

Portfolio Construction Under Economic Scenarios **In Action**

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Northfield Webinar

December 2020

Motivation

- In the September 2019 Webinar Dan gave a presentation titled “Portfolio Construction Under Economic Scenarios”
 - Available at <https://www.northinfo.com/documents/900.pdf>
- Hurdle discussed was that organization spend a lot of resources on economic forecast, but how can organizations implement these economic forecast during the construction of a portfolio or an asset allocation decision?
- Proposed solution was an integration of an economic scenario analysis directly into the optimization. Would require:
 - Northfield’s Scenario Analysis tool
 - Northfield’s risk models which can translate the economic forecasts directly into forecasts of return, volatility, skew and kurtosis for any individual asset or any set of assets making up an asset class (i.e. a index portfolio).
 - Northfield Open Optimizer
- *“In Action” because this integrated functionality is available in the Northfield PRISM system!!*

Points About This Product Webinar

- This webinar will be approximately 30 minutes. If we are unable to get to all questions or you would like to learn more about the application, or want to discuss your own scenario, please contact me directly at mike@northinfo.com.
- Demonstration output has been pre-processed for speed and flow. If you miss any of the steps during the webinar, the tech tip in Northfield's December 2020 Newsletter will contain the set up for the example in this webinar in full detail.

Agenda:

1. Review theory of Northfield's Scenario Analysis tool
2. Discuss an example, where incorporating an economic scenario into an optimization will be useful
3. Add some complexity to the scenario analysis for our example
4. PRISM Demo:
 - Walk through the setup
 - Review a truncated subset of reports available

Northfield Scenario Analysis Review

- Northfield's preferred numerical simulation method for exploring the distribution of a set of outcomes is "bootstrap" resampling.
 - Any of the paths we generate are plausible
 - All of the statistical relationships between factors would hold together
- The results are not much different than if we did Monte Carlo simulations that incorporated the higher moments and serial properties of the expected distribution.
 - Use of an empirical distribution ensures that the effective distribution is realistic (it did actually happen).
 - Calculation in our Scenario Analysis tool are much faster.
- All asset classes can be included in the analysis using Northfield's multi-asset class risk model, Everything Everywhere (EE).
 - Example for this webinar uses equity, fixed income and an illiquid asset

Basic Bootstrapping in Brief

Mechanically, the process is easy and very, very fast.

- We use any of our risk models to get the factor profile of the portfolio
- Let's assume we want to make a period by period forecast of the return distribution for the next 12 months and that we have a 240 month history of factor returns.
- To create our first sequence of synthetic history as our forecast, we draw random number N between 1 and 240. The factor returns for month N are now the first month of our first sequence of our forecast factor events. We repeat the process 12 times, we will have one full sequence of potential future events.
- Note that since the choice is random each time, not only is the order of events randomized but some observations may be omitted and some observations may be repeated more than once.
- The probability of choosing each observation is $1/N$ at each moment
- For each path we estimate the return on the portfolio for each month, assuming a random draw from the distribution of idiosyncratic risk.

Demo Setup Overview

- Benchmark is Asset Allocation portfolio of ETF's representing the US Economy in a Merton style framework
 - Equity is represented with sector ETF's according to GICS sectors
 - Yield curve is represented by a range of long and short-term treasury yield curve ETF's
 - Credit and default risk are part of the equity factors
- Portfolio is a combination of our benchmark and a NYC Office Building which is our illiquid asset
 - For more information on how Northfield models illiquid assets please see “Risk Assessment of Alternative Investments” in the June 2016 Newsletter available at <https://www.northinfo.com/documents/700.pdf>.
- Scenario #1 of the hypothetical example:
 - Covid19 has led to many people working from home, we expect this will have a negative impact on office building rents.

More About The Portfolios

- ETF's representing the Equity portion of the US economy are weighted according to GICs Sector weightings.
- Bond index ETF's are weighted by relative implied alpha based on risk. This simply ensures an upward slopping yield curve so longer-term bonds will have higher returns than shorter term bonds.
- Benchmark is 50% equity and 50% fixed income.
- Portfolio is 80% of the benchmark and 20% of the NYC office building.

Benchmark and portfolio weightings of the ETF presentation of US Economy

	Weights (%)	
	Benchmark	Portfolio
iShares 1-3 Year Treasury Bond ETF	2.76	2.21
iShares 3-7 Year Treasury Bond ETF	5.94	4.75
iShares 7-10 Year Treasury Bond ETF	9.00	7.20
iShares 10-20 Year Treasury Bond ETF	14.78	11.83
iShares 20+ Year Treasury Bond ETF	17.53	14.02
iShares US Consumer Services ETF	5.78	4.62
iShares US Utilities ETF	1.32	1.06
iShares US Telecommunications ETF	5.40	4.32
iShares US Technology ETF	14.08	11.26
iShares US Real Estate ETF	1.49	1.19
iShares US Industrials ETF	4.15	3.32
iShares US Healthcare ETF	7.11	5.69
iShares US Financials ETF	4.84	3.87
iShares US Energy ETF	1.03	0.82
iShares US Consumer Goods ETF	3.51	2.81
iShares US Basic Materials ETF	1.31	1.05
NYC office building	0	20.00
	100	100

Elements

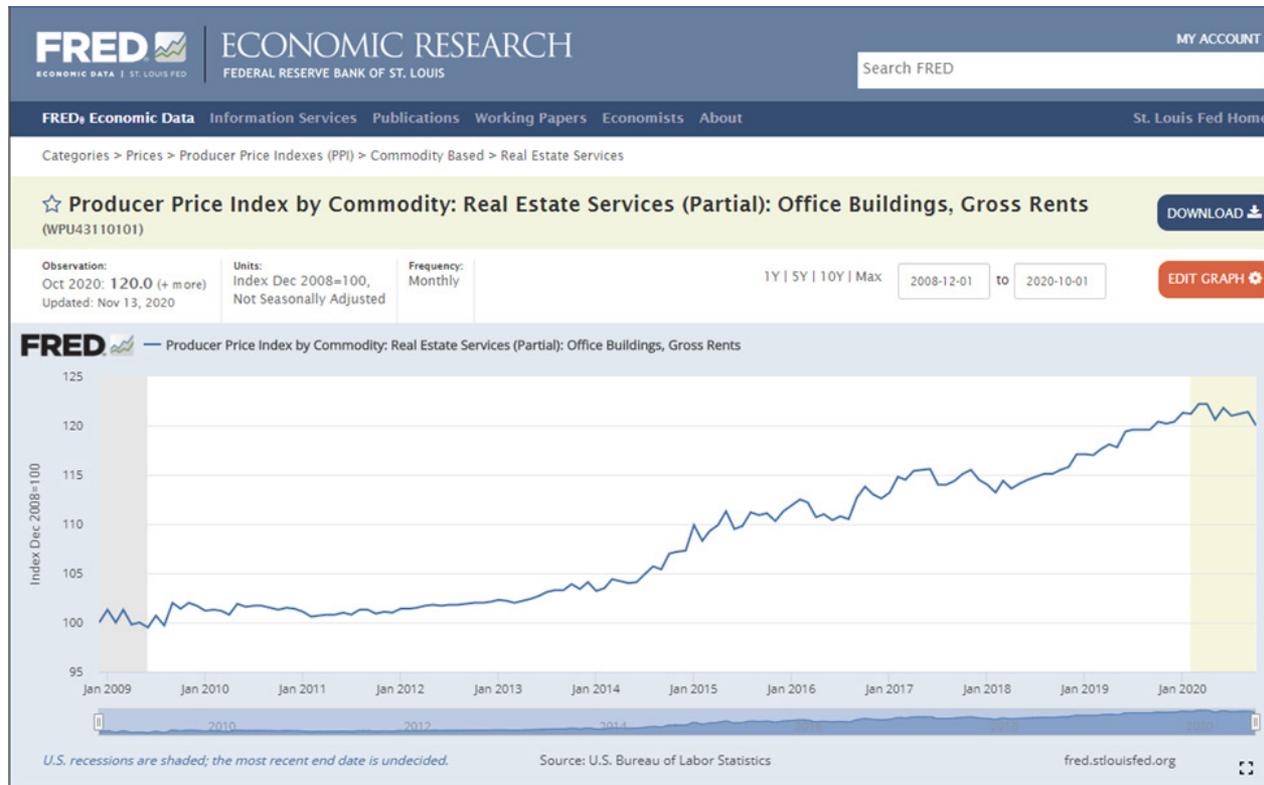
- Elements are how we define our scenarios
 - Dates within the confines of the elements have a higher probability of being chosen from the available date range.
 - User can choose up to 10 elements which can be weighted by importance
- Different types of Elements we can choose from:
 - Portfolio: data specific to a portfolio such as Net Asset Values
 - Series: any raw time series data can define a range of observation
 - FRED: includes data from the Federal Reserve Bank of St Louis' online database (FRED). FRED has a vast amount of economic data from a wide range of sources. PRISM automatically uploads FRED data into Scenario Analysis.

**Note Users must be familiar with the data and that the data is appropriate for the analysis. Some data series are copyright – this information is given in the Log output sheet.*

- For the purposes of our scenario, we will use “Office Buildings Gross Rents” from FRED as a measure of office rents.

Scenario Element #1

Below is screen shot describing Office Building, Gross Rents from FRED. For the purposes of our scenario, we are interested in dates on which there is a negative percent change in rents.



Optimization settings

- Let's set a few inputs to make the optimization more realistic.
 - It is not free to trade so we add a small transaction cost on buys and sells.
 - Tracking error target of 4%, which translates into a Risk Acceptance Parameter of 24.
 $RAP = 6 * TE = 6 * 4 = 24$
 - Since properties are difficult to sell in the short term, we set min/max constraints on the NYC office building ensuring the position doesn't change.
 - Alpha conversion is set to Reshape as Cross-Sectional Forecast.

Converted Alpha = Standardized Score * Information Coefficient * Cross-Sectional Volatility

For more information on setting up an optimization and the input adjustments applied in the Northfield optimizer please see Northfield Optimization Methodology in the December 2011 Newsletter available at

<https://www.northinfo.com/Documents/496.pdf>

Optimization: Scenario #1

- We want to compare 3 different portfolios:
 - The initial portfolio consisting of 80% of the benchmark and 20% of a NYC office building. This portfolio illustrates how adding the office building and decreasing the weight of the ETF's differ from the benchmark.
 - An optimal portfolio with all the optimization settings above, except the scenario analysis. This optimal portfolio sets the base case to help us understand the impact of the optimization settings versus the economic scenario.
 - Finally, the optimal portfolio with the optimization settings and the scenario analysis turned on. This portfolio helps us understand the impact of the falling rents scenario.

Adding Complexity

- In addition to decreasing rents in our hypothetical example we decide that business activity will slow down due to Covid19 and this will lead to lower interest rates.
 - We want to look a dates when interest rates have declined by 10% or more
- We still think rents will have a greater impact, so we weight the probabilities such that:
 - Decreased rents = 60%
 - Decreased interest rates = 40%
- From the FRED data set we use the 1-Year Treasury Constant Maturity Rate as a representation for interest rates.

Scenario Element #2

Below is screen shot describing 1-Year Treasury Constant Maturity Rate. For the purposes of our scenario, we are interested in dates on which there is a negative percentage change in interest rates of 10% or lower.



Demo

- Scenario Analysis
 - Parameters
 - Dates
 - Cumulative returns
 - Alpha
- Optimization Settings
- Optimization Scenario #1
 - Optimal portfolio with constraints
 - Optimal portfolio with constraints and decreasing rent scenario
- Optimization Scenario #2
 - Alpha
 - Optimal portfolio with scenario including decreasing rent and interest rates