Buying in a volatile market: variable or fixed price?

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Abstract

Many commodities are bought in a volatile market, where the purchasing price changes constantly. In this paper we discuss the best strategy for buying from a broker who offers such a commodity under fixed price contracts or variable price contracts. In particular, we pay attention to the best choice between buying for a certain period for a fixed or a variable price. Under reasonable assumptions we prove that the expected costs of variable price contracts are smaller.

Keywords: fixed price contract, variable price contract, volatile market, buying strategy.

Introduction

Many commodities are bought in a volatile market, where the purchasing price changes constantly. Sometimes price changes are relatively rapid, in markets like money, stock or oil markets; sometimes they are rather lengthy, in markets like the steel market. Most of these commodities are needed at a high and fairly constant (or at least well predictable) level by buying organizations. In these situations the price paid for the commodity is often the major determinant of the total costs of ownership for these commodities.

There are several interesting research questions related to this situation. Many purchasing related publications discuss how to deal with the behaviour of commodity markets (e.g. Heijboer 2003; Kingsman 1985; Morris 1959; Schwartz and Smith 2000; Szakmary et al. 2003; Voituriez 2001; Wang et al. 2003). There is an obvious relation of this research on commodity markets with the extensive literature on money-, stock- and options markets (e.g. Frechette and Weaver 2001; Hull 2002; Wang 2003). A major difference with the latter markets is that a purchase is required on the commodity markets. A buying organisation simply needs the commodity for its operation, whereas in the financial markets usually not making a transaction is also an option.
Morris (1959) and Kingsman (1985) are the first to provide extensive studies of purchasing raw materials solely based on commodity market price fluctuations. However, neither this nor any other paper considers the trade-off between different contract forms in volatile commodity markets.

In this paper we discuss the best buying strategy and in particular the best choice between buying a commodity required for a certain period (from the same broker) under a fixed price contract or under a variable price contract. In literature few have considered the choice between fixed price contracts and variable price contracts. Heijboer (2003) derived an optimal buying strategy in case we can choose between buying for a certain period or buying on the spot market. In this paper we assume that we are buying for a certain period. Then one of the questions is choosing between a fixed price contract and a variable price contract.

Research objectives

In this paper we present a framework for making the best choice between buying the commodity under a fixed or variable price contract. We first explain the composition of the commodity price under both fixed and variable price contracts. In the successive sections we provide insights in the costs of both contract forms, proving that variable price contracts have lower expected costs than fixed price contracts under reasonable assumptions.

Commodity price composition

Consider the following situation: the buying organization needs to buy a commodity (e.g. electricity) for a certain period of time. We assume that the buying organization does not want to trade on the daily commodity market by itself (as is the case for most organisations). For all transactions it will use an intermediary, a broker, from which it will buy the needed commodities. This broker offers contracts for either a fixed or variable price for that (fixed) period under the following two different price compositions.

1. Price composition under variable price contracts

When buying under a variable price contract the broker himself buys the commodity for the daily price on the commodity market and sells it (at a higher price) to the buying organisation. In this case the broker is assured that the commodity price on the market will be the same as the price he can charge the buying organization. In addition he will charge a gross margin on the commodity price for its operating costs, like trading, operations and profit. In table 1 the price components under variable price contracts are summarized.

Price Component	Description
c_A	Commodity price per unit
m_A	Gross margin for the broker per unit (operating costs, profit)

Table 1: Price components variable price

2. Price composition under fixed price contracts

If the organization buys under a fixed price contract, it is the broker (or someone else higher up in the chain) that has to buy the commodity on the volatile commodity market: he buys at a variable price and sells at a fixed price. When selling under a fixed price contract the broker bears the risks of price fluctuations on the commodity market. For the composition of the contract price the broker must make a prediction on the average commodity costs for the contract period. The broker will add a risk premium to counter the risks of price fluctuations. In addition a gross margin for operating costs and profit is added. In table 2 the price components under fixed price contracts are summarized.

Price Component	Description
c_B	Commodity price per unit
m_B	Gross margin for the broker per unit (operating costs, profit)
r_B	Risk premium per unit (price risk)

Table 2: Price components fixed price

Literature review

Before we can determine the best choice between fixed and variable price contracts we first have to know their very nature. According to Polinsky (1987) fixed price contracts and variable price contracts can differ in their allocation of risk. These differences in risk influence the prices paid for the commodity. In the vast body of literature on hedging we find the description of risks for the buyer and seller in these situations (Spinler et al 2003). When buying under fixed price contracts, the buying organization is protected against the fluctuations of the market price and is mostly completely assured of delivery. In this case, the broker bears the risks of higher commodity prices on the spot market than the contract price. The buyer bears the risks of lower commodity prices on the spot market.

When buying under a variable price contract the buyer is provided with prices in line with the market. Accordingly the buying organization takes the risk of uncertain cost and profit levels, due to the fluctuating commodity prices. This shows that the contracts differ in how the risks are distributed over the buying organization and the broker.

In the same discussion Spinler (2003) argues that a variable price contract is only preferable over a fixed price contract when the broker is more risk averse than the buying organization. These statements are in line with the findings of Borenstein et al (2000). They state that the fixed prices in the forward contract electricity market, a typical volatile commodity market, are higher than the spot market prices. This is because of the fact that the buyers are more risk averse than the sellers, boosting the demand for 'safe' long-term (fixed price) contracts. The more risk averse the buyer will be, the higher price he will accept for a long-term (fixed price) contract. This shows that the difference in risk avoidance between the buying organization and the broker can influence the market prices for different contract forms.

Comparing different contracts

For our framework we assume that both the buying organization and the broker act risk-neutral in the commodity market. No commodity price difference can be expected from a difference in risk behavior between sellers and buyers, working on the supply and demand in the market. For the sake of simplicity, we assume that the buyer has a constant demand. Now we compare the costs of fixed and variable price contracts.

1. Variable price contract

The commodity costs (c_A) of a variable price contract over the entire period are equal to the average of the commodity price on the market for the contract period multiplied by the total demand of the buyer. Due to certain fluctuations sometimes the variable price may be high and sometimes low, but as we assume that the commodity will be bought on a regular basis, the commodity costs will resemble the average commodity price on the market multiplied by the demand. The total costs are equal to the commodity costs plus the gross margin (m_A) for the broker.

2. Fixed price contract

Under a fixed price contract the broker has to predict the average commodity price in the market as good as possible, in order to minimize his risks and maximize his benefits. The expected average commodity price during the contract period multiplied by the total demand of the buyer equals the expected commodity costs ($E(c_B)$). In practice, sometimes the broker 'beats' the market and the broker pays a lower price on average than he charges a buyer. Sometimes the market 'beats' the broker and the broker pays a higher price on average. But on average the total costs for the broker are $E(c_B)$.

The risk premium (r_B) is not only necessary for risks during the contract period, but also for risks during the negotiation period. After all, when negotiating a new contract the broker usually offers a certain fixed price and the buyer is given some time to consider this offer. During this consideration time the market may change and the offer may become superseded. In some negotiation situations this uncertainty is covered by a fixed price, which depends on the market price during the negotiation period.

Table 3 summarizes the different cost components for the costs of buying under the two contract forms in a certain fixed period.

Cost component	Variable price contract (A)	Fixed price contract (B)
1	Commodity costs (c_A)	Expected commodity costs ($E(c_B)$)
2	Gross margin for the broker (m_A)	Gross margin for the broker (m_B)
3	-	Risk premium (r_B)

Table 3: Cost components of both contracts

Assumptions

Now we assume two things. First we assume that the broker succeeds on average in predicting the average commodity costs perfectly. Basically this boils down to assuming that the broker knows the market he is operating in. As this is his only 'raison d'etre' this is a reasonable assumption.

Secondly, we assume that the gross margin for the broker (m) will be the same on average for the variable price contract form and the fixed price contract form. Note that this is exclusive of a risk premium or a possible profit from taking risk. It just stipulates that normal operating costs and normal profit levels are (on average) the same for both contracts

Both assumptions are given in the following equations:

$$E[c_A] = E[c_B] \tag{1}$$

$$E[m_A] = E[m_B] \tag{2}$$

With the equations (1) and (2) it is possible to compare the costs for a commodity bought in a certain fixed period for both contract forms.

Implications

The equations (1) and (2) show that the average (expected) commodity costs (c) and the gross margins (m) of both contract forms are equal. Therefore the only difference in the contract forms is that the fixed price contract adds an additional risk premium to its costs. Comparing the costs of both

contracts and noting the risk premium will be positive, we find that the expected costs of variable price contracts are always smaller than the expected costs of fixed price contracts:

$$E [c_A + m_A] < E [E(c_B) + m_B + r_B] \tag{3}$$

We note that this statement refers to the expected values: on average over many cases this is true. But in individual cases c_A may be larger than $E [c_B]$ and the difference between c_A and $[E(c_B)]$ may jeopardize the inequality.

Stated differently, when using variable price contracts (A) the buying organization may of course have to deal with extra costs, or extra profit due to fluctuations in the market.

Examples of fixed price contracts or variable price contracts

To illustrate the differences between the fixed price contract and the variable price contract we give an example of buying electricity. Electricity is a typical volatile commodity, which can be bought under fixed price or variable price contracts. As an example we take a period of three months from January 1st 2005 to March 31st 2005.

For this period of three months the fixed price offered by the brokers was 50,27 euro/MWh. The actual average energy price was calculated (afterwards) at 45,83 euro/MWh. As shown in figure 1, the average spot price is 4,77 euro below the fixed price offered. This indicates a risk premium of 10 percent in the market for this specific period.
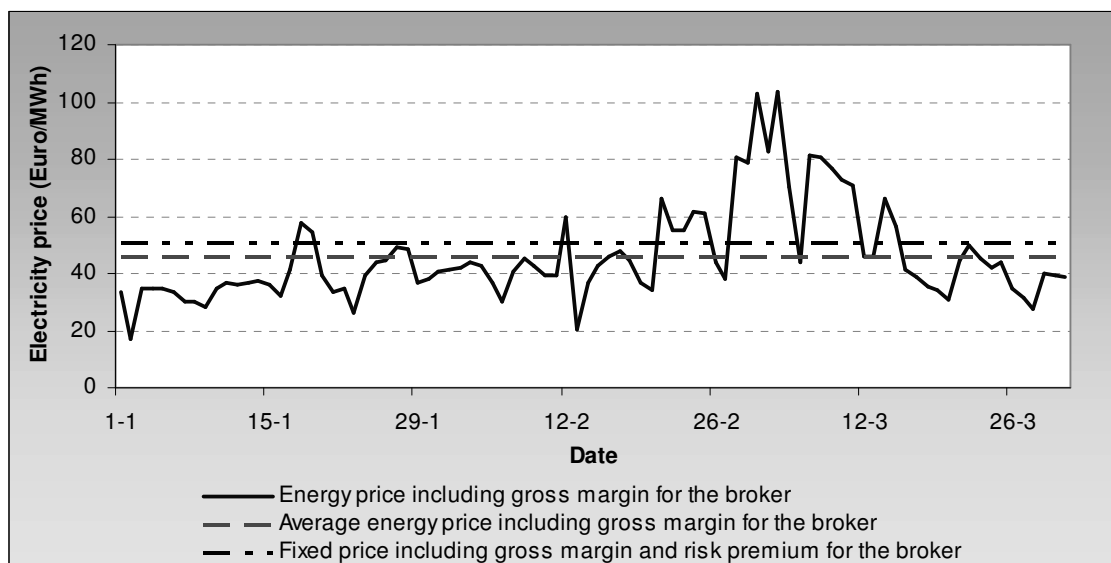

Figure 1: Example of energy prices in the first quarter of 2005

In another example (Beckman 2005), the ministry of Transportation and Water in the Netherlands bought electricity under a fixed price for three years. With this strategy the ministry intended to save money by simplifying the invoice administration. However, the contract had such a volume for such a long period of time that many of the suppliers had to calculate large premiums to cover their risks. The long negotiation times also enlarged the risks for the suppliers. In the end, a strategy that was intended to save money (on administration efficiencies) was much more expensive because of the added risk premium to the offered prices.

In practice, how large the risk premium is depends on how high the risks are. In the next section we will explore this dependency into more detail.

Risk premium versus risks

Removing risks and uncertainties through a fixed price contract involves extra costs for the buyer by having to pay a risk premium. In a volatile market the risks are higher and so is the risk premium. In a stable market risks are lower and so is the risk premium. Figure 2 visualizes the costs of risks. When using a variable price contract form (A) the inherent price risks may be high, but there are no risk

premium costs. With a fixed price contract form (B) there are no inherent price risks, but the risk premium costs may be high.
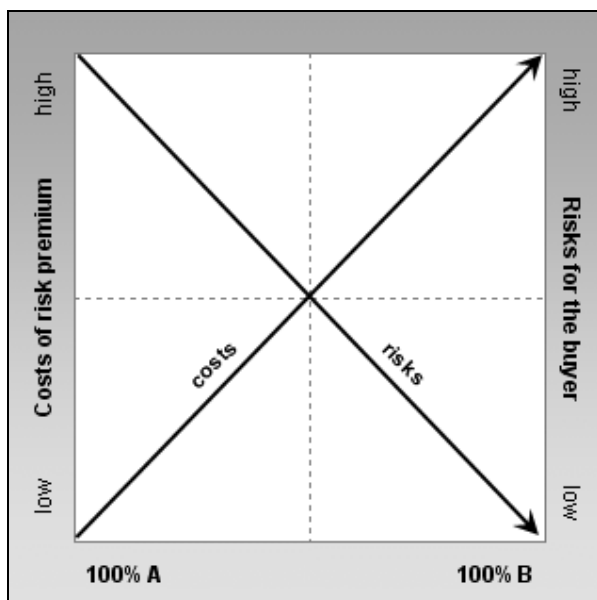

Figure 2: Costs of risk premium versus risks for the buyer

Now basically this is a well known figure: less risk for higher costs. Choosing between these options in a single contract is up to the buying organization. Some assistance may be gained from the theoretical exposure given before: on average (for many similar contracts) and given our reasonable assumptions the variable price contract is cheaper.

Summary and conclusion

The choice between different contract forms in volatile commodity markets received little attention in research so far. In this paper we discuss the choice between buying under a fixed price contract or a variable price contract from a broker for a certain period.
Fixed price contracts involve (1) the expected commodity costs, (2) a gross margin for the broker, and (3) a risk premium for the broker. Variable price contracts involve (4) the actual commodity costs, and (5) a gross margin for the broker.
For our framework we assume that both the buying organization and the broker act risk-neutral in the commodity market. Also, we assume that the broker succeeds on average in predicting the average commodity costs perfectly. Given these assumptions we prove that on average (1) is equal to (4), and (2) is equal to (5). Therefore, the costs of variable price contracts are on average smaller than the costs of fixed price contracts.

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