



# The Futures Hedging Project

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## What is this project about?

- You will learn how to use index futures contracts to hedge a stock portfolio.

## What case do I use?

- The FTS 500 Stock and Futures Case

## What are the pre-requisites?

- A basic understanding of portfolio betas, stock indexes, and index futures contracts.
- To learn how the system works, you should work through "[How Securities are Traded](#)"
- To learn about futures trading, you should work through "[Understanding Futures Contracts](#)"

## How much time does it take?

- It takes six weeks, in three steps:
  - Step 1: Create a stock portfolio. The exact portfolio does not matter since the goal is to learn how to hedge it. 1 week at most.
  - Step 2: hedge the portfolio over at least a month so you have time to see how well the strategy works. How much trading you do will depend on how much the market moves.
  - Step 3: evaluation of the results: 1 week.

## What software and data are required?

- You will use the FTS Real Time Client (RTFTS) and the "FTS 500 Stocks and Futures Case"
  - Windows: You can launch the FTS Real Time Client from the FTS System Manager
  - Other: use the browser based version at <http://www.rtfts.com>
  - You will need a trading name and password, assigned by your instructor
- You will also need Excel for formulating and evaluating the results

## How long is the report?

- 1 page executive summary
- 3-5 pages describing the stock portfolio, hedging strategy, predictions, results and conclusions.
- Other material in an appendix

## Background

A stock index futures contract is a cash-settled futures contract where the underlying asset is a stock index. One of the most widely traded such contract is the E Mini S&P 500 contract, defined on 50 times the value of the S&P 500 Index. Another such contract is the E Mini Nasdaq 100 contract, defined on 100 times the Nasdaq 100 index.

If you hold a stock portfolio and you want to hedge its risk, it is better to use stock index futures rather than hedge each stock individually. This is important to know: since stocks are correlated, you will over-hedge if you hedge each stock separately. On the other hand, you will face what is called basis risk because the futures contract is imperfectly related to your stock portfolio. Basis risk means that the price of the futures contract will not be perfectly correlated with the value of your stock portfolio. Experiencing the tradeoff between these factors and learning how to use analytics to manage the risk is the essence of this project.

The project is a “forward” test of the effectiveness of index futures in hedging a stock portfolio. This differs from “backtesting,” where the exercise is conducted on historical data. One advantage of forward testing is that you have to make decisions similar to what you would do in practice.

## Hedging with futures

The following material is explained in virtually any textbook on futures, and we provide a brief summary.

Let  $\beta$  denote the beta of the portfolio and let  $V$  denote the value of your stock portfolio. Let  $I$  be the value of the S&P 500 index, and let  $X$  denote the futures contract size ( $X=50$  in the case of the E Mini contract).

Then, to hedge the stock portfolio, you would sell

$N = \beta * V / (X * I)$  futures contracts.

If you did, your portfolio beta would be zero.

### Intuition

The intuition behind these numbers is quite simple. Think about beta: what is it? In our case, it measures how the return on one asset moves in relationship to the S&P index. If the stock portfolio has a zero beta, then it is uncorrelated with that index; if it is 1, then it moves “in synch” with the index.

- Suppose your stock portfolio had a beta of 1. Then, you would like to sell one S&P futures contract, but face a scale problem: if  $V$  is not equal to  $I * X$ , you have to adjust for the scale to get the relative magnitudes in line, and this adjustment is given by the term  $V / (X * I)$ . If your portfolio
- Suppose your portfolio beta is 1.8. Then, your portfolio “moves” like 1.8 of the index, so you want to sell 1.8 futures, except that again, you have to adjust for the scale.

**Notes**

- If you sold N1 of one futures contract and N2 of another, your portfolio beta would be:
- $\beta - (N1 * X * I + N2 * X * I) / V$
- Note that in general, different contract could have different underlying indexes and different contract sizes.
- Note also that beta is typically measured against the S%P 500 index. So if you use the Nasdaq futures contract, you will have to adjust for the difference. More on this below.

In the FTS Real Time Client, the futures hedging analytic shows you the following information; we provide two screen shots, one for the Windows version and one for the browser based version that runs on mobile devices.

**WINDOWS VERSION (in the Analytics tab)**

Financial TV and News   Analytics   Company Filings					
Edit	US Dollar	Equity Futures Hedges		Parameters	
	Value		Beta		
Equity Portfolio	51,861.00		1.1111		
Equity and Futures Portfolio	51,861.00		1.1111		
	Underlying Index	Contract Value	Index Beta	Contracts to hedge	Contract Size
E Mini S&P 500 March 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E Mini S&P 500 June 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E Mini S&P 500 September 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E Mini S&P 500 December 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E-MINI NASDAQ 100 STK IDX MAR 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00
E-MINI NASDAQ 100 STK IDX JUN 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00
E-MINI NASDAQ 100 STK IDX SEP 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00
E-MINI NASDAQ 100 STK IDX DEC 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00

## BROWSER VERSION (under the Reports tab):

History
Analytics
Heat Maps

Select Currency

Select Analytic

	Value	Beta			
Equity Portfolio	51,861.00		1.1111		
Equity and Futures Portfolio	51,861.00		1.1111		
	Underlying Index	Contract Value	Index Beta	Contracts to hedge	Contract Size
E Mini S&P 500 March 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E Mini S&P 500 June 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E Mini S&P 500 September 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E Mini S&P 500 December 2014	S&P 500 INDEX	92,118.5000	1.0000	-0.6255	50.00
E-MINI NASDAQ 100 STK IDX MAR 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00
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E-MINI NASDAQ 100 STK IDX SEP 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00
E-MINI NASDAQ 100 STK IDX DEC 2014	Nasdaq-100 Index	71,301.6000	1.1500	-0.7028	20.00

In each of these, you are shown:

- Your equity portfolio value
  - Calculated in real time
- Your equity portfolio beta
  - This is a value-weighted calculation based on stock betas
- The equity and futures portfolio beta
- All the futures contracts, the index that underlies they are based on, their beta relative to the S&P 500 index, the contract value and the contract size
  - The contract value is  $X \cdot I$
  - You can see that the Nasdaq index has a beta of 1.15
- The number of contracts needed to hedge the equity portfolio
  - This number changes as prices change.
    - The portfolio beta is value weighted, so that changes as prices change
    - The index values obviously change as prices change

The calculations are based on our having bought 100 shares of 5 different stocks. You can see that the portfolio value and the portfolio beta. We have not traded any futures contracts, so the two reported betas are the same.

## Understanding the numbers

Consider the first futures contract. Its index beta is 1. Why? Because the underlying asset is the S&P 500 index. The last column shows you the contract size.

The “Contracts to hedge” column tells you that *at the current moment*, you would short 0.6280 of this contract to hedge your position. If you look at the formula for calculating the number of contracts, you can see this number must be the same for all four E Mini S&P contracts. The contracts have different maturities, and so if you want to maintain the hedge for a long time, you could pick a contract with enough time to maturity.

Now, consider the fifth contract, defined on the Nasdaq 100. The Nasdaq 100 has a beta of 1.15, shown in the beta column. How do we calculate the number of contracts for this? The answer is that we have to adjust the formula for N, to

$$N = \beta * V / (X1 * I1 * \beta1)$$
 futures contracts, where  $\beta1$  is 1.15 in our case, and “I1” here refers to the value of the Nasdaq 100 index and X1 is the contract size for the Nasdaq 100 futures contract. The intuition is similar to before: the Nasdaq “behaves” like 1.15 times the S&P, so we replace the S&P index value with 1.15\*Nasdaq index value.

## Hedging

So how many contracts of which futures should you trade? We have two immediate issues

1. We can't sell fractional amounts of futures contracts.
2. As prices change, we will have to trade in and out of futures

You should minimize the first problem by scaling up or down your stock portfolio, but it will not be exact, and in any case, as prices change, the stocks and the index values will not move in exactly the same way. If you want a more advanced technique, you can buy and sell multiple futures contracts

## The Project

1. Login to the FTS 500 Stocks and Equity Futures trading case using your assigned trading name and password
2. Buy a stock portfolio
  - How you choose a stock portfolio does not matter for this project; just make sure that the value of the portfolio is either close to 50 times the S&P 500 index or close to 20 times the Nasdaq 100 index
    - Note that the Nasdaq 100 index is different from the Nasdaq Composite index!
3. Use the RTFTS analytics to sell futures contracts to hedge your portfolio
  - Pick one of the Nasdaq contracts or the S&P contracts to start with. You can trade different contracts later on.
4. Over time, the number of contracts you need will change, depending on what happens in the market. Adjust your portfolio as needed. This is called rebalancing.
  - Try not to make very small adjustments. You can use the beta of your stocks and futures as a guide; if this number is close to zero, you do not need to rebalance.

- Rebalancing is costly: you are charged a transaction cost per trade of \$9.95
5. At the end of the project, download your trading history
- History is obtained as follows:
    - In the “Reports---History” tab of the browser version
    - From the Reports menu of the Windows version
  - Describe the stock portfolio you chose
  - Describe your hedging strategy
  - Plot the daily values of your stock portfolio
    - You do this by obtaining the daily position values from your trading history
    - Then, export or copy/paste the data into Excel
    - Sum up the values of the stock portfolio
  - Plot the daily values of your whole portfolio
    - This is simply your market value history
  - Explain how well the strategy worked: were you able to use the index futures to hedge the risk of the stock portfolio?