

Basis Risk Analysis and Countermeasures for Enterprises' Commodity Price Risk Management by Using Futures Hedging Strategy -- A Case Study of "Metallgesellschaft" Hedging Failure

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Abstract. As the international economic situation was risingly unsteady and turbulent, many enterprises have come up to make use of the futures market to minimize commodity price fluctuation risks, however, not a few suffering massively high hedging losses. These events has showed that numbers of enterprises had a lack of incisive comprehension of the basis risk of hedging and made no fully preparation on how to control and erode losses in time as soon as the basis transfers deviated from expectation. This article intends to make an in-depth discussion on basis risk through the analysis of the well-known huge losses case of the Metallgesellschaft and put forward effective and logical countermeasures, for enterprises grasping potentially of basic risk resisting financial damage. In short, in order to lesson the high financial loss which exceeds the expectation caused by the unusual basis, the enterprises must establish a reasonable and supportive hedging risk assessment and optimal protective stop-loss scheme.

Keywords: Basis risk, futures market, hedging, risk management, commodity price risk.

1. Introduction

There has been growing unrest and relatively turbulent globally due to a series of events of force majeure and international tensions, the international economic development situation has been becoming more and more unpredictable. A range of financial derivatives have been widely utilized by many enterprises to conduct the commodity price risk management, such as hedging in the futures markets, which is synonymous with shifting risk. However, not a few of them have been suffered extraordinarily high hedging losses, which indicates that many enterprises lack the exact understanding of basis risk and success to develop a strict and optimal risk assessment and management system, including resisting the negative situation from deteriorating financial damage.

The essence of hedging is an asset portfolio, whose benefit or loss is determined by the difference between the spot price and the futures price, which is called BASIS [1]. According to hedging principles, under idealized basis conditions, hedging is to offset the loss in the spot market by the profit in the futures market, thus, to lock the commodity price, transferring the risk of price fluctuations to the market, in order to lessen the risk of operating. So under this utopian situation, enterprises have taken it granted that the risk of hedging is minute, neglecting the tiny possibility of basis, so they underestimate the importance of risk assessment. However, once there is an abnormal basis situation happening unexpectedly, it will lead to inestimable financial damage and difficult to remedy.

The aim of this article to make an in-depth discussion on basis risk by analyzing a famous classic case of the failure of hedging in the futures market-- the case of Metallgesellschaft, suffering a considerable loss in 1993. Moreover, the author would put forward reasonable and logical countermeasures, offering help to enterprises to raise their comprehension of basis risk and establish a reasonable and supportive hedging risk management system. Finally, this paper proposes that enterprises should formulate the hedging evaluation scheme in all aspects, choosing the optimal hedging opportunity and determining the appropriate hedging ratio, and then establish a rigorous hedging basis risk assessment and monitoring system, and set up the loss-controlled scheme to guard against the small probability of aberration of basis.

2. Case Description -- Metallgesellschaft

Metallgesellschaft A.G., a reputable industrial German conglomerate, is the production and consumption of metal, energy and etc., acting in global commodity trading market with its potent industrial background. Metallgesellschaft had been participated in spot, futures and options commodity transactions, not only conducting them for themselves, but also providing brokerage services to other enterprises involved in hedging, speculative and arbitraging trading. MG REFINING AND MARKETING (MGRM) is one of Metallgesellschaft's subsidiary in the United States, which specialized in oil commodity trading. But it was MGRM's involvement in the oil trade that led to almost bankruptcy of Metallgesellschaft resulted from a series of hedging strategies that bogged the enterprises into a severe liquidity crisis.

Back in the summer of 1993, the price of oil and natural gas was relatively low. German metal companies hoped to make a long-term contract with customers, locking the price in the next ten years, and selling regularly and quantitatively at a fixed price until ten years later, expanding into the American market and capture a certain market share at a low price. Reportedly, MGRM signed a ten-year contracts of 160 million barrels of oil with the clients that committed to supply them at fixed prices, which negotiated at the time that signing the contracts. Higher 3 to 5 dollars per barrel than prevailing spot prices commonly, those prices brought margin for the company [2]. Although that spot price was low at the time, it were likely to be incremental within ten years, their end users were willing to sign the contract.

Since MGRM did not produce its own oil, it would have to find a seller for the 160m barrels to earn the price difference. And since the price of oil they buy would not stay that low consistently, their risk management department had to develop a strategy to transfer the price risk from its contracts with customers. So MGRM established a magnitude of positions and swaps transactions in oil futures market to curb commodity prices of purchase.

The former part is that it buys standard short-term futures contracts from the New York Mercantile Exchange (NYMX), such as oil futures contracts that expire monthly, and at the end of each month, it rolled over the oil futures contract, selling the old contract and buying in a new one as the old contract expired. This was repeated until the 10-year period expires. It ended up buying about 55 million barrels of oil on a rolling basis with one-month futures contracts.

The latter part is to simultaneously make swap contracts in the over the counter market. For the remaining 105 million barrels, MG signed a two-year oil swap contract. It buys oil through futures and swaps, buying and selling on one side. Specifically, 55 million barrels of oil were bought through one-month oil futures contracts and then rolled forward each month. Another 105m barrels were bought through two-year swaps, which like futures, are rolled over when they expire, and that's how the deal is done.

This "stack and roll" strategy could yeild margin when markets are in backwardation, which means the prices of spot are higher than futures'. In the opposite, when markets are in contango, loosely speaking, futures prices are higher than spot ones, the company would be incurred losses. In a backwardation market, constantly rolling the short-termed positions forward could obtain "rollover gains" owing that immediate delivery of oil enjoys a higher price than "deferred-month" oil. In a contango market, however, MGRM would be suffered losses for rolling over, since it would be forced to purchase delayed-delivered futures at a higher price as contracts nearly expired. Thus, whether the success of this strategy could been realized mostly depends on market's change of BASIS—whether contango or backwardation [3].

Within its rich sophisticating experience in transaction in commodity markets globally, MGRM had great faith in its technical expertise in financial derivatives. Theoretically and empirically, though, the company is doing the right thing. Over the past decade, generally the price of oil futures had risen and been lower than the spot price, which is basically a backwardation. The basis risk ultimately makes the hedging strategy fail.

However, energy prices did fall, even below than \$15 per barrel in December 1993, resulting in a continued contango in the oil market, incurring MGRM have to fund a extraordinarily large sum of

money to margin calls (Required higher than norm resulted from preventing breach of contract). In December 1993, MG's Supervisory Board recruited a new risk management department, which took an initiative that terminating the position prematurely, but still carried on the forward supply contract by spot purchase, within nothing protective measure. The basis risk ultimately makes the hedging strategy fail, incurring approximately \$2 billion losses.

3. The Liquidity Crisis: Basis Risk

Table 1. Average Spot prices, Futures Prices and Basis of Crude Oil in 1993

Date	Price(\$/barrel)	AVERAGE SPOT PRICE \$/barrel	AVERAGE FUTURES PRICE (closing price) \$/barrel	Basis \$/barrel
2/1993		17.66	20.124	-2.464
3/1993		18.15	20.354	-2.204
4/1993		18.12	20.385	-2.265
5/1993		17.89	19.998	-2.108
6/1993		17.11	19.134	-2.024
7/1993		15.96	17.892	-1.932
8/1993		15.88	17.106	-1.226
9/1993		15.24	17.496	-2.256
10/1993		15.76	18.186	-2.426
11/1993		14.7	16.767	-2.067
12/6/1993-12/10/1993		12.97	14.686	-1.716

Data source: New York crude oil CFD (CL) historical trade recording. And "Review of International crude Oil Price Trends in 1993 and Outlook of Oil Price Trends in 1994." [3]

Table 2. Rollover Gains and Losses in Spot Prices of crude oil in 1993

Date	Price(\$/barrel)	Rollover Gain or Loss	Changes in Spot Prices
01/15/93		-0.16	-0.54
02/17/93		-0.03	0.46
03/17/93		-0.13	0.84
04/16/93		-0.24	-0.03
05/17/93		-0.32	-0.63
06/17/93		-0.30	-0.81
07/16/93		-0.28	-1.49
08/17/93		-0.43	0.71
09/17/93		-0.30	-0.85
10/15/93		-0.11	1.20
11/17/93		-0.38	-1.23
12/16/93		-0.42	-2.81
Total		-3.10	-5.18

*Calculate all by a three-day rollover rule: sell the due nearly contract and buy the contract which is the second closest to delivery at a third day before expiring date. The rollover gain or loss is calculated by the near-month price minus the second-month price.

Data Source: Knight-Ridder Futures Markets Database

1993 broke up a disastrously chaos to MGRM. The authors search for both historical prices of spot and futures of crude oil in 1993, then calculating the basis (See Table 1). It can be seen that crude oil was in contango every month in 1993, so almost every time MGRM carried forward its position, it suffered a loss. Assuming that had MGRM sustain positions for the entire 1993 and rolled forward monthly, the roll losses accumulation was \$3.10/barrel for crude oil. (See the Table 2.) Had MGRM

maintained this rollover loss for a specific period, its margins of \$3 to \$5 would have been finally vanished [4].

There are various possible reasons for the persistent aberration of basis. Experts have asserted that the magnitude--MGRM's positions oriented to large demand in the market, incentivizing corporations to more supply productions, thus, prices fell down. Tosco, one of the company who raise its supply in oil selling to NYMEX, 85 thousand cubic meters, announced that this strategy was formulated mainly resulted in MGRM's large positions in futures market. MGRM, which creates demand for futures by buying spot contracts and having a dominant market share, is one of the logical companies to take delivery.

What's more, it was estimated that world economic growth in 1993 will probably be only 1.1 per cent, or at best 2 per cent. Using a consumption elasticity coefficient of 0.5, annual oil demand growth is only 330,000 b/d. According to the most recent projections of the International Energy Agency, world oil demand in 1993 is even negative, falling from 66.9 million b/d in 1992 to 66.8 million b/d. The inevitable result of sluggish world oil demand due to the sluggish world economy is that the basic driving force of the recovery in oil prices is lost [5].

4. The Countermeasures

So what are the lessons from MGRM's case? What are the reasonable countermeasures to guard against basis risk? The author has opined a series.

Opt in the market at a favorable time and determine the optimal hedging ratio. As mentioned above, the world economy was depressed in 1993, and it can be seen from the 1993 chart that the basis was in the state of spot premium since the beginning of the year. When the hedge basis was significantly deviated from the normal level, the hedge transaction was carried out, which greatly increased the risk of the basis. This experience shows that the hedge transaction must choose the right basis to enter the time, so as to reduce the hedge risk. In addition, enterprises should choose the appropriate hedging ratio (that is, the ratio of the amount of hedging to the amount of spot holdings) according to different degree of basis risk. When the basis risk is high, the proportion of hedging should be reduced. After this incident, some scholars calculated the company's optimal hedging ratio. They found that MGRM should not have bought 160 million barrels from the start with a 1:1 hedging ratio. As mentioned above, the large position could have influenced the market direction. The optimal hedging ratio is actually 0.5, which means MGRM would have bought 80 million barrels to begin with.

Formulate a rigorous hedging basis risk assessment and supervision management system, and set a financial loss controlled scheme as soon as basis deviated from normal constantly. The hedging experience of foreign enterprises shows that there are two basic rules for successful hedging risk management. One is to clearly know what the risk is and how big the risk is, and the other is to ensure that all possible results have been anticipated in advance [6]. This requires enterprises to establish an effective hedge basis risk assessment and monitoring system. Apparently, MGRM did not assess the risks beforehand, so it cut its losses blindly and made the wrong move when incurring financial damage. After two months of losing money every day on the exchange, MGRM simply snapped up and chose to liquidate the bulk of derivatives positions of their program— purchasing oil from the futures market, but not the other side — long-term supply contracts, still carried on. Instead, they bought oil on the spot, without any protection. Even though in 1993, spot market prices were relatively affordable, but then, in general, the price of oil, which has been going up since 1993, has been going to be higher and higher if buy it on the spot market. As a result, they suffering an estimated \$2 billion loss resulted in prices unguaranteed. The big loss brought the company completely and utterly to its knees, eventually its financial strain rescued operation by 150 global banks kept MG from bankruptcy.

In an article entitled “Derivatives Dingbats”, Culp and Henke demonstrated the abortion of this hedging transaction prematurely contributed to this losses [7]. Besides, they illustrated algebraically that it would be a excellent hedge ultimately with costless, neglecting the cost of time value [8, 9].

According to those studies, these analysts also opined that, the Supervisory Board liquidated the bulk of MGRM's derivatives positions prematurely, in a word, it was their panick that converted a transitory financial damage into reality. Bollen and Whaley simulated results of MGRM's position statistically, concluding that had the firm maintained their futures positions, it would have earned \$1.1 billion finally. However, MG were required approximately \$1billion negative cash flow to maintain their large positions, noting by Verleger [10].

5. Conclusion

The failure of Metallgesellschaft is a typical hedging case; a worthy case study to enterprises. For all of corporations who intend to conduct hedging issues, it is highly thought of that analyzing representative and noteworthy former hedging case, thus, averting evitable financial losses.

The survey of Wharton Business School illustrates that in order to manage the basis risk of hedging, American non-financial enterprises generally adopt the stresstesting and valueatrisk (VAR) method to quantify the risk of hedging. In the basis risk assessment, in particular, pay special attention to the risk of small probability events that may incur large losses. Enterprises should learn from this mature risk management experience to strengthen the management of hedging risk and risk strain-resisted competence.

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- [2] See affidavit of W. Arthur Benson v. Metallgesellschaft Corp. (and others), U.S.D.C Maryland, Civil Action No JFM-94-484 (October 13, 1994). MGRM's markups were the same regardless of the length of the contracts. Critics have argued that higher mark-ups should have been used for longer-term contracts, perhaps because of increasing credit risk. See Special Audit Report of MG A.G. prepared by C&L Treuarbeit and Deutsche Revision and Wollert-Elmendorff, Frankfurt, Germany (January 20, 1995).
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