Chapter 16

Metallgesellschaft (1993)

This Chapter is based on Culp and Miller [13, 14], Edwards and Canter [16], and Mello and Parsons [51].

16.1 Summary

Metallgelsellschaft (MG), A.G. was a German industrial conglomerate located in Frankfurt, Germany that supplied raw materials, engineering, and financial services. In 1994 it was the 14th largest company in Germany. In 1993 MG's total sales exceeded 26 billion (Deutsch marks) DM, its assets equalled 17.8 billion DM, and it employed 43,292 individuals.

In 1993 an oil futures trading strategy lost the company an equivalent of 1.3 billion U.S. dollars. The management board at the MG subsidiary (MG Refining and Marketing) that was responsible for this trading strategy was fired and the company avoided bankruptcy only through a bailout in 1994 consisting of 1.9 billion U.S. dollars from a consortium of 150 international banks. The DM/$ exchange rate was approximately 1.6 at this time.

The background for the losses were as follows.

1. The company *sold* forward contracts on gasoline, diesel fuel, and heating oil for either 5 or 10 years into the future to its customers. Most of the contracts were for 10 years (see Mello and Parsons [51], p. 107). These were long-dated fixed price contracts. This was due to MG's marketing program. In September 1993, MG had sold forward approximately 160 million barrels of petroleum products. As a note, these contracts contained an embedded option that allowed the customer to terminate the contract early if market prices increased, presumably protecting the customers for credit risk if the customers

thought that MB would not be able to fulfill the contracts. The details of this embedded option can be found in Culp and Miller [13]. These contracts controlled counter party risk by limiting the contract size to any customer to 20% of the customer's needs (see Mello and Parsons [51], p. 107).

2. In an attempt to hedge the market price risks, MG *purchased* short-term oil futures contracts, rolling over the positions as the futures contracts matured. These contracts were one to three month futures traded on the New York Mercantile Exchange (NYMEX) with the underlying commodities being either New York harbor regular unleaded gasoline, New York harbor No. 2 heating oil, or West Texas Intermediate (WTI) grade light sweet crude oil. The futures position was for approximately 55 million bbl. These were among the most liquid petroleum contracts traded on NYMEX. MG also purchased commodity swaps in the OTC derivatives market for about 105 million bbl. MG's swap contracts paid fixed and received floating payments based on energy prices. These swap contracts were all short-term in maturity (mostly 3 months or less). The hedge ratios used for both the futures and swap contracts were unity (one). This is an important fact to remember in the subsequent analysis. Together, the total longs were about 160 million bbl, which equalled the total shorts (a hedge ratio of unity).

Energy prices dropped significantly in late 1993. For example, crude oil dropped from \$19 per barrel in June to below \$15 in December. This resulted in the following changes in the trading strategy's value.

1. The fixed price forward contracts increased in value, but since they were forwards, the change in value generated no cash inflows or outflows. These contracts were with customers and without collateral or margin restrictions.

2. The futures contracts lost value. Due to marking-to-market (daily settlement), the losses generated a cash outflow on the futures positions as margin calls needed to be satisfied. These negative cash flows were enormous. The OTC derivative contracts also lost value and more collateral would also have been requested to guarantee these positions. The total capital required to be posted to meet these funding demands was around \$900 million (see Edwards and Canter [16], p. 97).

To meet these margin and collateral calls, MG needed to employ other financing sources: either borrow cash, liquidate assets, or close out its futures and OTC derivative positions. MG did not use any of these alternative

funding sources. Perhaps no reasonable funding alternatives were available, although Edwards and Canter [16], p. 102 argue that this is not the case. A counter argument is given in Mello and Parsons [51], p. 110. Instead, MG's management board decided to liquidate its futures position (terminate the futures hedge). No details on the treatment of its OTC derivative positions is available.

MG also reduced the size of its customers' forward contracts. The exact magnitude of this reduction is unavailable. Note that MG reduced the size of its forward contract position because this naked position (without the hedge) generated significant market price risk on its balance sheet.

A bank bailout followed to cover the resulting losses and presumably MG's OTC derivative collateral needs. The company was restructured. MG eventually recovered and became profitable again. MB is now part of the GEA Group, A.G.

16.2 The Trading Strategy

This section describes the trading strategy in a simplified fashion to highlight the economics of the hedging strategy.

Time horizon $[0, T]$.
Spot price of commodity S_t.
Forward price $K(0, \tau)$ for delivery date τ.
Futures price $k(0, \tau)$ for delivery date τ.
The simplified trading strategy is as follows.

1. A short position in one forward contact on spot S_t with delivery date T and forward price $K(0, T)$. This is a *long-term* contract.

2. A long position in n_0 futures contracts on spot S_t with delivery date $\tau \ll T$ and futures price $k(0, \tau)$. Let $c \cdot \tau = T$ where $c > 1$ is an integer. At time τ when the futures expires, a long position in n_τ futures contracts on spot S_t with delivery date 2τ and futures price $k(\tau, 2\tau)$ is taken. At time 2τ when the futures expires, a long position in $n_{2\tau}$ futures contracts on spot S_t with delivery date 3τ and futures price $k(2\tau, 3\tau)$ is taken. This strategy is continued until time T. This is a hedging strategy based on *short-term* futures contracts.

In the implementation of its futures trading, MG set the hedge ratio $n_t = 1$ for all t.

Based on the models in Part III, the following is a list of the relevant risks involved in the trading strategy.

16.2.1 Market Risk

Note that there are three issues to be studied in the correctness of this hedging strategy:

(i) complete or incomplete markets,
(ii) forward versus futures contracts, and
(iii) long-term versus short-term contracts.

These simplify to the following two questions:

(a) are markets complete, and if so
(b) were the correct $n_0, n_\tau, \ldots, n_{(c-1)\tau}$ chosen to construct a perfect hedge?

At present and during this time period, due to the trading of futures contracts and swaps, the market for petroleum products was approximately complete. Hence, the question reduces to choosing the correct hedge ratios. In this regard, an exact hedge could have been obtained if a proper model was used. To account for the differences between forward and futures contracts, stochastic interest rates need to be included. This is easily handled by the HJM model in Chapter 4. This model was not used, although it existed at the time. To account for the maturity mismatch due to using short-term futures to hedge long-term forwards, a multiple-factor model for the term structure of futures prices analogous to that used in the HJM model in Chapter 4 is required. Such a model needs multiple futures to hedge the forward contract's value. This model was also not used, although it existed at the time. Instead, Metallgesellschaft used a single futures to hedge the forward contracts with the hedge ratio equalling unity.

16.2.2 Credit Risk

Credit risk is not a direct issue in this trading strategy. Margin accounts for exchange traded futures and collateral requirements for OTC derivatives mitigated credit risk to MG.

16.2.3 Liquidity Risk

This hedging strategy is subject to liquidity risk.

(i) The forward contract position is illiquid and generates no cash flows. Being contracts with customers for physical delivery, no collateral agreements analogous to those in OTC derivative contracts existed.

(ii) The futures contract position is liquid, but it is subject to cash flows (marking-to-market) in the futures margin account. In addition, the OTC derivatives position is illiquid and subject to the posting of additional collateral. If the futures and OTC derivatives positions lost significant value, a cash flow crisis could occur. This is funding risk, which is the conjunction of liquidity risk and binding margin requirements. If markets were otherwise perfectly liquid, MG could have sold assets to meet its margin requirements. But, in this case the assets were illiquid. Sales would have only generated increased losses on its balance sheet, not solving a cash flow crisis.

16.2.4 Operational Risk

The operational risk existing to the extent that MG's management incorrectly: (i) determined the market risk of the hedging strategy, and (ii) accounted for the funding risk.

16.3 Conclusion

The reasons for MG's losses are debated in the literature. Culp and Miller [13] argue that the hedging strategy was correct, but that liquidity risk was mismanaged. Edwards and Canter [16] argue that the hedging strategy was partially correct, and that funding risk was the cause of the failure. They make no judgements concerning mismanagement, leaving open the possibility that the event was just "bad luck." In contrast, Mello and Parsons [51] argue that funding risk was mismanaged and that the hedging strategy was incorrect.

The evidence supports the conclusions of Mello and Parsons [51]. In summary:

1) Market risk was not correctly hedged due to the use of incorrect models to capture both the maturity mismatch and the difference between forward and futures contracts. MG used a hedge ratio equal to unity. This is certainly not correct. An empirical paper supporting this assertion is Pirrong [55].

2) Funding risk was not properly anticipated by the management team.