FRM Part 1

Book 3 - Financial Markets and Products

USING FUTURES FOR HEDGING

Learning Objectives

After completing this reading you should be able to:

- ✓ Define and differentiate between **short and long hedges** and identify their appropriate uses.
- ✓ Describe the **arguments for and against hedging** and the potential impact of hedging on firm profitability.
- ✓ Define the basis and explain the various **sources of basis risk**, and explain how basis risks arise when hedging with futures.
- ✓ Define **cross hedging**, and compute and interpret the **minimum variance hedge ratio** and **hedge effectiveness**.
- ✓ Compute the **optimal number of futures** contracts needed to hedge an exposure, and explain and calculate the "**tailing the hedge**" adjustment.
- ✓ Explain how to use **stock index futures contracts** to change a stock portfolio's **beta**.
- ✓ Explain the term "**rolling the hedge forward**" and describe some of the risks that arise from this strategy.

Short Hedges vs. Long Hedges

A short hedge:

- Occurs when the trader **shorts (sells) a futures contract** to hedge against a price decrease in an **existing long position**.
  - The trader already owns the underlying asset.
- When the price of the hedged/underlying asset decreases, the short futures position realizes a **corresponding positive return that offsets the loss in value**.

A long hedge:

- Occurs when the trader **buys a futures contract** to hedge against a price increase in an **existing short position**.
  - The trader has a short position in the underlying asset.
- When the price of the hedged/underlying asset increases causing a loss, the long futures position realizes a cor**responding positive return that offsets the loss in asset value**.

Advantages and Disadvantages of Hedging

Advantages:

I. **It helps asset holders to lock in a price for their assets.** By taking a short position, a corn farmer, for example, who is anticipating a bumper harvest in a few months is able to lock in a predetermined price for their corn. By so doing, they **eliminate** – or at least reduce – the **risk of a price decrease**.

II. **It helps prospective buyers to lock in a price for the goods they intend to purchase.** Instead of a cereal company waiting to buy corn at the prevailing post-harvest price, the company can **lock in a predetermined purchase price** by getting into a long futures contract. Even if prices rise dramatically between the signing of the contract and the maturity date, the company will benefit from a **fixed price**.

Advantages and Disadvantages of Hedging

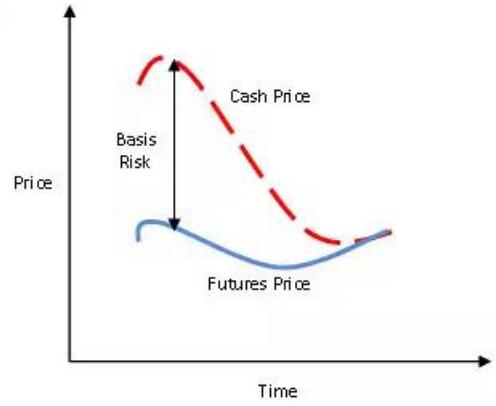
Disadvantages:

I. **Hedging might lock asset holders out of improving market prices.** Although hedging shields asset holders from price declines, it locks them out of increases in value. Even if the asset's price rises, the short futures contract holder is **obliged to honor all the terms of the deal**. They must sell the underlying at the contract price.

II. **Hedging is necessarily not beneficial to a company's shareholders.** Risk-averse shareholders are **assumed to hold diversified portfolios** that mitigate specific risks and reduce the effect of systematic risks. Thus, hedging at the company level doesn't necessarily benefit individual shareholders.

Basis Risk and Its Causes

- Basis risk is the risk that the value of a futures contract **will not move in normal, steady correlation** with the price of the underlying asset.
- For example, if the current spot price of gold is $1,500, and the six-month futures price of gold is $1,550, then the basis, the differential, is **$50**.
  - Basis risk, in this case, is the risk that between now and maturity of the contract in six months, the price of gold will **fluctuate by more than $50**.
- The fluctuation in the basis **makes hedges less effective** than they are meant to be.
  - Between contract initiation and liquidation, the price spread (the difference between the cash price and futures price) may either narrow or widen.



Basis Risk and Its Causes

Sources of basis risk:

Imperfect matching between the cash asset and the hedge asset

- e.g., hedging jet fuel with motor vehicle fuel

Changes in the components of the cost of carry

- e.g., interest, storage and safekeeping, and insurance

Maturity mismatch

- e.g., hedging an exposure to physical prices in May with a June futures contract

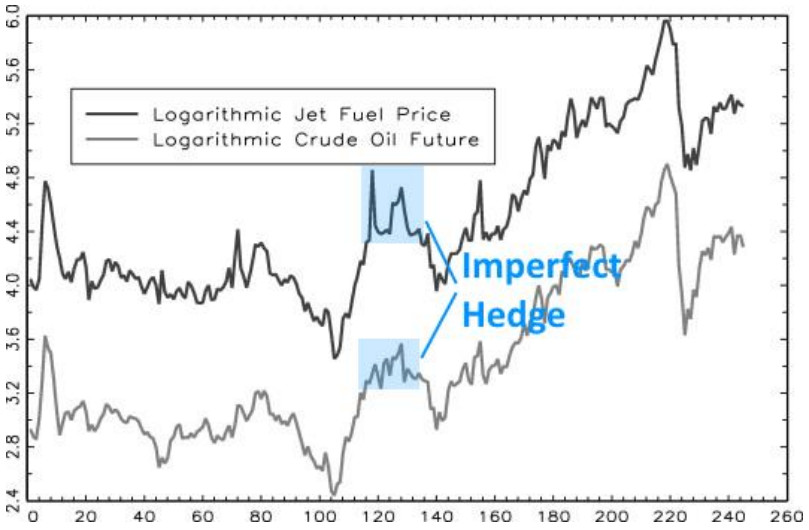
Location mismatch

- e.g., hedging crude oil sold in New York with crude oil futures traded in London (LIFFE)

- To minimize basis risk, it's imperative to choose the **hedge tool that's most correlated with the underlying**.

Cross Hedging

- There are instances when it may be **impossible to find futures contracts on a particular underlying**.
  - In such scenarios, the hedger may turn to futures on securities that **exhibit positive correlation with the underlying**.
- This is called **cross hedging**.
  - The hedger takes opposite positions in the two assets.
- Since the assets are not **entirely identical**, there must be **enough correlation** for the hedge to work.



The Optimal Hedge Ratio

- The optimal hedge ratio, also called the **minimum variance ratio**, is the degree of **correlation** between the underlying asset and the futures contract purchased to hedge financial risks.
- It's the ratio of the **futures position** to the **spot position**:

$$HR = \rho_{SF} \times \frac{\sigma_S}{\sigma_F}$$

- Where:
  - ρ_{SF} = correlation coefficient between spot prices and the futures prices
  - σ_S = standard deviation of the spot price
  - σ_F = standard deviation of the futures price

The Optimal Hedge Ratio

- Note:

$$\rho = \frac{Cov_{SF}}{\sigma_S \sigma_F}$$

- And:

$$\frac{Cov_{SF}}{\sigma_S \sigma_F} \text{x} \frac{\sigma_S}{\sigma_F} = \frac{Cov_{SF}}{\sigma^2_F} = \beta_{SF}$$

- The **effectiveness** of a hedge measures the amount of **variance that's reduced** by implementing the optimal hedge ratio.
- It can be evaluated using R^2, the coefficient of determination, where:
  - **Independent variable** = change in futures price
  - **Dependent variable** = change is spot price

The Optimal Number of Futures Contracts Needed to Hedge an Exposure

- The number of futures contracts required to **completely hedge** an equity position is given by:

$$N = \beta_{portfolio} \text{ x } \left[\frac{Portfolio\ value}{Value\ of\ futures\ contract}\right]$$

$$= \beta_{portfolio} \text{ x } \left[\frac{Portfolio\ value}{Futures\ price \times Contract\ multiplier}\right]$$

Trailing the Hedge:

- There is always the risk that a hedger will **over-hedge** the underlying exposure.
- The **trailing the hedge strategy** is implemented to avoid this.
  - It involves multiplying the number of futures contracts required by the **daily spot price to futures price ratio**.

Adjusting a Stock Portfolio's Beta using Stock Index Futures

- **Beta**, as defined in the **capital asset pricing model**, is a measure of a portfolio's **systematic risk**.
- When a trader **uses index futures to hedge** a position in an equity portfolio, they are effectively trying to **reduce the portfolio's systematic risk**.
- Hedging is actually an attempt to **reduce a portfolio's beta**.

$$Number\ of\ contracts\ required\ = (\beta^{*} - \beta)(\frac{P}{A})$$

  - Where **β** = Portfolio beta
  - **β*** = Target beta after hedging
  - **P** = Portfolio value
  - **A** = Value of futures contracts

➢ If the above result is **positive**, the trader would have to buy futures contract. If **negative**, they would have to **sell futures**.

Example >>

Adjusting a Stock Portfolio's Beta using Stock Index Futures

Example

- Rachel Zane, FRM, manages a portfolio of **$200 million** worth of tech stocks which has a **beta of 1.5 relative to the Nasdaq-100**.
  - The **current value** of the 3-month Nasdaq-100 Index is **2,500**, and the **multiplier is 300**.
  - Over the next three months, Ms. Zane wants to use the Nasdaq-100 futures to **reduce the systematic risk of the portfolio to 1.0**.
- To pull that off, which **how many contracts are required**?

Solution

- The manager is **long the Nasdaq-100**, so she should construct a **short hedge** and **sell futures contracts**. The exact number to sell is given by:
  - $\boldsymbol{Number\ of\ contracts\ required} = (\boldsymbol{\beta}^{*} - \boldsymbol{\beta})(\frac{\boldsymbol{P}}{\boldsymbol{A}})$
  - $= (\mathbf{1.0} - \mathbf{1.5})\ \mathbf{x}\ \frac{\mathbf{200{,}000{,}000}}{\mathbf{2{,}500\ x\ 300}} = \mathbf{-133}$

➢ The negative sign implies 133 contracts need to be **sold**.

- $\boldsymbol{\beta}$ = Portfolio beta
- $\boldsymbol{\beta}^{*}$ = Target beta after hedging
- $\boldsymbol{P}$ = Portfolio value
- $\boldsymbol{A}$ = Value of futures contracts

Rolling Hedge

- A rolling hedge is a strategy used to **replace expiring futures contracts** by obtaining **new exchange-traded futures**.
  - The trader gets a new contract with similar terms, except with a **different maturity date**.
- Typically, as a maturity date nears, the trader closes out the existing futures position in readiness for a new position.
  - However, a rolling hedge strategy comes with **roll-over risk**.
  - The trader is exposed to **basis risk** each time the hedge is **rolled forward**.

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