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The Use of Petroleum Futures Markets As A Hedge Tool in the Procurement of Railroad Fuel

by *Mark L. Fagan** and *James T. Kneafsey***

A MAJOR new opportunity exists for railroads to reduce their fuel costs and to lock in attractive prices for the future. During the 1970s, fuel costs increased dramatically, and because these increases were erratic, effective forecasting was very difficult. All indications are that these erratic movements will continue. However, the recent introduction of petroleum futures contracts on the New York Mercantile Exchange means that railroads can now use futures contracts to reduce significantly the uncertainty surrounding the prices they will pay for diesel fuel in the future.

This paper has three objectives. The first is to describe the principles of hedging: What is it? When is it appropriate? What are the associated benefits and risks? The second objective is to apply the principles of hedging to the procurement of railroad diesel fuel. The third is to present the steps necessary to develop an effective strategy for hedging.

Before turning to these issues, we review briefly the recent trends in fuel costs and fuel procurement in the railroad industry.

I. HISTORICAL PERSPECTIVE

The cost that railroads paid for diesel fuel soared during the 1970s—from 11 cents per gallon in 1971 to $1.00 per gallon in 1981 (see Figure 1). As a result of this increase, the proportion of the railroad industry's revenue that was required to pay its fuel bill rose from only 4 percent in 1970 to over 12 percent in 1981. The cost of fuel now has a tremendous impact on the railroads' bottom line; for example, a reduction of 5 percent in the cost of fuel in 1981 would have added almost $200 million to the industry's net income.

The railroad industry has responded vigorously to the increased economic importance of fuel. Operating departments have undertaken programs to improve fuel efficiency, especially through crew training. Equipment manufacturers have responded with lighter freight cars and locomotives featuring improved turbochargers, lower engine idle, and variable speed radiator fans. All these changes have induced improvement in fuel efficiency. Revenue-ton-miles per gallon, for example, increased from 199 in 1972 to 246 in 1981.

While operating departments have improved fuel efficiency, the response of the railroads' purchasing departments to the new environment has varied widely. Some railroads have not altered their purchasing techniques or increased their staff resources. Many railroads have continued to stress long-term contracts with major oil companies rather than rely on the spot market. Thus they ride with the ups and downs of the market, purchasing fuel as needed. This approach usually results in "industry typical" fuel costs and strong relationships with major suppliers.

Other railroads have increased the staff resources devoted to fuel procurement and have begun to mix long-term contracts with spot purchases. In making such changes, these railroads are seeking to better the "industry typical" fuel price even at the risk of alienating major suppliers. There are, however, a number of constraints on these programs. For example, available storage space often limits the ability to take advantage of low prices. Price forecasting remains very difficult: prices continue to move erratically as OPEC and the consuming nations respond to domestic and international pressures. The magnitude of this price volatility is seen in Figure 2, which shows the weekly price of #2 heating oil on the New York Mercantile Exchange from 1979 to 1983.

A major new opportunity, as yet unexplored by the railroad industry, exists in the petroleum futures market, specifically with #2 heating oil futures contracts traded on the New York Mercantile Exchange. Other industries have hedged in these markets to great advantage as a means of "locking in" favorable prices. Discussions with purchasing agents on a number of railroads indicate that the major stumbling block has been

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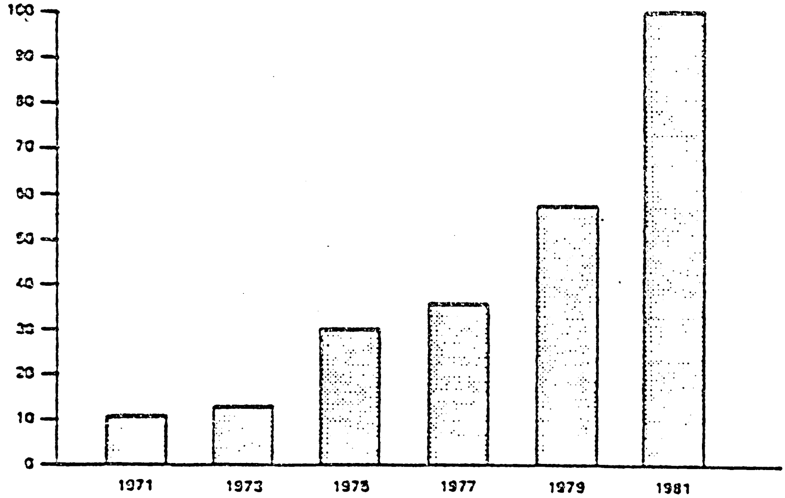
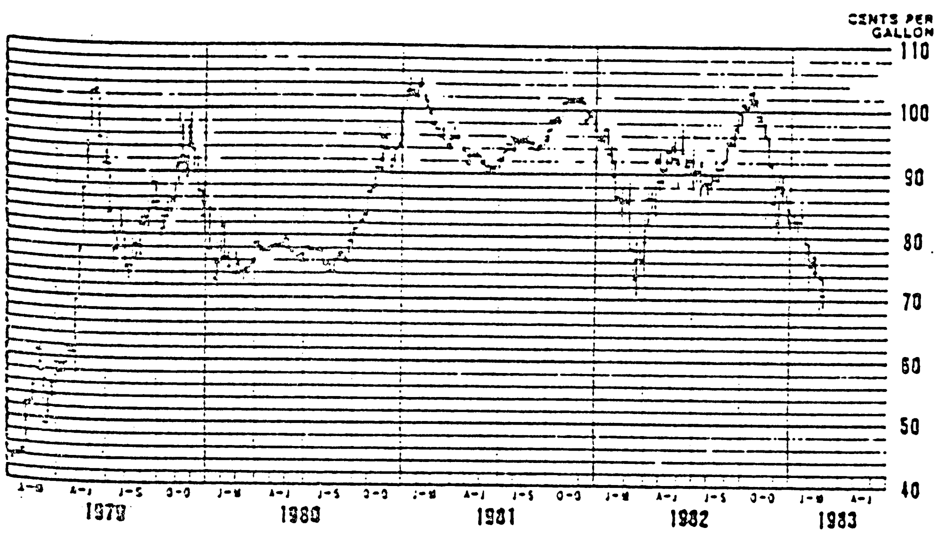
AVERAGE COST FOR RAILROAD DIESEL FUEL (CENTS PER GALLON)



Source: Yearbook of Railroad Facts, Association of American Railroads.

FIGURE 1

NUMBER 2 HEATING OIL PRICES (NYMEX — NEW YORK)



Source: Commodities Research Bureau.

FIGURE 2

the industry's lack of knowledge about such hedging. The intent of this paper is to supply the information needed to understand the hedging mechanism and to evaluate its application by railroads.

II. THE THEORY AND MECHANICS OF HEDGING

Hedging is the art of "locking in" today's prices for raw materials required by producers or consumers in the future. It is thus a form of insurance to the user, who otherwise would be forced to buy or sell his product on a spot basis and thereby suffer the uncertainties of future market events.[1] On the consumption side of the market, the insurance is to protect against rising prices, so consumers contract to buy required commodities in the future at a fixed price. This is known as a "long hedge." In the case of a railroad that must contract for diesel fuel, the insurance lies in locking in the futures price now and not worrying about the vagaries of the market over the length of the contract. On the production side, however, companies must be concerned with protecting themselves against falling prices in the future, which would reduce their revenues. Consequently, they contract to sell their products in the futures market to lock in the current futures price. This technique is known as a "short hedge."

A. Futures Markets: What They Are and How They Work

Futures markets are organized forums for buying and selling commodities. The unique feature of these markets is that the sales and purchases made are most often commitments for future action rather than for immediate transactions. Also, the commitment can easily be cancelled at any time by either the buyer or the seller.

The medium for transacting business in the futures markets is the futures contract. The contract establishes an obligation to buy or sell a given commodity at a set price at a specified time in the future. The buyer of a contract agrees to purchase X units of a particular commodity at a stated price and to make full payment at the expiration date of the contract (i.e., the delivery date). Or, at any given time before the expiration date, he can sell the contract in the futures market—just as shares are sold in the stock market—for a profit or loss.

A simple example will demonstrate the mechanics of the futures contract. On May 1, 1983, anyone can buy a crude petroleum futures contract with an expiration date of November 30 for between $29.65 and $29.95 per barrel (the trading range on May 1).[2] This means that the buyer is contracting to pay between $29,650 and $29,950 for receipt of 1,000 barrels of crude petroleum at the end of November at a designated terminal.[3] The buyer can either take the delivery of the oil in November, or he can "close out his hedge"—that is, sell his futures contract—any time before the delivery date in November. If he holds his contract, he has locked in a price of $29.65 or so for the whole period from May 1 to November 30, regardless of price changes during that period. If the price in November is $40.00 per barrel, his futures contract will show a "gain" of more than $10.00 for each of the 1,000 barrels, for a total gain of more than $10,000.

In fact, the situation is usually slightly more complicated. A railroad, for example, as a consumer of diesel fuel, can purchase a futures contract not for diesel fuel, for which there is no futures market, but rather for #2 heating oil, for which futures contracts are available. Because these two fuels are middle distillates, their prices are highly correlated. Thus in May the railroad purchases a futures contract for heating oil. If prices for heating oil rise from May to November, the hedge is a wise one. In November the railroad purchases its diesel fuel requirements in the spot market (paying November's higher price) and closes out its hedge in the futures market (profiting from November's higher price). (Note that the railroad, which ultimately is a buyer in the physical market, is a seller in the futures market in November.)

The participants in the futures markets are generally of three types: (1) hedgers (whether producers or consumers), who are simply protecting themselves against adverse price moves on the commodities they must buy or sell, (2) large traders, who are professional money managers and are taking speculative risks on behalf of their clients, and (3) speculators, who are attempting to profit by taking leveraged positions in the market (and who most frequently lose money). The risks that the hedgers wish to avoid are, in effect, absorbed by the large traders and the speculators, who take risks in search of profit and are often not aware of the valuable economic function that they serve.

The number of participants in the futures markets has increased greatly in recent years. This increase has been due both to the rapid growth in the use of hedging by commercial corporate interests on the one hand and to the increased participation by traders and speculators on the other. Evidence of this growth is the impressive annual gains in volume for the last 22 consecutive years. The more participants in the market, the more effective hedging is, since greater volume leads to greater liquidity—that is, ease of buying and selling contracts.[4]

Futures markets were established in the United States in the 1800s. Initially the futures markets, located in the principal distribution centers (New York, Chicago, London), focused on agricultural and metals commodities. With advances in communication and computer technology since the 1970s and with the volatile world markets following the oil crisis in the 1970s, the number of futures markets and commodities traded has increased dramatically. In 1983 there are 75 major futures markets in the U.S. and dozens more worldwide. Today the opportunities for hedging are almost unlimited: futures contracts are available for financial instruments, foreign exchange, metals, agricultural commodities, livestock, foods, products (e.g., petroleum), and even stock market indices.

In the energy area, there are presently three different futures contracts of interest to railroad management: (1) #2 heating oil at the New York Mercantile Exchange, (2) crude petroleum at the Chicago Board of Trade, and (3) gasoil (the btu equivalent of middle distillates) at the London Commodity Exchange. As noted above, #2 heating oil is of most interest from the railroads' perspective, since prices for this oil are extremely highly correlated with prices of diesel fuel.

Each contract for #2 heating oil is for 42,000 gallons at New York harbor and extends for a period of up to 18 months. This means that at any time, one can buy or sell a contract for any month up to 18 months into the future.[5] For the hedger, in particular, the #2 heating oil market offers excellent liquidity and diversity, as it is considered the leading petroleum futures market in the world.

B. Evaluating the Hedge Approach

As described above, hedging can be used by both consumers and producers to protect themselves against fluctuations in price. Specifically, for the consumer, buying a futures contract is a kind of insurance against rising prices, with no penalty if prices should fall instead. Viewed in this light, not hedging looks more like a form of risk taking than does the purchase of futures contracts. In fact, railroad managements who do not hedge are speculating that the price of diesel fuel will not rise during the contract period—hardly a safe bet.

One of our favorite ways to express the relative merits of hedging and not hedging is by analogy to Pascal's wager theorem, developed by the 17th-century mathematician and philosopher in his assessment of the benefits ond costs of belief in God. In each case, there are two choices: in the futures market, to hedge or not to hedge; and in Pascal's schema, to believe or not to believe in God. In the real world, prices go up or they do not (God exists or He does not). If they do and you are hedged long, you win. If they do not and you are hedged, you lose (but only a little, in transactions costs and the like). If you do not hedge and prices go down, you win (a little), but if you do not hedge and prices go up, you lose (a lot). Figure 3 summarizes these relationships.

Instituting and maintaining a protective hedge program is a new experience for most companies and quite naturally raises some concerns. The two most frequently asked questions are: Is it speculative? Can we lose? However, a hedge program, properly established, can become an efficient and easily maintained insurance tool. The true question is not

THE COSTS AND BENEFITS OF HEDGING

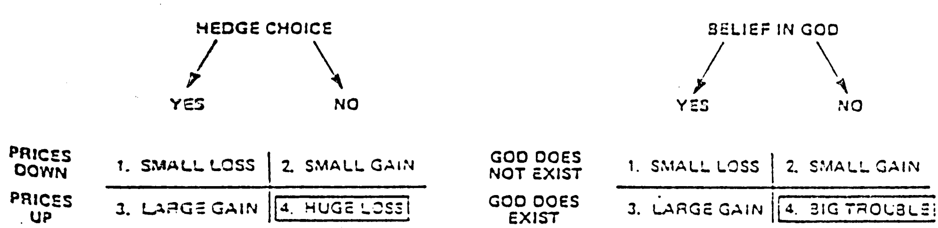


FIGURE 3

"Can we lose?" but "Do we want insurance?" Hedging should reflect the same caution exercised by a firm when it insures its top executives.

C. When to Hedge

It should now be clear that the strategic issue is not whether to hedge, but when. To the extent that hedging programs entail some risks, it is in their timing. That is, it must be decided when the hedge should be initiated and at what prices coverage should be sealed in. As a means of facilitating decision-making, hedge managers adhere to trading rules.[6] In determining the rules that best fit their needs, a process that is extremely critical to a successful hedge program, hedge managers draw upon the wide variety of timing methods developed by commodity trading advisors who are experienced in hedge application.

In actual use, trading rules practiced by hedgers fall into three general groups: (1) rules for risk control, (2) rules for profit protection, and (3) rules based on technical system signals. Each is described below:

- **Risk Control Rules:** These rules are designed to protect the hedger from an adverse move in prices—for the buyer, a drop in prices that makes his hedge less advantageous. A risk control rule may be triggered either by a dollar value movement or by a percentage movement: when a certain previously determined dollar amount or percentage is reached or approached, a trigger mechanism calls for the review of the logic associated with the original hedge position and/or the partial or total liquidation of the position.
- **Profit Protection Rules:** These rules are the converse of risk control rules. When a given dollar profit amount is reached or when a given percentage gain is earned, profit protection rules provide for a stop policy to be implemented to protect forward market gains. For example, if prices rise and then begin to fall, a buyer may wish to close out his hedge in order to protect the gain already made. This policy would result in the review and/or liquidation of the position if the profit were threatened, for example, by new market information or if the basis, or spread, was changing.[7]
- **Rules Based on Technical System Signals:** Trading rules of the last general type apply to those technical systems and techniques practiced by commodity trading advisors and by other commercial hedgers around the world. These signals pertain to the technical characteristics of markets and act as signposts or warning signals as the hedge contracts are placed in position and maintained. These signals include channel analysis, vertical bar chart signs, point and figure estimates, and moving average crossovers.[8] These techniques require more complex implementation than the percentage risk or profit protection levels, and their use may therefore require managers to seek outside assistance; nevertheless, they do play an important part in the success of well-maintained programs.

D. Classic and Dynamic Hedging

In general, there are two approaches to hedging: the classic hedge and the dynamic hedge. The classic hedge is simply hedging the complete commodity requirement at the beginning of the period (usually one quarter to one year). The primary benefit of this approach is locking in a known price for the future. The dynamic hedge is a more sophisticated approach that allows for monitoring and altering trading decisions; thus it is more "optimizing" than the classic hedge. Using the dynamic approach leads to all the benefits described in the following section. We should note that the majority of new hedgers in the business have elected the dynamic approach. The advantages and disadvantages of each approach are summarized in Table 1.

E. Benefits of a Hedge Program

Once the decision to hedge has been made and an integrated program for materials procurement and management has been developed, a number of benefits accrue.

- **Increased Price Protection:** The price of diesel fuel can be maintained at competitive levels. Forecasts of future prices of diesel fuel will indicate at what time usage requirements should be fully hedged, moderately hedged, or unprotected. The result of this planning should be reflected in consistently stable operating costs and increasing profit margins.
- **Improved Purchasing Strategy:** With an anticipated schedule of diesel fuel requirements (updated

TABLE 1

COMPARISON OF CLASSIC AND DYNAMIC HEDGING

	Advantages	Disadvantages
Classic Hedge	—Clean and straightforward —Historical precedent —Locks in **current** price —Does not require monitoring —Allows consistent planning —Better than nonhedging	—Often inflexible —Can possibly induce large losses —Requires spot and futures price relationships to remain stable —Inconsistent with contemporary management planning principles
Dynamic Hedge	—Systematic —Very flexible and responsive to market conditions —Allows newcomer to "test the water" —Is consistent with contemporary management planning principles —Limits losses dramatically —Requires smaller cash balances (and thereby improves profit performance) —Can be easily integrated with ongoing purchasing policies	—Requires market flexibility —Requires frequent monitoring —May require external assistance for coordination

to reflect changing needs), a purchasing strategy can be established based upon near-term and longer term price forecasts, so that the bulk of all requirements can be obtained at the best achievable price.

- **Flexibility of Inventory Levels:** Inventory levels can be managed to take advantage of expected price declines and to protect against expected price increases. General guidelines would establish the minimum level of inventory to be maintained as well as the maximum level achievable during an expected period of rising prices. Continued judicious application of price forecasts to current and future inventory needs allows for maximum flexibility in determining how much to protect and when to protect it.[9]
- **Commitment to a Long-Range Game Plan:** The beauty of a hedge program is that a prescribed "game plan" or strategy is consistently maintained and improved. Thus purchasing takes place in a controlled and well-planned environment. Also, as a hedge program develops over time, current information can be used to narrow any variance in budgetary goals.

The extent to which the hedge program will generate these benefits depends on how extensively the company wishes to hedge and the specific hedging approach used. As noted above, the dynamic hedge is a more "optimizing" approach.

III. HEDGING RAILROAD FUEL COSTS

In order to apply hedging theory to the railroad industry, let us consider as an example a regional New England railroad that uses 12 million gallons of #2 diesel fuel annually. For illustrative purposes suppose that the current (January 1) spot price for #2 heating oil (a distillate comparable in quality and quantity to diesel fuel) is 85 cents per gallon. Suppose also that a futures contract for heating oil for next December 31 on the New York Mercantile Exchange is priced at 83 cents per gallon on January 1 (reflecting a continuation of abundant supplies and seasonal factors). The outcome of hedging this requirement depends on: (1) the type of hedge used (i.e., classic versus dynamic), and (2) the change in prices during the year. The question facing management is how best to control fuel costs by avoiding the risk of rising prices in the future.

A. Classic versus Dynamic Hedge Applications

Four examples cover the range of outcomes resulting from the alternative hedging applications and possible changes in price:

- Case 1: a classic hedge with rising prices
- Case 2: a classic hedge with declining prices
- Case 3: a dynamic hedge with rising prices
- Case 4: a dynamic hedge with declining prices

The outcomes of these scenarios and their associated savings are presented in Table 2. (For simplicity, it is assumed that all spot purchases are made in December.)

In Case 1, a classic hedge is assumed. The spot price rises by 10 cents per gallon over the year, and the futures and cash prices converge in December at 95 cents. The resulting gross hedge gain would be 12 cents; however, a 10 cents higher spot price would have to be paid in December, leaving a net gain of 2 cents. Therefore, a net savings of $240,000 (12,000,000 gallons × 2 cents per gallon) is achieved as a result of hedging. If the hedge had not been placed, the additional cost incurred (i.e., the gross savings) would have been $1.44 million.

In Case 2, the placement of a classic hedge is followed by a drop of 10 cents per gallon. Here, the company in retrospect would have been better off without the hedge. (However, without the hedge, no protection would have been provided if prices had in fact risen.) Still, the net savings is $240,000 because the lower spot prices in December saved $1.2 million in spot costs, which more than offset the loss incurred through the hedge. As a result of the hedge, a gross hedge loss of $960,000 (83 cents – 75 cents × 12,000,000 gallons) was incurred.

In Case 3, the dynamic hedge gives exactly the same results as the classic hedge; since prices are expected to increase, the hedge is placed and is left on during the course of the year, provided that market conditions remain stable. (If, however, excessive unfavorable price movements had been experienced, trading rules could have been used to lighten or lift the hedge.) Using the example, the overall gross savings resulting from the dynamic hedge would amount to $1.44 million and net savings would be $240,000—the same as under the classic hedge scenario.

In Case 4, the policy of dynamic hedging suggests that no hedge be tak-

TABLE 2

OUTCOMES OF THE HEDGING ALTERNATIVES

Case 1: Classic Hedge with Rising Prices

	January 1	December 31
Spot Price	85 cents	95 cents
December Futures Price	83 cents	95 cents
Net Hedge Gain or Loss	--	+ 2 cents
Gross Hedge Gain or Loss	--	+12 cents
Net Hedge Savings	--	$ 240,000
Gross Hedge Savings	--	$1,440,000
Annual Protected Price	83 cents	83 cents

Case 2: Classic Hedge with Declining Prices

	January 1	December 31
Spot Price	85 cents	75 cents
December Futures Price	83 cents	75 cents
Net Hedge Gain or Loss	--	+ 2 cents
Gross Hedge Gain or Loss	--	- 8 cents
Net Hedge Savings	--	$ 240,000
Gross Hedge Savings	--	($ 960,000)
Annual Protected Price	83 cents	83 cents

Case 3: Dynamic Hedge with Rising Prices

	January 1	December 31
Spot Price	85 cents	95 cents
December Futures Price	83 cents	95 cents
Net Hedge Gain or Loss	--	+ 2 cents
Gross Hedge Gain or Loss	--	+12 cents
Net Hedge Savings	--	$ 240,000
Gross Hedge Savings	--	$1,440,000
Annual Protected Price	83 cents	83 cents

Case 4: Dynamic Hedge with Declining Prices

	January 1	December 31
Spot Price	85 cents	75 cents
December Futures Price	83 cents	75 cents
Net Hedge Gain or Loss	--	0 cents
Gross Hedge Gain or Loss	--	0 cents
Net Hedge Savings	--	0
Gross Hedge Savings	--	$1,200,000
Annual Protected Price	--	Spot price

Note: Assumes an annual fuel requirement of 12 million gallons.
Net hedge savings = the difference between the higher (lower) cost of the physical product in December as compared to January and the gain (loss) by the hedge in the futures market during this period.
Gross hedge savings = the gain or loss resulting only from the application of the hedge.

en, since prices are not expected to increase. (Again, indications of changes in the price environment would have resulted in institution of a hedged position.) Based on the example, the gross savings resulting from the dynamic hedge (no hedge placed) would be $1.2 million.

B. Inferences

These examples clearly demonstrate that the classic hedge locks in the futures price regardless of changes in the spot market. If prices increase, the hedge offers protection. If prices decrease, the cheaper spot prices in December offset any futures losses. Therefore, according to classic hedge theory, if the futures price is a "good value" price, lock it in and do not worry about what the market does from here on.

The examples also demonstrate that the use of the dynamic hedge not only protects current prices during times of rising prices but also permits the company to take advantage of falling prices.

While a dynamic hedge program requires greater market sophistication and more careful administration, the benefits can be sizable. For instance, in our regional example, each one-cent savings in fuel cost means a savings of $120,000 for the railroad. Given that annual savings of 20 to 30 cents are not unreasonable in view of the overall history of prices, this small railroad could save on the order of $2.4 million to $3.6 million per year. For a larger railroad using 300 million gallons, the annual savings under similar circumstances could range from $60 million to $90 million.

It is important to realize that the examples provided above are simplified for illustrative purposes. In actual trading many complexities must be taken into account. In the case of #2 heating oil, knowledge of seasonal variations and international processing costs, to name two factors, is critical. As shown in Figure 4, prices for heating oil vary greatly during the course of the year; thus the timing of hedges must exploit this variation.

C. Precedents

While no railroads, insofar as we know, have taken the plunge into formal hedging practices to date, important precedents do exist. First, the Southern California Rapid Transit District (by virtue of a 1981 referendum) has been using the New York market to hedge its bus fleet's diesel fuel requirements. Second, the San Diego bus system has recently received approval to do the same. Third, at least one trunk airline is hedging a portion of its jet fuel. Further, while many interstate motor trucking firms hedge their fuel supplies (through storage), a few have used the New York market for price protection. Finally, a major Massachusetts electric utility hedges its entire fuel requirement in the futures market. These examples attest to the growing recognition of the potential offered by hedging fuel prices in the regulated and transportation industries.

The following section describes the general tasks required to implement a hedging strategy.

IV. REQUIREMENTS FOR DEVELOPING A HEDGING STRATEGY

In light of the complexities of the hedging process, developing a successful strategy requires a sizable planning effort. Indeed, many hedging programs that have not been successful owe their failure to poor upfront planning. In our experience, the benefits of hedging can be obtained by completing the following four tasks:

- Assess how to incorporate hedging into existing policies and procedures
- Establish a corporate hedging policy
- Developing reporting procedures
- Continuously monitor the results of the hedging strategy

The first task in developing a comprehensive hedging strategy is to assess how the hedging program can best be incorporated into existing procurement policies and procedures. The initial question to be answered is: Do the benefits of hedging outweigh the associated resource requirements and risks? We believe that for the majority of railroads the answer to this initial question is yes. Next, the portion of the inventory that should be hedged must be determined. Finally, policies that require modification of development must be identified and defined.

The second task is to develop a corporate approved hedging policy. This task involves developing the organization structure required to implement the hedging programs as well as the mechanics of the document flow and information flow. In addition, the actual trading rules must be specified and documented in a written operating plan. This specification, of course, is the heart of

CHANGE OF COMMODITY PRICES OVER TIME

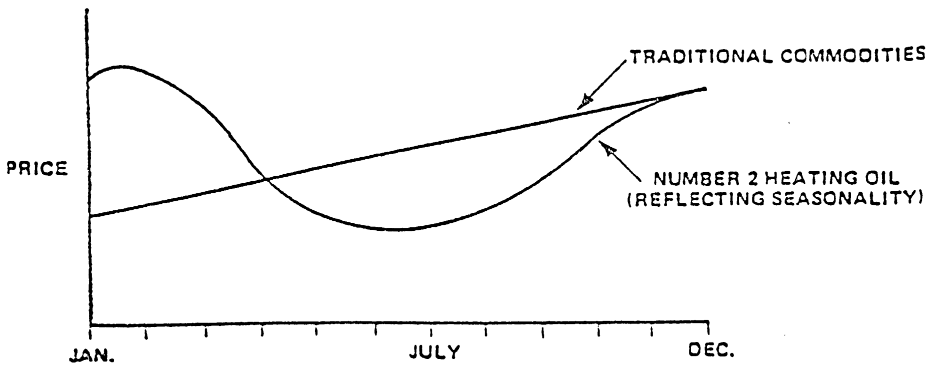


FIGURE 4

entire program, and is typically developed jointly by the purchasing, finance, and operating departments.

The third task is to develop reporting procedures. These procedures must define the information to be reported, the form and frequency of the distribution, and the individuals who will receive it.

The last step—review of the hedging program—addresses the dynamic nature of the strategy and the underlying markets. As time passes, the basis for developing the original strategy may change. This could result from major external forces (e.g., a Persian Gulf war), changes in the regulatory environment (e.g., fuel cost surcharges), or changes in corporate policy. As a result of such changes, the amount of hedging activity that is appropriate may change, or the trading rules may well be altered. Consequently, it is most important that senior management review the hedging strategy on a periodic basis to ensure that it is in tune with the times and that the benefits predicted to result from the program have in fact been achieved.

By prudently completing this planning process and implementing the hedging strategy, we believe railroad managements can make a significant contribution to increased corporate profitability.

FOOTNOTES

1 Futures markets offer the raw materials industries benefits in addition to those of hedging, such as inventory management and price setting for marketing purposes. For an excellent study on the numerous advantages of using the futures market, see Commodity Research Bureau, Inc., "New Hedging Concepts on Commodity Futures," April 1970.

2 The purchase of a contract requires a "margin deposit," which is a good faith deposit. In this case a standard contract (1,000 barrels or 42,000 gallons) requires a margin deposit of $1,000 per contract, or about 4 percent of the value of the contract.

3 The extent to which the final cost represents FOB and CIF factors depends on the exchange.

4 Most futures markets have daily volumes in excess of 10,000 contracts traded, which is considered extremely active by both securities and commodities standards.

5 The current trading hours are 10:00 a.m. to 2:45 p.m., Eastern time. Every participant must have an account with an approved brokerage firm, which has a seat on the exchange. For each trade, a commission is negotiated on a round-turn basis (i.e., representing a completed purchase and sale), but it is usually only $20.00 to $80.00 per contract.

6 A hedge manager is the designated individual (either in-house or external) responsible for the overall thrust of the hedge program as well as the day-to-day activities of monitoring, implementing, and accounting for the program.

7 Basis, or spread, refers to the difference between spot and futures prices or between values of different contracts. The normal relationship between these prices is for futures prices to be slightly greater than spot prices, reflecting the costs of storing, insuring, and carrying the inventory. This normal condition is known as contango. In some limited instances, such as a material shortage, the reverse relationship holds. This condition is known as backwardation.

8 Most standard commodity textbooks include a wide range of these signals. See P. J. Kaufman, Technical Systems Methods (New York: John Wiley and Sons, Inc., 1979) and Robert Gilson-Jarvie, The London Metal Exchange (London: Investor Publications, 1979).

9 As market conditions change, inventory management policy also must be flexible. As railroads' seasonal requirements vary, the tradeoff becomes one of holding more inventory (at a predetermined, hopefully minimal price (versus tying up capital in the monetary outlays for the physical product. The critical issues to be determined are: How much should be purchased and stored relative to cash outlay? How much should be contracted for in the futures markets, over what time period, and at what price?