

# FE620 Pricing and Hedging

## Lecture 2: Hedging Strategies Using Futures

Instructor: Dragos Bozdog

Email: [dbozdog@stevens.edu](mailto:dbozdog@stevens.edu)

Office: Babbio 429A

# Long & Short Hedges

- ▶ A long futures hedge is appropriate when you know you will purchase an asset in the future and want to lock in the price
- ▶ A short futures hedge is appropriate when you know you will sell an asset in the future and want to lock in the price

# Arguments in Favor of Hedging

- ▶ Companies should focus on the main business they are in and take steps to minimize risks arising from interest rates, exchange rates, and other market variables

# Arguments against Hedging

- ▶ Shareholders are usually well diversified and can make their own hedging decisions
- ▶ It may increase risk to hedge when competitors do not
- ▶ Explaining a situation where there is a loss on the hedge and a gain on the underlying can be difficult

# Basis Risk

- ▶ Basis is usually defined as the spot price minus the futures price
- ▶ Basis risk arises because of the uncertainty about the basis when the hedge is closed out

# Long Hedge for Purchase of an Asset

## ► Define

$F_1$  : Futures price at time hedge is set up

$F_2$  : Futures price at time asset is purchased

$S_2$  : Asset price at time of purchase

$b_2$  : Basis at time of purchase

Cost of asset	$S_2$
Gain on Futures	$F_2 - F_1$
Net amount paid	$S_2 - (F_2 - F_1) = F_1 + b_2$

# Short Hedge for Sale of an Asset

## Define

$F_1$  : Futures price at time hedge is set up

$F_2$  : Futures price at time asset is sold

$S_2$  : Asset price at time of sale

$b_2$  : Basis at time of sale

Price of asset	$S_2$
Gain on Futures	$F_1 - F_2$
Net amount received	$S_2 + (F_1 - F_2) = F_1 + b_2$

# Choice of Contract

- ▶ Choose a delivery month that is as close as possible to, but later than, the end of the life of the hedge
- ▶ When there is no futures contract on the asset being hedged, choose the contract whose futures price is most highly correlated with the asset price. This is known as cross hedging.



# Optimal Hedge Ratio (page 59)

Proportion of the exposure that should optimally be hedged is

$$h^* = \rho \frac{\sigma_S}{\sigma_F}$$

where

$\sigma_S$  is the standard deviation of  $\Delta S$ , the change in the spot price during the hedging period,

$\sigma_F$  is the standard deviation of  $\Delta F$ , the change in the futures price during the hedging period

$\rho$  is the coefficient of correlation between  $\Delta S$  and  $\Delta F$ .

# Example (Page 61)

- ▶ Airline will purchase 2 million gallons of jet fuel in one month and hedges using heating oil futures
- ▶ From historical data  $\sigma_F = 0.0313$ ,  $\sigma_S = 0.0263$ , and  $\rho = 0.928$

$$h^* = 0.928 \times \frac{0.0263}{0.0313} = 0.78$$

# Example continued

- ▶ The size of one heating oil contract is 42,000 gallons
- ▶ Optimal number of contracts is  
$$= 0.78 \times 2,000,000 / 42,000$$

which rounds to 37

# Alternative Definition of Optimal Hedge Ratio

- ▶ Optimal hedge ratio is

$$\hat{h} = \hat{\rho} \frac{\hat{\sigma}_S}{\hat{\sigma}_F}$$

where variables are defined as follows

$\hat{\rho}$	Correlation between percentage daily changes for spot and futures
$\hat{\sigma}_S$	SD of percentage daily changes in spot
$\hat{\sigma}_F$	SD of percentage daily changes in futures

# Optimal Number of Contracts

$Q_A$	Size of position being hedged (units)
$Q_F$	Size of one futures contract (units)
$V_A$	Value of position being hedged (=spot price time $Q_A$ )
$V_F$	Value of one futures contract (=futures price times $Q_F$ )

Optimal number of contracts if  
adjustment for daily settlement

$$= \frac{h^* Q_A}{Q_F}$$

Optimal number of contracts  
after “tailing adjustment” to  
allow for daily settlement of  
futures

$$= \frac{\hat{h} V_A}{V_F}$$

# Hedging Using Index Futures

(Page 64)

To hedge the risk in a portfolio the number of contracts that should be shorted is

where  $V_A$  is the value of the portfolio,  $\beta$  is its beta, and  $V_F$  is the value of one futures contract

# Example

S&P 500 futures price is 1,000

Value of Portfolio is \$5 million

Beta of portfolio is 1.5

What position in futures contracts on the S&P 500 is necessary to hedge the portfolio?

# Changing Beta

- ▶ What position is necessary to reduce the beta of the portfolio to 0.75?
- ▶ What position is necessary to increase the beta of the portfolio to 2.0?



# Why Hedge Equity Returns

- ▶ May want to be out of the market for a while. Hedging avoids the costs of selling and repurchasing the portfolio
- ▶ Suppose stocks in your portfolio have an average beta of 1.0, but you feel they have been chosen well and will outperform the market in both good and bad times. Hedging ensures that the return you earn is the risk-free return plus the excess return of your portfolio over the market.

# Stack and Roll (page 68–69)

- ▶ We can roll futures contracts forward to hedge future exposures
- ▶ Initially we enter into futures contracts to hedge exposures up to a time horizon
- ▶ Just before maturity we close them out and replace them with new contract reflecting the new exposure
- ▶ etc

# Liquidity Issues (See Business Snapshot 3.2)

- ▶ In any hedging situation there is a danger that losses will be realized on the hedge while the gains on the underlying exposure are unrealized
- ▶ This can create liquidity problems
- ▶ One example is Metallgesellschaft which sold long term fixed-price contracts on heating oil and gasoline and hedged using stack and roll
- ▶ The price of oil fell.....