March 2015

Northfield News

A Newsletter for the Friends and Clients of Northfield

Untying Gulliver: Optimal Deal Flow for Illiquids

By Emilian Belev, CFA and Richard B. Gold

Introduction

Modern portfolio theory has largely avoided the question of what to do with illiquid assets. In large part, this is not surprising since as their name implies illiquids operate under different conditions than that of their liquid cousins. Appraisal-based, rather than auction-based pricing, large lumpy assets, and sales cycles often measured in months, rather than milliseconds, are just a few of the differences between the asset classes and also some of the reasons why illiquids have not been the darling of academics and also not easy to fit in standard models. This in turn has made it more difficult for owners of illiquid assets to directly address the fundamental issue facing all investors: what to buy, when to buy, and finally when to sell. Recognizing that owners of illiquid assets cannot take the same path as their stock and bond counterparts, Northfield has developed a solution which merges techniques from fundamental and quantitative finance to tackle this problem in a unique but sensible manner. By fully integrating illiquids into the same pantheon as traditional holdings, investors can now concentrate their efforts on how to maximize their risk-adjusted returns rather than mulling over the best way to simply calculate their risk-adjusted returns.

Background

Illiquid assets continue to grow as a share of the typical institutional investor's portfolio. Driven by their perceived stability, low correlation to other asset classes and strong cash flows, real estate and infrastructure have become a diversifier and an extremely attractive investment vehicle for pension funds and other long-term investors for asset liability matching (ALM). In fact, illiquid investments can now consist of upwards of 30-35% of an institution's portfolio with that share only expected to increase in the coming years.[1]

But there is also a downside. Unfortunately, while illiquids' research occupies far fewer pages on the bookshelf than other asset classes, illiquid assets realistically should demand far more time from analysts due to their far more idiosyncratic/non-diversifiable risk per dollar invested because of their absolute size and complexity. Their "lumpiness" as well as their notoriously long closing times forces investors to live with their idiosyncratic risk far longer than stocks or bonds: thereby requiring a much higher level of due diligence and a much deeper understanding of the incremental impact of any individual deal entering or leaving the portfolio.

Because CAPM and APT only hint at their existence, they do not explicitly give investors a clear roadmap as to how to incorporate illiquids' appraisal-based pricing, inefficient and non-arbitrage free pricing, heterogeneity, and most important, their lack of pricing history into traditional quantitative analysis.[2] As a result, it is not surprising that real estate and infrastructure analysis is almost exclusively within the purview of fundamental investment analysis.

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Special Points of Interest:

- Main Article: Optimal Deal Flow for Illiquids
- Tech Tip: Issuer Risk
- London Seminar Announcement
- Introducing the Northfield Prism System

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Inside This Issue:

- Upcoming and Recent Webinars
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- Northfield Staff Profiles

2015 Northfield London Annual Seminar

Ironmongers Hall • London • April 21, 2015

We are pleased to announce Northfield's annual London seminar will take place on Tuesday April 21st, 2015. We have an impressive roster of presenters including:

Ironmongers Hall

Louis Scott
Founder of Kiema Advisors
Director of Portfolio Risk Research at FactSet

Michael Howell
Managing Director at CrossBorder Capital

Peter Hafez
Director of Quantitative Research at RavenPack

Daniel Mostovoy
Researcher at Northfield

Jason MacQueen
Director of Research at Northfield

Dan diBartolomeo
President and founder of Northfield

The seminar will be held at Ironmongers Hall. Built in the 1920's Ironmongers Hall is an elegant Tudor style Hall which feels much like a country house re-located to the heart of the City of London. Home to the Ironmongers' Company who earliest records suggest were an effective body in 1300. The Company is tenth in order of precedence and is, therefore, one of the Great Twelve Livery Companies. For more information on the hall please visit **http://ironmongers.org/.**

Steeped in historical tradition the first hall, dating back to 1457, was in Fenchurch Street; it was rebuilt in 1587 and rebuilt again in 1745 on the same site. The third hall was destroyed on 7 July 1917 by a bomb dropped during World War I. The present Hall was opened on 17 June 1925.

Invitations with full agenda and registration information will be sent in the next couple weeks. Contact the London office at **+44 (0) 20-3714-4130**, **sales-europe@northinfo.com**

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If you have any suggestions of what you would like to see covered in upcoming issues, please e-mail your ideas to general@northinfo.com

Webinar: Optimal Deal Flow for Illiquid Assets

March 31, 2015 • 11:00 AM EDT

Northfield's Emilian Belev and Richard Gold will be hosting a webinar on March 31, 2015.

Abstract

Modern portfolio theory has largely avoided the question of what to do with illiquid assets. In large part, this is not surprising since as their name implies illiquids operate under different conditions than that of their liquid cousins. Appraisal-based, rather than auction-based pricing, large lumpy assets, and sales cycles often measured in months, rather than milliseconds, are just a few of the differences between the asset classes and also some of the reasons why illiquids have not been the darling of academics and also not easy to fit in standard models. This in turn has made it more difficult for owners of illiquid assets to directly address the fundamental issue facing all investors: what to buy, when to buy, and finally when to sell.

Recognizing that owners of illiquid assets cannot take the same path as their stock and bond counterparts, Northfield has developed a solution which merges techniques from fundamental and quantitative finance to tackle this problem in a unique but sensible manner. By fully integrating illiquids into the same pantheon as traditional holdings, investors can now concentrate their efforts on how to maximize their risk-adjusted returns rather than mulling over the best way to simply calculate their risk-adjusted returns.

Visit **https://northinfoevents.webex.com** to register. There is no charge to register. If you cannot attend the live session, please register and we will send you the post webinar recording.

Webinar Wrap-up: Alpha Estimation for Quantitative Asset Managers and the Definition of Asset Specific Risk

January 7, 2015 • 11:00 AM EST

Northfield President Dan diBartolomeo hosted a webinar on January 7th, where he discussed the development of a positive definition of specific risk. In the presentation, Dan first examined whether the variation of estimates of asset specific risk across models is likely to be statistically significant or economically material. He then considered a positive definition of specific risk at both the firm and individual security level based on imposing a no-arbitrage condition on the capital structure of a firm. The presentation concluded with a discussion of how conditioning the estimates on alternative information sources such as quantification of text news reports can be used to capture time series variation in the true, but unobservable level of asset specific risk.

The presentation slides are available at **http://www.northinfo.com/documents/633.pdf.** Contact your Northfield Sales Representative if you are interested in viewing the full presentation recording of the event.

Webinar Wrap-up: "Guaranteed" Alpha - Using Risk Budgeting to Improve Performance by Reducing Management Fees and Other Expenses

February 24, 2015

Northfield President Dan diBartolomeo hosted a webinar on February 24th, where he discussed the use of risk budgeting to improve investment performance by reducing fees and expenses. The presentation began with the theoretical development of the metric "covenant information ratio." Dan then covered two different approaches to resolve the inherent conflict of risk preferences between asset owners and agent managers. The first being a unique concept of risk budgeting which optimally determines asset allocation, the allocation between active and passive management, and a mechanism to determine optimal aggressiveness levels for active managers. The second approach being to revisit the concept of Centralized Portfolio Management which has been successfully implemented in recent years.

The presentation slides are available at **http://www.northinfo.com/documents/634.pdf.** Contact your Northfield Sales Representative if you are interested in viewing the full presentation recording of the event.

Northfield Staff Profiles

Ghazanfer Baig, CFA - US Sales and Marketing Team

Ghazanfer Baig (Ghaz) is presently part of the US sales and marketing team focusing on institutional asset managers. Prior to his current role, Ghaz had been involved with various research and development efforts over the past 15 years at Northfield. In his past roles, Ghaz had been part of the team responsible for designing and implementing 2nd and 3rd generations of equity risk models, including contributions toward shorter horizon adjustments to longer term risk estimates. In his earlier role, Ghaz designed the production processes and controls required to digest various market data, central to the production of Northfield risk models and analytics.

Prior to joining Northfield, Ghaz was a fixed income securities trader at Emirates Bank International in Karachi, Pakistan. Ghaz holds a Master of Science degree in Finance from Bentley University, Elkin B. McCallum Graduate School of Business and a Bachelor of Arts in Business Administration from Institute of Business Administration, University of Karachi. Ghaz also holds the Chartered Financial Analyst® designation and is a member of Boston Securities Analysts Society (serving on the quantitative committee), Chicago Quantitative Alliance and the CFA institute.

Emilian Belev CFA, ARPM - Head of Enterprise – Wide Analytics

Emilian Belev has led the development of Northfield's Enterprise Risk analytics for the last 12 years. His responsibilities include modeling equity and fixed income, currency, interest rate, and credit derivatives, structured products, directly owned real estate, private equity and infrastructure, and developing an integrated framework for these asset classes to be analyzed side-by-side in a coherent, accurate, and economically logical fashion.

Emilian has introduced various innovative methodologies in the areas of convertible bonds modeling, MBS path dependency, efficiency of numerical derivative pricing algorithms, credit risk among tranches of seniority, infrastructure investments, and directly owned real estate. Emilian has presented on some of these topics at various industry events in North America and Europe.

Prior to joining Northfield, Emilian was with State Street Global Advisors. Emilian is an actively involved CFA, holder of the Certificate in Advanced Risk and Portfolio Management, a member and founding member of respectively QWAFAFEW Boston and QWAFAFEW Toronto, a member of the PRMIA expert advisory group for Market Risk, and a winner of the 2013 PRMIA award for New Frontiers in Risk Management.

Mike Knezevich - Technical Director of Investment Analytics, EMEA Region

Mike Knezevich joined Northfield in June 2006 and currently leads the EMEA regional sales and support function from the London office. In addition to managing the daily operations of the office, he is responsible for structuring and overseeing the implementation of client solutions, planning and marketing the annual research seminar as well as other marketing functions.

Previously Mike headed up Northfield's support function from the Boston office where he managed the support team and oversaw the development of educational documentation. He was instrumental in extending a better understanding of the application of Northfield theory and methodology.

Prior to joining Northfield, Mike held various support positions with Barra departing as a support consultant. He has a Masters of Applied Economics from the University of Michigan (Ann Arbor) and is active in LQG and Inquire-UK. He has also been a member of QWAAFEW in both Boston and San Francisco, serving on the planning committee for QWAFAFEW San Francisco.

(Optimal, Continued from page 1)

The Allocation Process

Since there is no official deal allocation Bible, every asset owner tends to have its own version of the investment process. Firms with specific investment goals and objectives tend to use highly focused filters by investment type (airport or generation plant, office or retail center) geography, deal value, expected return, location, quality (Class A, B, C), leverage, etc. and can rapidly and easily whittle down the list of viable candidates. Larger firms with multiple portfolios and investment strategies require a more formal and less flexible approach since it is entirely possible that a particular asset may fit several strategies. Often a simple "queuing" system is in place which allocates deals but it is just as likely that there is some formal allocation system which tries to channel a deal to the fund whose investment incremental investment objectives would be best met by that particular deal.

Another interesting contrast is that the investible universe available to the average investor at any given point in time is unknown. That is, the number and quality of deals from which an investor can select varies and changes from period to period. Unlike stock and bond investors which operate in well defined markets with a known investible universe, illiquid investors receive investment packages depending of the size of the firm, investment strategy, recent activity, reputation, and other factors. Furthermore, capital market and economic conditions can reduce deal flows to a minimum even for the most aggressive investors since owners always have the option not to sell if they do not like current pricing. Usually when an asset class is in distress (e.g. bonds or residential RE) there is a selloff which increases supply and tends to create a self-propagating bust cycle. However, typically with commercial real estate, there is a classic agency problem, due to visibility and reputational issues, where sale of losers is withheld, which not only simultaneously dampens the downwards price pressure, but also limits buying opportunities in a depressed market.

Also, unlike stock and bond markets, only a small portion of the asset class's universe is for sale at any given point in time, often making it difficult for an investor to rebalance their portfolio in a timely and efficient manner.

Because most deals are subject to competitive bidding, this raises the possibility that the "winning" bidder may actually be assuming unexpected risk by purchasing the asset above their desired purchase price; thereby making a suboptimal decision. This is the flip side of the earlier agency problem. In this case, asset managers need to stay invested and therefore are willing to pay excess prices to acquire an asset. However, there may be no real winners, since the losing bidders will now be required to move on down the investment "food chain" and add "lesser" assets at "higher" prices and take on more risk for less reward.[3]

It is for these very reasons that Northfield has developed the Optimal Deal Flow for Illiquids (ODFI) system.

Key Concepts

Since profitability is the cornerstone for grading virtually any investment, it is not surprising that it also important to Northfield's ranking methodology. Like most real estate analysts, we incorporate the tried and tested metrics of a building's profitability based on its expected cash flow such as: current and future rent levels, the probability of future lease renewals, expected occupancy, tenant credit quality and ensuing defaults, capital expenditures, upkeep costs, etc.

Turning to Modern Portfolio Theory (MPT), we then place an asset's performance in context to its relationship relative to other assets. Since an investment's absolute return and volatility alone are not sufficient conditions under which an asset should be added to a portfolio, an investor also needs to take into account the asset's correlation with all other assets as well as its resulting incremental volatility before considering its inclusion in a portfolio. Simply purchasing as asset based on absolute return may result in suboptimal portfolio performance.

One distinctive feature of Northfield's ODFI model is its approach to measuring risk. Unlike traditional risk models, which employ standard deviation as their preferred metric, ODFI takes a different approach. Since the absolute dollar price of a building or an infrastructure project at the time of its purchase is directly related to its investment performance, any absolute dollar loss relative to that initial purchase price in present value terms is viewed as a contingency claim for the ODFI model, and it is the value of the claim which is the model's risk metric. The ODFI approach is similar to the approach taken by Merton in his analysis of credit risk and contingency claims analysis (CCA).[4] In the case of an illiquid investment, underperformance, or any present value dollar loss, can be seen as a put option which the investor is short, the strike price being the purchase price and the underlying asset being the present value of the asset's future cash flows discounted back to today over its expected useful life.

CCA is useful for two important reasons. First, it provides investors with present value dollar loss amounts; something with which real estate and infrastructure investors are very familiar. Second, it allows investors to identify potentially underperforming assets both in absolute terms as well as relative to the expected mean outcome. This is unlike traditional mean variance optimization (MVO) which does not differentiate between over- and under- performance relative to a mean when calculating preferences. This does not mean, as we will later see, that our approach and MVO do not share common features.

It is important to note, that this application of CCA within MPT requires that the asset volatility used for option pric-

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(Optimal, Continued from page 5)
ing be the incremental portfolio-level volatility not the volatility of the individual asset itself. Therefore by extension, Northfield's ODFI is specifically interested in the incremental volatility that any new asset brings to the investor's portfolio.

Model Implementation

Step one of the model is to first estimate the value of a targeted deal under the assumption that there will be no loss below the purchase price. In our working paper on this topic (available upon request) we show why we believe this is the proper place to begin and why it also aligns with basic investor utility. The simplest metric that indicates individual investment value in the absence of unexpected drawdown beside the outlay for the purchase price is the expected present value (PV) cash flow employing a base discount rate such as the risk free rate.[5]

The second step is to calculate the incremental impact of the asset on the portfolio's volatility. It is possible to do this analysis specifically for the asset's designated portfolio, just for the illiquid portfolio, and/or the investor's entire portfolio. The only requirement is a multi asset class risk model such as Northfield's Everything Everywhere (EE) model.[6] While not necessarily unique, the EE model is the only model with which Northfield is familiar that has the necessary multi-asset class and geospatial capabilities to handle ODFI's requirements, as it is the only model that relates the risk of illiquid and liquid assets, as well as the risk of diverse illiquid markets, to a consistent set of risk factors.

Northfield's illiquid risk models express an illiquid asset's underlying cash flow characteristics as a function of factors in Northfield's EE model as well as bespoke econometric market analysis by property type and infrastructure usage by geography. Since this approach is no different than that employed for liquid assets, it unifies risk in a consistent manner across all asset classes in a consistent manner allowing investors to analyze intra- and inter-asset class risk. Moreover, since the model frees itself from the shackles of appraisal-based pricing, serial correlation and muted volatility are no longer an issue.

The model also provides information regarding the diversifying effects of an office building in London versus San Jose depending on the composition of the investor's equity portfolio and whether or not it is tilted towards financial services or high tech. It can also help measure the impact of a tenant's potential bankruptcy, not only across a real estate portfolio, but across an investor's bond and equity portfolios if the investor is a bondholder and/or stockholder for that tenant in other parts of their portfolio. The model can also help with determining a host of other issues such as whether to use fixed or variable rate financing and can also give simple metrics such as lease cash flow duration to compare to durations in reference fixed income portfolio.

We are now ready for the next step which is to estimate the expected loss using the Contingency Claim Approach (CCA) outlined above. Having already measured the factor exposure records for a new deal using the illiquids and EE models, it is now possible to compute the incremental volatility that the investment adds to the portfolio. Using that imputed incremental asset volatility, along with the asset's value and a "strike" price, the value of the real option equal to the investor expected loss can be calculated. In this case, the "strike" price is the baseline for the asset value at which we begin measuring a loss or the asset's purchase offer price. **(See formula below)**

Taking the estimated NPV, we subtract the expected loss and the result is the risk-adjusted NPV of a specific investment deal. The last step is to rank all deals under consideration in order from high to low and move down the list until their value exceeds the total available investable cash (with leverage if leverage is in play) for the period in question. An example of this can be seen in **Table 1**

(Optimal, Continued on page 7)

$$\sigma_{\text{Imputed}} = \frac{\sqrt{\omega^2_{\text{New Investment}} * \sigma^2_{\text{New Investment}} + 2\omega_{\text{Current Port.}}\omega_{\text{New Investment}} * \text{COV}_{\text{New Investment,Current Port.}}}}{\omega_{\text{New Investment}}}$$

Table 1. Potential investments are sorted by Adjusted NPV (per dollar invested) and included in the investment set up to the budget constraint.

Investment	PV Cash Inflows (mill dollars)	Offer Price (mill dollars)	PV (per dollar Invested)	NPV (per dollar Invested)	Time Horizon	Imputed Volatility	CCA Drawdown Value per dollar invested	Adjusted NPV (per dollar invested)	Cumulative Investment (mill dollars)	Cumulative Budget Constraint (mill dollars)
Investment 3	36.8	23.6	1.6	0.56	15	23.5	0.07	0.49	23.6	50
Investment 6	17.6	12.1	1.5	0.45	15	16.3	0.04	0.42	35.7	50
Investment 5	14.8	9.9	1.5	0.5	15	29.3	0.11	0.39	45.6	50
Investment 3	25.3	17	1.5	0.48	15	30	0.12	0.36	62.6	50
Investment 1	14.8	11	1.4	0.35	15	18.3	0.05	0.3	73.6	50
Investment 7	28.6	22	1.3	0.3	15	20	0.07	0.23	95.6	50
Investment 8	11	8.8	1.3	0.25	15	15.8	0.05	0.2	95.6	50
Investment 2	23.6	20.9	1.1	0.13	15	15	0.05	0.08	95.6	50

(Optimal, Continued from page 6)

Assuming a normal distribution of asset return, the ODFI objective function can be represented by the following expression[7]:

$$\textbf{ODFI Objective} = \mu_r + p(\mu_r) - \frac{\sigma_r}{\sqrt{2\pi}} + \frac{{\mu_r}^2}{2\sigma_r\sqrt{2\pi}} \quad (1)$$

where p is the p-value of the loss region of the asset distribution, μ_r is the mean asset return and σ_r is the standard deviation of this return.

In comparison (ignoring for a moment the effects of varying risk aversion levels):

$$\textbf{Mean Variance Optimization Objective} = \mu_r - {\sigma_r}^2 \quad (2)$$

These last equations show that both the ODFI and MVO objective functions benefit from upward shifts in returns and lower volatility. However, the ODFI function is more complex due to the interaction of the two variables. The ODFI function penalizes any shortfall of the distribution under the principal threshold/purchase price and that loss looks to the interrelationship of the mean and the variance of the distribution and in turn to their relationship to the purchase price.

To embed a risk aversion constant similarly to MVO, similar to:

$$\textbf{MVO Objective} = \mu_r - \lambda{\sigma_r}^2 \quad (3)$$

It is necessary to take into consideration all the terms that relate to risk disutility in our ODFI objective and apply a constant to all of them simultaneously. In Equation **(1)**, that would be the second, third and fourth terms.

Market risk aversion need not be considered since it is embedded in a deal's sales price which is known. It also blends effortlessly into the DCC option pricing model as the strike price or principal protection threshold under the assumption that an accepted offer has built into it an agreement with the market's risk aversion premium.

With respect to the last observation, ODFI has one additional advantage over mean variance optimization inasmuch as ODFI is not restricted to a single period unlike MVO. None of ODFI's calculation's are restricted to a single period which is critical to illiquid investors whose acquisition, disposition, and holdings periods, are much different than that of stock and bond investors.

We need to note one planned extension of the ODFI framework which will involve incorporating an investor's "option to wait." This option will have the following impact. If an investor has an investment window, which is often the case for illiquids, market conditions may shift thereby affording the investor the opportunity of finding a better deal. If economic conditions improve, there might be more deals coming to the market, but the improved asset position of sellers might put buyers at a bidding disadvantage price-wise. Clearly, there is going to be some distribution around this average trend (due to liquidity uncertainty) that will offer better deal outcomes in its lower tail, and the "better deal" amount and expectation will depend on the intensity of the overall number of deals offered in a "good market," and the dispersion of the liquidity distribution. Conversely, if economic conditions worsen during the investment window, there will likely be fewer deals coming to market, and the ones that do will be biased towards sellers that are cash strapped and willing to sell at a discount. In that case, the liquidity distribution will be wider; that is there will be fewer, but better, opportunities. Given that our approach centers on CCA, these potential interactions can be explicitly captured in the option valuation framework.

Final Thoughts

It has always been difficult to be an illiquid investor. Not only have there been limited investment options, but when deals do come to market, competition is usually fierce. Making things even more challenging is the absence of high quality data and issues such as appraisal bias with which to deal. Over the past 10 years, Northfield has developed several tools to help level the playing field. The ODFI model is another addition to that tool set. Borrowing from several well tested and long-standing financial doctrines, ODFI has one foot firmly planted in the fundamental camp through its use of discounted cash flows and capital budgeting, and the other foot in the quantitative camp by using rigorous optimization objectives. At the end of the day, ODFI is designed to give a simple answer to what until now was a concise but vexing question: what illiquid investments to buy and when to sell within the confines of an investor's optimal choices.

Endnotes

[1]See: Nesbitt, S.L.,"Trends in State Pension Asset Allocation and Performance": Cliffwater LLC, 2012.

[2]Appraisal smoothing has long been recognized as an issue in private equity real estate. See: Geltner, D.M., "Smoothing in Appraisal-Based Returns": *Journal of Real Estate Finance and Economics*, 1991, 4, 327 – 345.

[3]See: Akin, S. N., Lambson, V. E., McQueen, G. R., Platt, B., Slade, B.A., Wood, J., Rushing to Overpay: The REIT Premium Revisited (http://home.business.utah.edu/finmh/McQueen%27s%20REIT%20Paper%20for%20U%20of%20U.pdf), March 22, 2011.

[4]See: Merton, R.C., "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates": *Journal of Finance*, 29c(1974), pp. 449-470

[5]The more realistic situation where a term structure of risk free rates is used, is equally well admissible.

[6]See: Everything Everywhere: The Multi-Asset Class Risk Model, Northfield Information Services White Paper, http://www.northinfo.com/documents/71.pdf as well as Belev, Emilian, Dan DiBartolomeo, and Richard B. Gold, "Integrating Physical Real Estate and Infrastructure Assets In Enterprise Risk Management", *Enterprise Risk Management Symposium Monograph*, http://www.ermsymposium.org/2014/pdf/erm-2014-paper-belev.pdf, Sep. 29 –Oct 1, 2014 for a detailed description of Northfield's EE and Private Equity Real Estate Models.

[7]The complete derivation of the ODFI objective function is outlined in a working paper which can be obtained by contacting Northfield Information Client Support.

Technical Support Tip: Issuer Risk

By Steve Dyer

In the next release of the optimizer and risk models, there is a new feature to improve the specific risk estimation of portfolios with related securities. Traditionally, stock specific risk is assumed to be uncorrelated between securities, but correlation of specific risks across two securities can occur when the two securities are related to the same firm. For example, two different classes of stock in the same firm (Berkshire Hathaway A and Berkshire Hathaway Class B), the same stock traded on two different exchanges (Volkswagen traded in Frankfurt and Volkswagen traded as a NYSE ADR), or different seemingly unrelated securities of the same firm (Bank of America stock and a Merrill Lynch bond). Going forward, there will be an encrypted value in the EE and equity model exposure files that will contain issuer information, so the correlation between the stock specific risk of securities from the same firm can be correctly accounted for.

As for exactly what is happening and how we are calculating it, recall how stock specific tracking variance has been calculated – it is the sum of the squares of a security's active weight times its specific risk:

$$\sum_{i=1}^{n}((W_{pi}-W_{bi})^2\times S_i^{\,2})$$

Where:

W_{pi} is the portfolio weight in security i
W_{bi} is the benchmark weight in security i
S_i is the specific volatility of security i
N is the number of different securities in the union of portfolio and benchmark

So for a portfolio with two securities, 40% Berkshire Hathaway A and 60% Berkshire Hathaway B, with cash benchmark, we can easily calculate what the stock specific risk is.

According to the December 2014 Everything Everywhere risk model, Berkshire Hathaway A had a specific risk of 12.74 and Berkshire Hathaway B had a specific risk of 12.34. This gives $((0.40\text{-}0)^2 \times 12.74^2)+((0.6\text{-}0)^2 \times 12.34^2)= 80.82\%^2$

Optimization Summary

	Initial	
	Return	Risk(v)
Factor	0.00	77.84
Stock Specific	0.00	80.82
Total	0.00	158.67

Tracking Error	12.60
Active Risk	15.21

This calculation assumes that the specific risks of any two securities are uncorrelated. With the new Issuer Risk function and new fields in the model exposure file that link individual securities to their parent company or issuer, we can change the assumption of no correlation between related securities. When Issuer Risk is enabled, the stock specific variances of related securities are assumed to have a correlation of 1.

Portfolio Constraints

Maximum Turnover:	200%
Maximum Number of Trades:	20000000
Maximum Number of Assets:	5000
Maximum Tracking Error:	4%
Minimum Tracking Error:	4%
Base Currency Symbol:	*$$$
Cost Amortization:	100%
Enable Multiperiod Approximation:	☐
Adjustment Frequency:	1
Enable Issuer related risk:	☑

When related securities are present, the calculation **shown below** is needed for portfolio specific variance.

Where

P_{ij} = 1 if security i and security j are from the same issuer
P_{ij} = 0 if security i and security j are from different issuers

If no two securities in the problem are from the same issuer, all the P_{ij} values will be zero and the second term will drop out.

$$\sum_{i=1}^{n}((W_{pi}-W_{bi})^2\times S_i^{\,2})+\sum_{i=1}^{n}\sum_{j=1}^{n}[(W_{pi}-W_{bi})\times(W_{pj}-W_{bj})\times P_{ij}S_iS_j]$$

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In our example with Berkshire Hathaway A and B, this works out to be:

$((0.40\text{-}0)^2 \times 12.74^2)+((0.6\text{-}0)^2 \times 12.34^2) + [((0.40\text{-}0) \times (0.60\text{-}0) \times 1 \times 12.74 \times 12.34))+ ((0.60\text{-}0) \times (0.40\text{-}0) \times 1 \times 12.34 \times 12.74)] = 156.32\%^2$

Optimization Summary

	Initial	
	Return	Risk(v)
Factor	0.00	77.84
Stock Specific	0.00	156.32
Total	0.00	234.17

Tracking Error	15.30
Active Risk	18.48

As you can see, the specific risk is much higher when we enable the issuer risk functionality because the optimizer knows that we have a concentrated position in a single firm.

To access the issuer-related information, the **Main Table** display now contains three window panes. **(see below)**

The **top pane** contains all the data previously displayed in the Main Table.

The **bottom left pane** contains the list of issuers for any instrument that appears in the Main Table. There are three columns of information related to each issuer that apply to all those instruments that appear in the right pane when a particular issuer in the bottom left pane is highlighted. The Residual Variance (Uncorrelated) assumes that the instruments appearing in the right pane are uncorrelated (the normal assumption in the optimizer), the Residual Variance (Correlated) assumes that the instruments appearing in the right pane are correlated, and the difference between the uncorrelated and the correlated Residual Variances for the instruments appearing in the right pane that we're calling the Diversification Bias Correction.

The **bottom right pane** contains all the instruments issued by the issuer highlighted in the bottom left pane, along with the associated metrics and location indicators for the portfolio, benchmark and buy list.

The user can interact with the data in these three panes in several ways.

Clicking on any row in the Main Table **(top pane)** will result in the issuer being highlighted in the bottom left pane along with the relevant residual variance metrics for that issuer, and display all of the instruments and their uncorrelated residual variances for that issuer in the bottom right pane including those other instruments issued by that issuer not currently highlighted in the top pane of the Main Table. The sum of the uncorrelated residual variances for the instruments appearing in the bottom right pane will equal the uncorrelated residual variance appearing in the column for that issuer in the bottom left pane.

Clicking on the row for any issuer in the **bottom left pane** will cause the display of all those instruments in the Main Table issued by that issuer in the bottom right pane. This action will not cause any changes in highlighting on the Main Table.

Clicking on any instrument appearing in the **bottom left pane** will cause the row for that instrument in the top pane to be highlighted. This action will not cause any changes in highlighting on the bottom left pane. (Note this effect on the top pane will not behave as described if any of the columns in the top pane are sorted).)

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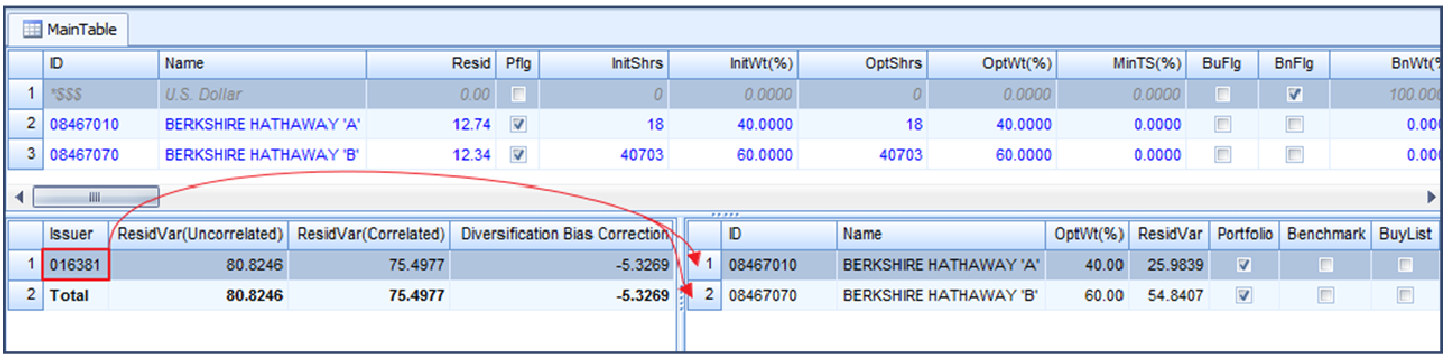

The Northfield Portfolio Risk Management System - PRISM

By Richard Dawson

Introduction

PRISM is a client-server, risk analysis and reporting application, designed to provide powerful and in-depth portfolio risk analytics at the touch of a button. The client user interface is an Excel Add-In, giving access to a number of point in time risk reports as well as through time performance attribution. The server can either be hosted by the customer, or by NIS on one of our own servers. In this latter case, all communications is done over a secure SSL connection.

PRISM is compatible with all Northfield risk models, including the new XRD models. It is also able to load other, third party risk models using PRISM's open data loading formats. NIS risk models are automatically loaded into PRISM over night, with no user interaction required. The server can be configured to do the same for user supplied data, such as portfolio holdings or stock level data.

The standard set of reports decompose portfolio risk in a number of different ways and at various levels of granularity, ranging from the broad overview given by the Summary Report, through a breakdown by risk model factors and factor groups, down to individual stock level analysis. Further reports calculate the number of independent bets in a portfolio and the sensitivity of a portfolio and benchmark to any number of macro-economic variables. All reports can be calculated either relative to a benchmark, or in absolute terms. Risk and Variance values are generally available as well as actual and percentage contributions to total risk.

A wide range of customization options are available, from the facility to load up and display custom stock data in reports. Hierarchical data structures can be defined, allowing one to aggregate stock risk numbers in user definable ways.

The Excel Interface

The user interface to PRISM was overhauled recently, with an Excel Add-In replacing the old web based UI. This has proved to be extremely popular with users, as it is extremely response, intuitive to use and places the report output directly into Excel workbooks. Excel's powerful charting and data analysis are now directly available for users to process the standard report out further.

The PRISM VBA API opens up all of PRISM's reporting functions programmaticallly, allowing users to easily automate report generation and customization. This makes it is easy to batch large numbers of reports and combined with PRISM Auto loading capabilities means that report production can be fully automated and scheduled to run overnight.

Report Details

The **Summary Report** gives a high level overview of the portfolio, benchmark and relative risk, showing the total risk of the portfolio and benchmark as well as the tracking error. The contributions from risk model factors and stock specific risk, as well as benchmark related systematic risk and residual risk are also given, followed by a short summary of the general portfolio structure – beta to benchmark, number of holdings, active share and dead weight, the diversification ratio.

The **Factor Risk Report** breaks down portfolio risk according to risk model factor contributions. PRISM calculates the contribution to portfolio variance for each factor, then splits it into that due to the factor alone, and that due to it's covariance with the other factors. This can highlight situations where a portfolio is expected to have a large contribution to risk from a particular factor bet, but doesn't, due to large negative covariance contributions. The Factor beta to the portfolio and the portfolio beta, as well as Marginal contributions to risk are shown. For those familiar with the concept of reverse optimization, the implied risk premium and implied contribution to return are also given.

The **Holdings Risk Report** performs a similar decomposition to the Factor report, but on a stock by stock basis. Each stock's total contribution to the portfolio's risk is given, split into it's factor contribution and stock specific contribution. Marginal contributions, correlation with the portfolio and reverse optimization fields are also calculated.

It is possible to further delve into the factor contributions to each stock and factor in these two reports. The relevant Factor Contributions report provides this deepest level of drilldown.

The **Independent Bets** report simply performs a principal components analysis on the portfolio beta weighted covariance matrix, showing how many truly independent bets are in the portfolio.

The **Macro–Economic Exposures Report** shows the sensitivity of the portfolio and benchmark to one of a set of predefined macro-economic variables.

Factor based **Performance Attribution** provides a comprehensive through time analysis of the portfolio's risk structure, exposures to the factors in the risk model and attribution of the portfolio return to those factors.

(Prism, Continued on page 11)

(Prism, Continued from page 10)

Data

Portfolios can be loaded by % holding or number of shares, with price and currency conversions handled automatically. PRISM can be configured to accept stock identifiers in Free or Strict mode. Either anything is acceptable as a stock id and no validity checking is performed. Or, in Strict mode, CUSIPs, SEDOLs, tickers and ISINs will be recognized as such and their history maintained.

PRISM allows you treat two (or more) issues of one company as the same issue, for example, if your portfolio holds an ADR and the underlying, or if one is held in your portfolio or the other is held in the benchmark. This optional function avoids overestimating total risk that results from treating them as unrelated entities. The user can customize which assets are treated in this way, and which assets are regarded as 'the same'.

PRISM also supports portfolios within portfolios, allowing the user to define composite assets.

The user is also able to define and load their own asset data. Hierarchical data structures may be specified and if such data is included in any of the holdings reports, appropriate summary values will be calculated for each leaf and node.

Future Development

The current development focus is on interfacing PRISM to Northfield's existing portfolio holding and index constituent data feeds, from custodians and index providers respectively. The automation of data exception processing for exotic instruments is also in the pipeline, which will relieve clients of much of their data management responsibilities.

As is the case with NIS model data updates, both the client and server software is updated automatically.

To learn more about the Northfield PRISM System, contact Northfield Sales, in Boston, 617.208.2050, **sales@northinfo.com.** In Europe, contact: **sales-europe@northinfo.com** or call +44 (0) 17 2244 RISK. In Asia, call +81(0)3 5403 4655 or +61(0)2 9238 4284 or **sales-asia@northinfo.com.**

Staff Speaking Engagements

Northfield President Dan diBartolomeo discussed sovereign credit risk at the FactSet Seminars in Sydney and Melbourne, Australia, on March 17th and 18th.

Dan and Attilio Meucci will be presenting at the Society of Actuaries Investment Symposium in Philadelphia on March 26th. The topic will be "Identifying Regime Distributions with Flexible Probabilities."

Dan will be speaking at the Spaulding Group Asset Owner Roundtable in Chicago on April 22nd. The topic will be "Modeling Illiquid Investments by Asset Owners."

Dan will be at the Spaulding Group Performance Measurement Conference on April 23rd where he will be presenting "Why Sharpe Ratios are Upward Biased as Measures of investment Skill."

On April 28th, Dan will discussing the long term impact of conflict and corruption on financial markets at QWAFAFEW, New York.

Northfield's Director of Research Jason MacQueen will be on a risk panel at the FactSet Investment Process Symposium in Washington, DC, March 29-31.

On April 14th, Northfield Asia's Nick Wade will be guest lecturing at the Hong Kong University of Science and Technology, in Hong Kong, on portfolio construction and risk management.

Nick will be speaking at the Q-Group Colloquium in Sydney on April 28th, and at the Q-Group/Monash event in Melbourne on May 22nd. The title for those talks is "Growth, Demographics, Amnesia, and Long-Term Returns."

On April 17th, Northfield's Emilian Belev and Richard Gold will be at the American Real Estate Society Annual Meeting in Fort Myers, Florida where they will be presenting "Optimal Deal Flow for Real Estate."

For a complete index of all former Northfield News articles, visit http://www.northinfo.com/documents/314.pdf

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