Metallgesellschaft AG and Its Hedging Program: Case Questions

Please refer to the MG Case Excel spreadsheet.

BACKGROUND

Question 1

Why did Metallgesellschaft AG's (MG's) U.S. subsidiary, MG Refining and Marketing Inc. (MGRM), want to offer a price guarantee on purchase contracts for its customers?

Question 2

What were the basic features of the hedging strategy?

EXCEL EXERCISE

The MG Case Excel spreadsheet replicates a simplified version of MGRM's strategy and gain/loss calculations. It assumes that MGRM enters into a forward contract to deliver 150 million (cell B5) barrels of crude oil monthly over a 10-year period [i.e., 120 monthly deliveries (cell B6) of 1.25 million barrels]. The MG Case Excel spreadsheet also assumes that MGRM hedges its forward position with a rolling monthly futures contract.

Assume a 15 percent discount rate (cell B7) for Present Value (PV) calculations.

Chester Lee (Wharton MBA, Class of 2011) prepared this case under the supervision of Assistant Professor Anastasia Kartasheva, The Wharton School, as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

FORWARD TRADES

This section calculates the impact of the US$1 increase/decrease in the spot price of crude oil on MGRM's forward position. Recall that MGRM agrees to sell crude oil at a fixed price over a 10-year period. Hence, MGRM will suffer a loss when the spot price rises.

Assume US$20 per barrel for the contract forward price (cell B13). If the spot price of crude oil rises to US$21 per barrel (cell B14), MGRM will incur a loss of US$1 per barrel (cell B15). If we assume that the spot price will stay at US$21 per barrel for 10 years, then MGRM will incur a loss of US$1 per barrel every month for 120 months (row 15). However, a US$1 loss in 1 month's time is worth a lot more than a US$1 loss in 10 years' time in today's dollar terms. Hence, we need to discount each month's gains/losses (row 16 calculates the discount factor compounded monthly).

The sum of the discounted gains/losses represents the impact of a US$1 change in the spot price of crude oil on MGRM's forward contract (row 23). For example, when there are 120 deliveries left (i.e., 150 million barrels of crude oil) a US$1 increase in the spot price generates a US$77.48 million loss for MGRM (cell B23). When there are 109 deliveries left (i.e., 136.25 million barrels of crude oil), a US$1 increase in spot price generates a US$74.18 million loss for MGRM. Note that this is a lot less than the product of a US$1 loss per barrel with 150 million barrels to be delivered.

The above calculations assume that the first delivery occurs one month from now (i.e., the impact of a US$1 change on January 1). How much does the US$1 change impact the forward contract on the day of the first delivery (i.e., on January 31)? Assuming there are 120 deliveries left, the gains/losses from the first delivery would not be discounted and gains from the remaining 119 deliveries would need to be discounted.

Question 3

Fill row 29 (the impact of a US$1 increase in the spot price of crude oil on the forward position at the end of the month). Hint: Since the first delivery is not discounted, each number in row 29 must be greater than the corresponding number in row 23.

FUTURES TRADES

This section calculates the impact of a US$1 increase/decrease in the spot price of crude oil on MGRM's futures position. Recall that MGRM agrees to buy crude oil at a fixed price after one month. Hence, MGRM will incur a gain when the spot price of crude oil rises.

Assume a 150 million barrel contract size (cell B34) and US$19 per barrel for the contract futures price (cell B35). Assume the spot price of crude oil at the time was also US$19. Shortly after the trade was put on, if the spot price rises to US$20 (cell B36), MGRM will generate a gain of US$1 per barrel (cell B37) in one month's time. The discount factor for one month is very close to one (cell B38). Hence, if the spot price rises by US$1, the futures position is expected to generate a US$148.15 million gain. Note that this is very close to the product of a

US$1 gain per barrel and 150 million barrels to be delivered, and substantially higher than the US$77.48 million loss we saw for the forward position.

Once again, the above calculations assume that the futures trade settlement occurs in one month's time. How much does a US$1 increase in the spot price impact the futures contract on the day of the delivery (i.e., on January 31)? The gains/losses would not be discounted.

Question 4

Fill row 51 (the impact of a US$1 increase in the spot price on the futures position at the end of the month).

Question 5

Assuming a 150 million barrel contract size, why does a US$1 change in the spot price bring such a different gain/loss impact for the forward position and the futures position?

GAIN/LOSS ANALYSIS

Assume MGRM puts on the 150 million barrel, 10-year forward trade at the beginning of the year. At the same time, the futures trade is also put on at the beginning of each month as a hedge and rolled over every month. The trade is evaluated and gains/losses are calculated at the end of every month. The following analysis calculates 1-year gains/losses for the hypothetical trades that are put on January 1, 1986. The same analysis can be performed for different years (e.g., 1987 and 1988) to see if the timing of the trade initiation affects the gains/losses.

Forward Trades

In January 1986, MGRM has an obligation to deliver 150 million barrels of crude oil over the next 10 years. In the same month, the spot price of crude oil crashes from US$25.56 (cell B60) to US$18.95 (cell B61) per barrel.

Question 6

Does this change in the spot price generate a gain/loss for the forward position and by how much (cell B66)? Show your work. Note that the trade is evaluated at the end of the month—not at the beginning of the month (i.e., the first delivery takes place now).

Question 7

In February 1986, MGRM has an obligation to deliver 148.75 million barrels of crude oil over the next 9 years and 11 months. When the spot price crashes from US$17.42 (cell C60) to US$13.23 (cell C61), how much gain/loss does this market movement generate for MGRM (cell C66)? Fill the rest of row 66.

Futures Trades

In January 1986, MGRM enters into a 1-month futures contract to buy 150 million barrels of crude oil at US$23.21 per barrel (cell B62).

Question 8

When the spot price crashes to US$18.95 (cell B51) at the end of the month, how much gain/loss does this market movement generate for MGRM (cell B71)? Show your work. Note that the trade is evaluated at the end of the month—not at the beginning of the month (i.e., the futures trade is settled now).

Question 9

In February 1986, MGRM enters into another 1-month futures contract to buy 148.75 barrels of crude oil at US$17.95 per barrel (cell C62). What is the gain/loss for the month of February (cell C71)? Fill the rest of row C71.

Replicating the Trades Across Time

Question 10

Replicate the same gain/loss analysis table for the years 1987 to 2002. First, copy the 1986 table and paste it into cell A75. The new table will look more or less identical to the 1986 table (except for the monthly gain/loss calculation results). Change cell A75 from '1986' to '=A55+1' and change cell B77 from '1/1/1986' to '=edate(B57,12).' All dates in rows 77 and 78 will change to year 1987, and the table will pull the correct spot and futures prices for the year 1987. Apply the correct calculations in rows 86 and 91 (monthly gain/loss calculations). Hint: If the '$' symbol is used wisely in referencing cells for the 1986 calculations, the pasted 1987 table will apply correct calculations without the need to make any changes to the calculations. Copy the 1987 table and paste it into cell A95. This will generate the 1988 table. Apply the correct calculations for the monthly gains/losses. Copy and paste the tables up until the year 2002.

Once the analyses are complete, fill in the following summary table:

Cumulative Yearly Gains/Losses (US$ Million)			
Year	**Forward**	**Futures**	**Total**
1986			
1987			
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			

Question 11

a. Make a bar chart that shows the total cumulative gains/losses for each year.
b. Compare this chart with the charts in Exhibits 1 and 2 in the case. What trends do you see? Explain these trends.

Volatility of Gains/Losses

Question 12

Let's assume the 150 million barrel forward trades are put on January 1 of every year and unwound on December 31 of every year (only to be put on again on January 1 of the next year). Name this the 'rolling forward trade.' Take all monthly gains/losses from the forward trades between 1986 and 2002 from the tables from Question 10—this represents the gains/losses from the rolling forward trade.

a. Plot a histogram of the monthly gains/losses for the rolling forward trade. Note that you need to use the Data Analysis package from the Data tab in Excel.
b. Calculate the mean and standard deviation of the monthly gains/losses.

Question 13

The strategy in Question 12 represents an unhedged position. Let's consider a hedged position. Take all monthly gains/losses from the futures trades between 1986 and 2002 from the tables from Question 10. Add them to the monthly gains/losses from the forward trades. This represents the gains/losses from the rolling forward trade.

a. Plot a histogram of monthly gains/losses for the forward and futures trade.
b. Calculate the mean and standard deviation of the monthly gains/losses.
c. Compare the results to the answers from Question 12. Was the hedge effective?

Question 14

Imagine that you are a member of the Board of Directors of MG at the end of 1993.

a. Why did MGRM generate such a huge loss in 1993? Hint: What happened to the spot and futures prices in 1993?
b. How much cash does MGRM need to survive?
c. Assuming MGRM has access to free capital, is MGRM's strategy sustainable in the long run?
d. What are the options available for MGRM at the end of 1993? What would you recommend?

Question 15

MGRM unwound its position at the end of 1993 after suffering a huge loss.

a. Should MGRM have kept the position?
b. Would you say that MGRM was just unlucky or was there something fundamentally wrong with MGRM's strategy?

