Financial Risk Management

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How Traders Manage Their Risks

- The trading function within a financial institution is referred to as the *front office*. The part of the financial institution that is concerned with the overall level of the risks being taken, capital adequacy, and regulatory compliance is referred to as the *middle office*. The record keeping function is referred to as the *back office.*
- There are two levels within a financial institution at which trading risks are managed. First, the front office hedges risks by ensuring that exposures to individual market variables are not too great. Second, the middle office aggregates the exposures of all traders to determine whether the total risk is acceptable.

- This chapter explains what are termed the “Greek letters” or simply the “Greeks.” Each of the Greeks measures a different aspect of the risk in a trading position. Traders calculate their Greeks at the end of each day and are required to take action if the internal risk limits of the financial institution they work for are exceeded. Failure to take this action is liable to lead to immediate dismissal.

Delta

- Imagine that you are a trader working for a U.S. bank and are responsible for all trades involving gold. The current price of gold is $1,300 per ounce. Table 4.1 shows a summary of your portfolio (known as your “book”). How can you manage your risks?
- **Table 4.1** Summary of Gold Portfolio

Position	Value ($)
Spot gold	3,180,000
Forward contracts	−3,060,000
Futures contracts	2,000
Swaps	180,000
Options	−6,110,000
Exotics	125,000
Total	−5,683,000

- The value of your portfolio is currently −$5,683,000. One way of investigating the risks you face is to revalue the portfolio on the assumption that there is a small increase in the price of gold from $1,300 per ounce to $1,300.10 per ounce. Suppose that this $0.10 increase in the price of gold decreases the value of your portfolio by $100 from −$5,683,000 to −$5,683,100. This means that the sensitivity of the portfolio to the price of gold is:

$$\frac{-100}{0.1} = -1000$$

- This is referred to as the *delta* of the portfolio. The portfolio loses value at a rate of about $1,000 per $1 increase in the price of gold. Similarly, it gains value at a rate of about $1,000 per $1 decrease in the price of gold.
- In general, the *delta* of a portfolio with respect to a market variable is:

$$\frac{\Delta P}{\Delta S}$$

where ΔS is a small increase in the value of the variable and ΔP is the resulting change in the value of the portfolio. Using calculus terminology, delta is the partial derivative of the portfolio value with respect to the value of the variable:

$$Delta = \frac{\partial P}{\partial S}$$

- In our example, the trader can eliminate the delta exposure by buying 1,000 ounces of gold. This is because the delta of a long position in 1,000 ounces of gold is 1,000. (The position gains value at the rate of $1,000 per $1 increase in the price of gold.) This is known as *delta hedging*. When the hedging trade is combined with the existing portfolio the resultant portfolio has a delta of zero. Such a portfolio is referred to as *delta neutral*.

- Example of Delta-Neutral Hedging:
- Assume you have a stock position that you believe will increase in price in the long term. You are worried, however, that prices could decline in the short term, so you decide to set up a delta neutral position.
- Assume that you own 200 shares of Company X, which is trading at $100 per share. Since the underlying stock's delta is 1, your current position has a delta of positive 200 (the delta multiplied by the number of shares).

- To obtain a delta-neutral position, you need to enter into a position that has a total delta of -200. Assume then you find at-the-money put options on Company X that are trading with a delta of -0.5.
- You could purchase 4 of these put options, which would have a total delta of (400 x -0.5), or -200. With this combined position of 200 Company X shares and 4 long at-the-money put options on Company X, your overall position is delta neutral.

- What is "In the Money" (ITM)?

"In the money" (ITM) is an expression that refers to an option that possesses intrinsic value. ITM thus indicates that an option has value in a strike price that is favourable in comparison to the prevailing market price of the underlying asset:

- An in-the-money call option means the option holder has the opportunity to buy the security below its current market price.
- An in-the-money put option means the option holder can sell the security above its current market price.

- What is "Out of the Money" (OTM)?

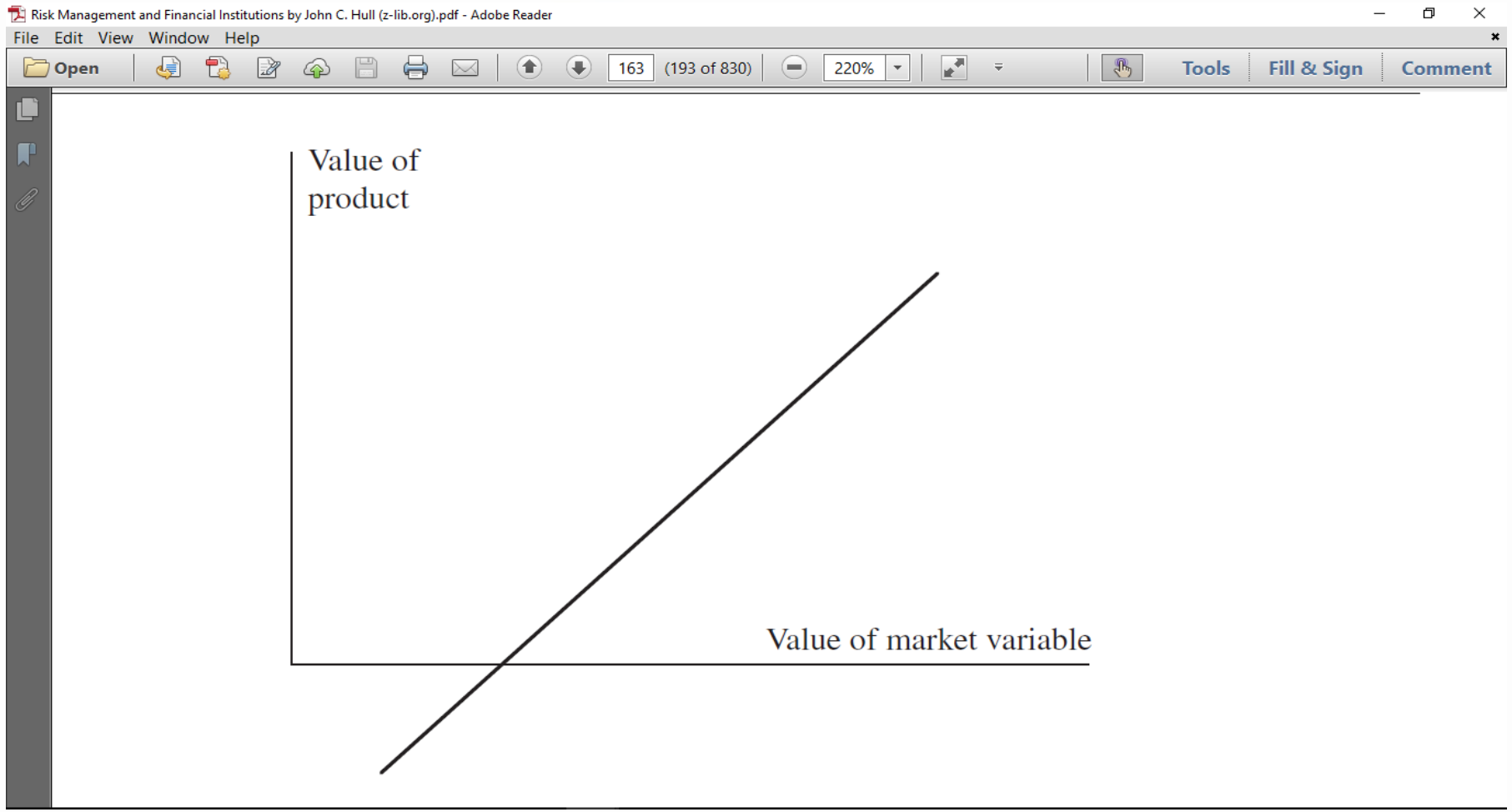
"Out of the money" (OTM) is an expression used to describe an option contract that only contains intrinsic value. These options will have a delta of less than 50.0.

- An OTM call option will have a strike price that is higher than the market price of the underlying asset. Alternatively, an OTM put option has a strike price that is lower than the market price of the underlying asset.
- OTM options may be contrasted with in-the-money (ITM) options.

- What is a Strike Price?
- A strike price is the set price at which a derivative contract can be bought or sold when it is exercised. For call options, the strike price is where the security can be bought by the option holder; for put options, the strike price is the price at which the security can be sold.
- The strike price, also known as the exercise price, is the most important determinant of option value.

- ***Linear Products:***
- A linear product is one whose value at any given time is linearly dependent on the value of an underlying market variable (see Figure 4.1). If the underlying variable is the price of an asset such as gold, a spot position in the asset is clearly a linear product. The value of the position varies linearly with the price of the asset. A forward contract is also a linear product.

- **Figure 4.1** A Linear Product



- A linear product can be hedged relatively easily. As a simple example, consider a U.S. bank that has entered into a forward contract with a corporate client where it agreed to sell the client 1 million euros for $1.3 million in one year. Assume that the euro and dollar interest rates are 4% and 3% with annual compounding. This means that the present value of a 1 million euro cash flow in one year is:

$$1{,}000{,}000/1.04 = 961{,}538 \text{ euros}$$

- The present value of 1.3 million dollars in one year is 1,300,000/1.03 = 1,262,136 dollars. Suppose that S is the value of one euro in dollars today. The value of the contract today in dollars is:

$$1{,}262{,}136 - 961{,}538S$$

- This shows that the value of the contract is linearly related to the exchange rate, S. The delta of the contract is −961,538. It can be hedged by buying 961,538 euros. Because of the linearity, the hedge provides protection against both small and large movements in S.
- When the bank enters into the opposite transaction and agrees to buy one million euros in one year, the value of the contract is also linear in S: $961{,}538S - 1{,}262{,}136$

- The bank has a delta of +961,538. It must hedge by shorting 961,538 euros. It does this by borrowing the euros today at 4% and immediately converting them to U.S. dollars. The one million euros received in one year are used to repay the loan.

- Linear products have the attractive property that hedges protect against large changes as well as small ones in the value of the underlying asset. They also have another related attractive property: the hedge, once it has been set up, never needs to be changed. (This is sometimes referred to as the “hedge and forget” property.)
- For an illustration of this, consider again the first forward contract we considered where a bank agrees to sell a client 1 million euros for 1.3 million dollars. A total of 961,538 euros are purchased to hedge the position. These can be invested at 4% for one year so that they grow to exactly 1 million euros in one year. This is exactly what the bank needs to complete the forward transaction in one year so that there is no need to adjust the hedge during the year.