Northfield News

June 2013

A Newsletter for the Friends and Clients of Northfield

Special Points of Interest:

- Main Article: Analysis of Pension Funding Risk by Bootstrap Simulation
- Northfield's Sovereign Credit Risk Approach
- Tech Tip: Liquidity Risk and Active Risk Calculations

Join us on LinkedIn

Click Here

Inside This Issue:

Analysis of Pension Funding Risk by Bootstrap Simulation

By Dan diBartolomeo

The funding status of pension funds (particularly US public funds) and the related risks has been the subject of considerable concern by financial market participants in recent years. According the Center for Retirement Research at Boston College (CRRBC), the average expected return assumption for public pension plans in the US is 7.7% per annum (4.4% real, 3.3% inflation) as the actuarial discount rate for their liabilities. There has been considerable criticism of this as many market participants consider these return assumptions as too optimistic for the future. Depending on what discount rate you believe is appropriate, it is clear that in aggregate public pension plans in the US are underfunded to an extent between $1.5 and $5 TRILLION. Corporate defined benefit plans whose funding has been governed for many years by Financial Accounting Standards Board (FASB) Rule 87 are generally believed to be in much better shape. In September of 2012, the Government Accounting Standard Board (GASB) enacted Statements 67 and 68, which will change the way in which public entities are required to account for pension costs and liabilities. These new rules will take effect in 2013 and 2014. While not as strict as FASB 87, these new methods put more pressure on public entities for realism and transparency with respect to pension programs.

(Pension, Continued on page 3)

Northfield's Award-Winning Approach to Credit Risk for Sovereign Governments and Banks

By Dan diBartolomeo

Starting with corporate bonds in late 2011, Northfield has done our own proprietary credit risk analysis using a variation on the "contingent claims" structural credit model pioneered in Merton (1974). Recently, we extended this work to analyze the credit risk of major sovereign nations and the joint potential for credit problems with both the governments and banks of those nations. Our analytical approach used to address sovereign risk is described in a research paper by Emilian Belev as principal author and me as a contributing author. This paper recently received the 2013 award for *New Frontiers in Risk Management* by the Professional Risk Managers International Association (PRMIA). We expect that over the remainder of 2013, we will be utilizing this new technique for all sovereign credit analysis. We hope that by the end of 2014, Northfield's models will be entirely free of any dependence on traditional agency based credit ratings.

(Sovereign, Continued on page 5)

Upcoming and Recent Events

2013 Northfield Annual Research Conference

The Nelligan Hotel • Montreal, Quebec, • October 6-9, 2013

We are pleased to announce our 26th annual research conference at the Nelligan Hotel in Montreal, Quebec. The conference will officially start on Sunday, October 6th and end on Wednesday, October 9th.

Placed in Old Montreal, Quebec, only steps from many attractions, this historic hotel offers European elegance, along with first-rate services and an extensive selection of on-site dining options.

The full seminar agenda and registration information will be posted to **www.northinfo.com/events.php** in the coming weeks as it becomes available.

Contact Kathy Prasad if you have any further questions, **kathy@northinfo.com**, 617.208.2020.

The Nelligan Hotel

2013 Newport Annual Summer Seminar Wrap-Up

Tennis Hall of Fame • Newport, Rhode Island • June 7, 2013

Northfield's annual summer seminar took place at the International Tennis Hall of Fame, in Newport, RI on June 7th. The seminar presented recent research and technical advances to an audience of Northfield clients and friends.

The agenda consisted of six presentations including: "A Cointegration Approach to Portfolio Allocation," "Alpha Capture & Dynamic Models Beyond the Black Box," "Experiments in Conditioning Risk Estimates with Quantified News," "Financial Assets Behaving Badly The Case of High Yield Bonds," "The Crippling of Quant Asset Management" and "Unlisted Assets and Enterprise Risk Management."

As is customary, the seminar coincided with the USA Professional Championship of Court Tennis. Following the presentations, attendees viewed a Semi-Final Match between Camden Riviere of the US and Bryn Sayres of the UK. Court Tennis, or "real tennis" is the medieval sport that is the progenitor of all modern racquet sports. Riviere won the match and went on to win the finals. To learn more, visit the US Court Tennis Association site at **http://www.uscourttennis.org.**

After tennis on Friday evening, everyone enjoyed a relaxing oceanfront dinner party at The Chanler in Newport. The complete proceedings have been posted to our website at **http://www.northinfo.com/research.php**. Northfield does not charge attendance for this event, however, we do accept donations on behalf of the Pine Street Inn, Boston's primary homeless shelter.

Attilio Meucci's Advanced Risk and Portfolio Management Bootcamp

August 12-17, 2013 • New York University • New York City

40 CE units CFA Institute, 40 CPE units GARP

The course provides in-depth understanding of buy-side quantitative modeling from the foundations to the most advanced statistical and optimization techniques, with theory, live simulations, review sessions, and exercises. Topics include portfolio construction, factor modeling, copulas, liquidity, risk modeling, and much more.

Visit **http://www.symmys.com/arpm-bootcamp** to register, and view the detailed program information. There is a discounted Northfield partner rate available. A short video is also available: **http://www.youtube.com/watch?v=BUnrgjNxBWk**

(Pension, Continued from page 1)

While many defined benefit plans are trying to contain funding costs by decreasing retirement benefits that will be offered to future workers that kind of solution will take many years to bring a typical plan into satisfactory funding according to the CRRBC. More alarming to us is the apparent trend that many public pension funds are opting for taking on more aggressive investments in an effort to increase expected returns and thereby justify keeping existing actuarial assumptions. We believe that this trend will increase the cross-sectional dispersion of fund returns, as the more aggressive approach succeeds for some funds but is likely to fail badly for others. Northfield has done several research papers in this area. In March of 2012, we released the white paper, *Ten Fundamentals of Pension Risk Management* to our clients, **http://www.northinfo.com/Documents/542.pdf**. A few months ago, the Society of Actuaries requested permission to use this paper as part of their accreditation curriculum, which we believe is an indication that the actuarial community is also becoming concerned about increased levels of risk in pension assets.

In June of 2012, our newsletter contained the article, *Risk and Asset Allocation Inclusive of Pension Funding: "Full" and Otherwise*, **http://www.northinfo.com/Documents/507.pdf**. This article frames the pension funding problem in a unique way wherein we assume that a defined benefit plan is always well funded by virtue of an implicit call option on a bond-like security from the sponsoring entity. Based on the funding level and the credit status of the sponsor, we can expand our view of asset allocation and the risk of the pension assets to incorporate funding risks.

In the minds of many pension executives, actuaries and board members, the best way to think about pension risk is to make a *year by year projection of the future distribution of the funding ratio*. By knowing the range of possible funding ratios at each future moment in time, pensions can plan out the contingencies of additional costs associated with asset returns that are below expectations. A very sophisticated approach to both making these projections and acting upon them in an optimal process was presented in diBartolomeo (2011), *The Discretionary Wealth Hypothesis in an Arbitrage-Free Term Structure Approach to Asset-Liability Management*, which was published as a chapter in the textbook, Asset and Liability Management Handbook (edited by Mitra and Schwaiger).

While we believe this methodology is best available approach for managing pension risk it is predicated on the concept that pension funds are actually willing to act in what we assert is the optimal fashion. For many defined benefit plans a more modest but practical process can fulfill the need for forecasting the future distribution of the pension funding ratio status. Our preferred approach for doing such analyses is to use bootstrap simulation. The process consists of two parts:

The first part of the analysis is to represent both the current investment assets of the plan and the outgoing benefit cash flows (somewhat similar to a portfolio of short positions in zero coupon bonds and inflation-linked bonds) into the factor representation of our risk models. Use of the factor representation allows us to fully incorporate illiquid assets (e.g. real estate or private equity) where period by period returns are both unobservable and equally not subject to effective period by period forecasting. An extensive discussion of how to represent illiquid assets through a factor model was provided in our 2012 research paper, *Factor Based Asset Allocation and Illiquid Investments*, **http://www.northinfo.com/Documents/543.pdf.** This process will provide a set of risk model factor exposures for the current asset/liability mix and an estimated volatility associated with random idiosyncratic returns.

Once we have our representation of the current situation in factor form, we can do a simple exercise to answer an important question. Given the factor configuration of our current asset liability mix how would our funding ratio status have varied through the past assuming we rebalanced our portfolio to keep our factor profile constant through time? Since we know the observed period by period returns for each factor back through time, we can easily calculate how we would have expected our portfolio to perform and how the funding status would have varied. Of course, the usefulness of this analysis is limited since it is *very unlikely that the future will be exactly like the past. The past we have lived through is just one sequence of how things might have worked out*.

We can use bootstrap methods to answer the broader question of "what if?." If we make the more limited assumption that the *distribution of future events is likely to be closely related to the distribution of past events* we are saying in formal terms that the distribution of returns is *stationary*. In bootstrapping we will be repeating our above exercise of estimating how our funding ratio would have varied through a set of factor return experiences. However, rather than using the actual sequence of factor returns we will be using many sequences of randomized events drawn from an historic set of experiences. In essence, we will assume that the future may follow one of an infinite number of paths that we might have experienced in the past.

Mechanically, the process is easy. Let's assume we want to make a period by period forecast of the distribution of the funding ratio of our defined benefit fund for the next thirty years (i.e. 360 months) and that we have a month by month history of factor returns available for the past twenty years (i.e. 240 months). To create our first sequence of synthetic history as our forecast, we draw ran-

(Pension, Continued on page 4)

(Pension, Continued from page 3)

dom 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. If we repeat the process 360 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. Given this sequence and our current factor exposures we can estimate the net factor related returns on the asset/liability portfolio (like a long/short portfolio). In each month, we would also have a random idiosyncratic return shock (just the magnitude monthly residual risk times a random draw from the normal distribution). We would now have one possible path through the future. At each point in each future path, we can calculate the estimated cumulative net return to date and the projected funding ratio. Given the simple computational process, we can repeat this entire procedure hundreds of times in a few minutes to *produce a very robust estimate of the future distribution of the funding ratio for each of the three hundred sixty months of our projection period.*

We can also make the process more sophisticated. If we believe that asset returns are serially correlated randomizing the sequences will fail to represent this aspect of the data. To address this we can follow the procedure above, but build our sequences of future events from blocks of multi-month periods so as to capture most of the dependence from one month to the next. It is also possible to "stress test" the projections by filtering the set of past observations from which our projected sequences of events are built. For example, we could include only months from periods of economic recession, or include only months that were perceived as particularly volatile.

It is important to distinguish this sort of procedure from traditional Monte Carlo simulations. Firstly, as compared to traditional "stress tests" that operate assuming that risks and stresses somehow occur instantaneously upon our existing portfolio, our procedure explicitly concentrates on the future distributions of funding ratio that may arise over time from the sequential paths of events that may arise in the future. Secondly, rather than simply using historic distributions of asset returns, we use a factor representation that mitigates the problem of biased or essentially unobservable returns for illiquid assets. Finally, our approach allows projections to arise from either our original assumption that the distribution of future events will be similar to the past distribution, or the projections can arise from filtered samples wherein the filtering process can be based on well understood and intuitive features of financial markets. This avoids the frequent problem in scenario-driven methods where the set of outcomes can be dominated by an extreme scenario having an infinitesimal probability of occurrence.

Northfield Speaking Engagements

Northfield's Emilian Belev presented "A Structural Model of Sovereign Credit and Bank Risk" at the International Association of Financial Engineers seminar in New York on June 19th.

On July 3rd, Northfield President Dan diBartolomeo will be at the Opti-Risk/Brunel Conference in London where he will be presenting "Credit Risk Assessment of Corporate and Bank Debt using Sentiment and News."

Dan will be speaking at the London Quant Group Annual Conference on September 9th, at Pembroke College, Oxford. The topic is still to be determined.

On September 18th, Dan will be presenting at the Alberta Investment Management Conference, in Edmonton, Alberta, Canada. The topic is still to be determined.

In late September, Dan will be speaking at the CFA Society of Mexico, in Mexico City. The topic will be "Analytical Aspects of the Investigation into the Bernard Madoff Fraud."

Northfield Asia's Nick Wade will be speaking at the Macquarie Quant Conference on September 16th and 17th. The topic will be "Explaining the Performance of Low Volatility Strategies."

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

(Sovereign, Continued from page 1)

Our analysis method is rooted in a just a few key concepts. Most central is the idea that the soundness of government bonds and the soundness of the banks that are heavy investors in those same government bonds are inextricably linked. The Global Financial Crisis of 2007-2009 and the ongoing problems of the European financial system leave little doubt about the current state of affairs. National governments have no choice but to keep major banks and financial institutions intact as demonstrated in major countries like the US, UK and smaller countries like Ireland, and Iceland. On the other hand, banks invest very heavily in sovereign bonds. If a sovereign nation defaults on their debts (e.g. the Greek write-down), the banks are the big losers as was recently seen in Cyprus. The end result is more bank bailouts, potentially leading to a "death spiral." To the extent that investors seek safety in government bonds during times of crisis, the potential impact on investment portfolio outcomes typically increases.

Emilian Belev Accepts the PRMIA 2013 Award

The basic concept of the analytical method is rather simple. Sovereign debt can be broken into two value portions. The first is "transcendentally riskless" the way we used to think of risk free assets. The second is equity in the banking system (adjusted for leverage) that holds the government's debt and also has a call on bailout funding. *The key attribute is the propensity for joint default between the sovereign credit and the banking system, which is different if the banks holding a given sovereign debt are domestic or foreign.* Governments have some options about what they do to manage their economies in difficult times. The relative attractiveness of the options depends on the nature of the liability mix, the volatility of their tax revenue stream and "strike price" of the option to print money.

These concepts were first put forward in Bodie, Gray and Merton (2005). The paper provides a complex system of theoretical balance sheet relationships among three types of entities: the Corporate Sector, the Financial Sector including Central Banks, and Sovereign Governments. The interrelationships between sectors are modeled as a set of put and call options among the players. The government has a call on corporate assets (taxes). The banks have a call on the government (bailouts). *A key attribute (asset) of some but not all governments is a monopoly authority on the printing of money.*

In our implementation of these ideas we draw parallels between sovereign nations and public companies. Under traditional government accounting standards there is no formal national balance sheet. Think of a country as a company: the government is management, the citizens are shareholders (and sometimes debt holders too) and non-citizen lenders are debt holders. We can further the balance sheet concept by the imposition of fiscal gap accounting, which is often preferred by economists for policy analysis. A major asset of a government is the present value of future tax revenues. The major liability of government is the present value of mandatory future spending. With our process, a nation's other assets include currency reserves, and government holdings of land, resources and business enterprises. Other existing liabilities are notional debt, unfunded government pensions and a reserve for bank bailouts.

In the contingent claims framework, an entity is bankrupt when it's balance sheet net worth is negative. In this situation, a nation has a portfolio of options that can be exercised in combination, (1) impose fiscal austerity to reduce the present value of the liability for future spending, (2) print money to provide a Keynesian style economic stimulus, thereby increasing the present value of future tax revenues or (3) devalue your currency to the point of worthlessness (e.g. Zimbabwe a few years ago), the functional equivalent of default. This last option doesn't work well if your own citizens hold most of the debt (e.g. Japan). *The nature of the asset/liability mix is the key feature in terms of which options a sovereign government will exercise in response to a negative "national" net worth.*

Since the debut of this approach at our 2012 client conference in California, the paper has been presented to very positive feedback at numerous industry and academic forums including the 2013 Annual Meeting of the Society of Actuaries, the London Quant Group and the International Association of Financial Engineers. We believe it is an important step forward in our commitment to provide the best possible analysis of financial market risk across all asset classes.

Technical Support Tip: Liquidity Risk and Active Risk Calculations

By Steve Dyer

Users who have upgraded to the latest version of the Optimizer released in conjunction with the 3rd Generation models have noticed an additional series of reports in the Optimization Summary–Active Risk and Liquidity-Adjusted Risk. In this article, we will discuss why these new reports were included, how the values are calculated, and how the user can interpret them to improve their portfolio's risk analysis.

Liquidity Risk

As a result of liquidity shortages during the Global Financial Crisis, firms have been reevaluating their liquidity policies and incorporating well-articulated liquidity policies into their investment strategies. In response to this increased focus on liquidity, Northfield has released a series of utilities and additional functionality to help managers and investors better analyze and describe their liquidity risk. The Optimization Summary report now contains Liquidity Adjusted Tracking Error, Active Risk and Absolute Risk Standard Deviations as well as their associated Value at Risk (VaR) details, as shown below:

Optimization Summary

	Initial		Optimal	
	Return	Risk(v)	Return	Risk(v)
Factor	0.00	5.12	0.00	3.91
Stock Specific	0.29	9.43	1.71	14.66
Total	0.29	14.54	1.71	18.57
Tracking Error	3.81		4.31	
Active Risk	3.94		5.45	
	Calculated	10 Day ParVar	Calculated	10 Day ParVar
Liquidity Adjusted Tracking Error	3.98	130732.71	4.49	147639.65
Liquidity Adjusted Active Risk	4.10	134839.74	5.63	185041.79
Liquidity Adjusted Absolute Risk	21.46	705316.49	22.36	734895.52
Portfolio Utility	-0.53		1.26	

These liquidity adjusted numbers combine the ability of the optimizer to calculate risk with its ability to estimate the cost of a transaction. This combination is done by estimating the parametric VaR as a percent of the portfolio, combining the cost of liquidation and then converted back to standard deviations. To best understand this, let's start by defining VaR. VaR is the amount of a potential loss in the portfolio given a level of confidence (P) and a time frame. Another way of putting this is if the VaR of a portfolio is Y, there is less than a 1-P percent probability that the portfolio will lose more than Y dollars over a certain period of time. VaR is represented more formally as:

$$VaR = V * N(P) * \sigma * (T^{0.5}) \qquad (1)$$

Where:

V = value of portfolio in dollars

N(P) = number of standard deviations of a normal distribution[1] (one tailed test) to have cumulative density equal to P

P = Level of confidence that we define our analysis

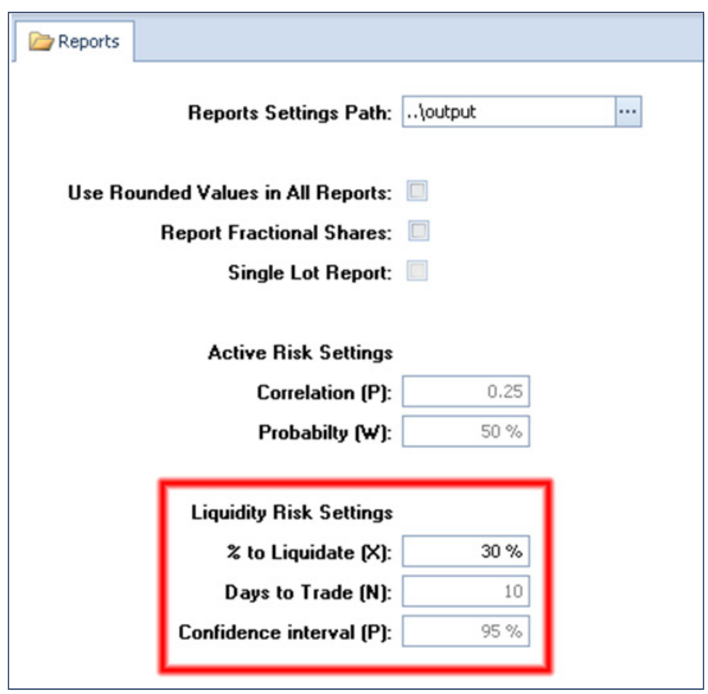
σ = Annual volatility of the portfolio in standard deviations

T = fraction of a year representing the period of time we are concerned about, equal to (N Days to trade)/(Trading days in one year)

Alternatively, VaR can also be restated in terms of the percentage of the portfolio value at risk to better fit our framework:

$$\%VaR = VaR / V = N_{(P)} * \sigma * (T^{0.5}) \qquad (2)$$

The next step to calculate liquidity adjusted risk numbers is to understand how liquid the portfolio is. Most liquidity policies are stated as "I must be able to liquidate X% of my portfolio in N days." The new reporting capabilities now allow the user to specify these assumptions under the Reports tab in the Optimizer:



(Tech Tip, Continued on page 7)

(Tech Tip, Continued from page 6)

Using the optimizer, we can estimate the cost to liquidate X% of the portfolio in N days. In these reports, the assumption is that the portfolio is liquidated proportionally, so the liquidation cost is the asset weighted mean transaction cost to sell across all assets times X% of the portfolio. The mean transaction cost to sell can be found in the Main Table by taking the asset weighted mean of values in the column labeled TransSell(%). Please note that these values can include market impact costs, by using Northfield's nonlinear transaction cost model, is distributed to clients (http://northinfo.com/documents/538.pdf). We simply add this liquidation cost to the %VaR term, and then reverse the process that we did in equation (1) to solve for the revised volatility, $\sigma_{(tr)}$

$$\sigma_{(tr)} = (\%Var + \%\ Liquidation\ Cost)/N_{(P)} * (1/T^{0.5}) \quad (3)$$

These revised volatilities are reported for tracking error, active risk, and absolute risk. We simply plug these revised volatilities into (1) to calculate our VaR over our chosen timeframe. In the example shown, we can calculate that at a 95% confidence:

$$\%VaR = 1.65 * 3.81 * (10/252)^{.5} = 1.252\%.$$

Using the main table, we can calculate the weighted average cost to sell these stocks times 30%:

% Cost to Liquidate Portfolio = 0.054%

Therefore:

$$\sigma_{(TEtr)} = (1.252\% + 0.0544\%) / 1.65 * (1 / (10/252)^{0.5}) = 3.98\%$$

Finally we can calculate the VaR associate with this to be:

$$VaR_{(TEtr)} = \$10{,}000{,}000 * 3.98\% * 1.65 * (10/252)^{0.5} = 130{,}732$$

(when not rounded)

The same calculation can be done for the other risk terms that are shown to yield the appropriate results.

Active Risk

Another addition to the Optimization Summary Report is the Active Risk calculation for the initial and optimal portfolio. Active Risk incorporates uncertainty of an active strategy's ability to produce results better than the benchmark, with the tracking error of the portfolio. Tracking error risk measures the amount of variability (expressed as a standard deviation) around the benchmark for a given portfolio. Tracking error risk excludes the possibility that the portfolio has a positive return above the benchmark. Active management is rooted in the expectation that the portfolio will on average outperform the benchmark. As a result, tracking error does not sufficiently describe the amount of variability in an active strategy. In addition to the variability around the benchmark, there is also the expectation that this outperformance will have some variability over time. The combination of the variability of the portfolio relative to the benchmark (σ_{TE}) with the variability of the active returns ($\sigma_{mean\ \alpha}$) yields our Active Risk number (σ_{active}). This combination can be expressed by the following equation:

$$\sigma_{active} = SQRT(\sigma_{mean\ \alpha}^2 + \sigma_{TE}^2 + (2 * \sigma_{mean\ \alpha} * \sigma_{TE} * \rho)) \quad (1)$$

where ρ is the correlation between uncertainty and tracking error. [2]

As with our previous example, to understand how the optimizer is calculating this measure of combined risk, we will use the sample project file:

C:\NorthInfo\Nisopt\Samples\fnd_active\active.fnd.

After the project is run using the April 30, 2013 model files, the following Optimization Summary is produced:

Optimization Summary

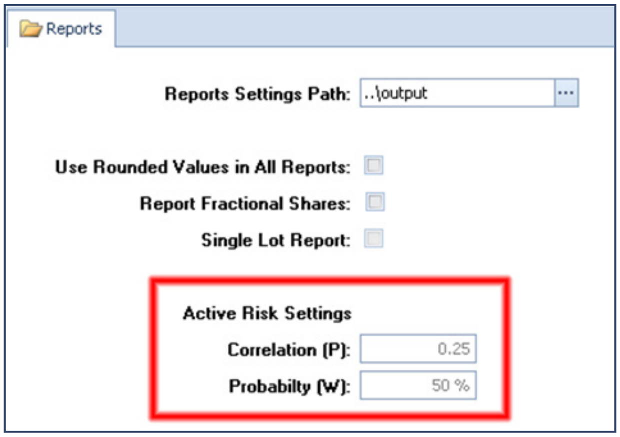
	Initial		Optimal	
	Return	Risk(v)	Return	Risk(v)
Factor	0.00	5.12	0.00	3.91
Stock Specific	0.29	9.43	1.71	14.66
Total	0.29	14.54	1.71	18.57
Tracking Error	3.81		4.31	
Active Risk	3.94		5.45	
	Calculated	10 Day ParVar	Calculated	10 Day ParVar
Liquidity Adjusted Tracking Error	3.98	130732.71	4.49	147639.65
Liquidity Adjusted Active Risk	4.10	134839.74	5.63	185041.79
Liquidity Adjusted Absolute Risk	21.46	705316.49	22.36	734895.52
Portfolio Utility	-0.53		1.26	

As shown, Active Risk for the Initial Portfolio is 3.94. Based upon our formula above, we need three inputs to arrive at this value. The first of the inputs is the tracking error of the portfolio (3.81) which is readily available in this report.

The two remaining inputs require that we make some assumptions about the probability of realizing the expected alpha and the relationship between variability of alpha generation and tracking error. On the "Reports" tab these two items are entered.

Tech Tip , Continued on Page 8

(Tech Tip, Continued from page 7)



If, for estimation purposes, we assume a binary distribution of active manager returns where a manager has some probability (w) of being correct, and we make the appropriate adjustments as described in above reading, we can estimate the variability of the active returns to be:

$$\sigma_{mean\ \alpha} = SQRT\ ((\ 1 - w\ ) * 4\ )^* \alpha_p \qquad (2)$$

In our example the result is:

$$\sigma_{mean\ \alpha} = SQRT((\ 1 - 0.50) * 4\ )^* 0.29 = 0.41$$

Finally, given our assumption of .25 for the correlation between the variability of active return and the tracking error, we can calculate the Active Risk.

$$\sigma_{active} = SQRT\ (0.41^2 + 3.81^2 + (2^* 0.41 * 3.81 ^*.25)) = 3.94$$

In some situations when the expected active return (α_p) is **not** available, the optimizer will estimate that the implied portfolio alpha to be tracking error divided by 3. This is based on the assumption that the portfolio must have a positive utility and an empirical "rule of thumb" that the RAP is about 6 times the tracking error. This means that we can estimate the variability of active returns to be:

$$\sigma_{mean\ \alpha} = SQRT\ ((\ 1 - w\ ) * 4 * (\ \sigma_{TE}\ /3)\ )$$

or

$$SQRT((\ 1 - 0.50) * 4\ )^* (\ 3.81 / 3\ ) = 1.80$$

and

$$\sigma_{active} = SQRT\ (1.80^{\ 2} + 3.81^{\ 2} + 2^* 1.80 * 3.81 ^*.25) = 4.60$$

This result is verified through running the same project file with no alpha file.

Now in addition to the standard tracking error, Northfield users can incorporate additional elements of risk in their analysis. By making some assumptions about the relationship between tracking error and strategy variability, we are able to give users a more complete view the risk of their approach. By incorporating expectations on transaction cost, we can expand that to include a measure of liquidity risk as well. Separately or combined, these two new measures of risk can easily be incorporated into risk budgeting and manager evaluations.

For further inquiries, contact Technical Support in Boston: support@northinfo.com or call 617.208.2080. European clients can contact: support-europe@northinfo.com or call +44 -(0)-20-7801-6222. In Asia, call +81(0)3 5403 4655 or +61 (0)2 9238 4284 or support-asia@northinfo.com.

End Notes

[1]We assume a normal distribution of returns and do not account for "fat tails," as even though returns of individual assets may have high skew or kurtosis, portfolios normally have a large number of assets and the Central Limit Theorem of statistics says that portfolio returns will be normally distributed.

[2]A more detailed description of this calculation is available in Part 5 of the "Northfield Readings in Investment Risk Management" (available by request) and "The Central Paradox of Active Management"; October 19, 2010; Dan diBartolomeo (http://www.northinfo.com/Documents/399.pdf).

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

Boston Office
77 North Washington Street, 9th Floor
Boston, MA 02114
Phone: 617.451.2222
Fax: 617.451.2122
Sales: 617.208.2050
Tech Support: 617.208.2080

London Office
Shakespeare House
168 Lavender Hill
London, SW11 5TG
Phone: +44-(0)-20-7801-6250
Fax: +44-(0)-20-7801-6261

Tokyo Office
Shiroyama Trust Tower
4-3-1 Toranomon
Minato-ku
Tokyo 105-6027
Phone: +81 (0)3 5403 4655
Fax: +81 (0)3 5403 4646

NORTHFIELD
Northfield News is a publication of Northfield Information Services, Inc., 77 North Washington Street, 9th Fl., Boston, MA 02114. If you have any questions or comments regarding the content of this newsletter, please call us, or e-mail us at staff@northinfo.com, or visit our home page at http://www.northinfo.com