December 2013

Northfield News

A Newsletter for the Friends and Clients of Northfield

Incorporating Commodities into a Multi-Asset Class Risk Model

By Dan diBartolomeo and T.J. Blackburn

Commodities and the Related Risk

One asset class that has gained substantial participation from institutional investors around the world is commodities. As this participation has increased, so has the need to include appropriate commodity positions in assessing the risk of multi-asset class portfolios. While our Global equity and "Everything, Everywhere" (EE) models have always included a selection of commodity contracts within the coverage universe, we recently undertook to improve the estimation process used to include such instruments within our models. These changes will be largely invisible to users, but will make a meaningful improvement in the quality of risk estimation when commodities are present. Our new analytical approach described here will go into 3rd Generation Global equity model production at the end of 2013, with the EE model to follow shortly thereafter.

A meaningful fraction of institutional investors now participate in commodities through holding passive index baskets as futures contracts. Numerous commercial commodity indices are now offered as investment products through various global exchanges. Different indices place different emphasis on various parts of commodity markets (energy, agricultural, precious metals, and industrial metals). Stoll and Whaley (2009) estimate institutional investment in US commodity index contracts at $175 Billion, or between 1 and 2% of the contemporaneous capitalization of US equity markets. Other institutional

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Cost of Constraints in Optimization

By Dan diBartolomeo

Investors using portfolio optimization methods often apply numerous constraints on the optimization process. The proper use of constraints is to prevent the optimization getting an incorrect result because one of the parameters of the problem has been improperly specified. Unfortunately, many investment practitioners use hard constraints to substitute for reasonable parameterization of the optimization problem. For example, a portfolio manager may feel that they cannot reliably estimate trading costs for equities in frontier markets. In place of reasonable transaction cost estimates, a fixed turnover constraint might be imposed on the optimization. Our experience is that constraints that are imposed as substitutes for missing parameters often have very adverse effects on portfolio outcomes. The potential cost of such constraints should be not taken lightly by investors.

In general, optimization constraints fall into three categories. The first category are constraints that are *linear combinations of asset weights*. For example, we could have limitations on asset weights themselves, or on groups of assets such as industry or country weights. These constraints have the convenient mathematical property that the optimiza-

(Constraints, Continued on page 7)

Special Points of Interest:

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Recent Events

2013 Northfield Annual Research Conference Wrap-up

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

Northfield held its 26th annual research conference at the Nelligan Hotel in Montreal, Quebec.

The Nelligan Hotel

The conference presented recent research and technical advances to a sold out audience of Northfield clients and friends. The agenda consisted of twelve presentations. Topics included: "A Case for Arithmetic Attribution," "Currency Risk in an Age of Globalisation," Experiments in Conditioning Risk Estimates with Quantified News," "Generating Alpha from Event Driven Investing," "Large Price Changes and Subsequent Returns," "Low Volatility Equity Investing: Anomaly or Algebraic Artifact," "No-arbitrage condition and expected returns when assets have different betas in up and down markets," "Portfolio Management and Risk Factors: A Business Case for an Institutional Real Estate Portfolio," "The role of luck, skill, technology (and behavioral finance) in selecting an asset manager," "Stability Is the Risk Dimension of Equity Style,""The Decision to Lever," and "What Can We Learn from the Price of Gold?".

The conference started on Sunday evening with the "Unofficial" welcome cocktail party and dinner. Monday afternoon was reserved for recreational pursuits. Conference attendees had a choice of Northfield sponsored activities including jet boating, a Montreal bike tour and a walking tour of Old Montreal.

Monday evening featured the traditional Northfield elegant "black tie" gala. Lunch on Tuesday featured a trip to the internationally know Montreal Biodome. Tuesday evening featured a trip to the Notre-Dame Basilica to watch the "And Then There Was Light" sound and light show. The proceedings have been posted to http://www.northinfo.com/research.php.

Webinar Wrap-up: Optimization 101

October 22, 2013

Northfield President Dan diBartolomeo hosted a webinar on October 22nd where he discussed the basics of how an optimizer works and what it is capable of doing and not doing. The webinar was aimed at both the novice and somewhat seasoned investor who wants to get more out of their current investment process. In addition to reviewing the basics, Dan discussed some interesting challenges that he has faced in the past and showed how these were resolved. He also discussed the top ten things not to do when optimizing a portfolio.

The presentation slides are available at http://www.northinfo.com/documents/565.pdf. Contact your Northfield Sales Representative if you are interested in viewing the full presentation recording of the event.

Northfield Asia Seminar Wrap-up

Hong Kong • Singapore • Sydney • November 2013

Northfield hosted our annual Asia Seminar Series with three highly successful events in Hong Kong, Singapore and Sydney. The seminars showcased our research on key topics in investment and risk management to our growing family of Australian and Far Eastern clients and prospects and broadened awareness of the range and depth of Northfield products, services, and research.

The presentations were given by Northfield's Dan diBartolomeo, Nick Wade and Chris Kantos. Guest speakers Stephan Malinak of Thomson Reuters and Katsunari Yamaguchi of Ibbotson Associates also presented. Topics included: "A Cointegration Approach to Portfolio Allocation," "An Innovative Look at Corporate Credit Risk," "Estimating Time-Varying Equity Risk Premium." "Experiments in Conditioning Risk Estimates with Quantified News," "Incorporating Commodities into a Multi-Asset Class Risk Model," "Liquidity Planning Tools and Strategy Capacity for Equity Markets," "Low Volatility Equity Investing: Anomaly or Algebraic Artifact," and "The Near Death Experience of Quant Asset Management."

The proceedings are posted at http://www.northinfo.com/research.php.

Northfield's London Research Seminar Wrap-up

15Hatfields • London • November 28, 2013

The Northfield 2013 European Investment Seminar was held in London at 15Hatfields on November 28th. The purpose of the seminar was to highlight recent advances in analytical techniques for the investment industry to our growing number of European clients and prospects.

The presenters included Northfield's Dan diBartolomeo, and Rick Gold. Guest speakers Ely Klepfish of HSBC Bank and Hari P. Krishnan of CrossBorder Capital also gave presentations. The topics included: "Beta-Blocker Revisited," Experiments in Conditioning Risk Estimates with Quantified News," "Incorporating Commodities into a Multi-Asset Class Risk Model," "Hedging Overlays for Global Balanced Portfolios," and Unlisted Assets and Enterprise Risk Management. The seminar proceedings are posted at http://www.northinfo.com/research.php.

There was no cost to attend, however, donations to the Chartered Institute of Environmental Health or the fair trade organization, Traidcraft, were encouraged. To Donate visit: http://www.traidcraft.co.uk/get_involved/giving/donate, http://www.cieh.org,

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Northfield Annual Holiday Party Wrap-up

Boston • December 12, 2013

Clients and friends joined Northfield for our annual holiday party on the evening of December 12th.

Complimentary cocktails and and Hors d'Oeuvres were served. A four piece band and singer made up of students from the Berkeley College of Music provided the evening's entertainment.

This is an annual event which is open to all. Registration goes live in November, so check the Northfield website next year if you missed this year's party.

Northfield Supports the United Way

As we enter the holiday season, it is always worthwhile to reflect for a moment on the fact that we live in a world where many people are not as fortunate as we are. Boston has been a wonderful home for Northfield for more than twenty-five years. It is a world center of education and research, and a community of great courage and compassion. Those traits were never more amply demonstrated than during the tragic events of the Boston Marathon bombing in April of this year.

Immediately after the bombing, the One Fund (www.onefundboston.org) was set up to receive and distribute charitable donations to support the victims of this terrible event. Since then more than $60 Million has been donated for this very worthy cause. Given that many corporate donors have relatively fixed budgets for charitable support, much of the money that went into the One Fund was not new giving but rather diverted from other charitable organizations to which our corporate community normally provides generous support. Many less fortunate members of our community are no longer receiving the degree of support that they need, *creating a broad second set of indirect victims of the bombing.*

As we believe is often the case, Northfield would like to again set a good example for the financial services community. From 12th of December 2013 to March 31, 2014 Northfield will donate 3% of the value of all new client contracts (both new clients and expansion of services to existing clients) to the United Way of Massachusetts Bay (http://supportunitedway.org/) in support of approximately three hundred community service agencies in our home region.

Staff Speaking Engagements

Northfield President Dan diBartolomeo will be presenting "Managing Investment Risk, (Really!)" at the University of Wisconsin Investment Conference on March 4th.

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investors now hold participation in commodity hedge funds (CTA funds) as an alternative to hedge funds investing in traditional securities.

In addition, there is a material participation by institutional investors in holding physical gold or ETF equivalents. Erb and Harvey (FAJ, 2013) do an extensive study of institutional investment in physical gold. They estimate the total supply of physical gold in the world to be worth about $9 trillion as of the study date. Of this total, about 20% or about $1.8 trillion is held by central banks as monetary reserves. Somewhat surprisingly, they report that another 20% or $1.8 trillion is held by non-bank institutional investors. They estimate the contemporaneous value of global stock markets at $48 trillion and the portion of the bond market defined by the Barclay's Global Aggregate as $41 trillion. This implies that the average institutional investor has allocated about 2% of their marketable assets to physical gold. The estimate of 2% is consistent with estimates published by the World Gold Council.

There is an extensive treatment of commodities in the finance literature. Feldman and Till (2006) provides an analysis of price differentials between cash and futures markets (backwardation) and the resultant effects on returns of agricultural commodities. More immediately relevant to risk assessment is Till and Eagleeye (2006) which reports on historical analysis of commodity volatility and correlation. A well known paper by Gorton and Rowenhorst (2006) asserts that return premiums in commodities are predictable risks associated with inventory effects. Some commodities, like industrial metals, are easily stored in large quantities while others such as gasoline or natural gas are particularly difficult or dangerous. Market participants tend to keep small inventories of problematic items, leading to risk of shortages.

Schneeweis and Kazemi (2008) assert that momentum effects in commodity prices are structural, rather than being perceived as a risk premium or anomaly as have been proposed explanations for similar behavior in stocks. Buyuksahin, Haigh and Robe (2010) show that correlation of commodities and equities is not increasing over time, suggesting that commodities remain a viable diversification asset for institutional investors. Black (2009) argues that the influence of institutional investors on commodity prices is modest and observed increases commodity prices were not driven by institutional investment. Finally, Kaplan (2010) addresses the modern practice of institutional participation in commodity index contracts. This research argues that "long-only" commodity index products are structurally limited to be return/risk inefficient.

Let us consider a simple example of how commodities might fit into the risk decomposition of a typical multi-asset class portfolio. We will assume an institutional investor with $US base currency and a 52% allocation to MSCI EAFE, a 44% allocation to Barclays Government Aggregate and a 4% allocation to gold. Over the entire historical period over which both market indices existed, the annualized volatility values were EAFE 12.17%, Barclays GA 3.25% and Gold 21.47%. The pair-wise correlations were EAFE/Barclays GA .23, EAFE/Gold .27, Barclays GA/Gold .25. Using this sample data, our usual calculations provide a total portfolio annual volatility of 7.11% (variance = 50.54%^{2}). If we credit half of each covariance term to each asset in a pair, 86.26% of total variance is from equities, 8.77% from bonds, 4.97% from gold. While the risk contribution from equities dominates, *surprisingly the commodity risk contribution is the same order of magnitude as bonds*. Conventional risk systems for investors have typically put much more emphasis on analysis of fixed income relative to commodity participation.

One possible approach to including commodities in a risk model is to simply include each commodity as its own additional factor (basically a full covariance matrix). We reject this approach for two reasons. The first is that the observed correlation of commodities to each other and other asset classes is very unstable over time. A factor approach will help separate persistent from transient effects. The other is that adding lots of new factors to the model increases the potential for an ill-conditioned factor covariance matrix, which could negatively impact the quality of forecast for all asset classes.

To illustrate the issue of unstable correlations, let's consider the correlation of the gold and the MSCI EAFE index (in $US). To provide a typical analysis, we obtained an estimate of correlation from the V Lab website of New York University. Daily returns for the two years ending 28 October 2013 were analyzed using a GARCH correction for volatility shifts. The in-sample average correlation was .27, with a conditional forecast of .28. However, the *upper 90% confidence interval value of correlation is .82 and the lower 90% confidence interval is -.63.* Such unstable correlations would manifest in a factor representation as factor exposures that would vary greatly over time even if the factor representation was explanatory in-sample.

One way to improve the analysis of commodities is to consider structural relationships to other asset classes. Many public companies either produce or consume large amounts of commodities that are widely traded. However, operating companies are often active in hedging commodity and currency exposures so the net exposures of share investors are often difficult to assess. A series of papers, Bartram (2006), Bartram and Aretz (2010), Bartram, Burns and Helwege (2013) all describe the activity of operating companies to hedge such risks.

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Another theoretical link across asset class is that exhaustible commodities (e.g. oil, gold) are directly linked to fixed income markets through Hotelling's Rule (1931). This concept suggests that leaving a resource in the ground is an investment decision in itself as the owner could choose to extract and sell all of the resource now and invest the cash proceeds. We must therefore assume that the price of "in-ground" commodities should grow at least with the risk adjusted interest rate, clearly linking expected variation in commodity prices to fixed income volatility. Such linkage limits the ability of governments or companies to control prices by adjusting availability of supply from reserves. Further analysis of the relationship between gold prices and the financial aspects of gold mining companies is presented in diBartolomeo (1993).

Putting Commodities into Baseline Models for Multi-Asset Class Risk

We introduced the Northfield Everything Everywhere (EE) model in 2001. The current version has 90 factors in total, with combination of specified exogenous and statistical factors *for equities from our equity models.* Among the factors defined are multiple geographic regions around the world, and a range of economic sectors. To address the interest rate aspects of fixed income instruments observed yield curves are used for major markets, while implied yield curves are used for small bond markets. In another relatively recent enhancement (2011), the EE model links fixed income credit risk to equity market risks via our version of the contingent claims model from Merton (1974). EE also provides "on demand" data creation for derivatives and non-public instruments. Currently the EE model provides factor representation of more than six million individual securities, currencies and commodities which are used to provide portfolio level risk forecasts for two time horizons. Our long horizon process is calibrated to annual horizon (update monthly) while our "near horizon" process targets a 10 trading day forecast horizon (updated daily). Extensions to non-traded asset classes including real estate, infrastructure and private equity are available.

Our previous approach to estimating factor representations of commodities was the same process we use to estimating risk of any asset in the absence of fundamental knowledge. The widest use of this procedure is to estimate risk for a hedge fund with no position transparency, as described in **http://www.northinfo.com/Documents/508.pdf**. With respect to commodities this process generally produced good estimates of absolute volatility but factor exposures for commodity contracts were very unstable over time. This outcome is consistent with correlations between commodities and other asset classes being very unstable as previously stated.

To improve our risk estimates of commodities, we have created a new three stage estimation procedure. The first stage is to subdivide the universe of commodities into four groups. Intuitively you consistently get four clusters: agricultural, energy, precious metals, and industrial metals. The second stage of the method is to use the return times series history of the "near" futures contract to create four Principal Component Analysis (PCA) factor models. In our process, this orthogonal representation is done via the Singular Value Decomposition (SVD) approach. Each commodity has exposures for the two (usually) strongest principal components defined for its cluster. The PCA analysis is updated monthly, using rolling 60 month estimation window.

The third stage is to restate the PCA factor exposures into a factor set defined by a given risk model (either our 3rd Gen. Global model or EE). To do this, each commodity PCA factor is treated as a new security within the existing risk model. Factor loading are established by regressions of the PCA factor return time series against apparently relevant factors (energy commodities should have an obvious relationship to oil prices). During the regressions regional factors are excluded. Algebraic restatement of commodity exposures to their group's PCA factor into the model factors is per diBartolomeo (2012). Due to the multi-stage procedure it is necessary to test and adjust for interactions between second stage PCA factors and third stage residuals. We also adjust specific variances to account for kurtosis and serial correlation per Parkinson (1980).

Some illustrative data on the precious metals group as of June of 2009 is presented in **Table 1 below**. The first principal component (PC1) might be described as the behavior of the precious metals markets overall. The second principal component (PC2) highlights the difference between gold and silver as compared to other precious metals such as palladium. Together, these two orthogonal factors explain 93% of the return variation across the members of the group. The remaining components do not meet our usual tests of statistical significance and are assumed to be random noise.

TABLE 1

	PC1	PC2	PC3	PC4
Tocom-Palladium Continuous	0.58	0.45	-0.22	0.11
CMX-Gold 100 OZ Continuous	0.17	-0.43	0.32	-0.73
NYM-Palladium Continuous	0.53	0.30	-0.07	-0.43
NYM-Platinum Continuous	0.39	-0.08	0.80	0.44
CMX=Silver 5000 OZ Continuous	0.44	-0.71	-0.46	0.27
Proportion of Variance	0.76	0.17	0.04	0.02

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To map the principal components into an existing model, we use a regression estimation procedure. By regressing return time series for each principal component against the factor return times series of the 3rd Generation equity model, we obtain the following relationships as of June 2009.

PC1 Return ~ 1.8(GLOBAL MARKET) + 2.4(NON-ENERGY MINERALS SECTOR) + 2.8(INTEREST RATE SENSITIVE SECTOR) + 0.04 (OIL) + 0.40 (WORLD GOVT BOND INDEX) + $\varepsilon 1$

PC2 Return ~ 0.92(NON-ENERGY MINERALS SECTOR) -0.32 (ENERGY MINERALS SECTOR) + 1.9(WORLD GOVT BOND INDEX) + $\varepsilon 2$

To test the effectiveness of the estimation procedure we undertook an extensive empirical test. We begin by estimating the model as of December 31 of each year from 1996 to 2011. At each year-end, we form thousands of equal weighted portfolios of randomly chosen commodity contracts. The number of members in each sample portfolio ranged from to 2 to 25. Some portfolios draw members from just one category (e.g. energy), while some drew from all categories. Given the portfolio compositions, year-end factor exposures were calculated. From those exposures and the realized factor returns for the risk model, we created forecast portfolio returns for each of the subsequent twelve months. We then calculated the twelve month correlation of forecast returns with actual realized returns out of sample for each portfolio. Over the entire sample of portfolio-years, we were also able to observe the statistical distribution of the correlation values.

Agricultural commodities had the weakest but still statistically significant results. Across years, the average correlations between forecasts and outcomes ranged from .15 (T=2.89) for 3 contract portfolios to .22 (T = 3.24) for 15 contracts. In 4 out of 18 years, the average correlation was zero or negative (wrong sign) for 15 contract portfolios. Energy commodities had the best results as is expected since oil prices are a factor in the risk model. Across years, the average correlations for 2 contract portfolios averaged .71 (T= 19.22) and .79 (T= 27.61) for 4 contract portfolios. Obviously, with T statistics in double-digits these are very strong predictive relationships. The two metals groups were in the middle. For precious metals, across years the average correlation of 2 member portfolios was .38 (T=4.19) and .38 (T=3.65) for 4 member portfolios. Correlation across portfolios was negative in 3 years out of 18. For industrial metals, across years the average correlation of 3 member portfolios was .47 (T=7.79) and .51 (T=8.51) for 4 members portfolios.

For portfolios that drew members from the full universe of contracts, the results are very strong. Across years, the average correlation of 3 member portfolios was .41 (T=12.45), .53 (T=12.85) for 10 member portfolio and .59 (T=11.16) for 25 member (index like) portfolios. For 25 member portfolios the average correlation is .70 over the last ten years. For commodity indices that are heavily weighted toward energy (i.e. GSCI) the results are stronger.

As a check on the robustness of the method, we tried changing the company sector factor definitions. We tested both the regular sector factor return histories and revised histories based on separating producing companies from consuming companies for each type of commodity. The choice of whether a company was a producer or consumer was based on membership in the equity portfolios used in certain ETFs designed to mimic commodity returns. Results were slightly worse for "purified" sectors but differences were not statistically significant.

We also carefully reviewed the process with respect to possibly spurious PCA factors. The potential for spurious factors in PCA models is discussed in Miller (2006) and Bouchard, Laloux, Cizeau and Potters (2000). The latter paper estimates a rule for the number of "apparently significant" eigenvectors in covariance matrices known to have been created by simulated return times series based on entirely random numbers. Obviously, the intent is to omit factors likely to be spurious.

As a last check, we can convert the factor representation of a commodity contract (or portfolios) and other assets (e.g. S&P 500) to the numerically equivalent full covariance matrix, as described in diBartolomeo (1999) http://www.northinfo.com/Documents/58.pdf. We can now conveniently compare the forecasts from the Northfield model to forecasts from various time series models using the V Lab website from NYU. Review of selected forecasts was conducted without finding any differences that were statistically significant at the 90% level.

Conclusions

As institutional asset owner portfolios continue to expand participation in commodities it was necessary to improve the way commodities were represented in our models. Effectively incorporating commodities in a multi-asset class risk model is a complex task but our new estimation procedure is a substantial improvement over prior methods.

As the volatility properties of commodities are relatively well behaved over time, but correlations are very unstable we chose to relate commodities to existing model factors rather than add new factors to the existing models. We believe our process reasonably separates transient effects (noise) from effects which are likely to be persistent. It also preserves the structure of the existing models which have been proven effective for larger asset classes and utilizes intuitive relationships between commodities and equity behavior of related companies.

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tion's objective function has continuous partial derivatives with respect to the asset weights.

A second category of constraints are generally called *cardinality constraints*. These would be constraints on portfolio composition but are not linear combinations of asset weights. Typical among these would be constraints on the maximum number of assets, the requirement that assets trade in "round lots," or that portfolios should avoid small nuisance positions (abs(weight) < X). The third category of constraints would be *limitations on the optimization process* itself such as limit on portfolio turnover or the maximum amount of capital gains that can be realized. In general, the usual optimization objective function does not have continuous partial derivatives with respect to these two types of constraints.

In economics and finance, the cost of the first type of constraints is often referred to as a "shadow price." These obtained from the partial derivative (ratio of the rates of change) of the objective function value with respect to *infinitesimal* changes in the magnitude of the constraint. The mathematical term for the calculation of shadow prices is a Lagrange multiplier. Consider a very simplified example:

Let's assume you had *one* hard constraint on a portfolio to force the portfolio price/earnings ratio to be at least 18 but not more than 20 (e.g. $18 < P/E < 20$) . One way to do this would be to add a new term to the objective function of the form:

$$U = (\text{existing terms}) - L * (M-C)^2$$

Where:

U= the optimization objective (expectation of risk-adjusted return net of costs)

M= the midpoint between the minimum value and maxi mum value of P/E ((min + max)/2)

C= the value of portfolio P/E

As the optimization runs, we start at L = 0 and then we can increase the value of L to pull C (the portfolio P/E) within the acceptable range. Once we have found the smallest value of L that brings C within the constraint, we're done. If we multiply out the term being squared and multiply through by L, we can easily take the first partial derivative of U with respect to M (to be evaluated at the relevant value of C) and find the **shadow price**. If we run the same optimization problem with L set to zero, we can find out what the unconstrained optimal value of the portfolio P/E is, which we call C*. If we wanted to know the total cost of the constraint, we can take the second partial derivative of U with respect to M. Using the first and second derivatives, and the difference between C and C*, we can algebraically obtain the total cost of the constraint.

If there are multiple constraints which are interacting (e.g. security weights and industry weight in an equity portfolio), we are forming a multidimensional space formed by the "violation vectors." We can still use the method of Lagrange multipliers but the computations and interpretation are more complex. In an effort to make the interpretation of Lagrange multipliers more intuitive in the investment setting, Scherer and Xu (2007) provides an algebraic way to convert the shadow prices into return equivalent units. Unfortunately, as noted above, not all commonly used constraints have continuous partial derivatives so there are limitations to the applicability of Lagrange multipliers.

A general alternative approach is to use a concept known as the *transfer coefficient*, as first defined by Clark, deSilva and Thorley (FAJ, 2002). It represents the fraction of an investor's forecasting power that is actually utilized in forming their portfolio. For example, let's assume an investor is very good at forecasting which stocks will outperform others but the investor is constrained to have zero trading turnover and must therefore keep their existing portfolio. In this instance, the transfer coefficient would be zero since the none of the investor's forecasting ability would be utilized in the formation of their ongoing portfolio. If a investor had no constraints on their portfolio we would expect that 100% of the available forecasting ability would be utilized in forming the ongoing portfolio.

To the extent we are trying to form mean-variance optimal portfolios net of trading costs, we can refine the transfer coefficient concept. For every portfolio we consider optimal, there must exist a vector of expected returns (*implied alpha* input values) that would cause the optimization to bring us to the portfolio we consider optimal. In effect we are running the optimization process in reverse from optimal portfolio to input values. If the portfolio constraints and trading costs are not binding, the correlation of the implied alphas and our actual input alphas should be very close to one. To the extent that the implied alphas and input alphas are correlated at a value materially less than one, the constraints are having a real cost. Under the assumptions in Grinold (JPM, 1989), we assume that portfolio alpha is approximately linear in forecasting ability. As some portion of the investor's forecasting ability goes unused, so will our expectation of portfolio active performance. In practice, we recommend the use of rank correlation measures (Spearman or Kendall Tau) so as to remove the ambiguity around quantifying the risk aversion of the investor. Northfield optimization tools routinely report implied alpha values to facilitate such analysis.

Technical Support Tip: New Real Estate Analysis Tool Now Available

By Steve Dyer and Rick Gold

Private equity real estate and infrastructure investors face several unique challenges when assembling and analyzing their investment portfolios. Not only are transaction times often measured in terms of months or quarters, but transaction costs are commonly hundreds of basis points. Investors also face limited investments options since at any given point in time only a small portion of the market is available for purchase. However, even more daunting is the reality that "unlisted" assets tend to be "lumpy"; that is, purchases are by their very nature large and not easily divisible into discrete units. You either buy a building or you do not - investors cannot purchase or sell 500 square feet of a New York office building to balance their portfolios. When combined with the reality that appraisal-based valuations and returns are both smoothed and suffer from return persistence, it is not surprising that real estate and infrastructure portfolios are often "faith-based" rather than "fact-based."

To help unlisted investors deal with these realities, Northfield has developed a factor-based risk model that does not rely on appraisals. A paper describing this granular bottom-up approach can be found on our website (**http://northinfo.com/Documents/191.pdf**). Furthermore, we have also built several tools to assist investors interpret the model's results. While specifically designed for private equity real estate and infrastructure portfolios, the tools may also have applicability for other asset classes.

The first tool builds an *ex ante* N x N pairwise correlation matrix of individual real estate investments providing users a simple heuristic means to identify portfolio outliers and clusters. Because of their long cash flow streams, most real estate investments tend to behave like long bonds and are most sensitive to yield curve shifts (level, slope, and curvature) leading to fairly high correlations across investments. However, low correlations do arise because of significant differences in leverage, tenant credit quality, and other factors. Of course, correlation and causality are not the same. Therefore, a high correlation between two properties may be caused by disparate reasons. A property with low leverage but low credit quality may be highly correlated with a property with high leverage and high credit quality.

The second tool permits users to measure a property's incremental contribution to portfolio risk. Because of its lumpiness, more traditional marginal metrics are inappropriate when measuring marginal contributions for both real estate and infrastructure investments. Faced with rebalancing, real estate investors are typically either "in or out" since it is normally too costly to take small partial ownership positions in buildings. While equity positions can be changed by adding or subtracting leverage, doing so also impacts equity risk. Northfield's solution is to measure a property's incremental risk contribution by comparing a portfolio's risk profile with and without the subject property. Taking this approach permits a direct comparison of portfolio exposures when a property is added or subtracted, something that cannot be done without a granular bottom-up approach to real estate risk.

Our developers have created a simple script that takes the EENIAC real estate output and generates the necessary files for the analysis, runs the optimizer, and then generates the risk reports for the portfolio, each individual property, and the portfolio with each property removed or replaced with cash, as well as the property correlation matrix and covariance matrix. Below are instructions for installation and use and descriptions of output.

Installation:

The script and files are available from the following link:
ftp://clientshare:HifWaj-5@demoweb.northinfo.com/reu.zip

Clients are invited to download and extract this zip file, which contains the script and an example project to try out this utility. The example below will assume C:\NorthInfo\Real Estate Utility, but any directory will suffice.

Running the Script:

This assumes that the client has generated the exposure records for the portfolio using sEENIAC. A description of sEENIAC can be found here (**http://northinfo.com/Documents/345.pdf**), and a sample template (SampleTemplate.xlsm) and resulting asset file (asset_file_20131031_USD.csv) are included in the sample files.

1) Once sEENIAC has finished running, copy all of the EENIAC output into a new folder.
2) Copy the following three files into this folder containing your EENIAC output:
   a. ee[DATE].mdl, where [DATE] is the month-end date of analysis in format YYYYMMDD
   b. ee[DATE].cor, where [DATE] is the month-end date of analysis in format YYYYMMDD
   c. cash.csv, included in the "Script" folder.
3) Open Command Prompt and navigate to the folder where you have saved the script.

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4) Run the script by typing RealEstateScript.bat [PortfolioFile] [Date(yyyymmdd)]

   The portfolio file will be the RE.hld file generated by EENIAC, and you'll have to enter the full pathway. The date must be the same as the .cor/.mdl model files and RealEstateExpos[DATE].csv file generated by EENIAC. **(see screen shot below)**

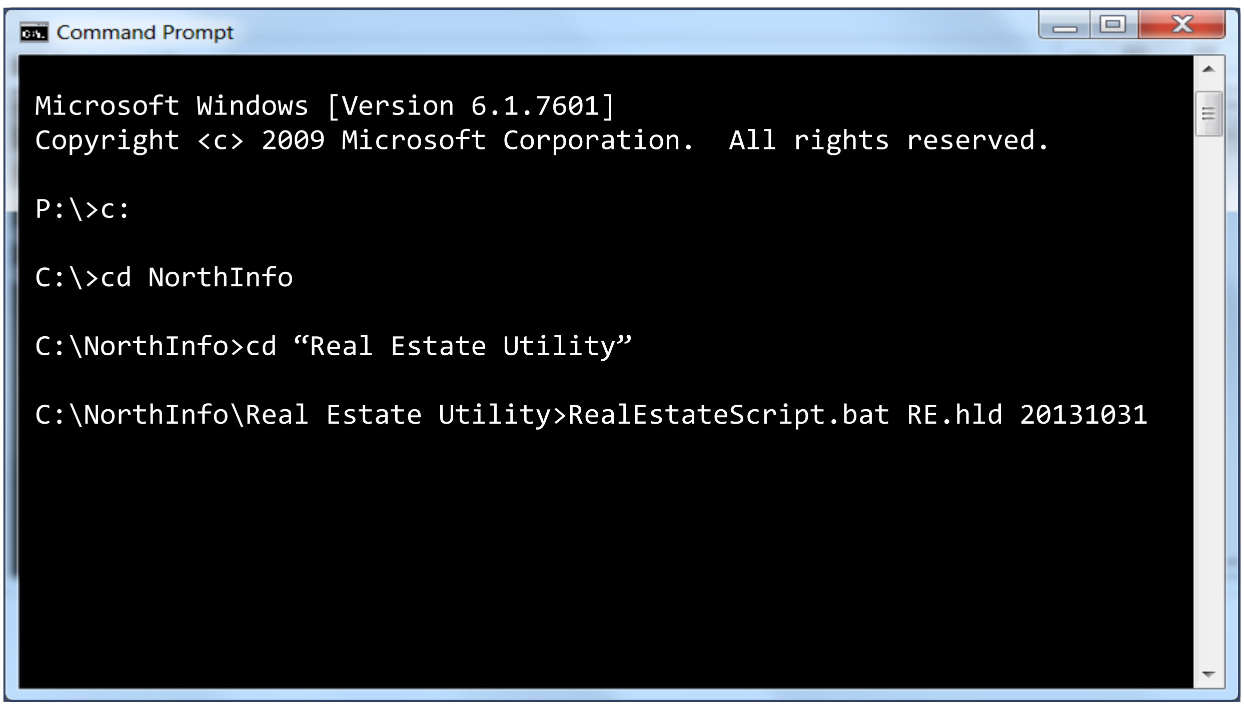
5) Once you hit enter, you'll see some messaging as it validates files, creates files, runs the optimization, and compiles reports. It will give you feedback about missing files or other errors.

Output:

The script generates 7 output files in flat text format. Please note that in the attached zip folder, there's a sample of each report as well as an Excel workbook with the column headers added, OutputHeaders.xlsx.

1) factorexp.csv – The exposures of each of the properties to the factors in the EE model
2) portriskdecomp.csv – Portfolio-level risk decomposition report from the standard Optimizer reports
3) propcorr.csv – The correlation matrix of the properties (in the order listed in RE.hld)
4) propcovar.csv – The covariance matrix of the properties (in the order listed in RE.hld)
5) proprisk.csv – Risk of each property (factor risk, stock specific risk, total risk, tracking error, total risk of portfolio, total risk of benchmark, R^2 between portfolio and benchmark)
6) proprisk_cash.csv – Risk of the portfolio replacing each asset with cash (same format as proprisk.csv)
7) proprisk_nocash.csv – Risk of the portfolio removing each asset and reweighting proportionally (same format as proprisk.csv)

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.



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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

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