# Reconciliation of Conflicting Risk Reports

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# Motivation

- *When crossing a street you are not likely to be hit by a car you see coming.  You get hit by the car you don't see coming.*
    - Often referred to as Knightian uncertainty (see Knight, 1927).
    - Another common reference is US Defense Secretary Donald Rumsfeld who said, "in war there are the known unknowns, and *the unknown unknowns"*.


- In the world of investment portfolio management, this idea implies that the risk model that a portfolio manager likes because that model is most familiar to them is apt to be the least useful.
    - Such a model provides a detailed analysis of what the PM already knows but omits other perspectives making it a less useful for the actual task of managing risks.

# Introduction

- In this presentation we will consider the issues of why an effective risk management process involves multiple risk models.

  – If an investment organization is using multiple risk models or risk reporting systems, the risk assessments will vary from one model to another to some extent.

- The variation across models arises two sources.

  – Differences between intended time horizon for risk

  – Differences between model designs (different factors)

- Different risk systems can also use different reporting conventions in how risks are decomposed by factors or portfolio positions.

  – We have documented different ways to do decomposition in Northfield News-June 2014 (northinfo.com)

# Empirical Illustration

- To illustrate how assessing risks with multiple models might be sensibly done, we will show eight different risk reports for the same investment circumstance.

- For all eight reports our portfolio will be the S&P 500 equally weighted and the benchmark will be the S&P 500 capitalization weighted.

- All analyses were done as of the 15th of September 2021.

- We will use four Northfield one-year horizon risk models
  - US Fundamental, US XRD, US Single Market and US Macro APT
  - Four different factor configurations

- We will also use "short horizon" risk models
  - US Short Term (2 day) and the "near horizon"(2 week) versions of the US Fundamental, the US Single Market and the US Macro APT

- *In all we have five factor configurations and three distinct time horizons.*

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# Differences in Model Design (factor list)

- The Fundamental Model and the XRD models are endogenous designs.
  - Security level factor exposures are observable from financial statements or market data, factor returns must be statistically estimated.
  - The XRD model blends results from the current model and the three previous weeks of model estimation to smooth "noise" in the estimation process.

- The US Single Market and the US Macro APT models are hybrid designs.
  - For each model there is a list of specified exogenous factors for which factor returns can be observed but security level factor loadings must be estimated.
  - In-sample returns not explained by the chosen factors are subject to principal component analysis to estimate transient factor effects.

- The US Single Market Model is a "blind factor" process estimated as a set of eigenvectors (principal components).

# Unconditional and Conditional Models

- Most risk models are unconditional in the sense that a past period is chosen for analyses, and the model assumes that the *future will be like the selected past.*

- The Northfield US Short Term model and the near horizon versions of other models are conditional.
  - We start with an unconditional analysis and then adjust the models daily to reflect observable information about the current state of the financial markets.

- The conditioning information arises in three types:
  - In the US Short Term Model we observe abnormal relationships between historical and option implied volatility for assets with traded options.
  - Data on contemporaneously observable market-wide metrics for financial risk (VIX, bond yield spreads)
  - Our *Risk Systems That Read®* process adjusts for text news on companies which is then aggregated at the industry, country and factor levels.

# **Annual** Risk Values from Long Term Models

| | Fundamental | XRD | Single | Macro | Average | Standard Deviation | GLS Estimate |
|---|---|---|---|---|---|---|---|
| S &P 500 Equal | 21.26 | 25.63 | 17.45 | 17.20 | 20.39 | 3.96 | 20.82 |
| S & P 500 Cap Wt | 20.31 | 23.40 | 16.03 | 16.15 | 18.97 | 3.56 | 19.80 |
| Tracking Error | 5.11 | 5.40 | 5.09 | 4.27 | 4.97 | 0.49 | 5.06 |
| R-Squared | 0.94 | 0.96 | 0.92 | 0.94 | 0.94 | 0.02 | 0.94 |

*No value is statistically significantly different from the respective simple mean or GLS estimate.*

# A Couple Insights

- Four different models with four different factor structures produce about the same results for multiple metrics by which risk is commonly evaluated.
    - None of the key values is statistically significantly different from the simple mean of four models or the GLS estimate (weighted by the inverse of the squared distance from the mean).
- In forming consensus values, I might also want to consider different error structures for different models, so I may want to set weights.
    - Endogenous models have observable security level factor exposures so the errors show up in the covariance matrix of factor returns.
    - Exogenous models have observable factor returns, but estimated factor exposures at the security level.
    - Statistical models estimate both inputs
    - For endogenous models the errors cannot be diversified away, while for exogenous models the errors diversify

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# **Annualized** Short Term Risk

| | Fundamental NH | Single NH | Macro NH | Short Term | Average | Standard Deviation | GLS Estimate |
|---|---|---|---|---|---|---|---|
| S &P 500 Equal | 17.00 | 15.28 | 13.89 | 13.54 | 14.93 | 1.57 | 14.88 |
| S & P 500 Cap Wt | 16.38 | 14.53 | 13.15 | 12.13 | 14.05 | 1.84 | 14.11 |
| Tracking Error | 4.36 | 4.50 | 3.86 | 7.10 | 4.96 | 1.46 | 4.51 |
| R-Squared | 0.93 | 0.91 | 0.92 | **0.72** | 0.87 | 0.10 | 0.89 |

*I'm cheating because the Short Term model is designed for a two day horizon while the other three are calibrated for a ten day horizon.*

*("NH" is Near Horizon, indicating a ten day horizon.)*

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# Comments on Short Term Risk

- The three 10 day models produce no values that are statistically significantly different from the three value simple mean or GLS estimate.
  - Even when inappropriately adding in the Short Term 2 day model, the results get farther apart, but not that much.
- What is significant is the differences in mean values between long horizon risk and shorter horizon risk estimates.
  - Given that things have calmed down a lot in terms of the COVID pandemic it seems intuitive that the short horizon risks are lower than in the longer term.
  - Put differently, in the longer horizon there is more time for conditions to change just as things have changed significantly from time to time within the historical sample periods of the model.
- For very short horizons, we have to be talking about daily returns, not weekly or monthly, which should be adjusted for kurtosis (e.g. a T-5 distribution) which would tend to move the Short Term model values in line with the others.

# Two Fun Things to Think About

- Since variances of any time series are additive, I can do forward estimates of future risk.
  - If I have a volatility estimate for the next two days and a different estimate for the next ten days (inclusive of the next two) I can infer the volatility estimate for the eight days starting two days from now.
  - We use this concept in our Optimizer to allow users to blend short term and long term risk estimates to best fit portfolio turnover.

- Even across a set of models with entirely different factor structures, the degree of explanatory power is almost identical.
  - This means that all the models are explaining roughly the same risk sources from different perspectives (i.e. linear combinations)
  - **It's like looking at different sides of Rubik's cube. All six sides look different but it's only one cube. You just need to rotate it to see from all sides.**

# XRD versus Single Market Decomposition

XRD

Single Market

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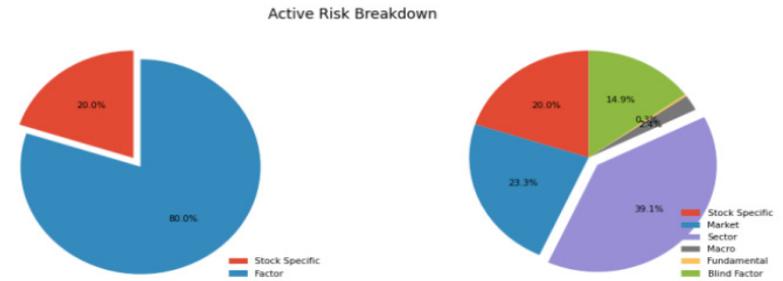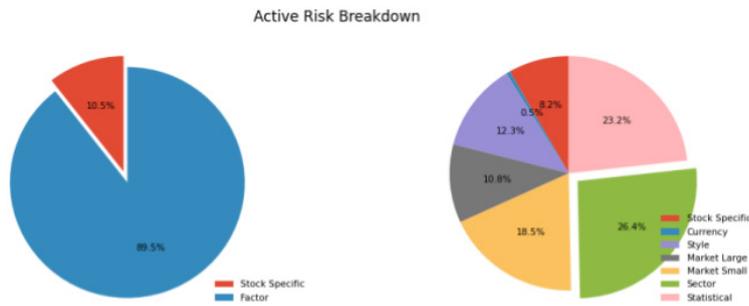
# A Woeful (But True) Tale

- One of our plan sponsor clients routinely sent an annual survey to their external managers asking them to forecast how about a dozen macroeconomic variables (e.g. oil prices) would change over the next year.

- Managers would return the surveys indicating their opinions.

- The sponsor would then put each manager's forecasts, portfolio and benchmark into our Macro model as a scenario and calculate expected active returns.

- In about two thirds of these cases, *the expectation of active return was negative conditional on the manager's own forecast coming true.*

- Managers generally tried to talk their way out of this embarrassment by saying they are fundamental in style and don't pay attention even to their own macro forecasts.

# Conclusions

- Risk assessment of investment portfolios is routinely conducted using factor models.

- Different factor model designs are better suited than others depending on time horizon and the level of portfolio diversification.

- It's important for portfolio managers to see the risks of their portfolio from perspectives other than the ones they routinely think about.

- Major discrepancies in the perceived level of portfolio risk arise from inappropriately mixing **annual** and **annualized** values.