TITLE

ENERGY RISK MANAGEMENT METHOD

BACKGROUND OF THE INVENTION

Related Application

This application claims the benefit of U.S. Provisional Application No. 60/015,756, filed April 16, 1996.

1. Field of the Invention

The invention herein relates to methods for managing the consumption risk costs of a commodity sold at a fixed price and, more particularly, methods for managing the weather-related risks associated with energy pricing.

2. Brief Description of the Prior Art

Energy consumers nationwide suffer substantial cost risk from month-to-month and year-to-year. As an illustration, the NYMEX contract for natural gas has been the most volatile contract ever traded with near-term volatilities regularly exceeding 40 to 70%, well above that for all other commodities traded. For budget-sensitive customers, actual expenditures for energy can easily be 20% or more above or below what was budgeted.

There are two key sources for the energy cost risk facing these customers: price risk and consumption risk. In natural gas, price risk is evidenced in the volatilities of the NYMEX contract and other over-the-counter location-specific instruments (swaps, basis swaps, forwards). In electricity, the new NYMEX electricity contract is showing at least as much volatility as natural gas.

Because of the proliferation in price risk management tools over the last 5 years, though, price risk is now easily managed in energy markets. Consumption risk, on the other hand, is *not* currently managed in energy markets. Accordingly, there is a need for a fixed bill product to manage total energy cost risk including the consumption risk.

SUMMARY OF THE INVENTION

The risk management method of the present invention is based upon a fixed bill product which essentially guarantees the customer a normal winter and locks in a payment stream (a fixed energy bill) for whatever period the consumer wishes. This is not the "budget bill" offered by many local distribution companies, wherein the consumer pays a temporary fixed payment but must make a full accounting in a subsequent period in the event actual consumption or prices are different than what has been charged for.

The fixed bill method of the present invention manages the risk-associated costs of a commodity sold by a commodity provider at a fixed price. Such risk-associated costs include the weather-related costs of a fixed-price energy bill. However, it is to be distinctly understood that the present method can be used for any commodity to manage consumption risk in a fixed bill price product. The commodity provider initiates a series of transactions with consumers of the commodity wherein the consumers purchase the commodity at a fixed rate based upon historical averages. The fixed rate corresponds to a risk position of the consumers. The commodity provider then identifies market participants for the commodity who have a counter-risk position to that of the consumers. The commodity provider then initiates a series of transactions with such market participants at a second fixed rate such that the series of market participant transactions balances the risk position of the series of consumer transactions.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention can best be illustrated in connection with the management of weather-related risks associated with fixed bill energy pricing. A consumer's unhedged energy bill for a given period i can be shown as in Equation (1) below:

(1) $\text{Energy Bill}_i = F_i + (C_i + T_i + LD_i) \times Q_i$

wherein,

F_i = fixed costs in period i,

C_i = variable commodity costs in period i,.

T_i = variable long distance transportation costs in period i,

LD_i = variable LDC or local delivery costs in period i, and

Q_i = consumption in period i.

In Equation (1), the consumer could easily fix a portion of the costs by using futures or over-the-counter instruments to lock in a price on the portion of consumption that is known with certainty. For instance, any energy consumption that is not weather driven may be highly predictable. A consumer could then fix the cost of this portion of total consumption with confidence that an effective hedge is achieved. To the extent, however, that the consumption is weather driven, the consumer cannot confidently lock in a price.

An industrial consumer with baseload process requirements can achieve all the hedge required by simply locking in prices. A school district or hospital with significant unknown weather-driven requirements cannot reduce risk with the same hedge; a large portion of its risk is tied up in the weather risk as opposed to the price risk. For these reasons, one can think of the consumption variable, Q_i, as in Equation (2).

(2) $Q_{i,l} = f(B_i, W_{i,l})$

wherein,

B_i = base (predictable) consumption in period i, and

$W_{i,l}$ = a location-specific weather indicator, either $HDD_{i,l}$ for heating degree days during the ith period and location l, or CDD_i for cooling degree days for the ith period at location l. For a given day, one takes 65 degrees less the average daily temperature at a given location to find the number of heating degree days (HDD) for that day. Similarly, one takes the average daily temperature at the same location less 65 degrees to find the number of cooling degree days (CDD) for that day. Both numbers are by definition non-negative.

For a given consumer, Equation (2) can be estimated with ordinary least squares in a model of the form:

(3) $Q_{i,l} = \alpha + \beta W_{i,l} + \varepsilon_i$

Since goodness of fit is the objective in estimating Equation (3), the results of Equation (3) can be variously estimated with non-log, semi-log or log-log forms.

Next, an assumption is made that $W_{i,l} \sim N(\mu,\sigma)$, that is, that the HDD or CDD variable of the location-specific weather indicator is normally distributed with mean μ and standard deviation σ.

With the assembling of the various estimations and identities the fixed bill estimate for a consumer can be shown as in Equation (4).

$$(4) \qquad \text{Fixed Bill} = F_i + [(C_i + T_i + LD_i) \times (\alpha + \beta E(W_1)]$$

Equation 4 assumes that the provider's margin is included in C_i.

As Equation (4) shows, the usage level, once estimated for a given consumer in a given location, is now fixed as an expected value for purposes of defining consumption.

The model presented above identifies a conceptual approach to understanding how a fixed bill transaction might be calculated for a consumer. In practice, this concept is only a starting point. A provider of fixed bill transactions will be much like a provider of other risk management tools in that the risk that is extracted from consumers must be laid off with counterparties that have an opposite appetite for the risk. All risk management markets are made up of parties with appetites for length positions and parties with balancing appetites for short positions. Thus, the provider will have the goal of matching "shorts" (sales to consumers) with length while maintaining a margin between these positions.

The natural counterparty for the energy transaction discussed above is a reasonably collocated distribution company who has the opposite economic appetite for weather patterns. Where consumers are concerned about colder than normal winters, distribution companies are concerned about warmer than normal winters. The opposite risk positions make a risk management trade possible. The provider's goal then is to find a distribution company that is willing to pay an amount of money when the winter is colder than normal in return for payments to the utility when the winter is warmer than normal. This is a swap.

At the simplest level, once Equation (4) is approximated for a given consumer one can divide the variable cost portion of the calculated Fixed Bill by the E(HDD) or E(CDD) to obtain the provider's marginal cost per HDD or CDD. Given this, the provider would search for a distribution company interested in the swap that satisfies the following condition:

(5) $\partial \text{ Costs}/\partial/\text{HDD}_l = \partial \text{ Swap Receipts}/\partial \text{HDD}_l$

Condition (5) simply says that when a provider's costs increase with actual heating degree days at the lth location he would want a precisely offsetting swap receipt to cover the marginal weather-driven cost.

Laying off risk for a fixed bill transaction, however, is vastly different than it is for most risk management products. This results because (a) weather is not a fungible commodity, and (b) the counterparties will often desire risk protection at different, imperfectly correlated weather locations. Contrasted with a situation like the NYMEX contract where a provider could establish equal and exactly offsetting positions the provider retains some unhedgeable weather risk when short positions are established at one location and long positions are established at different locations. The best the provider can do is build a book around reasonably correlated weather patterns.

In theory, one could evaluate the economically weighted joint probability density function $W_{i,l} \sim N(\mu,\sigma)$ parametrically for all locations in the provider's book. However, this proves quickly intractable as the number of locations increases to approximately three. Rather, the steps taken in pricing a deal, and in managing the portfolio, involve the following steps:

1. evaluate the usage and all costs for a prospective deal;

2. perform a Monte Carlo simulation across all deals at all locations in the book over the last 20 years of weather patterns and establish the payoffs from each deal under each historical weather pattern;

3. assume that the summed payoffs are distributed $N(\mu,\sigma)$;

4. perform one-tail tests to determine the marginal likelihood of losing money on the deal and the marginal likelihood of retaining at least the design margin included in the initial evaluation of Equation (4);

5. if the transaction as initially priced leads to a reduced expected margin or increases the likelihood of a loss add more margin to Equation (4) and vice versa until the expected portfolio margin and the likelihood of portfolio loss is acceptable.

With the fixed bill thus calculated for a consumer several risks remain for the provider of such service:

1. How does the provider allow for the fact that the consumer may be encouraged to become less efficient in its utilization of energy now that it can consume all it wants for a fixed payment?

2. How does the provider allow for price volatility, apart from the weather volatility?

A key feature of the final consumer agreement is that energy use per HDD or CDD remains within a band established as the annual standard error of the intercept in the usage estimation. This is typically a band with a width of 2% or so. In the event the consumer uses more energy per degree day than shown historically it is penalized. And in the event the consumer uses less energy per degree day it is refunded dollars, regardless of whether the energy pattern is warmer or colder than expected and used in the fixed bill calculation.

Finally, embedded in the deal pricing steps above, the commodity price volatility within the fixed bill must be managed. If only the expected value is purchased one can guarantee that it will have too little or too much fixed price energy available for the customer. A rule that seems to work in this regard is for the provider to purchase forward, fixed price energy at one standard deviation below the expected consumption level for the consumer, and to purchase at-the-money calls on the next two standard deviations of consumption. This strategy covers 86% of the possible weather pattern events, with minimal but symmetric outliers beyond what is financially covered. The provider will, of course, want full physical coverage on all possible weather patterns.

While the variable C_i implicitly contains fixed forward prices, there is no reason why the commodity price component of the transaction could not be priced as a pure option or a price range. In the call option formulation the weather itself would be fixed but pricing could be adjusted to allow the consumer to benefit if commodity prices fall over the course of the transaction. This, of course, would imply an option payment by the consumer up front. With a price range feature the consumer would give back a floor to the provider of equal value to offset the cost of the call option. Here then the commodity price would not go above the call strike and would fall until the market price hit the put strike on the lower end. Other option-based structures could include a sharing of price increases and/or decreases with the weather fixed.

Also, through the Monte Carlo simulation process, one could establish a cap on the weather. Here, the pricing process would run as follows:

1. evaluate the usage equation and all costs for a prospective deal;

2. perform a Monte Carlo simulation across all deals at all locations in the book over the last 20 years of weather patterns and establish the payoffs from each deal under each historical

weather pattern assuming that the price in the deal being priced floats down when the weather is below normal;

3. assume that the summed payoffs are distributed $N(\mu,\sigma)$;

4. perform one-tail tests to determine the marginal likelihood of losing money on the deal and the marginal likelihood of retaining at least the design margin included in the initial evaluation of Equation (4);

5. continue repricing the margin in the transaction until the expected portfolio margin and likelihood of portfolio loss is acceptable;

6. established in this way the margin becomes essentially the cost of a call option on weather at location 1.

A model is presented that allows for the full risk management of a budget sensitive energy consumer. Energy consumers have heretofore been able to manage price risk but not overall cost risk. This is because the weather pattern has been previously unmanageable. With a combination of price risk management and the ability to "lay off" weather risk to natural counterparties an energy provider can provide complete energy cost risk management.

While certain present preferred embodiments have been shown and described, it is distinctly understood that the invention is not limited thereto but may be otherwise embodied within the scope of the following claims.

CLAIMS:

1. A method for managing the consumption risk costs of a commodity sold by a commodity provider at a fixed price comprising the steps of:

(a) initiating a series of transactions between said commodity provider and consumers of said commodity wherein said consumers purchase said commodity at a fixed rate based upon historical averages, said fixed rate corresponding to a risk position of said consumers;

(b) identifying market participants for said commodity having a counter-risk position to said consumers; and

(c) initiating a series of transactions between said commodity provider and said market participants at a second fixed rate such that said series of market participant transactions balances the risk position of said series of consumer transactions.

2. The method of claim 1 wherein said commodity is energy and said market participants are transmission distributors.

3. The method of claim 2 wherein said consumption risk is a weather-related price risk.

4. The method of claim 3 wherein the fixed price for the consumer transaction is determined by the relationship:

$$\text{Fixed Bill Price} = F_i + [(C_i + T_i + LD_i) \times (\alpha + \beta E(W_i)]$$

wherein,

F_i = fixed costs in period i;

C_i = variable costs in period i;

T_i = variable long distance transportation costs in period i;

LD_i = variable local delivery costs in period i;

$E(W_i)$ = estimated location-specific weather indicator in period i; and

α and β are constants.

5. The method of claim 4 wherein said location-specific weather indicator is at least one of heating degree days and cooling degree days.

6. The method of claim 4 wherein said energy provider seeks a swap receipt to cover the marginal weather-driven cost.

7. The method of claim 4 wherein the energy price is determined by the steps of:

(a) evaluating the usage and all costs for a prospective transaction;

(b) performing a Monte Carlo simulation across all transactions at all locations for a predetermined plurality of years of weather patterns and establishing the payoffs from each transaction under each historical weather pattern;

(c) assuming that the summed payoffs are normally distributed;

(d) performing one-tail tests to determine the marginal likelihood of losing money on the deal and the marginal likelihood of retaining at least the design margin included in the initial evaluation of the fixed bill price; and

(e) adjusting the margin of the fixed bill price if the transaction as initially priced leads to a reduced expected margin or increases the likelihood of a loss until the expected portfolio margin and the likelihood of portfolio loss is acceptable.

8. The method of claim 4 wherein a cap on the weather-influenced pricing is established by the steps of:

(a) evaluating the usage equation and all costs for a prospective transaction;

(b) performing a Monte Carlo simulation across all transactions at all locations for a predetermined plurality of years of weather patterns and establishing the payoffs from each transaction under each historical weather pattern assuming that the price in the transaction being priced floats down when the weather is below normal;

(c) assuming that the summed payoffs are normally distributed;

(d) performing one-tail tests to determine the marginal likelihood of losing money on the transaction and the marginal likelihood of retaining at least the design margin included in the initial evaluation of the fixed price bill;

(e) continuing to reprice the margin in the transaction until the expected portfolio margin and likelihood of portfolio loss is acceptable; and

(f) establishing the margin as a call option on weather at a predetermined location.

9. The method of claim 1 wherein said commodity provider seeks a swap receipt to cover the price risk of the consumer transaction.

ABSTRACT

A method is provided for managing the risk-associated costs of a commodity sold by a commodity provider at a fixed price. Such risk-associated costs include the weather-related costs of a fixed-price energy bill. The commodity provider initiates a series of transactions with consumers of the commodity wherein the consumers purchase the commodity at a fixed rate based upon historical averages. The fixed rate corresponds to a risk position of the consumers. The commodity provider then identifies market participants for the commodity who have a counter-risk position to that of the consumers. The commodity provider then initiates a series of transactions with the market participants at a second fixed rate such that the series of market participant transactions balances the risk position of the series of consumer transactions.