NATURAL GAS AND ENERGY PRICE VOLATILITY

PREPARED FOR THE
OAK RIDGE NATIONAL LABORATORY

BY THE

American Gas Foundation

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2 Comparison of Natural Gas Markets to Other Commodities and Markets

2.1 INTRODUCTION

In Chapter Two of this report on the results of a study on natural gas and energy price volatility for the American Gas Foundation and the U.S. Department of Energy, we evaluate the causes of price volatility, and the impacts of volatility on consumers, industry participants, and on the penetration of new technologies such as distributed generation (DG).

Over the last five years, energy price volatility has become the most significant issue facing the natural gas industry and energy companies. Natural gas, electricity, crude oil and oil product markets have all exhibited price volatility for some portion of the period. Price volatility has contributed to a climate of uncertainty for energy companies and investors and a climate of distrust among consumers, regulators, and legislators.

The study is intended to improve the understanding of the root causes of energy price volatility, to project the likely level of energy price volatility in the future, and to develop strategies to reduce the destructive impact of future volatility.

One of the primary objectives of the study is to propose methods to mitigate the potential negative consequences of extreme energy price volatility. However, it is also critical to recognize that the ability for energy prices to fluctuate in response to changes in supply and demand is a key characteristic in the operations of our free market energy systems. Energy prices transmit critical information about the balance between supply and demand, moving up and down in order to balance energy supplies with energy demand, both on a short-term, day-to-day basis as well as over a longer, multi-year investment planning horizon.

While the primary focus of this study is on volatility in natural gas markets, most commodity markets tend to experience periods with sharp changes in prices. In addition, most commodity markets also exhibit changes in the rate at which prices change (e.g., price volatility). The changes in price volatility observed in the natural gas markets over the last five years are not unique to natural gas markets, and the impacts of and solutions to price volatility for the natural gas market can also be observed in other markets.

In this chapter of the report we look at volatility in the natural gas market relative to volatility in other markets in order to identify similarities and highlight differences with these other markets. Section Two of this chapter provides a brief overview of the theory of commodity pricing. The comparison of price behavior of the natural gas commodity to behavior in other commodity markets is located in Section Three.

This chapter of the report also includes a comparison of the natural gas industry structure to the structure of two other industries (the airline industry and the telecom industry) that have undergone a similar process of deregulation. This comparison, located in section four, highlights similarities and differences between these two industries and the natural gas industry in order to identify potential impacts on price volatility of the different approaches that may be taken by the natural gas industry as natural gas markets evolve, as well as identifying potential approaches to mitigating price volatility that can be gleaned from the experiences in the other two industries.

The comparison of price behavior for natural gas relative to other commodities and industries provides valuable insights into the expected future volatility of natural gas, and the expected trends in natural gas industry development.

2.2
REVIEW OF COMMODITY PRICING THEORY

2.2.1 Role of Commodity Prices

Exchange traded commodities markets, including daily spot markets, futures markets, and options markets, provide three important economic benefits because of their highly competitive nature:

1) *As a mechanism for price discovery*: With many potential buyers and sellers competing freely, market trading is a very efficient means of determining the price level for a commodity.
2) *As a forum for hedging*: Producers, processors and users of commodities can use futures and options markets to pass the price risks inherent in their business to traders who are willing to assume these risks. The market participants that assign the highest cost to the risk will be willing to pay participants that assign a lower cost to risk to transfer their risk, resulting in a more efficient marketing system and lowering costs for consumers.
3) *As a focal point for the collection and dissemination of market information:* Commodities and futures markets operate efficiently only when market information is widely distributed and available. As a result, these markets generally become among the best sources of market data and information.

2.2.2 Types of Commodities

There are three broad types of commodities. Metals such as gold and silver are examples of *investment* commodities. Holders of investment assets typically would be prepared to sell their physical holdings and purchase futures or forwards contracts, if the futures contracts provided a financial advantage. These commodities typically have a very low "convenience" yield (see page 2-6 for definition of this term).

Consumption commodities such as energy or agricultural products have intrinsic value only when consumed. Individuals and companies who keep such commodities do so because of their consumption value, not because of their value as an investment. Users of these commodities generally assign a value to holding the physical commodity, as the futures contracts cannot be consumed directly and may not allow delivery of the physical asset at the desired time or location. These commodities tend to have high convenience yields.

The third broad type of commodities, *financial* commodities, includes stocks, bonds, currencies, and associated financial derivatives. These financial commodities are sufficiently different in terms of behavior and fundamental drivers from the energy commodities that we have chosen not to focus on this group of commodities in this analysis.

2.2.3 General Characteristics of Commodity Prices

Commodity price behavior varies from commodity to commodity depending on the specific factors influencing the supply and demand of each commodity. However, several characteristics are common across most commodities:

1) *Commodity prices tend to fluctuate in the short-term due to day-to-day and seasonal variations in supply and demand, but revert toward a long-term equilibrium.*

In a competitive market, price is the mechanism for balancing supply and demand. In the short-term, market prices adjust to the level that clears the market by balancing aggregate supply and demand. The short-term equilibrium price generally differs from the long-term equilibrium price level. At any given point in time, prices provide information to the market concerning longer-term market trends, and stimulate market decisions that will impact available supplies and the level of demand in the future.

The spot price fluctuates in the short-run but is driven towards a long-term stable value by market forces of supply and demand. If prices remain above the long-run equilibrium, supply increases and demand decreases until the market moves back toward the long-run equilibrium. The lag between short-term market clearing prices, and the impact of the short-term prices on longer-term supply and demand tends to lead to cyclical price behavior. The market is almost never in both a short-term and long-term equilibrium between supply and demand.

2) *Commodity price volatility influences the level of commodity prices.*

Changes in price volatility have a direct effect on natural gas prices, supply, and storage inventories in a variety of ways.[1] First, volatility influences the marginal convenience yield, or premium, on holding physical supplies of the commodity. For natural gas, this means that with increased volatility, the value of natural gas storage and pipeline capacity is enhanced. As a result, an increase in price volatility can result in short-term increases in demand to fill natural gas storage.

Second, an increase in volatility increases the marginal opportunity cost of production, or "option premium," associated with producing reserves at today's prices. As volatility increases, the theoretical cost of a marginal unit of production increases to reflect the higher option premium, resulting in a reduction in current production. The result is an increase in the absolute level of natural gas prices needed to generate the same level of supply.

3) *The long run equilibrium price can and does shift over time to reflect fundamental changes in the characteristics of supply and demand.*

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[1] For a more complete discussion, see Pyndick, Robert, Volatility and Commodity Price Dynamics, August 19, 2001.

General economic pricing theory also suggests that price volatility tends to revert to the mean. While volatility may increase or decrease relative to the long-run average due to market shifts away from equilibrium, over time as the market returns toward a long-term equilibrium, volatility will also tend to return toward the long-run equilibrium ***unless there has been a fundamental change in the nature of the market.***

4) *Price behavior for different commodities varies, sometimes dramatically, based on the underlying characteristics of the supply and demand of the commodity.*

Differences in the characteristics of supply, and the behavior of demand in different commodities create differences in price behavior and the level of price volatility in different markets. Typically, prices for energy commodities have been more volatile than most other commodities. Demand for energy commodities tends to vary on a day-to-day and month-to-month basis due to the direct impact of weather on demand, while there is generally a substantial lag between changes in prices and the corresponding changes in supply. In addition, energy industries tend to be very capital intensive, with high fixed costs, and relatively low variable costs of energy production resulting in relatively low elasticity of supply in the short-term. As a result, energy demand tends to vary substantially from season-to-season and from day-to-day, while energy supply tends to be relatively stable.

In this sense, energy commodities tend to behave quite differently from most other commodities. For most commodities, demand tends to be relatively stable from day-to-day and from season-to-season. Supply tends to vary seasonally for agricultural commodities, and to be relatively stable (day-to-day and season-to-season) for most other commodities.

2.2.4 Relationship Between Spot Market Pricing and Futures Markets Pricing

Futures contracts are firm commitments to make or accept delivery of a specified quantity and quality of a commodity during a specific month in the future at a price agreed upon at the time the commitment is made. In most futures markets, the prices tend to move in parallel to spot market prices. Generally, factors that influence cash prices have similar impacts on the price of the commodity for future delivery. In addition, since most commodities can be stored, discrepancies between spot and futures prices create arbitrage opportunities across time periods, ensuring a relatively close relationship between spot and futures prices.

Commodities futures markets for investment assets and other commodities that are easily storable tend to be "contango" markets. This means that the price of the physical commodity for future delivery generally trades at a premium to the spot price. The difference between the futures market and the spot market is limited by the cost of carrying the physical commodities as inventory (storage cost, losses, insurance and interest costs). Therefore, an upward trend to the prices of distant contract months is evident. In this analysis, we are looking at copper, which is a typical contango market commodity.

A market can also exhibit "backwardation," when nearby months trade at a higher price relative to the outer months. This pattern is evident in periods of low supply or high demand (particularly for highly seasonal products). The supply/demand imbalance causes the spot price to be bid up, thus encouraging increased production or the withdrawal of stocks. Agricultural products, such as coffee, which is evaluated in this study, often exhibit seasonal backwardation of prices in the months prior to a new harvest. Other markets with a high convenience yield also often have backwardation of prices.

The relationship between futures prices and spot market prices tend to differ by the type of commodity. Factors influencing the relationship between futures prices and spot prices include:

- The convenience yield – The convenience yield of a commodity is the incremental value of spot prices relative to futures prices after accounting for carrying costs. There is value to holding physical supplies of a commodity relative to a futures contract when short-term supply or demand factors can influence the value of the underlying commodity, or when the futures contract does not provide equivalent timing and location flexibility of holding the physical asset.
- Cost of holding the physical asset – The magnitude of storage costs affects how quickly the inventory is pushed into the market. Storage costs are paid only by the holders of the inventory, not by the holders of futures contracts.
- Perishable or non-storable commodities – These features are incorporated into the spot and futures market pricing.

Energy commodities (natural gas, crude oil) tend to behave like other consumption commodities, but also have unique characteristics that influence pricing behavior relative to other consumption commodities. The price differences between energy spot and futures markets can be attributed to the combination of a number of factors, including:

- Quality of the product – Quality differential between various grades of petroleum products reflect the associated production costs and the product's value in the market.
- Location – Prices at different locations reflect the value of transportation between two markets. Intermediate demand pressure and supply/transport constraints can create significant transitory price dislocations.
- Timing and payment differentials – In the case of petroleum products, inventories are maintained at relatively low levels in order to control costs, thus there is a propensity for petroleum markets to trade in a backwardation structure. In addition, the surplus of crude oil stocks and excess refining capacity contribute to the petroleum market's tendency to discount forward price levels.
- Supply factors – Seasonal supply and demand factors also have a significant impact on the spread of a given product. Heating fuels are expected to exhibit backwardation structure during winter and contango structure during fall. Motor gas shows a contango pattern during winter and spring and backwardation during late summer and early autumn.

2.2.5 Definition of Price Volatility Used in this Analysis

For our study, we are defining historical price volatility as the annualized returns on daily (or monthly) price movements. The return on a commodity is a relative measure of the average change in price of the commodity, and is measured as the standard deviation of the logarithmic price changes measured at regular intervals of time using settlement-to-settlement price changes.

Each price change is measured as $(x_I) = \ln (P_i/P_{i-1})$ where P_i is the price of the underlying contract at the end of the i_{th} time interval.

The annualized return is calculated by multiplying the standard deviation of the price changes in a given period by the square root of the time interval between price changes. Since we look at price changes every business day, the time interval is 365/(365/252) (assumes 252 business days each year, excluding weekends and holidays).

2.3 COMPARISON OF NATURAL GAS PRICE VOLATILITY TO PRICE VOLATILITY IN OTHER MARKETS

2.3.1 Introduction

For this analysis we have compared price volatility for natural gas to price volatility in several other markets including other energy markets (crude oil, distillate fuel oil, and electricity), agricultural commodity markets (coffee), and metals commodity markets (copper). We have also compared pricing behavior in the natural gas futures markets to futures market behavior for crude oil (WTI), copper, and coffee.

As a commodity, natural gas is related to, and behaves in much the same way as, the other energy commodities. The energy commodities tend to differ from other types of commodities, such as agricultural and metals commodities, in three fundamental ways:

1) First, energy demand tends to be highly seasonal, and tends to fluctuate widely based on changes in the weather. Demands for natural gas, distillate fuel oil and electricity tend to be driven primarily by heating or cooling demand, which fluctuates widely from day-to-day, and from season-to-season based on changes in weather conditions.

2) Second, energy commodities tend to be more expensive to store than most other commodities. Electricity storage is generally not economically feasible. Natural gas storage requires substantial investment, and is subject to a variety of geological and geographic constraints. Petroleum storage is relatively expensive compared to other commodities, such as copper and coffee.

3) Finally, energy tends to be more expensive to transport from region to region, resulting in a large number of regional markets. While more important for natural gas and electricity, this can also be important for petroleum products due to the relatively rapid shifts in demand for these products.

However, differences in production patterns, transportation requirements, and the ability to store natural gas, separate natural gas price behavior from the other energy commodities in terms of market behavior. In this section we compare price and price volatility in natural gas markets to crude oil, distillate fuel oil, and electricity markets. Crude oil and distillate fuel oil markets tend to be international in scale, with differences in prices and markets reflecting transportation costs and quality concerns. North American natural gas markets tend to be fully decoupled from international markets, and regional markets within the North American market tend to be differentiated by physical constraints on natural gas transportation capabilities. Electricity markets are primarily local markets, with only little ability to store electricity, or to move electricity from one regional market to another.

Agricultural commodities, such as coffee, share several qualities with natural gas and other energy commodities. Agricultural commodities are subject to a high degree of weather related uncertainty and to seasonal trends. Therefore, price movements are sudden and may be large in magnitude. Storage of agricultural commodities is also more closely related to storage of energy commodities than many of the other classes of commodities. Agricultural storage costs tend to be relatively high due to the need to control the environment. Agricultural products also have a limited storage time period reflecting product shelf life, spoilage and degradation of product quality over time.

We have selected coffee as the agricultural commodity to include in this analysis. Coffee is one of the most actively traded international commodities, with supply primarily from tropical countries in the Southern Hemisphere, and demand mainly in North America and Europe. Coffee plants require three to five years to mature, hence the coffee supply cycle is more closely related to the natural gas production cycle than many of the other commonly traded commodities, such as corn or cotton.

Metals commodities tend to have some of the same long-term drivers of supply and demand as natural gas, without the impacts of short-term weather-related volatility, and without the constraints on storage imposed by the nature of natural gas. For example, demand for products such as copper tend to be dependent on longer-term factors such as economic activity rather than short-term or seasonal issues.

Long-term supply trends for metals commodities also tend to be quite similar to long-term energy supply trends. Mining and refining operations are generally very capital intensive, leading to substantial lags in developing new sources of supply when prices increase. However, metals mining and refining operations also tend to have relatively high variable costs, meaning that in even a moderately slack market, less economic operations will be shut down, setting a floor on commodities prices that is generally higher than similar supply responses in the energy industry, and also resulting in fairly quick potential increases in supply in response to higher prices. In addition, metals are generally relatively inexpensive to store, with storage costs primarily related to interest rates rather than physical storage costs.

The data series for each of the commodities reviewed in this analysis is summarized below:

- Natural gas (Henry Hub): Henry Hub represents the most actively traded point for U.S. natural gas markets. There is both a physical market and a NYMEX futures market for natural gas at Henry Hub. Contracts are quoted in dollars per MMBtu. Futures contracts are available for 72 consecutive months commencing with the next calendar month.
- Crude oil (WTI): Crude oil is traded in a variety of different markets. These markets differ by location and the specific characteristics of the crude oil. The market used in this analysis is West Texas Intermediate (WTI) crude oil. Both WTI spot and futures contracts are traded on the NYMEX. Prices are quoted in dollars per barrel and futures

are available for 30 consecutive months plus long-dated futures initially listed 36, 48, 60, 72, and 84 months prior to delivery.

- Heating oil (New York Harbor): Heating oil, or No. 2 fuel oil, accounts for about 25% of the end-use demand for products from crude oil. Heating oil users and those hedging on diesel and jet fuel use heating oil futures. Contracts are quoted in dollars per gallon. Futures contracts are available for 18 consecutive months commencing with the next calendar month.
- Electricity (PJM): There are currently no active exchange traded commodity or futures markets for electricity. For our analysis we have used reported market prices for transactions in the bilateral, wholesale power market in the PJM (Pennsylvania, New Jersey and Maryland) Interconnection Western Hub. The PJM began reporting index prices for this location in 1998 with the implementation of locational marginal pricing (LMP). The hourly LMPs for next operating day are calculated using generation offers, demand bids and bilateral transaction schedules. The market price is set by the eligible generating unit with the highest bid price running to meet the load.
- Copper: Copper is traded heavily in markets worldwide. Copper futures are well established and are traded on the London Mercantile Exchange and the NYMEX. For this analysis, we have used NYMEX prices. The NYMEX prices are quoted as cents per pound and trades are made for delivery during the current calendar month and the next 23 consecutive calendar months.
- Coffee: Coffee and coffee futures are traded on several markets. For this analysis, we have used the New York Board of Trade (NYBOT) coffee market. Coffee prices are quoted in cents per pound. Futures contracts are available for specific contract delivery months within the next year. Contract delivery months include March, May, July, September and December.

Appendix C includes a more detailed technical description of each commodity as provided by the relevant exchange. We evaluate general price and price volatility behavior for each of these commodities in sections 2.3.2 through 2.3.7 below.

2.3.2 Natural Gas Price and Price Volatility Behavior

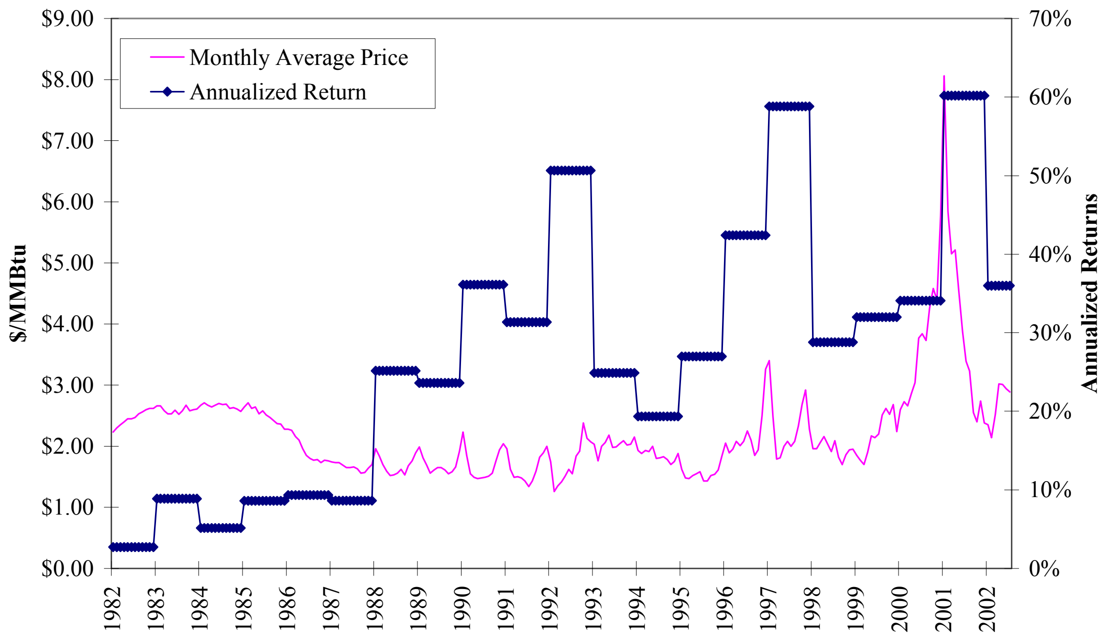
Figure 2-1 shows the long-term price and price volatility behavior patterns for Henry Hub natural gas prices. In the short-term, natural gas prices are set by weather-related changes in day-to-day demand. In the longer-term, natural gas prices are set based on both supply and demand trends. While natural gas price volatility has only been in the public spotlight for the last several years, Figure 2-1 illustrates that the current levels of price volatility are the result of a long-term upward trend, starting around 1988.

Market Characteristics Influencing Natural Gas Price Volatility

Natural gas is one of the most volatile of the widely traded commodities. The increase in volatility relative to other related commodities such as crude oil can be traced, at least in part, to several key characteristics of natural gas:

Figure 2-1

Long Term Henry Hub Natural Gas Price and Price Volatility



1) <u>Natural Gas Demand is Highly Seasonal</u>

The majority of the gas used in the residential and commercial sectors is consumed for space heating requirements, peaking on the coldest days during the winter. These loads swing dramatically with changes in the weather, and in the short-term tend to be insensitive to changes in price. Industrial use tends to be relatively flat with modest peaks during the winter for space heating load. Industrial load tends to be relatively sensitive to changes in price, with a certain amount of load switchable from natural gas to oil based on relative prices. Power generation usage, which represents the fastest growth sector of the natural gas market, responds to changes in electricity demand, which tends to be summer peaking in most parts of the U.S., but winter peaking in New England (with PEPCO and Puget Sound examples of winter-peaking utilities in other parts of the U.S.). Power generation gas demand tends to be very price sensitive while dual-fuel fired plants are still burning natural gas, but very price insensitive once all of the switchable capacity has moved away from natural gas. Natural gas is generally used for marginal generation units that are dispatched only after virtually all other sources of capacity are utilized. As the use of natural gas for power generation increases, the price of natural gas and the price of electricity are increasingly interrelated, particularly in locations with significant marginal gas-fired generation capacity.

2) Natural Gas Production Does Not Vary Significantly By Season

Natural gas production tends to operate at almost 100 percent of capacity, all of the time. Natural gas producers are generally price insensitive in the short-term. The marginal cost of producing natural gas is relatively low, providing little incentive to shut-in production in the face of falling prices. In addition, shutting in capacity delays production, hence revenues, to the end of the resource production life. Hence, shutting in current production due to low prices tends to delay revenues for several years. As a result, a substantial decline in gas prices below the long-term forecasted price of natural gas is required before the value of future production at a higher price is greater than the value of current production at the lower price. Since most producers operate at nearly full capacity, there is little ability to increase production in the short-term in response to higher prices.

In the longer-term, the market responds to changes in natural gas prices by increasing or decreasing investment in new supplies. The impacts of changes in supply investment are generally observable in the market from six to eighteen months after the decision to increase or decrease investment. As a result, any imbalances between natural gas supply and demand tend to persist for extended periods of time before the market can successfully react by increasing or decreasing supply. This factor is more important for natural gas than for crude oil or distillate fuel oil because natural gas markets tend to be more regional in scope. In broad terms, natural gas markets are integrated throughout North America, while crude oil and petroleum product markets are global in scope.

3) Natural Gas Transportation and Storage Infrastructure Constraints

Natural gas delivery is constrained by the existing transportation, distribution and storage infrastructure. Because natural gas has to be moved by pipeline, the price in any specific area is totally dependant on the availability of pipeline capacity. Unlike fuel oil or almost any other commodity, natural gas cannot be shipped by truck, train, or ship to alleviate local market shortages. As a result, natural gas price volatility in markets without sufficient pipeline delivery capacity can be much higher than price volatility in other markets.

In addition, natural gas storage is limited geographically, and is relatively expensive. Unlike commodities such as oil or coffee, natural gas must be compressed for storage. The compression requirements limit potential storage locations and substantially increase the costs of storage. Furthermore, most storage capacity in North America has distinct seasonal storage withdrawal and injection patterns that must be followed within certain tolerances in order to maintain the characteristics of the storage fields.

4) High Natural Gas "Outage" Costs

Natural gas service disruptions present an unacceptable risk to health and safety. Space heating and other gas application represent essential human needs. The result of a supply disruption to these applications go far beyond an economic loss. Historically, the gas industry and its regulators have correctly placed a preeminent emphasis on maintaining service to these customers.

Moreover, natural gas supply disruption could create a greater risk to health and safety than a disruption of electricity service to similar human needs customers. In all but the most extreme instances, e.g. "black start" conditions[2] such as those that existed in the Northeast on November 9, 1965, returning customers to service involves restoring individual lines to those customers that have lost service. For natural gas, however, a loss of service to a portion of a distribution system, known as a re-light, requires that all customers be "valved-off", purging the gas lines, and individually re-lighting all of the pilot lights for all customers in the region. If not done properly, the process can create risk of fire or explosion.

Such disruptions are extremely rare because of the emphasis that the industry has placed on reliability. Nevertheless, since regional supply disruptions must be avoided at all costs the risk of such disruptions differentiates natural gas from other commodities.

5) Regulated Nature of Natural Gas Markets

Finally, relative to most commodities other than electricity, the natural gas industry remains highly regulated. Deliverers of natural gas often have service obligations imposed by law, which makes it distinctly different from most other commodities with the exception of electricity. As noted previously, in most markets, natural gas provides a key service with significant, and in many cases, potentially life-threatening consequences for shortages. In addition, the critical role of storage and transportation infrastructure on natural gas delivery results in market results in a public interest in monitoring the construction and operation of these facilities. Hence, transportation, storage and distribution of natural gas remains highly regulated at both the federal and state level. The impact of regulation can be seen in several areas. Most major facility investments require approval at either the state or federal level. Delay in citing capacity additions because of regulatory restrictions does not often enable immediate near-term capacity relief. It's not uncommon to spend 5 to 10 years trying to site additional pipeline capacity into areas vulnerable to shortage.

Regulatory oversight can also constrain free market solutions to the issues of volatility. For example, a free market industry would react to eliminate economic disadvantage created by volatility via the buying and selling of risk. However, this type of hedging is often prohibited or limited in a regulated industry since hedging practices generally increase average costs, while minimizing price volatility. In addition, many LDCs face either actual or perceived disincentives to hedge, since benefits of hedging programs that produce actual gas cost savings generally are refunded to ratepayers, while hedging costs may be subject to prudence reviews and disallowance if the programs do not generate actual savings.

Deliverers of natural gas often have service obligations imposed by law, which makes it distinctly different from most other commodities with the exception of electricity. In most

2 "Black start" conditions refer to the conditions were very large regions of the electric grid loose service. In these cases, re-energizing the system is complicated by the need to synchronize generators at multiple locations.

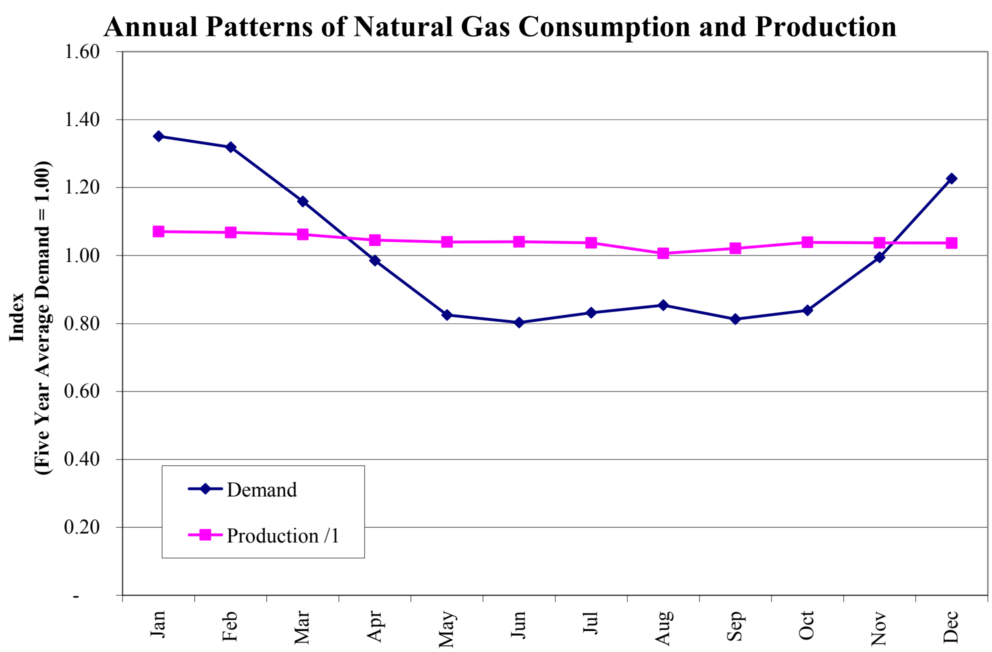
markets, natural gas provides a key service with significant, and in many cases, potentially life-threatening consequences for shortages.

Figure 2-2 illustrates the normal relationship between seasonal changes in demand and the relatively constant supply. Supply and demand are balanced through the use of natural gas storage. During high demand periods, typically but not always in the winter, demand is met through withdrawals from storage to augment production. During low demand periods, excess production is injected into storage. The use of storage to meet seasonal swings in demand is one of the characteristics of natural gas not shared by other commodities.[3]

The high volatility in prices is due to the tightness of production and the magnitude of the supply-demand imbalance, which became too large to be moderated by the behavior of customers who could easily respond to price conditions. The increasing link to volatile electricity markets also contributes to the volatility.

Figure 2-3 illustrates natural gas price volatility trends over the 1999 - 2002 time period. The annualized returns from 1999 until 2002 range from 22 to 192 percent.

Figure 2-2

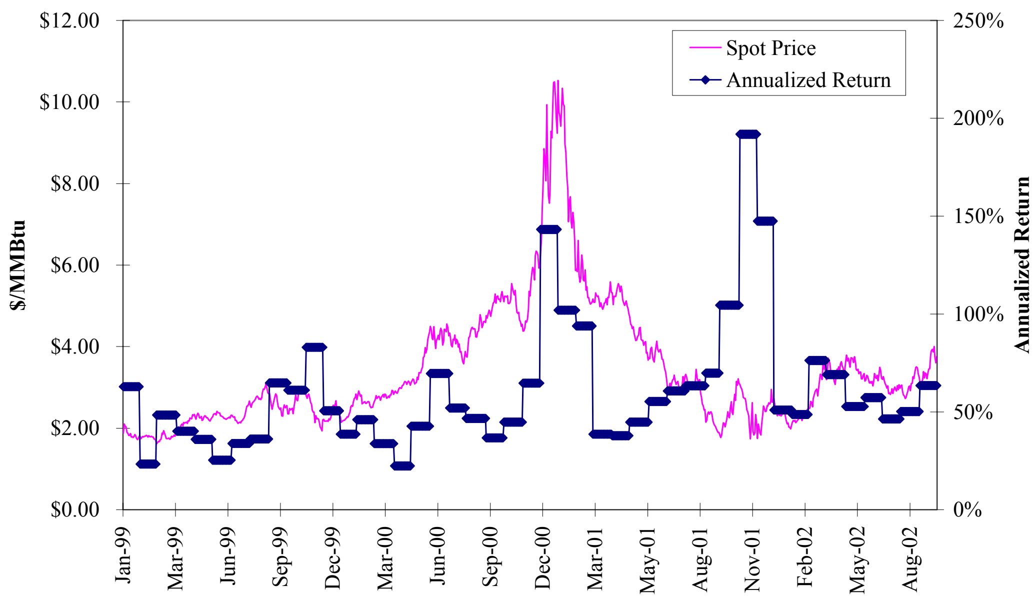


1/Production includes imports from Canada and Mexico

[3] Gasoline and distillate fuel oil markets also rely on storage to meet seasonal swings in demand, albeit to a much lesser degree than natural gas markets.

Figure 2-3

Henry Hub Natural Gas Prices and Price Volatility
Daily Series: 1999-2002



Impact of Location on Natural Gas Prices and Price Volatility

Generally, we consider the North American natural gas market to be an integrated market. However, the nature of natural gas and natural gas transmission and distribution systems creates substantial locational differences in natural gas prices and price volatility within the greater North American market. Figure 2-4 illustrates the differences in natural gas prices in six regional markets – Henry Hub, Cheyenne Hub, Rocky Mountains, New York City, the Florida Citygates and Alberta Canada. As this figure suggests, the gas prices generally track each other. However, certain locations experience substantial price spikes or price dips relative to other markets at particular times.

Recent trends in natural gas price volatility at these locations are compared in Table 2-1 and Figure 2-5. In the last four years, price volatility in all of these locations has dramatically increased. The general natural gas marker market, Henry Hub, has been the most stable of these six markets.

Prices in the production areas of the Rocky Mountains have been the most volatile of the markets considered. It is worth noting that volatility in these markets has not received the press or generated the concern created by volatility in other markets. Prices in the Rocky Mountains have been particularly volatile due to regular downward movements in prices caused by a lack of pipeline capacity exiting the region.

At the other extreme, price volatility in New York City has been created largely by lack of pipeline capacity into the city, resulting in price spikes during periods of high demand. These high prices have received a substantial amount of public attention.

Figure 2-4

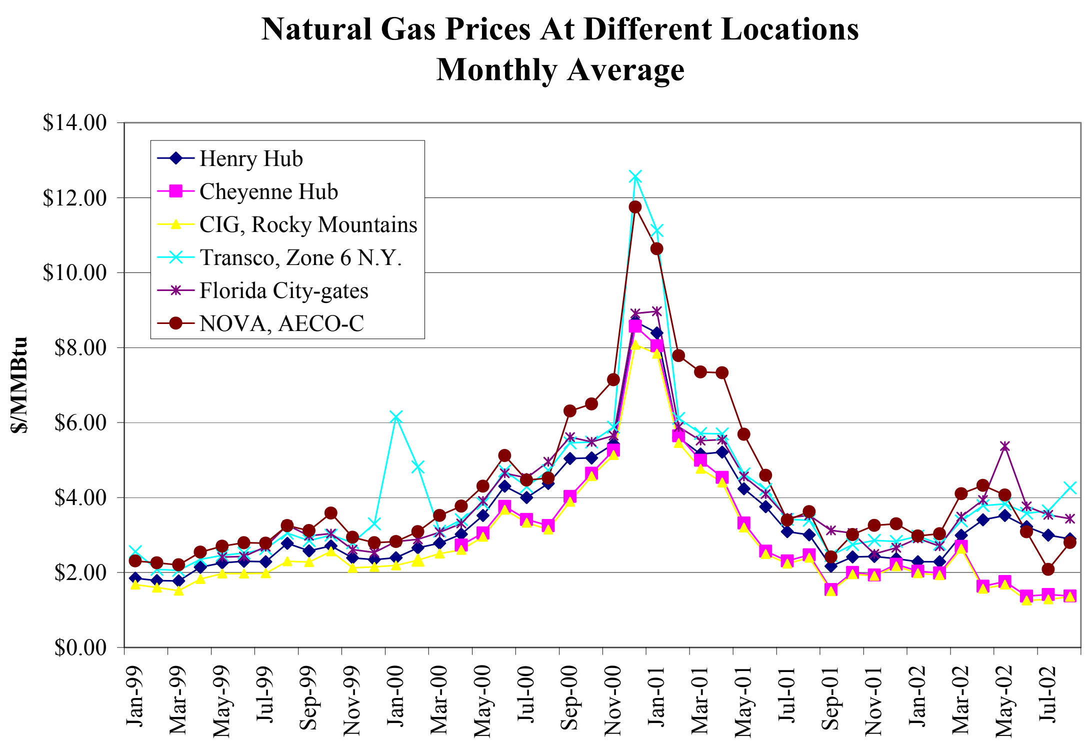


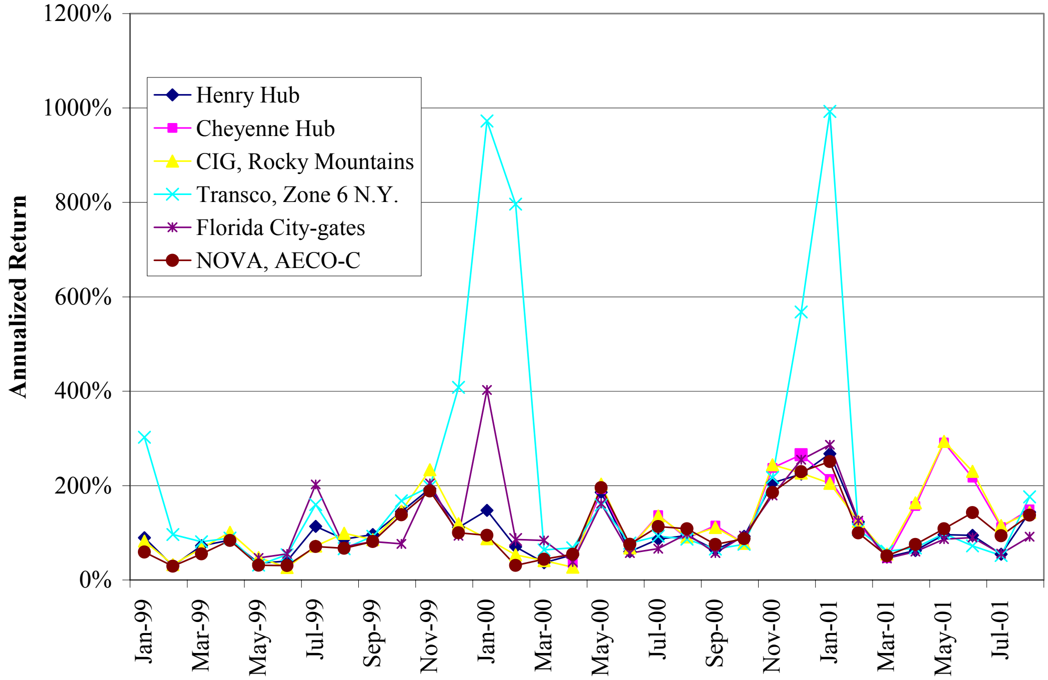
Table 2-1

Impact of Location on Natural Gas Price Volatility
(Annualized Return)

	1999	2000	2001	2002	Total
Cheyenne Hub	0%	90%	179%	377%	231%
CIG, Rocky Mountains	55%	79%	174%	363%	184%
Transco, zone 6 N.Y.	89%	196%	151%	152%	152%
NOVA, AECO-C	41%	71%	122%	138%	96%
Florida city-gates	62%	78%	91%	125%	90%
Henry hub	50%	61%	94%	57%	69%

Figure 2-5

Impact of Location on Natural Gas Prices Volatility



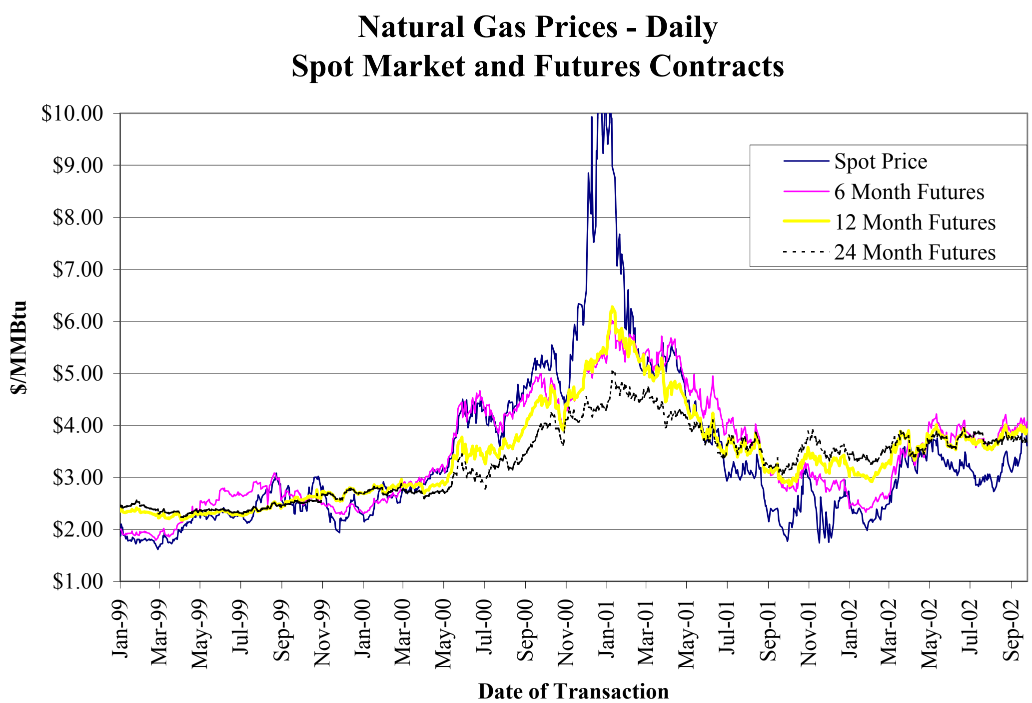
Natural Gas Futures

Figure 2-6 shows the spot prices and the prices for futures contracts traded on NYMEX. These futures contracts have maturity dates six, nine, twelve and twenty-four months after the trading date.

The natural gas futures market tends to behave more like the agricultural commodities than the metals or other commodities. It tends to follow two general patterns. The first is a seasonal pattern, similar to an agricultural commodity, with futures prices typically lower for summer months and higher for winter months. In addition, the natural gas futures market tends to follow movements in the short-term spot price.

While natural gas futures contracts generally follow the trends of the spot markets, the volatility of prices in the futures market tends to be much lower than the volatility in the spot market. Volatility tends to decline with the length of the contract (e.g., 12-month futures are less volatile than six-month futures). This is illustrated in Figure 2-7. The range for the annualized return for the spot prices is from 22 to 192 percent; for the six-month contract it from 19 to 72 percent; and the range for the 12-month contract is from nine to 56 percent. Note that the spikes in spot price volatility are not reflected in the futures prices.

Figure 2-6



2.3.3 Crude Oil Price and Price Volatility Behavior

Figure 2-8 shows the long-term price pattern for WTI crude oil. Oil prices have varied widely, ranging from lows of below $15 per barrel in 1986 and 1999 to highs of about $35 per barrel in 1991 and 2001. Growth in supplies in areas outside of OPEC – primarily the North Seas, Russia, and South America – have precipitated the major declines in prices, while the major price increases are due to demand increases stimulated by economic growth, and to political factors that have curtailed supply, e.g., wars in Iraq.

Compared to natural gas, crude oil price volatility has been relatively stable, with only two exceptions. In 1986, prices dropped precipitously when Saudi Arabia stopped supporting prices at a higher level in the face of increased production from other non-OPEC Countries, and during 1990/1991when the Gulf War resulted in interruptions in Kuwaiti and Iraqi oil production. It is worth noting that crude oil price volatility has not increased substantially in the last several years, even though the absolute level of oil prices has changed relatively dramatically.

Figure 2-7

Henry Hub Natural Gas Spot and Futures Price Volatility

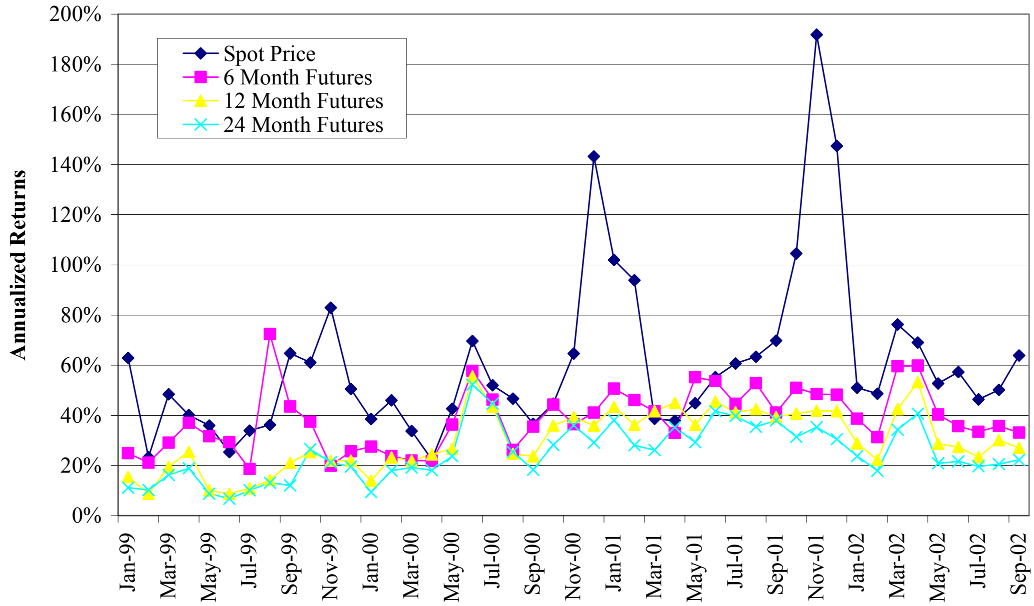
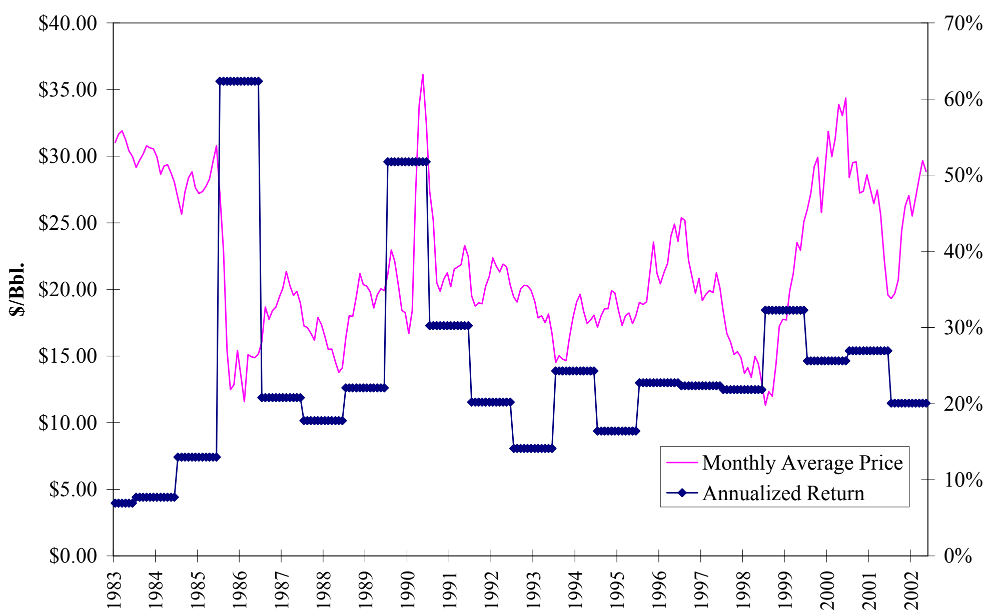


Figure 2-8

Long Term WTI Crude Oil Price and Price Volatility



Market Characteristics Influencing Oil Price Volatility

Crude oil is a "complex" commodity. This means that the demand for crude is driven by the demand for its derivative products, including heating oil, gasoline, diesel fuel and petrochemicals. The demand for these refined products is influenced by different factors including seasonal impacts and economic growth or decline.

Economic growth, environmental regulations, and energy efficiency trends tend to be the primary drivers of long-term crude oil demand. Price is a secondary driver, influencing fuel selection in certain applications, as well as the rate of energy efficiency improvements.

In the shorter-term, while not as extensive as for natural gas, there is a distinct seasonal demand trend for crude oil. In the U.S., heating fuels, particularly distillate fuel oil and residual fuel oil, tend to be highly seasonal, with peak demand occurring during the winter heating season. Gasoline use tends to peak during the summer driving season, somewhat offsetting the seasonality of the heating fuels.

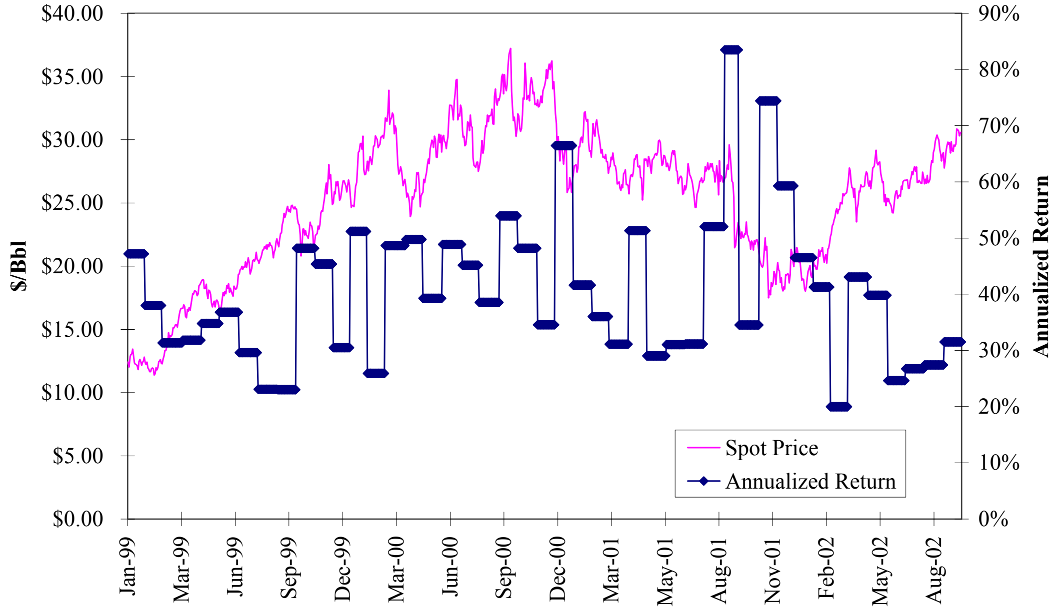
Historically, governmental policy in a handful of producing countries has been the primary driver of the price of crude oil. Prior to 1968, production allocation decisions by state regulators in the United States, particularly those made by the Railroad Commission of Texas, were the dominant influence on world oil prices. Since 1973, production decisions by the OPEC countries, primarily Saudi Arabia, have dominated world oil prices. Currently, the price of crude oil is set on the open market, but is heavily influenced by the production decisions of the OPEC countries as well as a handful of non-OPEC producers including Russia, Norway, and Great Britain. OPEC targets a price and fixes production levels, taking into account world demand levels and domestic revenue requirements. As a result, the price of crude is sensitive to global politics. For example, Saudi Arabia announced an increase in oil production after the September 11 terrorist attacks in order to reduce oil prices and support the world economy.

The price volatility of WTI crude is lower than that of other energy commodities. The high levels of activity in trading, varied sources of supply, and WTI demand characteristics help moderate price volatility.

Figure 2-9 illustrates recent trends in WTI oil prices and price volatility. Price volatility shows great variation through the months, with values ranging from 20 percent to almost 83 percent. Month-to-month volatility can also exhibit great magnitude, as in the fourth quarter of 2001 when the measure shot up from 31 percent in June to 83 percent in September and back down again to 35 percent in October.

Figure 2-9

WTI Crude Oil Prices and Price Volatility
Daily Series: 1999-2002



Crude Oil (WTI) Futures

Figure 2-10 compares the spot price to the settlement prices for contracts expiring 6 months, 12 months and 24 months into the future. The price of WTI oil futures contracts closely track that of the spot price.

The crude oil market is unique in its pricing structure.[4] For at least the last few years, futures prices have stayed below the spot price. This tends to occur when there is a general supply-demand equilibrium or if there is a supply shortage. Due to a lack of long-term storage for crude oil, refiners continually purchase to feed production. Therefore, most oil is purchased for immediate consumption. This puts upward pressure on the spot market, causing the backwardation. Thus, crude oil futures exhibit both contango and backwardation patterns.

Figure 2-11 illustrates the impact of the futures markets on price volatility. Like natural gas, price volatility in crude oil futures is dampened as the time to maturity of the contract lengthens. The peak volatility of the spot price exceeds 80 percent, while volatility for the six-month future contract reaches 56 percent and the 24-month futures contract reaches only 39 percent.

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[4] Errera, Steven and Brown, Stuart L. Fundamentals of Trading Energy Futures and Options. ©2001, Penn Well.

Figure 2-10

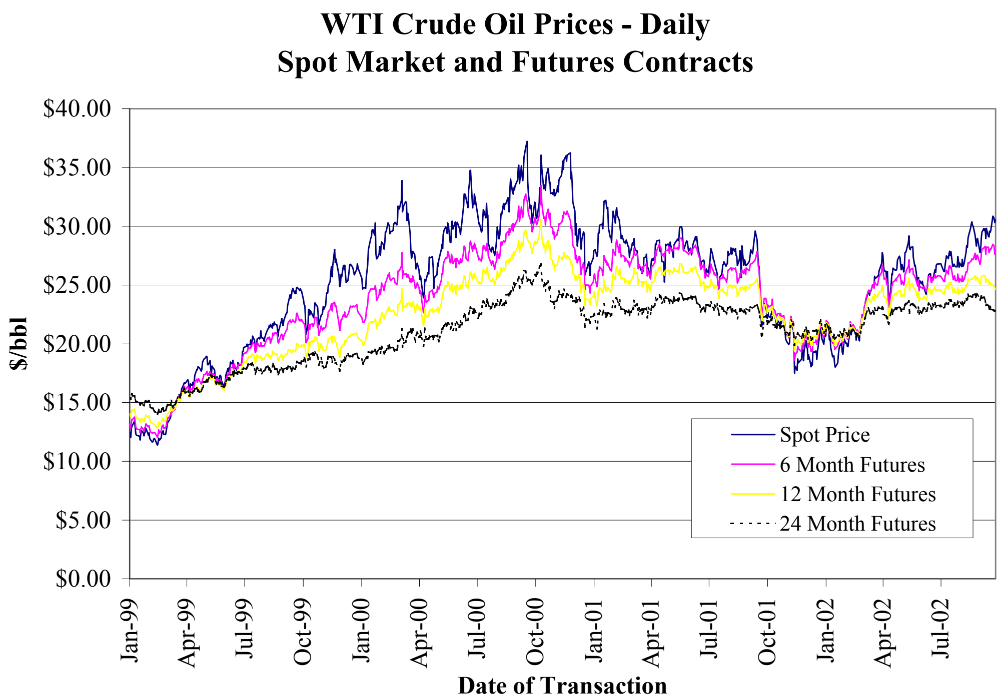
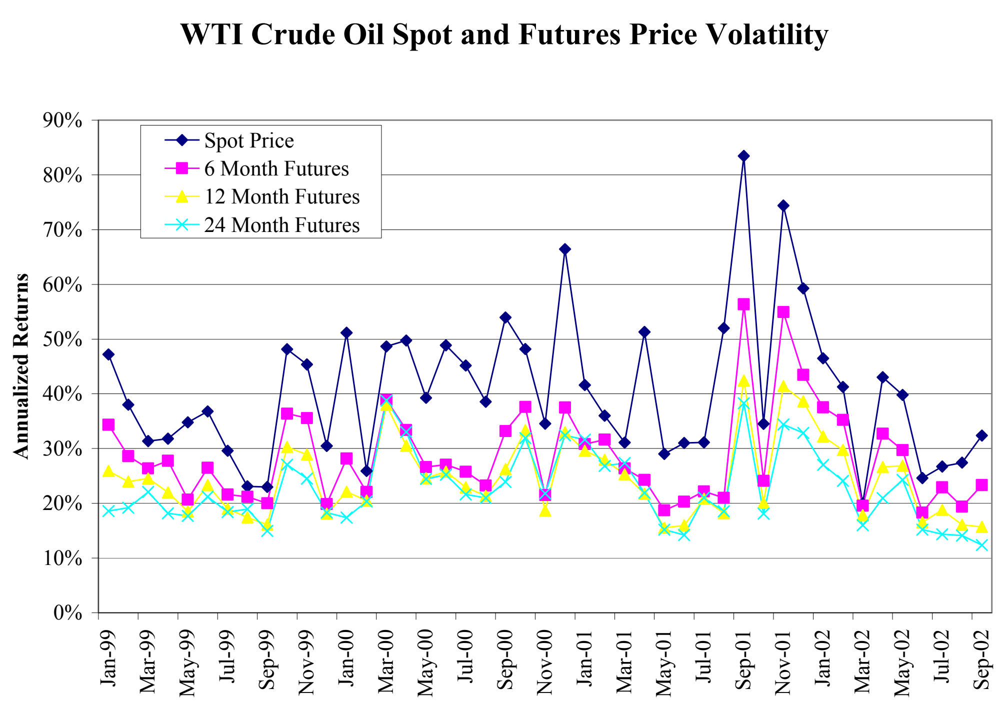


Figure 2-11



2.3.4 Heating Oil Price and Price Volatility Behavior

Crude oil is refined into a slate of petroleum products, including several that are widely traded as commodities. There are active markets for several grades of heating fuel, gasoline, jet fuel, and other petroleum products. We have selected the New York Harbor heating oil market for further analysis due to its similarities with natural gas markets. Heating oil is one of the only commodities other than natural gas to exhibit a distinct seasonal demand trend.

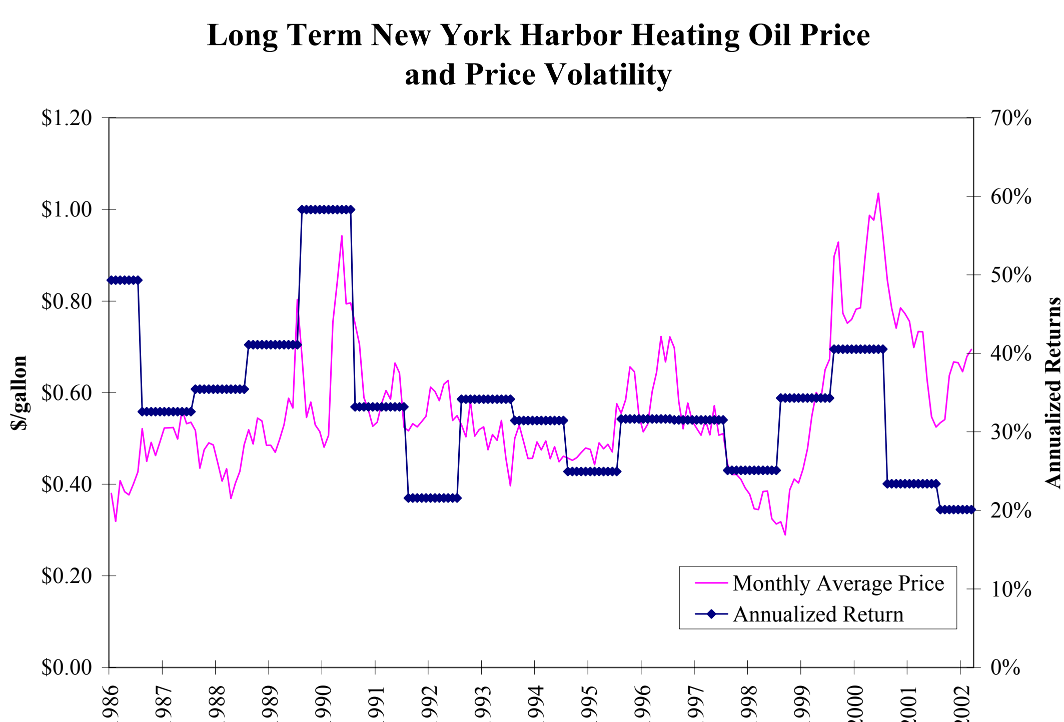
Market Factors Influencing Heating Oil Price Volatility

Figure 2-12 illustrate the long-term price and price volatility trends for the fuel oil market. Overall, fuel oil prices and price volatility behave very much like prices and volatility in the underlying crude oil market.

Heating oil is consumed primarily by residential and commercial customers for space heating, and as diesel fuel for transportation. The space heating demand is highly seasonal and peaks from December through February. Transportation diesel fuel use is relatively flat on a monthly basis.

Power generators and industrial users also use heating oil as fuel. However, since most of the consumers burning significant amounts of heating oil have fuel-switching capability, the relative prices of substitute fuels influence their demand.

Figure 2-12



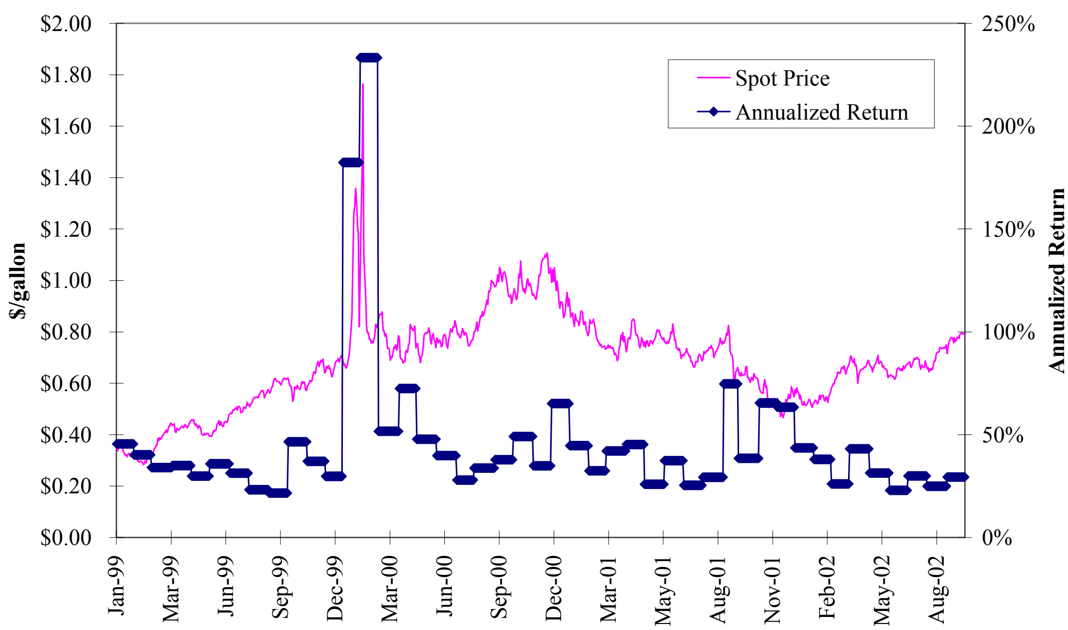
Overall, the demand for distillate fuel oil is moderately seasonal. In order to meet this seasonality, refineries tend to shift some production from gasoline, which has a moderate summer peak in demand, to distillate fuel oil, with a winter peak demand. In addition, refineries and distributors build inventories of distillate fuel oil during the fall in preparation for the winter heating season. However, there are technical limitations at the refinery level on the amount of distillate that can be produced relative to gasoline and other products. In addition, storage capacity is somewhat limited and storage costs tend to be quite high. As a result, distillate fuel oil is subject to occasional supply shortages during particularly cold winters. Heating oil prices thus tend to be somewhat more volatile than crude oil prices.

Price Volatility

Distillate fuel oil is refined from crude oil. Therefore, the price of fuel oil is influenced primarily by the price of crude oil. However, refinery constraints on production, along with limited storage inventories, can lead to demand-induced spikes in prices and price volatility. The heating oil market exhibited this type of price spike in the first quarter of 2000. The causes of this price spike are discussed in detail in the first volume of this study, but can be summarized as a supply shortage caused by extremely cold weather during a period with lower than normal inventories. During this period the price volatility reached values as high as 233 percent in annualized returns. However, except for this period, the volatility of heating oil remained at a more moderate level, ranging from 22 to 75 percent, and corresponding very closely to the price volatility observed in the WTI crude oil prices.

Figure 2-13

New York Harbor Heating Oil Prices and Price Volatility (Daily Series: 1999-2002)



Futures Prices

Figure 2-14 compares the spot and futures contract prices for fuel oil. This figure indicates that, in general, the heating oil futures market is characterized by prices slightly lower than current spot market prices, indicating a significant convenience yield associated with holding physical inventories. The price spike in the spot market during 2000 was not reflected in the futures market prices during the same period. This is consistent with the short-term nature of the price spike. When the cold weather moderated, prices returned to more normal levels relative to crude oil. The relatively minor impact of the supply shortage on futures prices indicates that the market believed that the short-term factors driving the price increase were not systemic, and would not persist into the future.

Figure 2-15 illustrates the impact of the futures markets on price volatility. Like natural gas and crude oil, price volatility in heating oil futures is dampened as the time to maturity of the contract is lengthened. This is evident as the peak volatility of the spot price exceeds 200 percent, while the six-month futures reaches only about 50 percent. Contract price volatility is generally lower for twelve-month futures contracts than for 6-month contracts.

Figure 2-14

New York Harbor Heating Oil - Daily Spot Market and Futures Prices

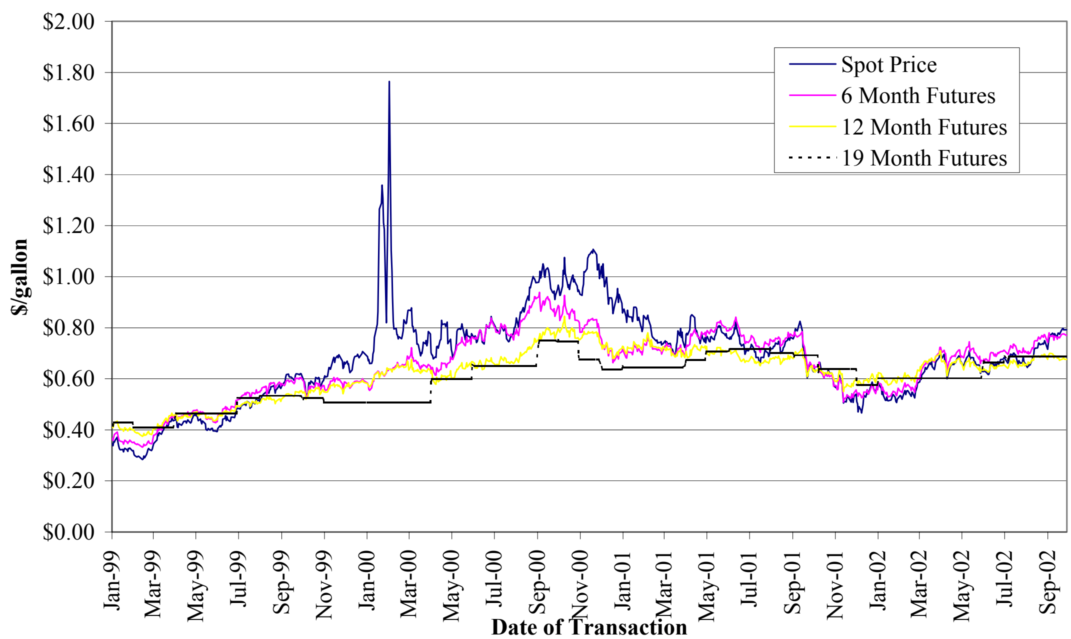


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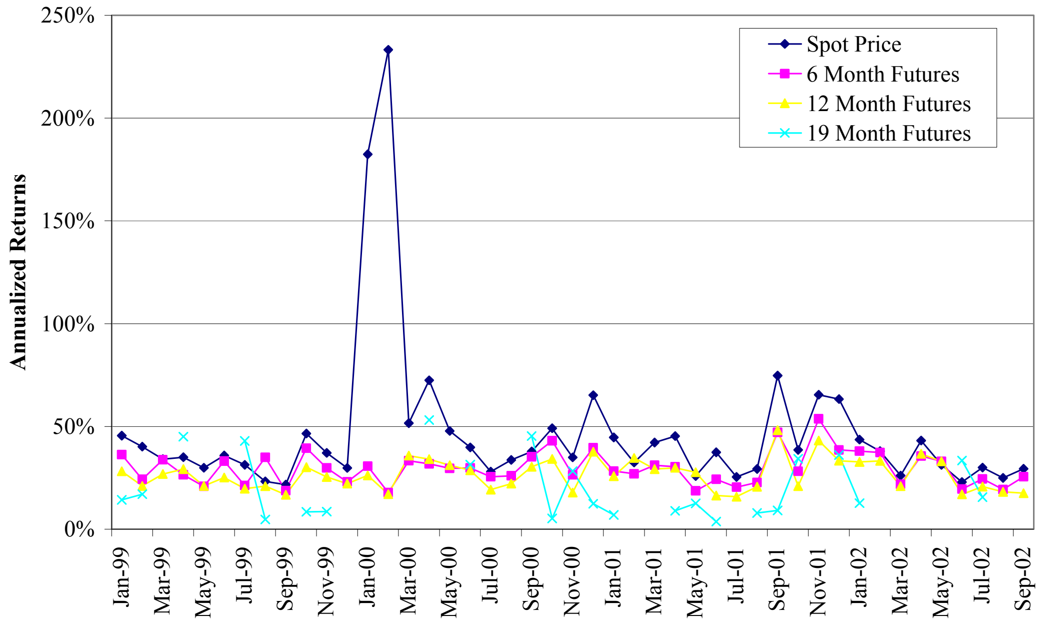
Figure 2-15

New York Harbor Heating Oil Spot and Futures Price Volatility



2.3.5 Electricity Price and Price Volatility Behavior

Today's electricity markets differ widely from state to state in terms of the degree of market deregulation and the existence of functioning wholesale electricity markets. Electricity prices in the functioning wholesale markets typically exhibit the highest price volatility amongst the commodities studied.

Market Characteristics Influencing Electricity Price Volatility

Figure 2-16 shows the average peak day price and price volatility for electricity in the PJM-West market area as reported in the Platt's *Megawatt Daily*. This figure illustrates the very high degree of price volatility observed in the wholesale electricity markets in the last few years. As a commodity, electricity has certain characteristics that differentiate it from other traded commodities. These characteristics include:

- *Value of power is time-dependent.* This is driven by the fact that power is a non-storable commodity. When transmission or generation is at capacity, supply becomes inelastic. Additionally, there are no alternatives for most electricity consumers, so there is a high cost to not serving load. Utilities and other firms with load-serving responsibilities will therefore bid up the power to very high prices in order to serve their load.

- *Value of power is regional*. Because there is a limit to how far generators can transmit electricity, power markets are very regional. Also, market rules vary significantly across regions. These two conditions restrict the number of participants in a given region, causing markets to be fragmented.
- *Large swings in demand and supply of product*. Electricity demand is dependent on unpredictable factors such as weather. Supply, particularly of hydroelectric power, is also dependent on weather.
- *Lack of hedging tools.* Financial risk management products to use in hedging risk are lacking. Unlike other commodities, most trades in power settle into physical delivery.

Electricity alone, among the other commodities under study, has these characteristics. This is part of the explanation for the very high levels of price volatility seen in the past several years.

Impact of Location on Electricity Price Volatility

The volatility of electricity markets, as measured by the annualized average returns, is extremely high. There is also a strong relationship among price volatility levels in different markets. Table 2-2 shows the relationship among the levels of price volatility in the different markets. Notably in the summer of 1999, all the markets studied showed a similar spike, even though the markets are in different regions.

Table 2-2 illustrates electricity price volatility for the top seven trading points[5] reported by Platt's *Electricity Daily:*

- CINER – Deliveries into the Cinergy system, comprising the old systems of Public Service of Indiana and Cincinnati Gas & Electric Co.
- PJMW – Deliveries into the western hub of the Pennsylvania-New Jersey-Maryland pool
- ENTGY - Deliveries into the Entergy system
- COMED – Deliveries into the Commonwealth Edison system
- ERCOT – Deliveries within the Electric Reliability Council of Texas
- ECAR – Deliveries within the northern portion of the East Central Area Reliability Council
- NEPOOL – Deliveries within the New England power pool.

Figures 2-17 and 2-18 illustrate the relationship between price movements in the different markets. The figures show daily prices and price volatility for daily on-peak period prices for five of the seven top markets included in the earlier table. The markets selected reflect a variety of locations and deregulation status.

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[5] As measured by volumes traded in 2001 and 2002.

Figure 2-17 indicates that, in general, the wholesale power prices tend to move in the same patterns. However, when prices diverge, the divergence can be quite large. The price volatility for these points, shown in Figure 2-18, exhibits the same behavior.

Figure 2-16

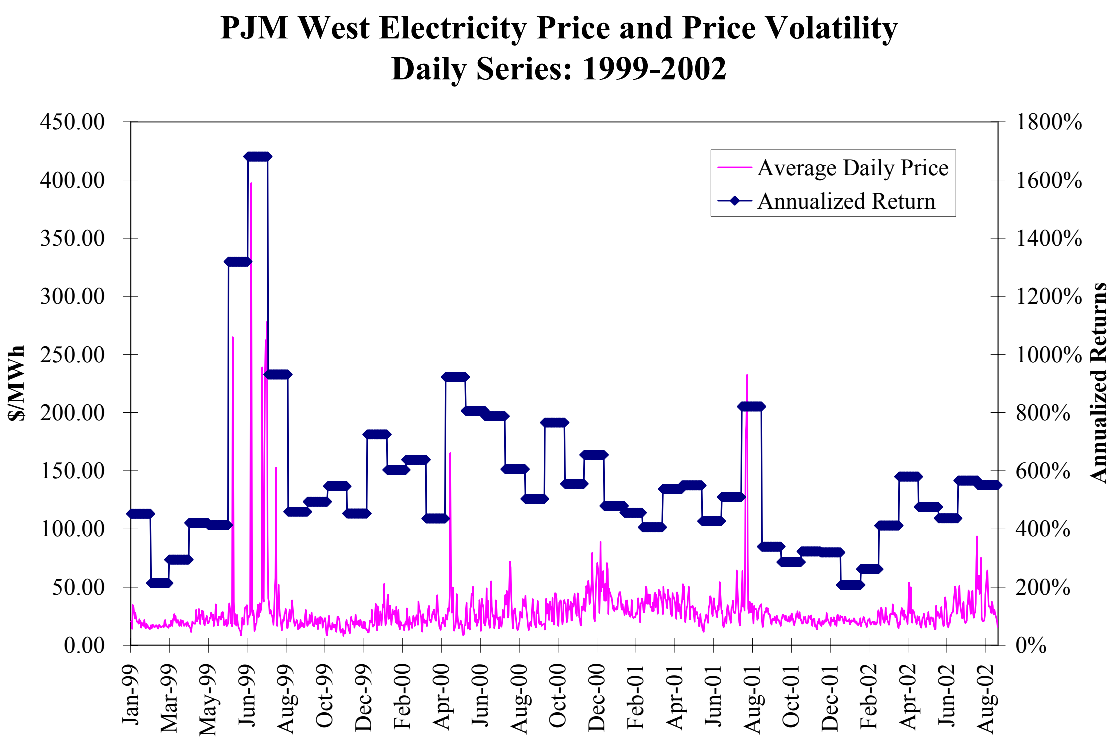


Table 2-2

Electricity Price Volatility in Different Markets
Annualized Returns

	1999	2000	2001	2002	1999-2002
PJMW	496%	398%	286%	240%	390%
ECAR	525%	421%	294%	197%	408%
Cinergy	592%	443%	289%	195%	440%
COMED	691%	432%	277%	172%	476%
ENTGY	531%	309%	181%	140%	355%
NEPOOL	354%	349%	312%	128%	325%
ERCOT	314%	297%	88%	120%	245%

Figure 2-17

On-Peak Electricity Prices in Different Markets

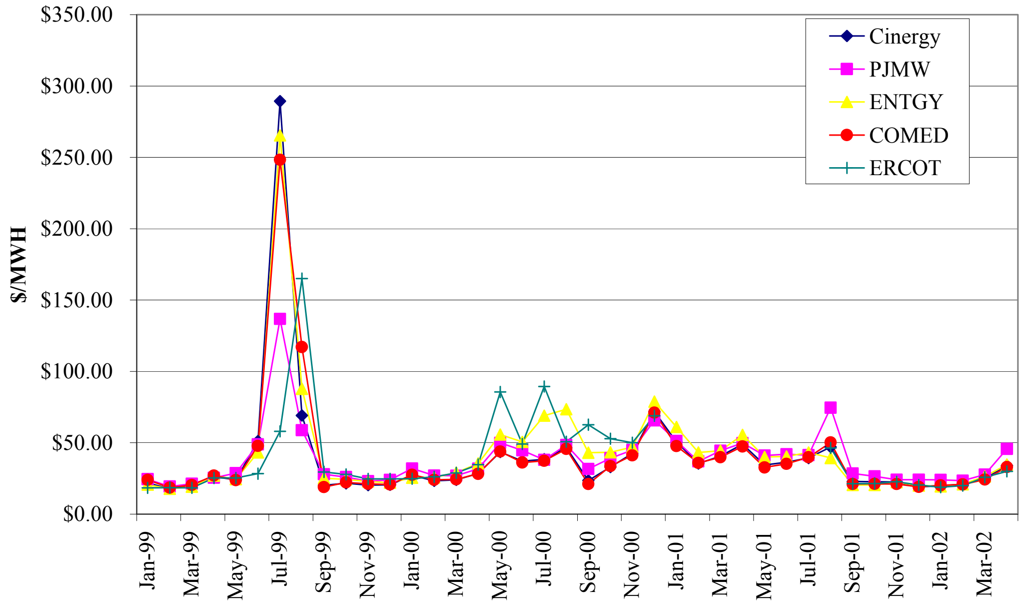
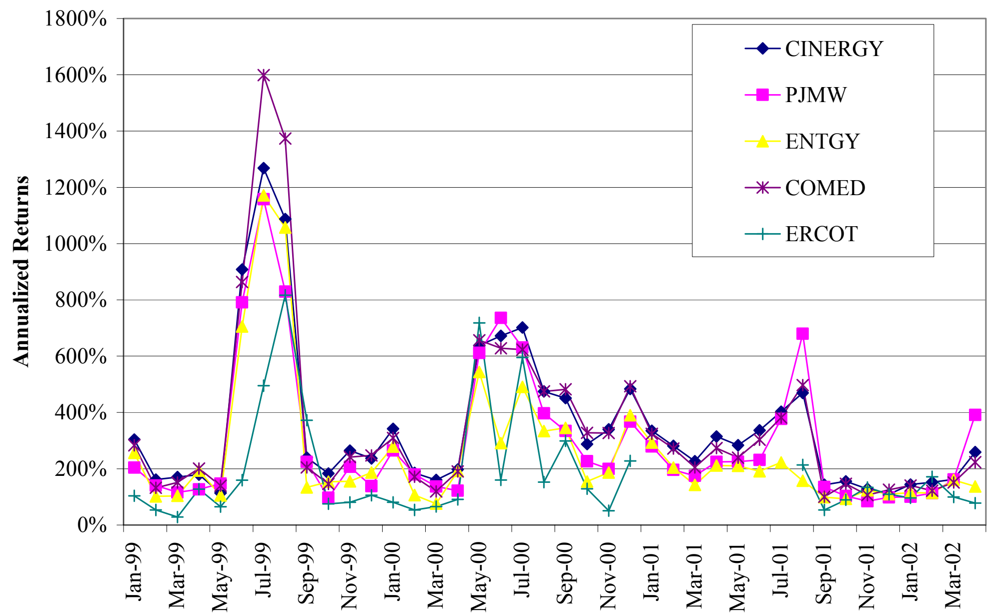


Figure 2-18

Electricity Price Volatility in Different Markets



2.3.6 Copper Price and Price Volatility Behavior

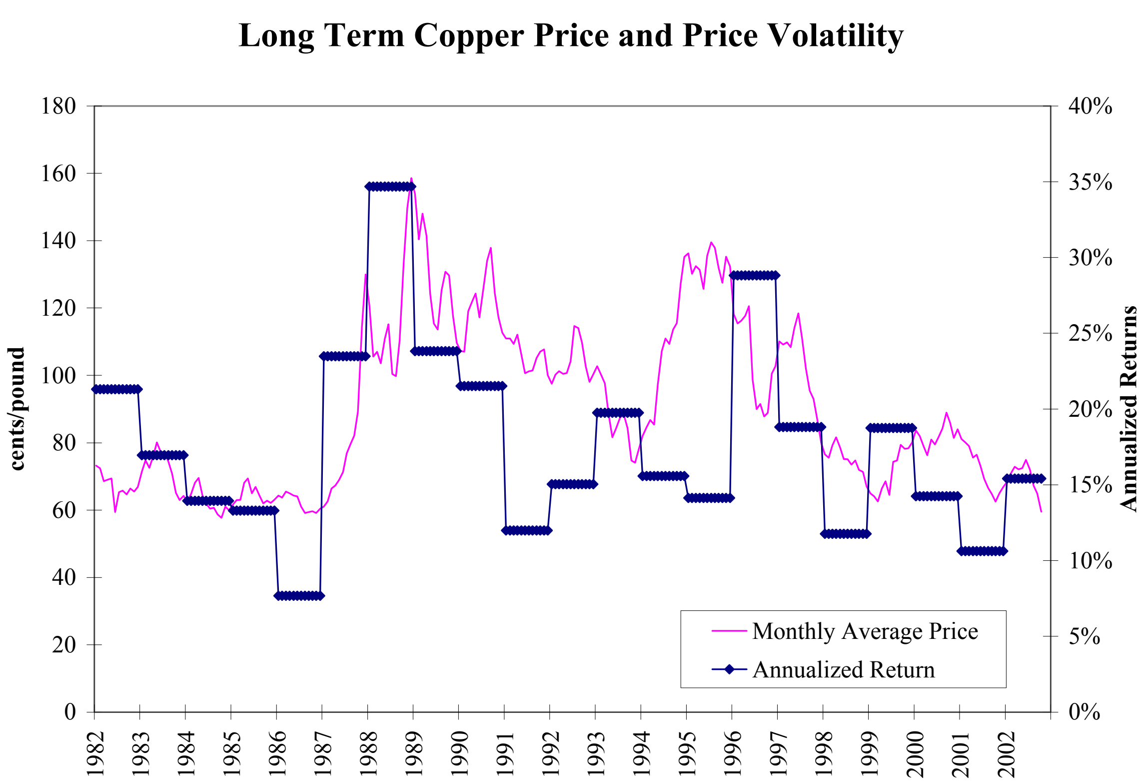
Review of Copper Markets

Figure 2-19 shows copper prices and price volatility for the last twenty years. Compared to the other commodities in this review, copper prices have been relatively stable. Prices have ranged from about $0.60 per pound to about $1.60 per pound, but generally remain in a range from about $0.80 to $1.00 per pound.

Copper demand fluctuates primarily in response to economic activity and as a result of technological changes (e.g., replacement of copper cable by fiber optic cable).

A handful of major producers dominate the capital-intensive copper industry. Copper production capacity has a significant lifecycle, similar to natural gas and oil production capacity. New investments in copper production capacity take several years to bring online. Supplies tend to vary in response to price and in response to international political events, but are not largely affected by other factors such as weather.

Figure 2-19



Unlike the other commodities considered in this analysis, copper has an essentially unlimited storage life. The interest rates that determine the major component of copper storage costs set the time value of the capital invested in inventories. As long as prices are expected to increase more rapidly than the costs of carrying inventory, there is an incentive to produce and store copper even when prices are relatively low. As a result, price volatility tends to be more muted than is true for commodities that are more costly to store.

Copper Price Volatility

Figure 2-20 shows copper prices and price volatility from 1999 through 2002. Price volatility has been very stable over this period, with monthly volatility ranging from about 12 percent to 35 percent.

Copper Futures Prices

Figure 2-21 illustrates the relationship between copper spot market prices and futures prices for the 1999 - 2002 time period. In general, futures markets for metal commodities tend to be relatively stable compared to spot prices, with futures prices exhibiting a small premium relative to the current spot market. The availability of inventories in storage tends to provide a compelling arbitrage link between the futures markets and the spot market.

Figure 2-20

Copper Price and Price Volatility
Daily Series: 1999-2002

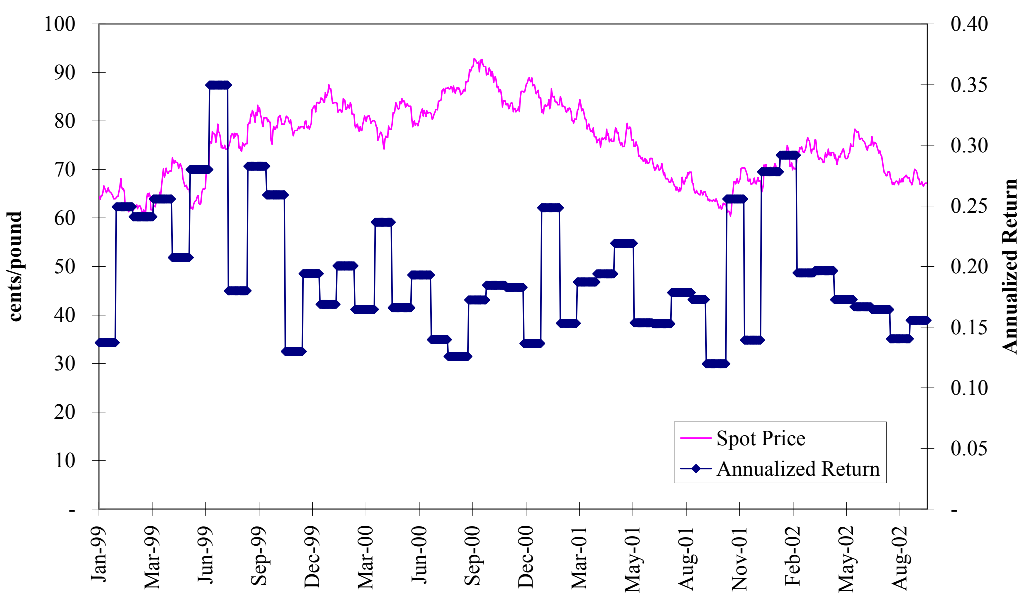
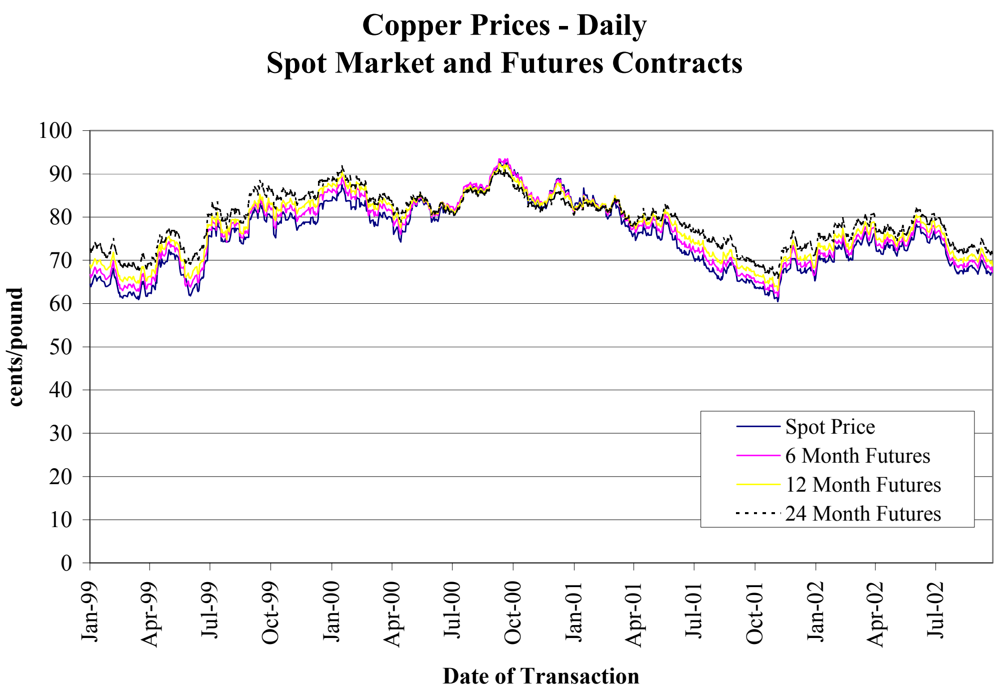
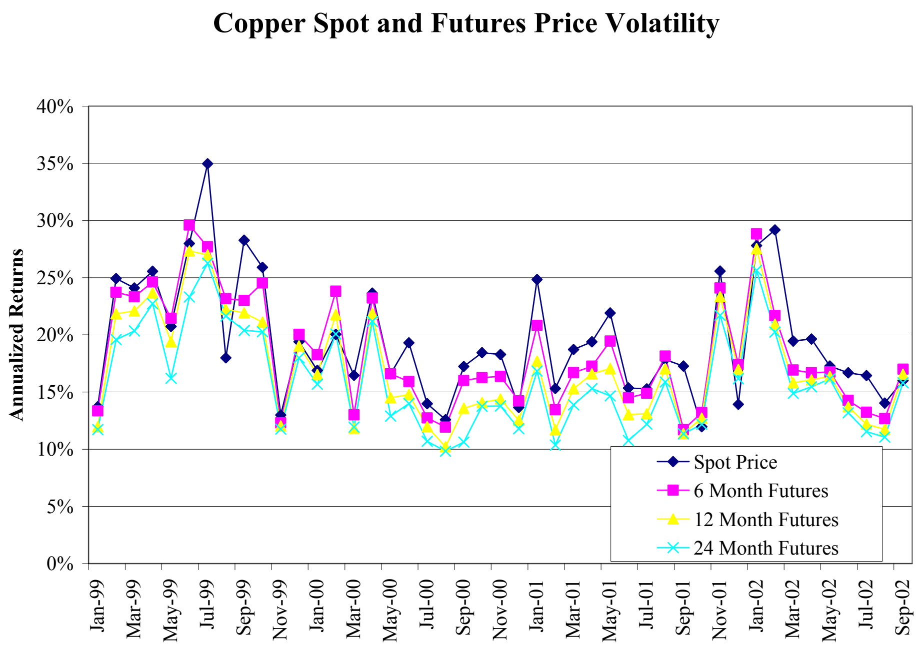


Figure 2-21



Like the energy commodities, price volatility in copper futures, shown in Figure 2-22, is dampened as the time to maturity of the contract lengthens.

Figure 2-22

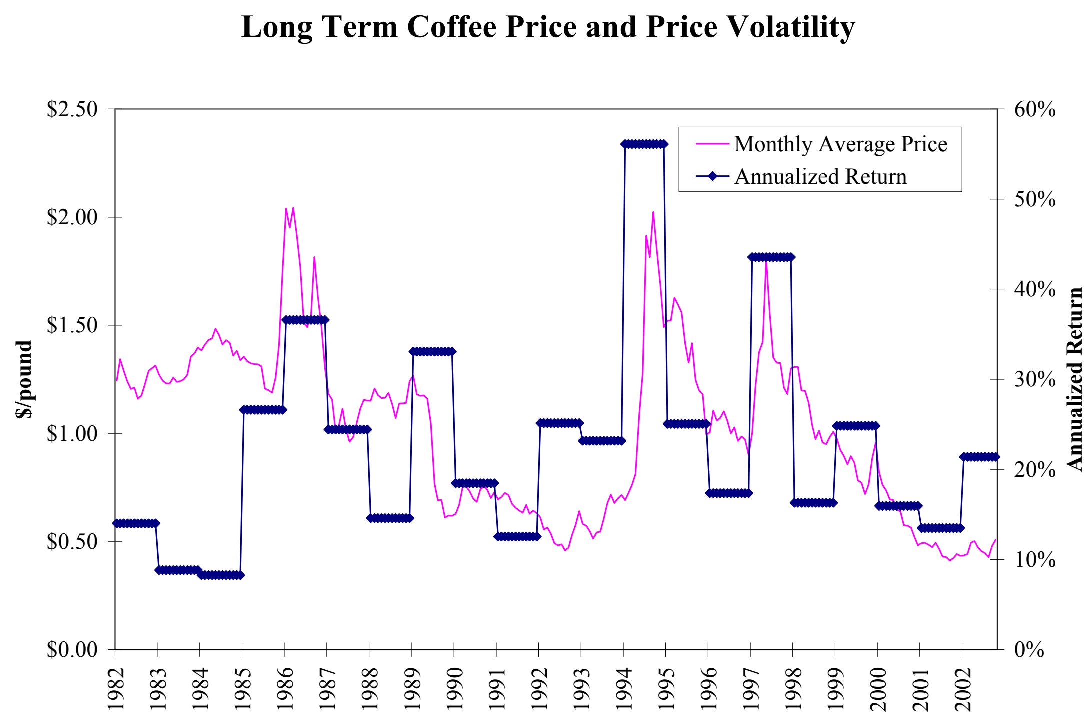


2.3.7 Coffee Price and Price Volatility Behavior

Coffee Price and Volatility Characteristics

As illustrated in Figure 2-23, coffee prices tend to spike periodically, but then gradually decline back toward a longer-term equilibrium value. Coffee trees are highly vulnerable to frost and drought, which can weaken trees, leading to the spread of infectious diseases that can destroy a significant share of the trees in a given production region. As a result, coffee supplies are vulnerable to substantial and abrupt declines in producing capacity, resulting in rapid price run-ups. In addition, low prices can result in abandonment of coffee plants, or a switch from coffee plantations to other agricultural products.

Figure 2-23



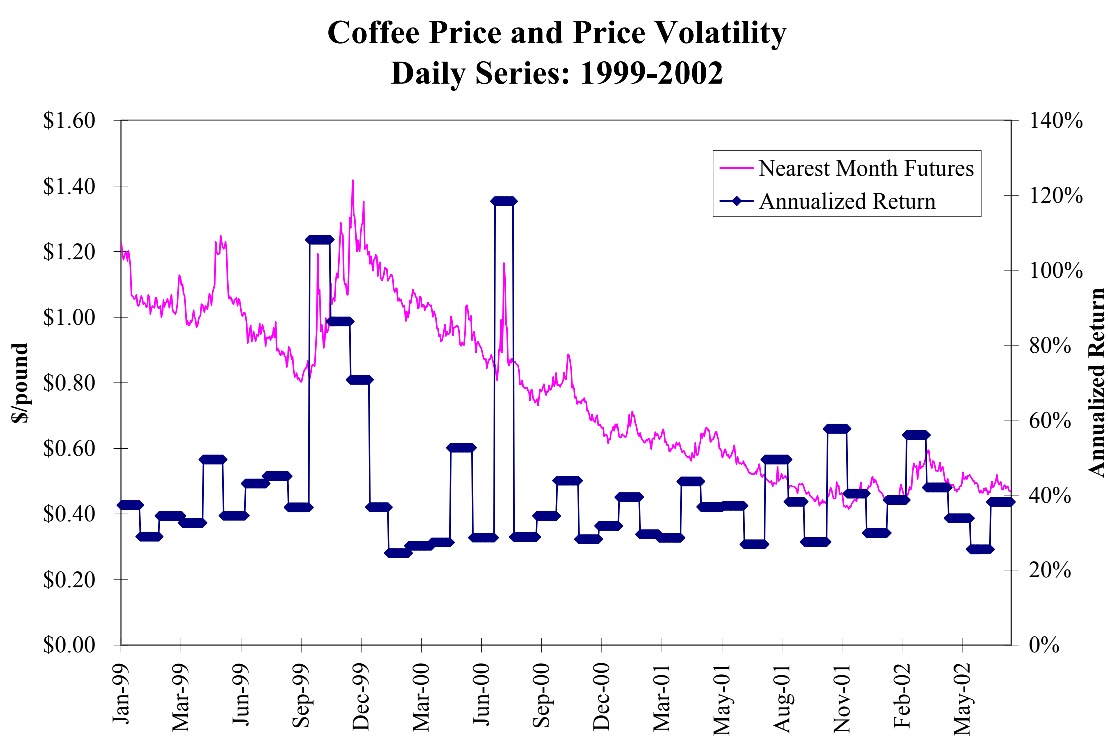
Coffee stocks also have a finite shelf life. While storage for one to two years may be acceptable, coffee storage does lead to product degradation and a decline in the value of the product. In addition, coffee trees can take three to five years to grow before commercial harvesting. As a result, coffee supply tends to be very volatile, with large drops in available production from time to time that lead to long-term "boom and bust" cycles in coffee prices.

In the last few years, coffee prices have fallen dramatically, due in part to growth in supplies from plantings made during the 1998-1999 high price cycle. In addition, a major new source of supply has become available to the world market: Vietnam has aggressively expanded production of lower quality/lower price Robusta coffee. Starting from an insignificant world market share in 1986, Vietnam is currently the third largest coffee exporter after Brazil and Columbia. The growth in coffee supplies from these two different sources has driven coffee prices down to levels considered potentially unsustainable.

Coffee is consumed mainly in North America and Europe. Coffee demand is relatively price inelastic. The wholesale price of coffee, currently about $0.50 per pound, represents only a small portion of the cost of coffee sold to consumers. In addition, consumers are slow to change coffee consumption habits since coffee has no real substitute. Recently, due to lifestyle changes, there has been a downtrend in the demand for coffee, particularly in the U.S.

The small demand response to changes in price, combined with coffee production's vulnerability to shocks in weather and political conditions and its limited source, contribute to the commodity's price volatility.

Figure 2-24



Coffee Futures

Figure 2-25 shows the daily prices of the futures traded on the NYBOT from 1999 until 2002. Coffee futures prices generally track spot prices, and trade at a slight premium to spot prices, indicating that coffee is a classic contango market. This pattern reflects the fact that there is enough supply in the market at any given point in time to fulfill demand. Demand is relatively stable, and any supply shocks are expected to equally impact current and future markets. As a result, price volatility in coffee futures is almost exactly the same as price volatility in the spot price. The increasing premiums as time to maturity lengthens are a reflection of the cost of storage and the convenience yield.

There is also a modest seasonality in coffee price behavior. Coffee prices tend to decline in the February – April period, rising in May with the advent of the frost season in the Southern hemisphere growing countries.

2.3.8 Comparison of Price Behavior and Price Volatility for the Selected Commodities

Comparison of Price Patterns for the Selected Commodities

Figure 2-27 compares the relative price movements over the past 20 years for five of the six commodities considered in this analysis: coffee, copper, WTI crude oil, New York Harbor distillate fuel oil, and natural gas.[6]

This chart indicates that over a long period of time, price levels fluctuate over a wide but recurring range. Copper, the most stable commodity considered in this study, has exhibited peak prices at about two and one-half times greater than the lowest price. With coffee and oil, the highest prices are about four times greater than the lowest price. Natural gas prices vary by a factor of five from lowest to highest prices over the twenty-year period.

Comparison of Price Volatility for Selected Commodities

Table 2-3 provides a comparison of the price volatility for each of the six commodities studied. The table provides general statistics on daily price movements from January 1999 through September 2002, and also shows annualized returns over the same period and for each year within the longer time frame.

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6 Electricity prices have only recently been deregulated, and a long-term perspective on electricity prices currently provides no significant explanatory value to understanding commodity prices patterns.

Figure 2-25

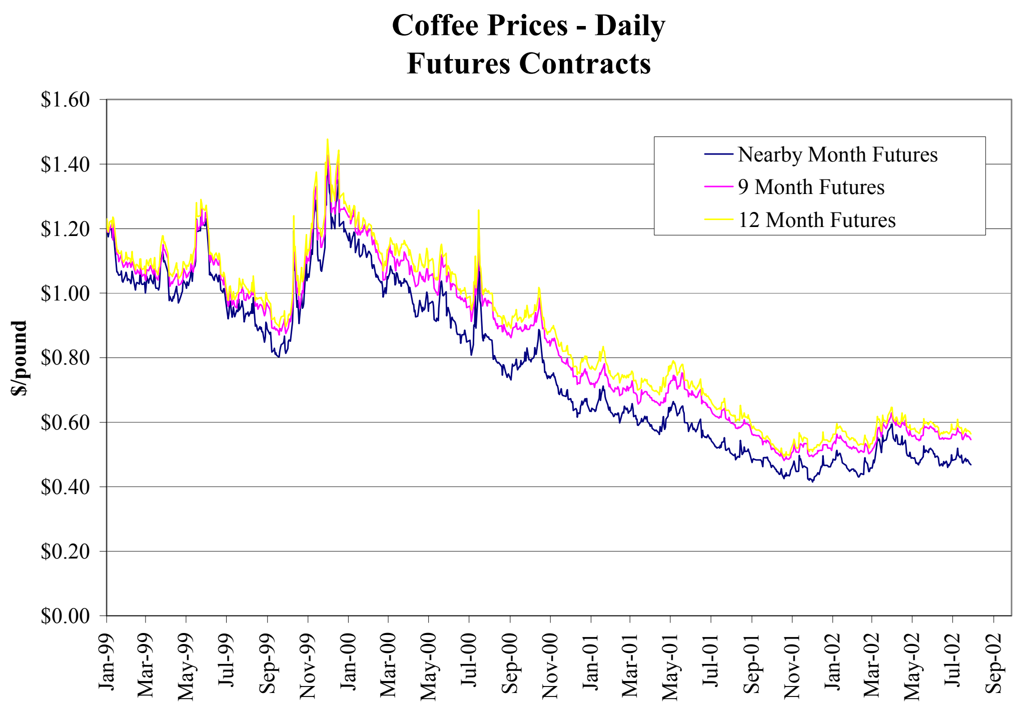


Figure 2-26

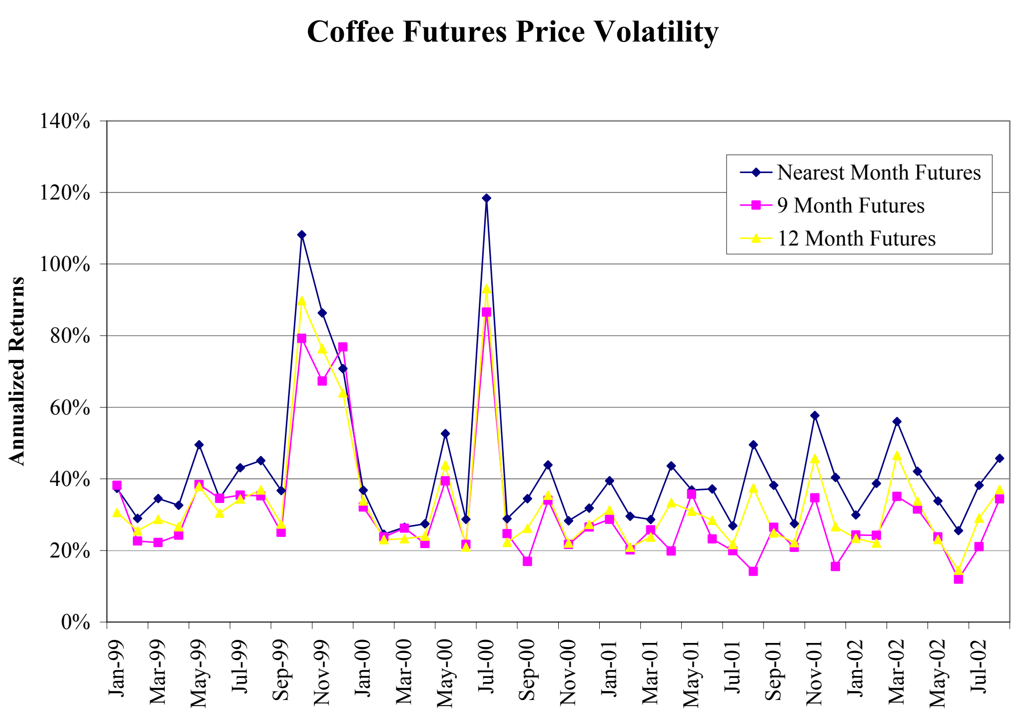


Figure 2-27

Historical Price Index for Selected Commodities (January 1, 1990 = 1.0)

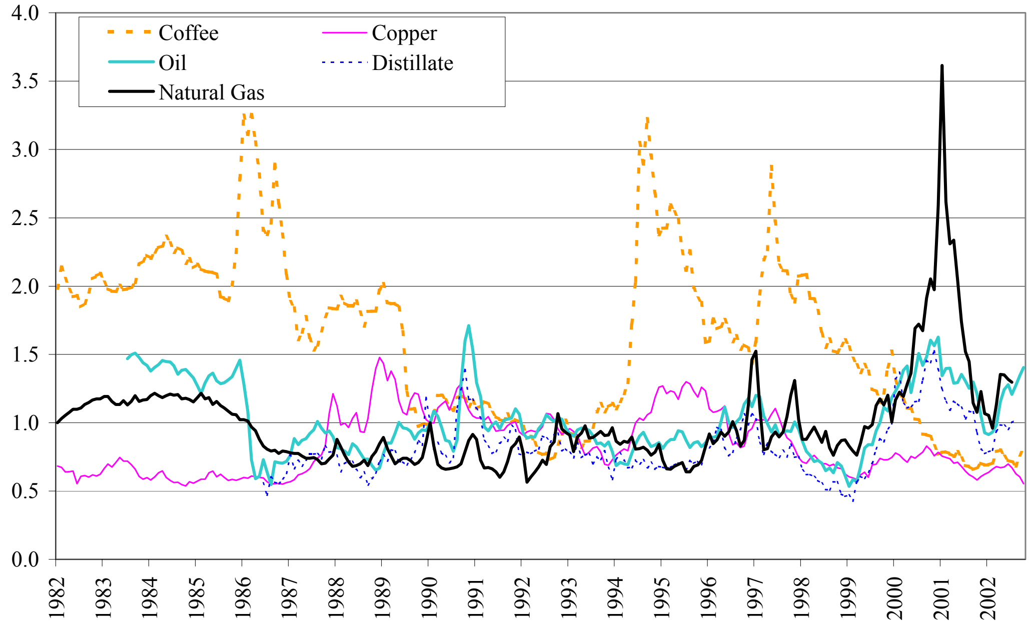


Table 2-3

Daily Returns: January 1999 - September 2002

	Standard Deviation	Min	Max	Range
Electricity - PJM	32.2%	-260.6%	278.4%	539.0%
Henry Hub Natural Gas	4.3%	-30.8%	21.4%	52.2%
Heating Oil	3.6%	-47.0%	23.0%	70.0%
Coffee	2.9%	-12.8%	21.2%	34.0%
WTI Crude Oil	2.6%	-17.1%	10.1%	27.1%
Copper	1.3%	-4.8%	7.4%	12.2%

Annualized Returns

	1999-2002	1999	2000	2001	2002
Electricity - PJM	511%	633%	558%	390%	375%
Henry Hub Natural Gas	69%	50%	61%	94%	58%
Heating Oil	58%	35%	92%	45%	33%
Coffee	46%	56%	46%	38%	39%
WTI Crude Oil	42%	36%	47%	47%	34%
Copper	20%	24%	17%	19%	20%

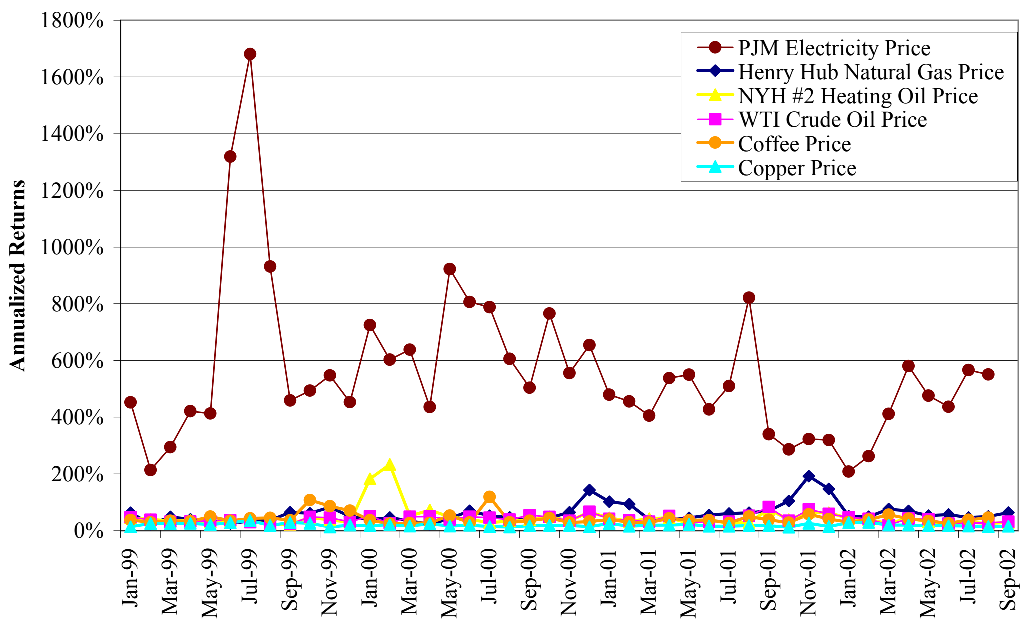
As illustrated in this table, PJM electricity prices consistently have been the most volatile of the commodities reviewed. Natural gas prices are the next most volatile. Copper was the least volatile commodity across the board.

Figures 2-28 and 2-29 illustrate the price volatility for each of these commodities over time using the annualized returns[7] as a measure of volatility. Figure 2-28 shows the price volatility for all six commodities for the period from 1999 through September 2002. The price volatility for PJM electricity prices has been notably high, with annualized returns averaging more than 500 percent per year, and occasionally hitting values above 1,000 percent per year. The annualized returns of the other commodities generally fall between 20 and 60 percent per year.

Figure 2-29 highlights the behavior of price volatility for the other commodities, excluding electricity. This figure shows that price volatility for natural gas has been significantly higher than the other commodities during most of the last four years. Volatility in the copper market has generally remained below 30 percent per year, while coffee price volatility has spiked on an occasional basis to above 100 percent per year.

Figure 2-28

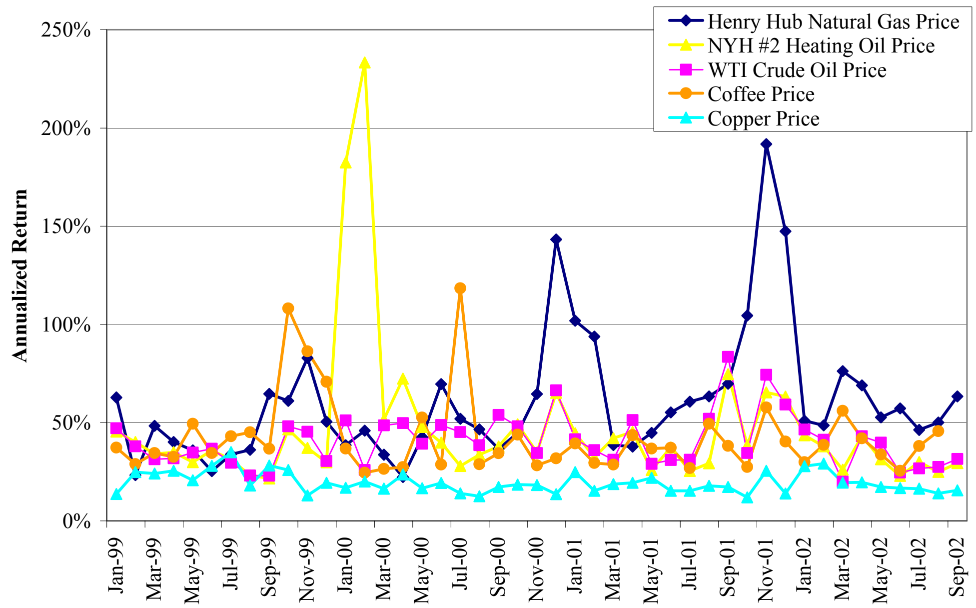
Price Volatility for Selected Commodities



[7] The annualized return represents a relative measurement of daily price movements annualized using the number of trading periods in a year. Returns are measured as the percentage change in daily prices, measured on a log-normal basis. This measure of volatility is useful when comparing price volatility for different commodities when prices are measured in different units or have different baseline prices.

Figure 2-29

Price Volatility for Selected Commodities (Excluding Electricity)



Crude oil prices have been volatile relative to copper prices, but relatively stable when compared to coffee. In contrast, the end-use energy commodities – heating oil and natural gas – have occasionally experienced much larger volatility spikes. Heating oil volatility exceeded 200 percent per year in the winter of 2000, while natural gas price volatility reached almost 200 percent during the fall of 2001, when prices dropped dramatically.

Implications for Natural Gas Markets

The review of price volatility in the different commodity markets highlights the following key factors influencing the overall level of volatility.

1) Storage is a key element in reducing volatility.

One of the key relationships observed in the evaluation of price volatility is that price volatility is directly related to the ability to store the commodity. Electricity, which is the most difficult commodity to store, is also the most volatile. Copper, which is the easiest to store of the commodities we examined, exhibits the least price volatility. Heating fuel oil, which is somewhat more difficult to store than crude oil due to the distributed nature of fuel oil demand, shows somewhat more price volatility than crude oil.

When commodities can be stored easily and inexpensively, traders can arbitrage between current and future prices, reducing the volatility of both current and future prices. This can be observed directly in the natural gas markets. Prices tend to be more volatile when storage levels are below average than when storage levels are above average.

2) Commodities that are easily transported are less volatile than those that are not.

Transportability reduces volatility in much the same way that storage does. The commodities that can be moved from market to market with relative ease, such as copper, crude oil and coffee, also tend to be commodities with lower price volatility. The natural gas and electricity price event case studies we profiled in Chapter 1.4 illustrate how pipes and wires infrastructure constraints have contributed to the higher levels of price volatility observable in these markets.

The characteristics of the product being transported contribute to relative ease of transportation. At one extreme lie electricity and natural gas, commodities that can only be transported through appropriately engineered, fixed networks of pipelines and electric power cables and wires. Copper, crude oil and coffee, while demanding certain conditions for transport, may be moved via rail, truck, ocean and river shipping, and by air (and, in the case of oil, by pipeline as well).

Land-, air- and water-based shipping routes are widespread, with long-established networks that are relatively easily and economically constructed and/or maintained. Access and utilization via railroad, trucking, shipping and air transport companies are relatively simple, flexible and competitive. Natural gas and electricity transportation and distribution infrastructures, conversely, require relatively greater investment and longer planning horizons; are more complicated to construct and maintain; and feature more constraints on access and utilization.

All of these factors underlie the greater ease of transportation observable in the copper, coffee and crude oil commodities we examined, which indeed show lower volatility than natural gas, electricity and heating oil.

3) Commodities with relatively constant (predictable) supply and relatively variable demand are more volatile.

Looking at the agricultural commodity (coffee) and the end-use energy commodities examined in this chapter, we may observe that in comparison with one another, agricultural commodities are characterized by relatively variable supply, with year-round weather conditions affecting production both directly and indirectly, and relatively constant (predictable) demand. As we have seen, coffee supply is subject to substantial and abrupt declines in production capacity, while demand changes only slowly as there are no real substitutes. Coffee exhibits occasional spikes but is centered around returns to a long-term equilibrium value.

The end-use energy commodities, on the other hand, are characterized by relatively variable demand that fluctuates with weather and relatively constant (predictable) supply. Increases in production capacity for natural gas, heating oil and electricity come about over months or years, while demand can peak sharply and quickly when extremely cold weather arrives with short notice. In fact, all of the major price events profiled in the Chapter 1.4 case studies resulted from supply constraints combined with a weather event that created additional demand. Electricity, natural gas and heating oil each exhibit greater volatility than coffee.

The factors underlying relatively constant supply and variable demand in the energy end-use commodities we examined mean that production changes cannot be made fast enough to stabilize prices when demand plummets or soars. The elements shaping the relatively variable supply and constant demand in the agricultural (coffee) commodity we examined mean that when supply falls off sharply and quickly, prices may spike, but they gradually return to a long-term equilibrium value, resulting in less overall volatility than end-use energy commodities.

2.4 REVIEW OF OTHER DEREGULATED INDUSTRIES

2.4.1 Introduction

Natural gas markets share some characteristics with other markets that have been deregulated over the last twenty years or so. After a review of the different industries that have been deregulated, we have focused on two industries – airlines and telecommunications – in greater detail in order to identify similarities and differences between these industries and the natural gas industry. The areas of analysis include:

- Residential price regulation
- Degree of market segmentation
- Price volatility
- Strategies for revenue maximization.

The two industries selected highlight different approaches to deregulation, with different implications for the natural gas industry. Marketing and rate structures in the airline industry are fully deregulated, and have developed into sophisticated models employing price discrimination and product differentiation to maximize company profitability. By contrast, the deregulation in the telecommunications industry is much more limited. The trend in the telecommunications industry has been toward a flatter rate structure, resulting in lower price volatility to customers in order to increase revenues through growing market share.

The pricing patterns in the downstream (transportation and distribution) sector of the natural gas industry are currently more similar to the telecommunications industry model, as local distribution companies (LDCs) and marketers strive to protect customers from natural gas price volatility in order to capture market share, maintain customer base and address regulatory concerns.

2.4.2 Airline Industry Deregulation

Prior to the passage of the Airline Deregulation Act of 1978, airline prices and service availability were fully regulated. The Act opened the industry to the entry of new airlines and the expansion of established airlines to new markets. Today, airline fare structure is almost entirely deregulated. Domestic airline capacity, route servicing selection and scheduling is generally deregulated, although subject to local constraints on airport capacity and schedules. International route selection and scheduling remains somewhat regulated. Increased competition has generally led to lower fares and has improved scheduling and services in the more competitive markets.

Pricing and route structures in the airline industry are essentially fully deregulated. The airlines use price discrimination and market segmentation in order to maximize revenues. Passengers flying on the same plane pay dramatically different prices. For example, the price paid by a business travel passenger is generally much higher than the price paid by a vacation passenger. The airlines segment customer classes by recognizing differences in behavior such as willingness to include a "Saturday night stay" in the itinerary and willingness to book advance purchase non-refundable tickets. In addition, prices for tickets on the same plane and for the same class of service can change dramatically from day to day based on demand.

The ability to price discriminate maximizes airline revenues, but results in a fair amount of ticket price volatility to airline customers. In many cases, the upstream (production, transmission and storage) sectors of the natural gas industry are attempting to follow this model by unbundling services, differentiating among different levels of service, and aggressively promoting development of products priced at the margin.

Comparison of the Airline and Natural Gas Industries

The airline industry is similar to the natural gas industry transmission and distribution industry in several fundamental ways. For both the airline industry and natural gas producers, there are high investment requirements and fixed costs, while short-term variable costs tend to be relatively low. The relationship between high fixed costs and low variable costs dominates the pricing behavior in both markets.

The airline industry is fundamentally in the transportation sector, and in structure and product is more similar to natural gas transmission and distribution than to natural gas production.

Airline fixed costs, including aircraft, leases, and terminal and landing rights fees correspond roughly to the natural gas pipeline transmission and distribution system. The airline industry uses a complex and interconnected flight network among airports, which in operation acts in a manner similar to the natural gas pipeline system. Most of the major airlines utilize a hub-and-spoke system. In this system, most flights originate or end in hub airports, enabling airlines to increase the number of destinations offered. Flights from hub to hub provide the same type of service as the mainline transmission systems, while flights into the major hubs from smaller markets, and flights from the hubs to smaller markets serve the same purposes as short-haul transmission and distribution systems.

Even though airline variable costs tend to be quite high, the incremental cost of an additional passenger on a previously scheduled flight is very low. The airline industry has relatively high variable costs. Fuel costs account for about 12 percent of total operating expenses, and labor costs account for an additional 38 percent of total operating costs. Airlines can control total expenditures on fuel and labor by reducing or increasing the number of flights. However, fuel and labor costs do not vary significantly with the number of passengers on a given flight. Once a flight has been scheduled for departure, the variable costs associated with the number of passengers on the flight are very small.

In addition, both airlines and the gas industry possess fixed and highly perishable inventory. In the airline industry, this inventory is the seats on a specific flight. When the plane departs from the gate, the value of this inventory is zero. In the gas industry, this corresponds with unused pipeline capacity.

There are, however, also significant differences between the two industries. From our perspective, the most important difference is the ease with which capital can be shifted around in the airline industry relative to the natural gas industry. This manifests itself in the following several ways.

1. The airline industry capital structure is somewhat shorter lived, has a higher salvage value, and is more flexible than pipeline infrastructure. Aircraft can be assigned to fly to different routes, or taken out of service altogether to meet changing demands. In addition, aircraft can be upgraded or replaced on an incremental basis. Older aircraft are often sold to start-up airlines or cargo carriers, while aircraft that no longer meet domestic air-worthiness requirements are often sold to airlines operating in third world countries.

2. As a result, there are fewer barriers to entry in the airline industry than in the natural gas transmission and distribution industry, and there is less potential market power system-wide in the airline industry. However, on individual routes, a single airline can still exercise market power, the ability to raise prices to maximize revenues or reduce prices to limit competition, when a specific airline dominates a hub or provides service to less competitive markets.

3. At the same time, there are also fewer barriers to failure in the airline industry relative to the natural gas industry. To put this into perspective, 43 airlines were launched from 1978 until 1993, but more than that number of airlines failed during the same period.

In addition, natural gas industry regulations have resulted in several characteristics that are not duplicated in the airline industry. The existence of capacity release and resale markets in the natural gas industry is arguably the most important. The airline industry has no effective capacity release or resale market. In addition, the airline industry has limited options to re-bundle services (i.e., ticket aggregators). This is slowly changing: the Internet has facilitated the development of an alternative distribution mechanism for tickets (industry-owned aggregators and discount travel sites) and airlines are joining together in code-sharing and other similar co-marketing arrangements. However, the airlines have been generally successful in controlling and constraining the secondary market.

Control of the secondary market is one of the necessary components of the airline pricing strategy. By controlling the secondary market, the airline industry is able to differentiate price by both quality of service and time frame of the ticket purchase in order to maximize revenues.

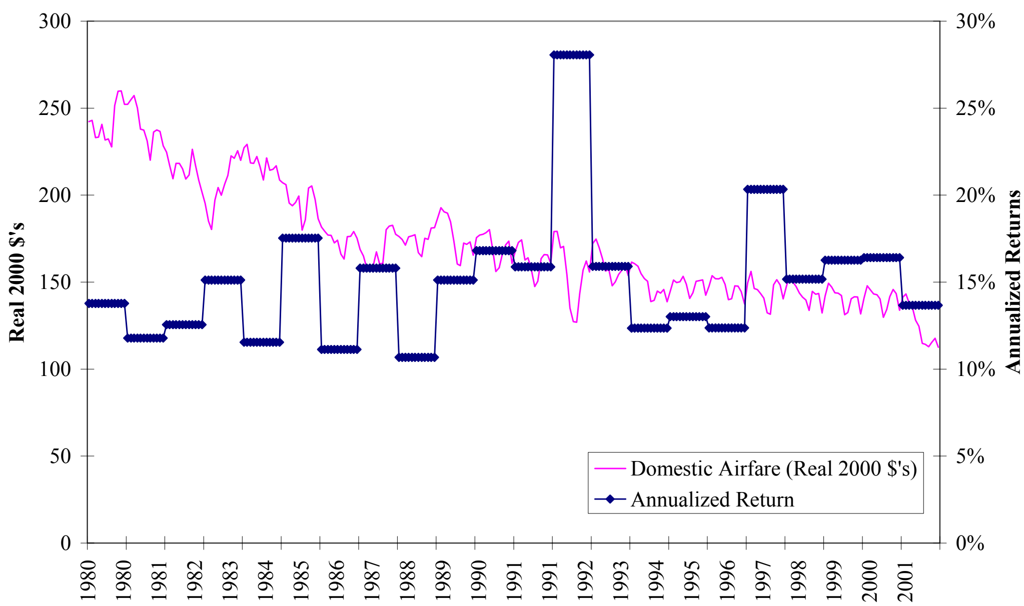
While the pipeline industry differentiates price by quality of service, price discrimination among similar customers is not generally allowed. The airlines set prices based on perceived profit maximization strategies, and are not required to price their services at fair and equitable rates.

Price Volatility in the Airline Industry

Figure 2-30 shows the annual passenger yields (revenue per passenger mile) in terms of real 2000 dollars. Passenger yields have declined steadily since the deregulation of the industry in the mid-1970s. Increased price volatility has accompanied the decline in prices.

Figure 2-30

Average Domestic Airfares
(US Majors excluding Southwest)



Source: American Transport Association

The drop in passenger yields can be attributed in part to the high level of competition in the industry, and in part to improvements in technology, such as larger aircraft, more fuel efficient engines, and increased employee efficiency due to advances in automation. The imperative to lower costs in a competitive environment has driven these technology improvements.

The high degree of competition has also resulted in periodic bouts of destructive fare wars, which have created profit pressures leading to bankruptcies as well as mergers and acquisition activity among all but the most efficient of the airlines.

There are two main reasons for this manner of price competition. First, start-up carriers typically implement aggressive pricing tactics since they operate with substantially lower costs than the major airlines and are eager to gain a foothold in the market by attracting the price-sensitive consumers. Secondly, the cost structure of the industry implies that an airline benefits by selling a seat even at a low price -– below total cost but above marginal costs. Major airlines are thus induced to cut fares to improve capacity utilization. The industry is susceptible to fare wars when capacity levels exceed demand. This can occur both due to entry of existing and new players in certain routes, resulting in excess capacity on those routes, as well as to system over-expansion or sudden demand shocks.

Sudden demand shocks, such as the decline in unrestricted business travel associated with the "dot-com" bust, the general economic slowdown and drop in travel that occurred after September 11th, have a dramatic impact on profitability. The combined effects of reduced volume and the price-cutting associated with the airlines' drive to preserve capacity utilization have a highly negative effect on cash flow and net income.

Pricing Structures

The airlines have been among the most aggressive companies in developing sophisticated product pricing methodologies designed to maximize profitability. These methodologies, referred to as "yield management", use dynamic analysis of demand in order to come up with multiple pricing schemes. Yield management allows airlines to maximize both capacity utilization and price charged per customer by understanding and managing demand. The goal is to sell as many seats as possible at full fare then fill empty seats with discounted fares that exceed variable costs. These strategies are rooted in two marketing concepts: customer segmentation and price discrimination.

Customer Segmentation

Air travel consumers fall into two general segments: business travelers and leisure travelers. Business travelers are considered relatively price inelastic, as they typically have a short lead time to purchase tickets and value the ability be flexible in their travel arrangements. Therefore, they are more likely to pay a higher airfare in order to ensure their seats on a specific flight. Leisure travelers are relatively price elastic. Vacations are typically planned long in advance and travelers are willing to adjust schedules to obtain lower fares.

Airlines use sophisticated computer systems in order to forecast the demand on each route at different times of day, different days of the week, and different seasons of the year. The airlines' efforts have been aided by the existence of computerized reservation and ticketing systems such as American Airlines' Sabre system. The airlines project demand for each flight and adjust fares according to the type of passenger mix they forecast for the flight. Tickets are then priced according to each passenger's willingness to pay. Airlines offer higher-priced tickets to business passengers while offering lower-priced tickets to leisure and last-minute travelers. The success of this strategy is highly dependent on the ability to minimize dilution.[8] Dilution is prevented by

[8] Dilution refers to the reduction in revenue when a passenger who is willing to pay a higher price is able to purchase a lower-priced ticket. This happens when a business customer is able to purchase the discounted ticket aimed at a leisure passenger.

a technique called "fencing." An example of this is when cheaper tickets are sold with restrictions that make them unusable for business passengers, including advance purchase requirements, Saturday night stay and off-peak travel requirements.

In addition, airlines continuously track demand. They monitor booking patterns, identify abnormal behavior and adjust fares continuously before a flight's departure. Airlines can now fill seats that otherwise would have gone empty by offering last-minute deep discounts. Conversely, they can maximize revenue by hiking fares for routes that have become unexpectedly popular.

Price Discrimination

Airlines offer multiple fares based on several variables. These include:

- Level of service: Airlines differentiate by class of service. As shown in Figure 2-31, first class or business class fares can be as much as double the fares for unrestricted coach tickets.
- Level of restrictions: Airlines typically sell full-fare coach tickets without restrictions on flight dates or refunds. These fares are targeted at business travelers who are unable or unwilling to plan ahead or include a Saturday night stay in their itinerary. Discounted coach fares that require advance purchase and Saturday night stays typically cost about half the full coach fare.
- Level of demand: Airlines employ peak and off-peak pricing, charging higher fares for flights during major holidays and other peak travel periods.
- Level of competition: Airlines reduce fares to destinations served by more competitors.

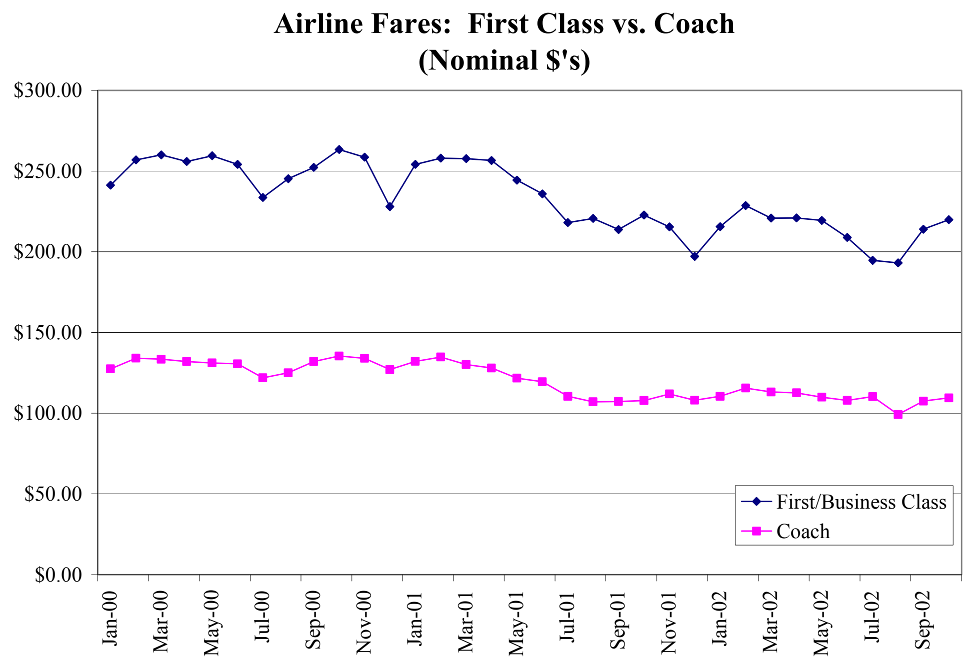
These pricing strategies allow the airlines to capture much of the traditional consumer surplus. In economic terms, the pricing strategies as a whole fall somewhere between first- and second-degree price discrimination. With first-degree price discrimination, the firm is aware of the price each consumer is willing to pay for the seat and thus can capture the maximum possible value from the consumer. Second-degree price discrimination allows the firm to capture some but not the entire consumer surplus by offering several well-defined price categories.

Long-Term Effectiveness of the Airline Pricing Model for Maximizing Revenues

The airline's pricing model worked particularly well during the past few years, when capacity was under control and demand was high. However, there are now threats to the model.

1) Alternative business models – Budget airlines have achieved a lower cost structure than the major airlines by operating a point-to-point route structure and offering fewer services. They are able to offer fares that are lower than those offered by the major airlines and remain financially sound while doing so. For example, in the face of bankruptcies by major U.S. airlines, Southwest Air has continued to remain profitable.

Figure 2-31



2) Price transparency – In the past, customers had difficulty discovering the prices available for a given route and schedule. Passengers would call a travel agent and accept the ticket prices the agent offered. However, the Internet has increased price transparency. Passengers can use online tools to seek out the different fares available and choose the lowest price on offer. This increased transparency constrains the ability of the airlines to price discriminate.

3) Changes in customer behavior – Due to the economic slowdown and the increase in price transparency, business travelers are becoming more price conscious. The old airline strategy of counting on a small percentage of business travelers to provide a majority of the airline's revenue is becoming less and less viable.

Key Lessons from the Airline Industry

While there are several key distinctions between the natural gas industry and the airline industry, in particular the ability of airlines to slice demand and price within very narrow and well-defined segments, the airlines' application of market knowledge to structure prices offers several key lessons for the gas industry.

1) Understand demand and practice price discrimination.

The first lesson is to know the customers and determine the characteristics of demand. What do they need? How can a supplier best structure product offerings to fill those needs? LDCs answering these questions are likely to look to such strategies as extensions of firm and interruptible contract offerings. They might take advantage of their ability to deliver gas within certain criteria (i.e., at a pre-defined pressure, at a specific time) and charge higher prices for these services.

2) "De-commoditize" services.

By crafting specific products and making these products available to targeted customer segments at the maximum price they are willing to pay for it, the airlines are able to maximize revenue. Once LDCs have gained a thorough understanding of the nature of customer demand and identified the bases for price discrimination, they can begin to adapt this practice to fit their own set of circumstances. Creative market segmentation, insightful packaging of products and services, and careful testing of price points will help ensure success.

2.4.3 The Telecommunications Industry

Current Telecommunications Industry Structure

The deregulation of the telecommunications industry began in 1984 when the long-distance market was opened to competition. The monopoly provider, AT&T, was split up into a long-distance provider and seven local exchange carriers, the regional Bell operating companies (RBOCs, also known as "baby Bells"). The local market was further opened to competition with the passage of the 1996 Telecommunications Act, which required the incumbent RBOCs to open their monopolized markets to competition by providing interconnection to new entrants. Appendix D traces the path of this deregulation as an evolution in prices and pricing strategy.

Currently, the telecom industry is subject to regulation from both federal and state agencies. The general policy framework is to "develop interconnected competition in all parts of the market"[9] with the objective of preserving competitiveness in the industry and ensuring universal access to telecommunications services. Consumer prices for long distance services are generally deregulated and open to competition. The costs of local services and competitive access to local telecom systems are still highly regulated at the State level.

Similarities to the Natural Gas Industry

As with the airline industry, the structure of the telecommunications industry results in more similarities with the downstream sector (transmission and distribution) of the natural gas industry, than with the natural gas production sector. Key similarities include:

- Like natural gas pipelines, the telecommunication industry utilizes its network in order to deliver products and services to end-users. The "backbone" operators, including WorldCom, Qwest and Level 3, operate much like the mainline natural gas transmission

[9] Martine E. Cave, Sumit K. Majumdar and Ingo Vogelsang (eds), Handbook of Telecommunications Economics, Volume 1: Structure Regulation and Competition, p 73.

systems. The local phone networks, including Verizon, SBC, Bell South, and others, are similar to the short-haul transmission companies and LDCs.

- The telecom industry has relatively large fixed costs, for construction and maintenance of infrastructure and equipment.
- Variable costs in the telecom industry are low in relation to fixed costs.
- Telecommunications equipment has capacity limits, as do natural gas pipelines. Costs rise sharply as these capacity limits are reached.
- Both the telecom industry and the natural gas industry consist of a mix of competitive service providers and regulated monopoly service providers. Like natural gas LDCs, local telecommunication monopolies can exist in areas where demand is not high enough to sustain multiple carriers and providers.

There are also key differences between the two industries:

- The cost conditions facing established telecom firms and potential entrants have changed radically with the emergence and use of new technologies. Companies can now deliver more of the same services at lower costs due to technological advances in fiber optics and signal compression. However, increased competition also means that they must deliver more goods and services to the consumer. This requires increased investment in higher-cost technologies and equipment.
- Natural gas companies deliver a service that can be varied by changing the service level (interruptible versus firm contracts) and quality of the product (predefined pressure, specific time).
- In the past few years, the telecommunication companies have seen an explosion in the variety of products and services they can offer. Telecommunications companies can deliver multiple services from the same network. Using the same fiber optic cables, customers can receive both voice and data services. This has increased their flexibility in pricing. For example, the average price of basic telecom service has decreased, but the price for newer services such as broadband has increased.
- The ratio of fixed to variable costs is much higher in the telecom industry than in the natural gas industry. The natural gas commodity cost is typically the largest single cost component of delivered natural gas, while the variable costs in the telecom industry are close to zero. As a result, price volatility in the telecom industry is primarily related to capacity costs and capacity availability, and unlike the natural gas market, is not subject to volatility in commodity prices.
- Shortages in telecom services due to capacity outages do not have the same costs associated with an outage of natural gas services.

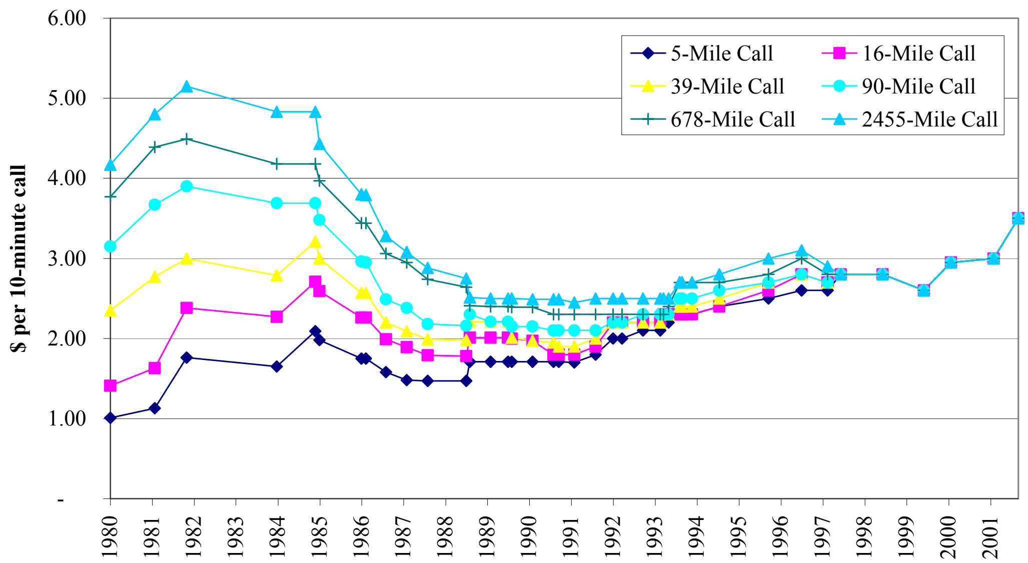
Current Trends

For the past decade, industry deregulation and technological development have driven trends in the telecom industry. This has led to an industry with greater competition in some segments of the market, as larger numbers of players offer new value-added products and services tailored to industry players and end-use consumers. There is also currently a capacity glut brought about as highly optimistic projections of future demand failed to materialize after driving companies to invest in massive infrastructure development. The increased competition and the capacity glut have led to pressures on the bottom line and on firms' cash flow.

Several pricing trends have emerged recently, as detailed below. Figure 2-32 illustrates these trends.

Figure 2-32

AT&T Basic Schedule Residential Rates for 10-Minute Daytime Interstate Calls



1) Convergence of prices – Distance used to be a relevant factor in the billing of phone calls. In the early 1980s there was almost a $0.40 per minute premium for a 2,000-mile call over a five-mile call. However, this premium was whittled away as the cost for shorter distance calls increased and as those for longer distance calls decreased. Currently, distance is not typically a factor, as long distance companies are offering plans that charge one rate for calls regardless of distance.

2) Peak vs. off peak pricing – As a way of capturing value and spreading out demand, long distance prices are structured so that the cost of calling during peak daytime hours is higher than the cost for nighttime calls. As Figure 2-33 illustrates, the cost of a daytime

phone call can be almost double that of a nighttime phone call. Figure 2-34 illustrates that the charges for businesses services are higher than those for residential services.

Figure 2-33

AT&T Basic Schedule Residential Rates for 90-Mile Interstate Call

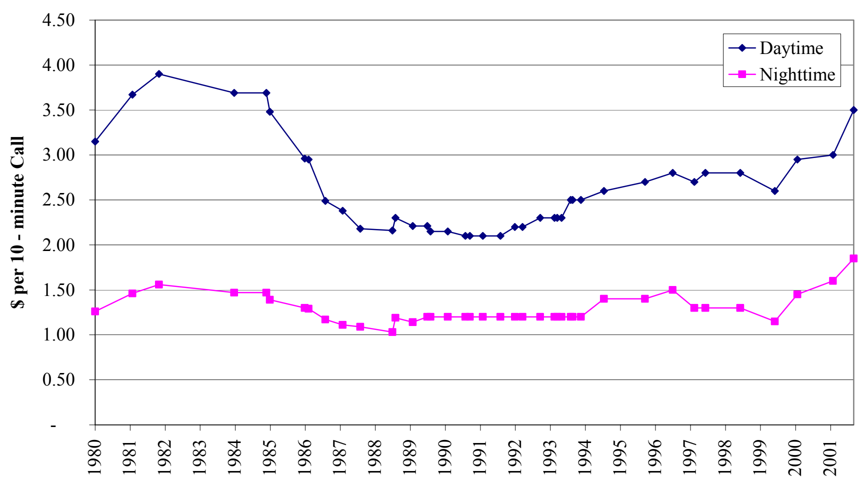
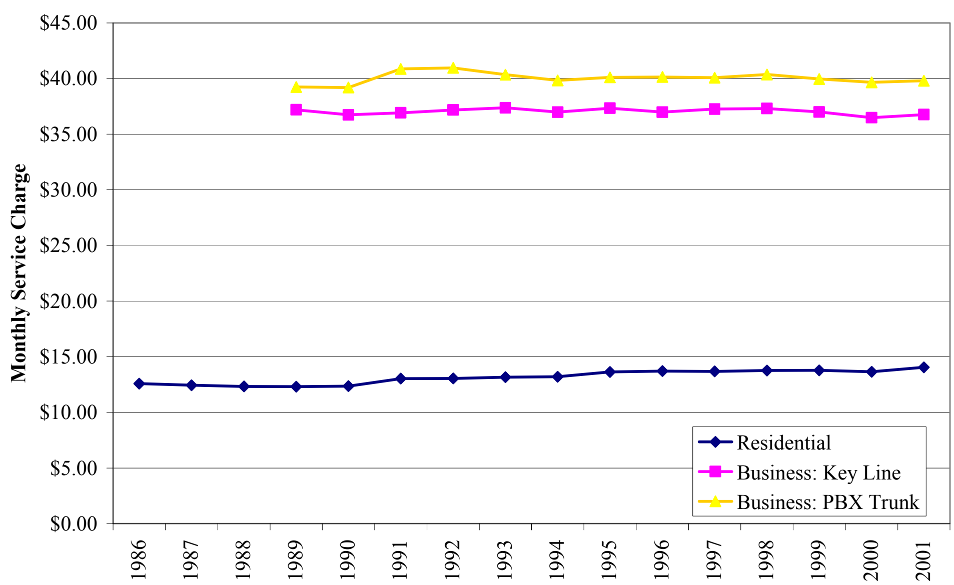


Figure 2-34

Average Local Rates*



*Rates are based upon flat-rate service where available and measured/message service with 100 (for residential) and 200 (for business) five-minute, same-zone business-day calls elsewhere.

The long distance providers increased basic long distance rates, but the range of discount offerings aimed at medium and heavy users of long distance services has been expanded. In the residential market, the telecom providers are developing "branded" discount calling plans such as AT&T's “Reach Out America” and MCI’s "Friends and Family" calling plan. AT&T's plan features two-part tariffs with tapered rates and purchases by time block. MCI’s plan offers discounted calling to a “calling circle” of family and friends.

Larger volume business users typically enter into contracts with long distance carriers rather than paying for services at the posted rates. Because of the proliferation of these discount plans, posted rates do not necessarily reflect the prices that business customers pay for long distance services. Therefore, even as posted rates (as reflected in Figures 2-33 and 2-34) seem to be kept constant, the average revenue per minute, shown in table 2-4, is decreasing.

Table 2-4

Average Revenue per Minute for Interstate Phone Calls

Year	*Revenue per Minute*
1992	0.15
1993	0.15
1994	0.14
1995	0.12
1996	0.12
1997	0.11
1998	0.11
1999	0.11
2000	0.09

Source: Federal Communication Commission

New Strategies

Telecommunications companies are now exploring several new pricing strategies in order to maximize revenue and value generated from customers. These are:

1) Multiple services - In order to maximize utilization of the high capacity networks they have built, telecommunications companies are now trying to find new ways of generating high value-added demand for these wires. They are examining the demand for the provision of new services such as network management for businesses and broadband connections for consumers.

2) Flat rate vs. value-based pricing - The current "in vogue" pricing strategy is a flat rate for all billings. However, this has caused problems for the telecom companies, as the revenue per customer keeps going down. Because of the glut in capacity and the high level of competitiveness among the telecom companies, prices are being driven down and revenue

per customer is decreasing. In response to this, these companies are developing innovative pricing models, combining flat rate, usage-based and value-based pricing, then optimizing the model to provide the services required by the customer while maximizing revenue.

Key Lessons from the Telecommunications Industry

The telecom industry differs from the natural gas industry both in terms of competitive threats and market opportunities. The natural gas industry has not faced technological revolution in methods of delivering natural gas, hence has faced neither the imperative to invest in radically new technology nor the situation of over-investment. In addition, the natural gas industry has not experienced the growth in the number and type of services provided that has occurred in the telecommunications industry. However, there are several lessons from the telecom experience that can be applied to the natural gas industry:

1) *Innovative pricing strategies* - Like natural gas companies, telecommunications companies have to navigate between highly regulated and deregulated segments of the marketplace. The telecommunications companies have been able to analyze the demand for their services in the competitive segment and adjust their pricing schemes based on the current market conditions in order to maximize revenue.

2) *Increase in the variety of services* - Telecommunications companies constantly seek to develop new products and services that utilize existing network capacity. This allows them to both increase revenue and maximize capacity utilization.

2.4.4 Implications for the Natural Gas Industry

Threats Due to Overcapacity

The profitability and long-term survival of companies in previously deregulated industries have been threatened by over-capacity. In the past, regulated monopolies created companies that exhibited higher than normal returns at a relatively low level of risk. This made the regulated industry appear very profitable, attracting the attention of potential competitors. When such industries underwent deregulation, new entrants arose to serve the market, armed with capital to invest in additional infrastructure. In both the telecommunications and airline industries, this has led to over-capacity. In the airline industry, over-capacity and price wars have led to periodic bankruptcies and corporate takeovers. In the telecommunications industry, extremely optimistic demand projections led to over-investment and multiplication of networks, resulting in a capacity glut. Profitability was threatened by the failure of expected revenues to materialize, and increased costs associated with operations and debt servicing.

The current difficulties plaguing the airline industry are caused in part by excess capacity that was added to meet business travel demand generated by the "dotcom" bubble. This section of the market paid premium prices, supporting the capacity buildup. Collapse of this segment of the market left the industry with an excess of capacity and a collapse in prices. In the telecom industry, the buildup of high-capacity networks to meet as-yet unrealized projections of demand growth for premium services based on new technology (e.g., internet, data streaming) has led to a massive excess of capacity and a collapse of demand.

Opportunities through Price Customization and Customer Segmentation

In order to respond to increased competitive and profit pressures, the companies in the two industries have sought to increase revenue by utilizing creative pricing strategies. They have utilized price differentiation in various ways. By better understanding the needs of the customers, they have sought to price to value (instead of pricing to cost) and thus increase revenue. Realizing that value is product-specific, idiosyncratic (varies from customer to customer and from segment to segment), contextual and dynamic,[10] both industries have utilized price customization in an attempt to capitalize on these features. They offer different prices based on:

- Customer segmentation – Different customer groups pay different prices for the same good or service.
- Product form pricing – Different versions of the same product are priced differently, but not in proportion to their respective costs.
- Image pricing – The same product is priced at more than one level based on differences in the image projected to different customer segments.
- Location pricing – The same product is priced differently at different locations even though the costs are the same.
- Time pricing – Prices are varied by season, day or hour.[11]

Based on the regulatory structure, the characteristics of demand and the kind of products and services that the firms could offer, the airline and the telecommunications industry have changed their pricing structures and service offerings in order to maximize revenue.

Stability Through Management of Revenue Volatility

Customer segmentation and price customization have given both the airline industry and the telecom industry the opportunity to maximize revenue, but have also increased revenue volatility. In a deregulated environment, reducing the quality of service has been one of the primary responses to revenue shortfalls. Airlines in particular have cut costs by accepting a lower level of reliability and a lower level of service. This issue is likely to be watched closely in the energy industry, with regulators particularly sensitive to reliability and quality declines.

The successful companies have been able to minimize the impacts of revenue volatility. Currently, the successful telecom companies are the companies with a large regulated revenue

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[10] Homa, Kenneth. http://www.HomaHelp.com, Georgetown University.
[11] Kotler, Philip. A Framework for Marketing Management, © 2001, p 229.

base from retail sales, primarily the RBOCs. Airline companies such as Southwest Airlines that have not traditionally offered premium services at premium prices have been able to maintain their customer base without reducing prices.

Issues for Natural Gas Industry LDCs

The airline industry has been able to leverage concepts related to customer segmentation and price discrimination in order to maximize the value gained from customers. Natural gas marketers and utilities have already implemented forms of the customer segmentation and price discrimination pricing strategies widely used in the telecom and airline industries. For example, by differentiating between firm and interruptible services, natural gas providers are applying both customer segment and product form pricing. There are, however, certain restrictions that prevent natural gas providers from employing different forms of price discrimination. The following section discusses how the rate structure in use by utilities makes it hard for the players in the natural gas industry, particularly the regulated LDCs, to follow the airlines' lead.

Utility Rate Structure

Natural gas transmission and distribution tariffs remain heavily regulated. Most utility regulators believe that customers in the same rate class should face similar pricing structures. This is particularly true with respect to residential and small commercial customers. In this case, the gas industry would be closer to the structure of the telecommunications industry. In the telecommunications industry, states have jurisdiction over local telephony and intrastate toll services.

Most utility rates are made up of three different components: a fixed component, a semi-variable component and a variable component. The fixed component is the monthly customer charge that is typically regulated by state public utilities commissions. The customer fixed charge supports the investment and fixed costs associated with gas delivery, including construction and maintenance of pipelines and systems. Customers in a given community and a given rate class typically will pay the same amount in fixed charges regardless of the size of their houses or the quantity of gas they consume. Therefore, the more a consumer uses, the lower the average price per unit consumed.

Using the airline industry pricing structure as a model, LDCs could segment customers based on levels of consumption and requirements, and set prices based on the value the customers assign to the service. Gas utilities would then be able to charge these customers different rates, depending upon the customer's willingness and ability to pay, assuming state commissions approved the rate.

This is starting to occur in the telecom industry as telecommunications companies have begun to utilize customer segmentation and demand analysis to maximize the revenue that they generate from the non-regulated portion of the local bills. In voice telephony, the telecommunication companies have encouraged demand growth by offering both flat fee and usage fee structures. Higher-volume consumers can pay a higher monthly fixed charge with low usage fees. The consumer thereby has the option to increase consumption without incurring a high charge. Lower-volume consumers pay a lower monthly fixed charge, but their usage fee is higher.

So far, however, this has occurred only on a limited basis in the natural gas industry. While some gas utilities have special rates for residential uses such as natural gas fireplaces, few offer different rates for customers with both a hot water heater and a furnace relative to customers with just a furnace, even though the combination of the two appliances has a flatter overall load factor and hence a lower cost impact on the utility.

In the commercial and industrial sectors, LDCs occasionally offer special rates for natural gas cooling customers. Gas cooling demand occurs primarily during summer off-peak periods, which tend to be cheaper to service than winter load. However, LDCs could be much more aggressive about providing special rates for distributed generation customers and other high load factor natural gas uses.

2.5 CONCLUSIONS

Price volatility for natural gas and electricity is exhibit substantially greater than the other commodities examined in this report. That said, volatility is a natural feature of commodity markets and the mechanisms that result in volatility are fundamentally the same. In any efficient market, prices adjust to correct imbalances of supply and demand. The magnitude of the change in prices is determined by the size of the imbalance and the willingness and ability of producers and consumers to respond to relieve the imbalance. This is true for both the short term and the long-term.

The large capital requirements and significant lead times associated with energy production and delivery make energy markets more susceptible to the imbalances in supply capability and demand that result in price volatility. The lead times for large energy infrastructure projects do not allow for rapid increases in energy supply that could mitigate short-term imbalances.

In addition, energy markets such as natural gas, electricity, and heating oil are particularly susceptible to market and price volatility because fluctuations in weather can change the underlying demand for the commodities significantly, and the increase or decrease in demand affects all of these commodities in the same direction.

Nature gas and electricity have exhibited a particularly large increase in volatility because the restructuring of these industries compounded the incentive for efficiency improvements and cost cutting that tend to reduce the amount of underutilized supply capability available to moderate volatility. Other deregulated industries, such as telecom and rail transportation provide only limited lessons regarding the management of volatility.