.9	
15	49.4	55.0		56.7	74.9	72.4	59.0	58.8	
16	50.0		59.7	58.4		70.3	57.9	59.1	62.2
17	49.9		60.4	59.0		63.8			62.2
18	49.9	54.7	59.9		82.9	65.1			58.5
19		54.2	60.5		83.2	64.7		58.8	58.6
20		55.6	59.8	59.9	83.7		57.8	59.4	57.7
21	51.0	56.7		60.0	87.5		57.9	59.6	
22	50.8	56.1		60.9	92.8	62.8	58.2	58.1	
23	51.0		58.0			60.2	58.3	57.7	57.4
24	51.0		58.3	61.2		61.1			56.2
25	50.8	56.8	58.0			61.0			56.2
26		56.8	56.8		108.0	60.5	59.2	56.8	56.6
27		58.1	57.3	60.7	115.2		58.0	57.4	57.0
28	50.9	58.1		60.4	108.4		57.2	58.0	
29	51.2	58.8		60.4	100.3	61.5		58.2	
30	52.4		57.2	61.9		59.6		58.9	50.3
31	53.1		58.5			58.7			

Table E.15 U.S. Propane Stocks, 1988-90

	(Millions of Barrels)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	36.7	31.1	30.0	38.3	46.0	52.2	58.7	63.6	63.1	51.8	59.2	50.4
89	45.2	36.5	32.4	36.8	44.0	49.6	56.5	60.4	60.5	57.0	52.6	33.1
90	33.0	32.2	31.1									

Table E.16 U.S. Propane Production, 1988-90

	(Thousands of Barrels per Day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	858	862	857	863	860	832	859	870	861	885	878	863
89	904	857	884	895	888	857	872	846	844	825	849	861
90	874	914	880									

Table E.17 U.S. Propane Imports, 1988-90

	(Thousands of Barrels per Day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	126	138	89	88	79	77	126	120	107	104	112	106
89	154	141	100	85	70	99	99	111	111	102	107	117
90	172	147	117									

Table E.18 U.S. Propane Product Supplied, 1988-90

	(Thousands of Barrels per Day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	1,306	1,155	954	639	662	674	745	797	951	981	1,019	1,192
89	1,198	1,275	1,072	796	688	730	707	804	918	1,011	1,074	1,525
90	1,012	1,048	993									

Table E.19 PADD I Propane Stocks, 1988-90

	(Millions of Barrels)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	2.6	2.5	2.1	2.5	2.9	3.0	3.7	4.7	4.9	4.8	4.9	3.8
89	3.9	2.9	2.3	2.6	3.1	4.0	4.9	4.8	4.9	4.8	4.9	1.8
90	2.5	2.7	2.7									

Table E.20 PADD I Propane Imports, 1988-90

	(Thousands of Barrels per Day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	22	48	24	19	18	5	28	17	19	13	29	22
89	41	37	22	19	16	19	21	4	17	9	22	20
90	64	49	40									

Table E.21 PADD I Propane Product Supplied, 1988-90

	(Thousands of Barrels per Day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	210	167	124	71	61	66	80	80	100	119	128	115
89	230	239	203	131	104	95	108	141	160	162	166	170
90	233	187	155									

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Appendix E Supplementary Charts and Tables

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Table E.25 Wholesale and Retail Propane Prices, 1989-90

(Cents per Gallon)

	WHOLESALE		RETAIL									
	MI.		PADD			PADD				PADD		PADD
	Bellevue Texas	Conway Kansas	MA	IA NH	VT	NJ	IB NY	PA	IN	II OH	TN	III TX
01-Dec	22.5	23.8	106.3	103.3	99.3	101.0	100.0	85.0	66.0	79.6	88.6	56.7
04-Dec	24.3	25.6										
05-Dec	24.3	25.1										
08-Dec	24.8	25.6										
07-Dec	26.0	27.1										
08-Dec	26.5	28.4										
11-Dec	29.0	32.9										
12-Dec	29.0	33.1										
13-Dec	29.3	33.6										
14-Dec	30.3	36.1										
15-Dec	34.5	43.1	125.0	111.0	100.8	102.0	107.5	90.0	74.0	79.6	88.6	58.3
18-Dec	40.5	49.9										
19-Dec	50.0	65.3										
20-Dec	50.0	64.5										
21-Dec	51.3	67.5										
22-Dec	55.0	71.0										
26-Dec	51.8	62.5										
27-Dec	56.0	66.3										
28-Dec	66.0	73.6										
29-Dec	69.0	81.0										
02-Jan	70.0	95.5	143.7	144.0	140.8	136.5	140.0	119.3	100.0	109.9	119.0	90.7
03-Jan	52.0	86.0										
04-Jan	43.0	73.0										
05-Jan	56.0	78.5										
08-Jan	50.0	67.5										
09-Jan	47.5	64.5										
10-Jan	47.0	65.5										
11-Jan	47.0	62.8	145.3	149.8	153.5	141.5	146.5	132.0	101.9	120.6	119.0	91.3
12-Jan	51.5	63.3										
15-Jan	55.0	62.5										
16-Jan	52.0	51.0										
17-Jan	47.5	48.0										
18-Jan	43.8	42.3										
19-Jan	42.0	41.5										
22-Jan	37.3	35.3										
23-Jan	32.5	31.5	142.0	147.3	151.0	141.5	142.5	120.8	100.3	116.6	115.6	88.0
24-Jan	33.5	31.5										
25-Jan	38.5	31.5										
26-Jan	37.8	31.5										
29-Jan	37.3	31.3										
30-Jan	37.3	32.3										
31-Jan	32.3	30.5										
06-Feb	28.8	26.8	142.0	134.8	124.0	134.0	132.5	113.0	89.6	104.0	110.0	78.0
23-Feb	23.6	21.4	128.0	122.0	117.3	125.5	125.0	99.3	82.3	102.0	108.0	74.7
06-Mar	23.4	20.4	122.3	119.0	109.8	120.5	117.5	97.3	79.0	90.3	106.6	67.7
20-Mar	24.1	20.6	120.7	113.8	107.0	114.0	115.0	97.3	75.6	87.6	104.6	67.0
01-May	22.4	21.1	115.0	110.0	107.0	104.5	112.2	91.3	68.6	84.2	101.3	61.7

Table E.26 U.S. Kerojet Stocks, 1988-90

(Millions of Barrels)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
88	38.0	36.7	39.5	39.0	39.2	38.8	40.1	39.7	40.1	40.8	39.7	37.7
89	37.9	37.4	37.9	38.1	39.2	38.4	40.8	42.3	41.8	44.2	44.6	34.5
90	36.4	40.1	41.9									

Table E.27 U.S. Kerojet Production, 1988-90

(Thousands of Barrels per Day)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
88	1,231	1,205	1,242	1,088	1,059	1,133	1,154	1,138	1,177	1,158	1,118	1,259	1,164
89	1,312	1,216	1,188	1,074	1,031	1,139	1,194	1,237	1,218	1,300	1,305	1,149	1,197
90	1,299	1,298	1,224										

Table E.28 U.S. Kerojet Imports, 1988-90

(Thousands of Barrels per Day)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
88	82	68	95	81	108	75	85	100	59	143	76	72	87
89	82	117	96	125	110	108	111	81	92	67	89	110	99
90	155	145	108										

Table E.29 U.S. Kerojet Product Supplied, 1988-90

(Thousands of Barrels per Day)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
88	1,360	1,281	1,195	1,173	1,157	1,206	1,193	1,237	1,216	1,277	1,221	1,314	1,236
89	1,315	1,330	1,267	1,175	1,103	1,273	1,219	1,255	1,292	1,262	1,339	1,545	1,281
90	1,369	1,264	1,257										

Appendix E Supplementary Charts and Tables

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Table E.30 Kerojet Prices, New York Harbor Cargoes and Gulf Coast Waterborne, 1989-90

(Cents per Gallon)

NEW YORK							GULF COAST					
	OCT	NOV	DEC	JAN	FEB	MAR	OCT	NOV	DEC	JAN	FEB	MAR
1		63.13	64.50		63.50	58.25		61.13	61.88		60.25	55.13
2	64.50	63.13		92.50	64.25	58.88	61.88	60.63		95.38	61.25	56.25
3	64.50	63.13		104.50			61.88	60.50		95.38		
4	63.75		66.75	98.00			61.00		61.88	98.13		
5	62.50		67.00	88.50	61.00	61.38	60.13		62.25	88.13	58.63	58.38
6	62.75	63.13	67.25		60.50	61.50	59.88	60.00	62.38		58.88	57.63
7		63.25	67.75		60.50	60.75		60.25	64.00		57.25	56.63
8		61.63	68.50	82.50	59.25	57.88		58.88	64.50	76.00	56.38	55.88
9	63.00	62.00		79.50	58.75	56.25	61.00	58.88		76.25	56.13	54.25
10	64.25	61.75		94.00			61.75	57.88		76.00		
11	64.38		68.50	87.50			61.75		65.25	85.75		
12	65.13		69.00	92.50	60.25	55.88	62.38		65.75	86.75	57.13	53.88
13	65.13	61.50	71.00		60.75	56.00	62.25	57.13	66.88		57.88	53.88
14		61.38	70.50		61.38	56.13		56.63	66.63		58.50	54.38
15		60.13	72.50	82.00	61.50	57.00		56.38	70.38	79.25	59.13	55.38
16	64.75	61.50		82.50	61.25	57.75	61.88	58.13		78.50	57.75	54.88
17	65.00	62.00		75.50			62.25	58.88		71.50		
18	64.38		80.50	76.50			61.88		74.63	73.00		
19	64.25		80.75	78.50		57.75	62.25		74.88	73.88		54.63
20	64.38	62.50	82.00		62.13	57.75	61.50	59.13	74.88		57.38	54.63
21		63.00	83.75		59.63	58.25		59.00	79.13		57.13	55.63
22		63.50	86.50	77.50	60.13	57.88		60.13	78.75	69.38	58.00	55.13
23	62.63			75.00	59.88	57.88	59.63			67.63	57.88	55.63
24	62.50	63.50		72.50			59.75	60.38		67.88		
25	62.50			69.50			60.00			68.13		
26	61.38		102.50	69.00	62.75	57.38	58.63		83.00	65.50	58.38	54.13
27	61.50	63.00	105.50		61.75	57.88	59.25	60.00	90.13		57.38	54.63
28		62.50	101.50		59.25	58.25		59.13	82.75		56.88	53.88
29		62.50	94.00			58.50		59.13	87.00			54.00
30	61.75	63.75				58.63	59.25	60.88				54.13
31	62.00						60.38					

Table E.31 Natural Gas Consumption, by Region and Sector, 1988-89

(Million Cubic Feet)

RESIDENTIAL

	Dec 88	Nov 89	Dec 89	Percent Change to Dec 89 from	
				Dec 88	Nov 89
New England	21,946	12,705	25,407	15.8%	100.0%
Middle Atlantic	103,907	64,390	132,739	27.7%	106.1%
South Atlantic	53,452	30,988	68,042	27.3%	119.6%
East North Central	204,493	138,061	262,228	28.2%	89.9%
Total U.S.	630,000	400,000	789,000	25.2%	97.3%

COMMERCIAL and INDUSTRIAL

New England	15,831	12,801	16,206	2.4%	26.6%
Middle Atlantic	88,722	70,524	100,176	12.9%	42.0%
South Atlantic	79,449	71,833	76,382	-3.9%	6.3%
East North Central	201,817	151,954	216,905	7.5%	42.7%
Total U.S.	911,000	827,000	1,045,000	14.7%	26.4%

ELECTRIC UTILITIES

New England	287	1,645	8	-97.2%	-99.5%
Middle Atlantic	2,388	12,060	4,422	85.2%	-63.3%
South Atlantic	7,137	14,351	10,595	48.5%	-26.2%
East North Central	3,094	2,112	2,794	-9.7%	32.3%
Total U.S.	137,000	187,000	170,000	24.1%	-9.1%

Table E.32 Electric Utility Consumption of Petroleum Fuel, 1988-89

(Thousands of Barrels)

TOTAL PETROLEUM

	Dec 88	Nov 89	Dec 89	Percent Change to Dec 89 from	
				Dec 88	Nov 89
New England	6,761	5,584	7,824	15.7%	40.1%
Middle Atlantic	11,026	6,529	13,257	20.2%	103.0%
South Atlantic	6,493	2,600	7,477	15.2%	187.6%
East North Central	740	622	1,038	40.3%	66.9%
Total U.S.	30,556	19,246	37,153	21.6%	93.0%

HEAVY FUEL OIL

New England	6,485	5,480	7,306	12.7%	33.3%
Middle Atlantic	10,238	6,064	11,390	11.3%	87.8%
South Atlantic	5,970	2,318	6,042	1.2%	160.7%
East North Central	553	467	740	33.8%	58.5%
Total U.S.	28,383	17,762	31,374	10.5%	76.6%

(Percentage of Total Volume Represented by Heavy Fuel Oil)

	Dec 88	Nov 89	Dec 89
New England	95.9%	98.1%	93.4%
Middle Atlantic	92.9%	92.9%	85.9%
South Atlantic	91.9%	89.2%	80.8%
East North Central	74.7%	75.1%	71.3%
Total U.S.	92.9%	92.3%	84.4%

Table E.33 No. 6 Residual Fuel Prices, New York Harbor Cargoes, 1989-90

(Dollars per Barrel)

0.3-PERCENT SULFUR

	Oct	Nov	Dec	Jan	Feb	Mar
1		18.33	19.25		20.88	18.63
2	19.38	18.33		35.13	20.88	18.63
3	19.38	18.33		35.13		
4	19.45		19.45	35.13		
5	19.25		19.88	35.13	21.13	18.50
6	19.13	18.33	20.23		21.13	18.38
7		18.33	20.48		21.13	18.25
8		18.33	20.80	35.13	21.13	18.05
9	19.05	18.33		34.88	20.88	18.05
10	19.05	18.38		34.63		
11	18.80		21.88	32.63		
12	18.63		22.75	31.88	20.88	18.05
13	18.63	18.38	23.50		20.38	18.00
14		18.38	24.38		20.25	17.88
15		18.45	26.25	29.88	20.00	17.88
16	18.63	18.65		29.13	19.38	17.75
17	18.63	18.88		27.13		
18	18.63		27.38	26.13		
19	18.63		28.13	25.63		17.75
20	18.63	18.88	28.88		19.38	17.63
21		18.88	29.63		19.38	17.38
22		18.98	32.13	24.88	19.13	17.50
23	18.68			23.88	18.88	17.58
24	18.68	18.98		21.88		
25	18.68			21.38		
26	18.68		34.13	21.13	19.13	17.63
27	18.43	19.13	34.13		19.13	17.63
28		19.13	35.13		18.75	17.63
29		19.13	35.13	21.13		17.63
30	18.43	19.25		21.00		17.53
31	18.43			20.88		

1.0-PERCENT SULFUR

	Oct	Nov	Dec	Jan	Feb	Mar
		17.53	18.13		18.38	17.13
	17.63	17.68		25.13	18.38	16.88
	17.63	17.68		25.38		
	17.73		18.28	26.00		
	17.73		18.38	26.38	18.38	16.63
	17.73	17.68	18.53		18.38	16.38
		17.68	18.78		18.38	16.13
		17.68	18.78	25.88	18.38	16.13
	17.63	17.68		25.63	18.13	15.98
	17.63	17.78		25.38		
	17.63		19.38	25.38		
	17.63		19.73	25.38	18.13	15.98
	17.78	17.78	20.38		18.13	15.38
		17.78	21.13		18.13	15.38
		17.78	21.38	25.13	18.13	15.38
	17.78	17.88		24.88	18.03	15.13
	17.78	18.08		24.63		
	17.78		21.88	24.13		
	17.78		22.13	23.88		14.88
	17.78	18.08	22.13		18.03	14.88
		18.08	22.63		17.88	14.88
		18.13	23.25	23.13	17.38	14.98
	17.78			22.13	17.13	14.98
	17.78	18.13		20.63		
	17.78			20.13		
	17.78		23.75	19.88	17.13	15.08
	17.53	18.13	24.38		17.13	15.18
		18.13	25.13		17.13	15.18
		8.13	25.13	19.63		15.38
	17.53	18.13		19.38		16.03
	17.53			18.63		

Note: 0.3-percent Sulfur residual fuel oil is an average of low-pour and high-pour spot prices.

Table E.34 Crude Oil Composite Refiners Acquisition Cost, 1983-90

(Dollars per Barrel)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
83	30.73	29.49	28.64	28.33	28.64	28.85	28.75	28.88	28.97	29.14	28.85	28.83	28.99
84	28.67	28.81	28.81	28.77	28.83	28.77	28.79	28.69	28.60	28.56	28.30	27.97	28.63
85	27.02	26.49	26.76	27.03	27.12	26.76	26.59	26.50	26.45	26.66	26.86	26.72	26.75
86	25.63	19.76	14.80	13.05	13.05	12.83	11.26	11.93	13.13	13.05	13.30	13.84	14.55
87	16.16	16.83	17.04	17.44	17.85	18.47	19.13	19.36	18.57	18.43	18.02	17.09	17.90
88	15.92	15.61	14.88	15.81	16.22	15.71	14.71	14.36	13.94	12.96	12.58	13.97	14.67
89	15.70	10.31	17.55	19.22	19.03	18.43	18.16	17.23	17.66	18.24	18.39	19.54	17.97
90	20.64	20.35	19.17										

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Source: National Association of Attorneys General, *Attorneys General Task Force Reports on Winter Heating Oil Crisis*, Washington D.C., March 20, 1990; State of Maine, *Interim Report — Governor's Task Force on Home Heating Oil Prices*, January 25, 1990; State of New Hampshire, *Energy Supply Crisis Review Board Report*, February 14, 1990; New Jersey Division of Energy Planning and Conservation, *An Analysis of December 1989 Heating Oil Price Increases*, February 5, 1990; Pennsylvania Energy Office, *Interim Report — Heating Oil/Propane Survey*, February 12, 1990.

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