December 2011

Northfield News

A Newsletter for the Friends and Clients of Northfield Information Services

Special Points of Interest:

- Main Article: Risk Modeling of Frontier Equity Markets
- Tech Tip: Northfield Portfolio Optimization Methodology
- EE Model Revision with Test Results
- The Euro Zone Debit Crisis

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Inside This Issue:

Risk Modeling of Frontier Equity Markets

By Dan diBartolomeo

Over the next six months, Northfield will be introducing coverage on a large number of additional equity markets around the world. This additional coverage will take the form of a separate risk model for emerging and "frontier" equity markets, and the incorporation of these additional markets into the broad coverage provided by our "Everything, Everywhere" (EE) model.

In 1999, Northfield committed itself to providing risk models for all asset classes for all countries around the world, leading to the creation of the EE model. During the intervening twelve years, we have largely made good on this promise. Our coverage now includes the complete equity markets in approximately seventy countries, and more than six million fixed income instruments from all over the globe. Previous newsletter articles have described our EENIAC companion service providing Northfield risk data on demand for a very wide range of derivative instruments, as well as other optional services that provide detailed analysis of alternative investments such as private equity, directly owned real estate and infrastructure financing.

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The Euro Zone Debt Crisis vs. Northfield's Near Horizon Adaptive EE Risk Model - A Reality Check

by Emilian Belev, CFA

Prompted by client interest and an ongoing effort to assure that our risk models predict risk favorably in a consistent manner, we conducted an experiment. The experiment involved the risk characteristics of the sovereign debt of Italy, Greece, Spain, and Portugal which have been at the crux of the current Euro zone crisis. Hereby, we describe our methodology and results, and we also offer our interpretation.

The experiment utilized the market adaptive EE model which incorporates the latest major revision of credit risk treatment. This methodology, also known as firm sustainability credit, has been reviewed in a recent article that we made available to our audience on October 7, 2011. The article is also published later in this newsletter starting on page 8.

In our experiment, we first created four portfolios, each consisting of all the current sovereign debt issues of the respective European countries and hedged into Euro currency. Then, we traced back in time, over a period of seven months, whether there have been any credit downgrades for each of the sovereign issuers. Since the sustainability credit

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Recent and Upcoming Events

Northfield's Annual Holiday Party

77 North Washington Street, Boston, MA • December 14, 2011

Northfield will be holding our annual holiday party on December 14th in our Boston office. There is no charge to attend. All clients and friends of Northfield are welcome. Register online at **http://www.northinfo.com/events.php**. Contact Kathy Prasad if you have any questions, **kathy@northinfo.com**, 617.208.2020.

European Seminar Wrap-up

Chelsea College of Art and Design, London • November 17, 2011

The Northfield 2011 European Investment Seminar was held in London at the Chelsea College of Art and Design on November 17th. 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, Chris Kantos and Anish Shah. Guest speaker Dr. Sohnke Bartram of the Warwick Business School also gave a presentation. The topics included: "A New Paradigm for the Hiring and Evaluation of Institutional Asset Managers," "An Introduction to Model Based Clustering," "Beating the Bond Market With No Skill," "High Frequency Trading, Algorithmic Buy-Side Execution and Linguistic Syntax" and "Post-Retirement Benefit Plans, Leverage, and Real Investment."

The seminar concluded with a well deserved post seminar reception. There was no cost to attend, however, donations to the Prince's Trust were strongly encouraged. The Prince's trust is a very worthwhile organization that makes a huge positive difference to the lives of many thousands of young people. Visit **http://www.princes-trust.org.uk** to learn more.

The seminar proceedings have been posted to **http://www.northinfo.com/research.php**

Asia Seminars Wrap-up

Hong Kong, Singapore, Sydney and Tokyo • October 2011

Northfield hosted our annual Asia Seminar Series with four highly successful events in Hong Kong, Singapore, Sydney and Tokyo. 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, James Williams. and guest speaker Dr. Jim Walker of Asianomics, Ltd. Topics included: "A Detailed Examination of Minimum Variance and Low Volatility Equity Strategies," "A New Paradigm for the Hiring and Evaluation of Institutional Asset Managers," "Are Diversification Benefits Still to be Found In International Investing?," "Beating the Bond Market With No Skill," "High Frequency Trading, Algorithmic Buy-Side Execution and Linguistic Syntax," "Stagflation in Asia," and "The X Factor: Grouping Securities, Defining 'Similar' and Forming Estimates." The proceedings are posted at **http://www.northinfo.com/research.php**.

São Paulo Research Seminar Wrap-up

São Paulo, Brazil • September 29, 2011

Northfield held its first Latin America research conference in São Paulo, Brazil on September 29th. In 2010, Northfield began to provide services in Latin America. The seminar showcased our research to our growing list of interested prospects in the region.

The presenters included Northfield's Dan diBartolomeo and Rick Gold. Guest speakers Dr. Steven Malinak of Thomson Reuters and Dr Jerome Kreuser of RiskKontrol Group also presented. The presentations included: "A Detailed Examination of Minimum Variance and Low Volatility Equity Strategies," "An Innovative Look at Credit Risk," "High Frequency Trading, Algorithmic Buy-Side Execution and Linguistic Syntax." "Real Estate's Contribution to Portfolio Risk and Return in the New World Financial (Dis)Order," and "Risk Management Failures in the Crisis and Other Myths."

The seminar proceedings have been posted to **http://www.northinfo.com/research.php**

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Over the next year, we will be continuing to enhance coverage for the EE model across many types of investment assets include non-US structured fixed income, mutual funds, ETFs, and most importantly increased coverage of equities across a broad set of "frontier" markets. Such incorporation into EE will be in addition to a standalone risk model for less developed markets. There are a number of challenges in providing a model explicitly focused on frontier markets:

Localness

In designing our existing Global equity model (which forms the equity portion of EE), we made the explicit assumption that the model would generally be used by asset managers and owners primarily in relation to capitalization-weighted benchmarks. The preponderance of weight in such benchmark indices comes from large, often multinational firms that compete with similar firms (e.g. Ford, Toyota and Daimler Benz) on a global level. Given this assumption, the Global model gives global sector factors dominance over geographic region factors, whereby security level exposures to regional influences are estimated from the residual returns after accounting for global sector effects. *In the case of emerging and frontier markets, this logic is reversed.* Returns to local firms in frontier markets are likely to be more influenced by economic conditions within the home country rather than by head to head competition with large, multinational firms.

Regional Structure

Our Global model breaks the many nations of the world into a set of regions. We believe that such groupings arise from two sources. The first source of economic linkage across countries is direct trade. It is obviously easier to trade with a neighboring country than it is to trade with another nation half a world away. The second source of economic linkage is common culture and history that has led to political as well as economic relationships. A good example would be the close relationships between the US, UK, and Australia.

We believe this conceptual model also holds for emerging and frontier market nations. One need only observe the recent "Arab Spring" political developments across North Africa and the Middle East to see that cultural linkages as well as geography play a strong role in the evolution of nations. Of course, the regional groupings will be different from a model that includes developed nations (e.g. Non-Arab Africa, Eastern Europe, Southeast Asia).

National Systemic Risks

It is routine in the estimation of risk models to *assume* that the observed volatility of stock returns is a reasonable proxy for risk. However, there is an obvious bias in this assumption that arises from the "single period" assumption in portfolio theory. Under the single period assumption, an investor's portfolio is assumed to exist both at the beginning and the end of the investment period in question. In reality, when we consider volatility as a measure of risk we are observing only the volatility of securities that *still trade as of now*. We routinely ignore the potential for a company to go bankrupt and disappear entirely. Except under rare circumstances such as the Global Financial Crisis of 2007-2009, the economic meaningfulness of this bias is relatively small at the portfolio level as bankruptcies of major firms in developed nations are rare, and usually arise from firm-specific rather than systemic causes.

However, in the case of frontier markets the risks of entire national markets being wiped out by currency collapse, government expropriation, revolution or other political upheaval are material. Our best way to account for this risk is to consider a crisis scenario for each nation and adjust factor exposures and the correlation of regional and currency factors to account for the potential event risk as an increase in the covariance between stock market and currency risk. Calibration of such adjustments will probably be based on information external to our usual risk model factors. The potential set of conditioning information includes statistics from the World Bank, IMF and private services such as the International Country Risk Guide (from PRS Group).

Lack of Liquidity

In addition to the aforementioned event risk, frontier markets exhibit another characteristic that confounds the traditional assumptions of portfolio theory. Frontier markets are normally quite illiquid, and trading volumes will often not support the large position sizes that could easily be undertaken by large institutional investors. The day to day impact of this illiquidity is a strong degree of positive serial correlation in security returns. The lack of "random walk" behavior will be captured by the "Parkinson volatility" measure that is derived from low-to-high price ranges in each observation period, and has been used in the Global model for many years. In the presence of positive serial correlation the stock volatility estimated using the price range method will be higher than for the usual measure (i.e. standard deviation of return).

Frontier markets will also be added to our equity transaction cost model that is provided to all risk model clients. This will allow "liquidity adjusted" risk estimates to be produced within our software suite. Users will need to articulate a liquidity policy framed as "we want to be able to liquidate X% of our portfolio, within T trading days." By incorporating the high market impact costs of trading fron-

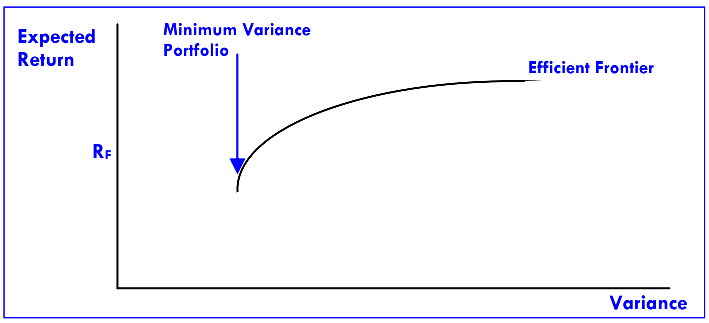
(Risk Modeling, Continued on page 14)

Tech Support Tip: Northfield Portfolio Optimization Methodology

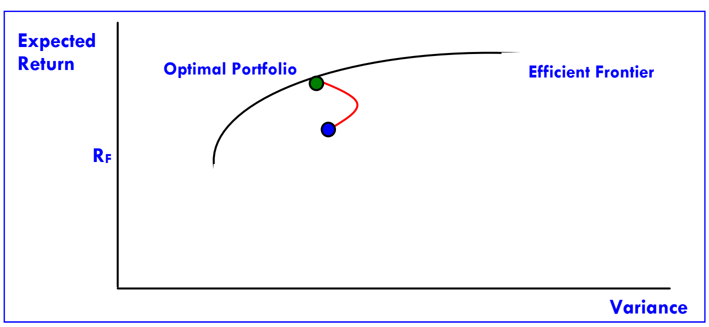
By Mike Knezevich

Optimizing an investment portfolio can be as much an art as it is a science. Resulting portfolios are only as good as the inputs provided and as such it is important for users to understand the impact of their inputs on the portfolio construction process.

In its simplest form the objective of a Mean-Variance portfolio optimization is to find the portfolio with the most efficient tradeoff between risk and return. An investable set of efficient portfolios is created by the inputs representing the user's belief. This set is represented by the Efficient Frontier.



The Northfield Optimizer's objective is to maximize a Mean-Variance utility function using a pairwise gradient method. This approach trades two assets at a time, charting an intuitive path from the initial portfolio to an optimal portfolio with the highest achievable utility provided user inputs.



Beyond the simple risk return trade off, various inputs in utility maximization may be expressed in an objective function which is defined as:

Utility Function:

$$\text{Max } U = \alpha - (\sigma_s^2 / RAP_s) - (\sigma_u^2 / RAP_u) - ((C + T) * A) - P$$

Where:

- α = forecasted portfolio return
- σ_s^2 = portfolio variance risk due to common factors
- σ_u^2 = portfolio variance risk due to stock specific risks
- RAP = risk acceptance parameter
- C = transaction costs for the optimization
- T = capital gain taxes for the optimization
- A = amortization constant
- P = quadratic penalty cost

Let's expand upon each component of the utility function and explore possible input settings for constructing an economically feasible portfolio optimization:

Alpha (α):

Forecasted asset returns are a user-supplied input having a positive impact on utility. Much has been written on the different theories of what information best forecast future asset out-performance which is not the focus of this discussion, but Northfield does provide tools to better represent and convert data to fit within the optimization process.

If no alphas are provided the optimization is a risk/cost minimizing exercise, but when alphas are provided to the optimizer they should be scaled as benchmark relative active annual returns.

Active forecast may be converted to standard units compatible with the optimizer using the reshape as cross sectional forecast (see Technical Support Tip: Reshaping Alpha as a Cross-Sectional Forecast, **http://www.northinfo.com/documents/343.pdf**).

Misspecified alphas can profoundly impact output results. Northfield provides tools softening the impact of these effects using Bayesian adjustments:

- Bayes Adjust combines user supplied returns with an equilibrium portfolio based on the universe of provided assets (see Technical Support Tip: Bayes Adjust, **http://www.northinfo.com/documents/345.pdf**).
- Bayes-Stein Shrinkage combines user supplied returns with the expected return of a minimum variance portfolio constructed from the universe of provided assets (see Technical Support Tip: Bayes-Stein Return Covariance (Return Shrinkage), **http://www.northinfo.com/documents/408.pdf**).

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Risk Cost (σ^2):

Risk Cost is the negative impact on utility when portfolio bets are taken. Risk is measured by the variance of returns and is composed of four parts in the utility function.

- Systematic Variance (σ_s^2)
- Unsystematic Variance (σ_u^2)
- Systematic RAP (RAP_s)
- Unsystematic RAP (RAP_u)

Northfield provides both systematic and unsystematic variance estimates via single country, regional and global risk models. For users with shorter term holding horizons or for those interested in gauging risk on an inter-month basis, Northfield provides Near Term Horizon version of the different models (for more information please see **http://www.northinfo.com/modelssoftware.php#details**.)

Users may also choose to use their own models in the Northfield Optimizer (for calculations see Technical Support Tip: Calculating Risk Using Northfield Flat Text Files, **http://www.northinfo.com/documents/348.pdf**).

As with errors in return estimates, errors in risk estimates can be blunted in the Optimizer by enabling one or both of the below Estimation Error Adjustments:

- Bayes-Stein Shrinkage combines individual asset risk with the risk of a minimum variance portfolio constructed from the universe of provided assets (see Technical Support Tip: Bayes-Stein Return Covariance (Return Shrinkage), **http://www.northinfo.com/documents/408.pdf**).

- Blend Covariance Matrix is a combination of the covariance matrix with up to three more structured versions of itself (see Technical Support Tip: Estimation Error Adjustment-Covariance Blend, **http://www.northinfo.com/documents/347.pdf).**

RAP:

RAP is the Risk Acceptance Parameter which determines the return premium necessary for an investor to undertake risk. Geometrically RAP is the slope of the highest indifference curve tangent to the efficient frontier which can be mathematically derived. Users can determine an appropriate RAP by starting with suggested RAP numbers and comparing the results versus the expected portfolio results (for a more detailed discussion see Tech Support Tip: Risk Acceptance Parameter (RAP), **http://www.northinfo.com/documents/413.pdf**). Suggested starting RAP:

- Northfield's default RAP= 100.
- RAP should fall with in the range of between >0 and 200.
- Rules of thumb:
    - Absolute space: *RAP* =2 x *(A-L)/A*
        - Where A=Assets, L= Liabilities
    - Active space: *RAP* = 6 x *E(TE)*
        - Where TE=Tracking Error

Transaction Cost (C):

Transaction costs have a negative impact on utility. The increase in utility based on risk reduction or improved return must be enough to undertake the cost incurred by making the trades. Such cost can be broken into the linear and non-linear components (for a detailed discussion and calculations please see Transaction Cost Model **http://www.northinfo.com/Documents/354.pdf**). The Northfield Transaction Cost model is represented by the function:

Transaction Cost = A + NLTC + CMI

Where:

- A = Linear component
- NLTC = Non Linear Transaction Cost
- CMI=Cross Market Impact

Let's discuss each in more detail.

A: Linear costs are the familiar per-share cost in terms of currency or percentage charged by the trading agencies involved. This is a known per-share fixed cost increasing at a constant rate as the number of shares transacted increases.

NLTC: Non-Linear Transaction Costs are the additional costs associated with the impact of trading in a particular asset.

$$NLTC = (B_i/G^R)\, S + (C_i/(G^{(0.5*R)}))\, S^{0.5} + D * Max[S-L, 0]$$

Where:

- B_i = the coefficient on the linear process
- C_i = the coefficient on the square root process
- S_i = the number of shares to be traded
- G = number of days required for the trade (Note: fractional days are permissible)
- R = the proportion of temporary versus permanent market impact is the impact decay and is usually R≤1. Empirical evidence suggests .71.
- D = the coefficient on the quadratic process
- L = threshold of traded assets at which the quadratic process is invoked

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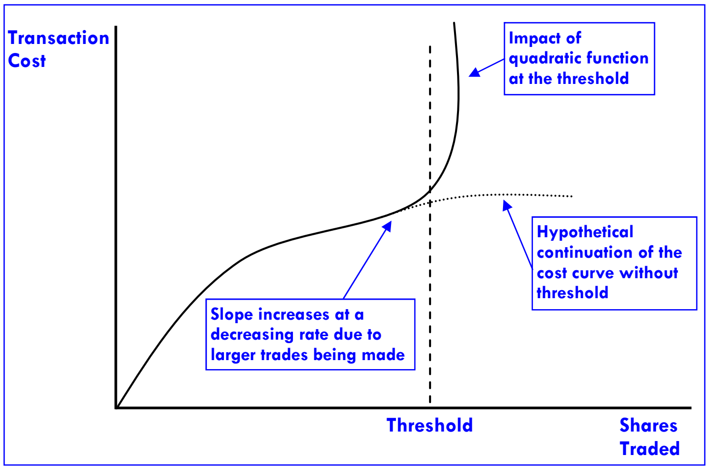
Graphically the non-linear transaction cost function should look something like:



*Northfield provides a monthly Transaction Cost file containing linear and square root coefficients to all clients.

CMI: Cross Market Impact is the effect on prices in concurrent trades with correlated assets.

CMI = Max[Z, -A]

- Z = cross market impact coefficient based on market impact (B, C & D terms) from all other assets and the correlation of assets (derived from the risk model) with every other asset being traded.

Tax Cost (T):

Tax functionality allows users to better incorporate incurred tax cost during the portfolio construction process allowing users to extract tax alpha. Tax cost is incorporated into the utility function as an additional cost being traded against risk and return. Losses increase the marginal utility to sell while gains decrease utility when sold. Trades are made in order from least taxed to most taxed lots, unless prohibited by wash sale rules. Long-term and short-term gains are offset by long-term and short-terms losses. For additional information on Tax Cost please see "Everything You Wanted to Know About Asset Management for High Net Worth Investors," http://www.northinfo.com/Documents/186.pdf.

Amortization (A):

Amortization measures how quickly the user will recognize the cost associated with trading assets. The default value of 100 indicates the user will incur 100% of the transaction within the year.

- To amortize turnover over two years, the amortization should be 50.
- To amortize turnover over six months, the amortization should be 200.

Users may increase or decrease the rate of amortization to better fit their tax strategy. A higher amortization rate at the end of the year provides greater utility for harvesting losses.

The multi-period approximation functionality in the optimizer dynamically changes the Amortization parameter for a more cost efficient transition from the initial to the optimal portfolio. For more information please see "Technical Support Tip: Multiperiod Approximation," http://www.northinfo.com/documents/390.pdf.

Quadratic Penalties (P):

Quadratic Penalties are set in the attributes file and directly affect the utility function. The further away from a desired exposure the greater the decrease on utility. Unlike constraints which must be adhered to, penalties may move further from the goal if other contributors to utility outweigh the penalty cost. For instance if a user wants a low beta portfolio, a penalty on beta can be used, however, the asset alphas used are directly correlated to beta. It is possible that the increased alpha may outweigh the penalty cost on beta. Changes to the penalty scale determine which of the inputs will be prevalent. The penalty cost function is represented as:

$$PenaltyCost = Scale \times (Goal - Current)^2$$

For additional information please see the quadratic penalty section of the "Technical Support Tip: Constraints", http://www.northinfo.com/Documents/435.pdf.

Constraints:

Constraints provide users a way of shaping the portfolio according to desired characteristics which cannot be expressed within the utility function. Although constraints can represent real world limitations on the portfolio construction, an unconstrained optimal portfolio best represents the most efficient portfolio given the user's inputs.

A variety of constraints can be applied to the portfolio construction process with the Northfield Optimizer. Different classes of constraints with differing levels of importance exist which are applied at different points during the optimization.

Class 1 Constraints are all those constraints which can be expressed as a linear combination of securities. Class 1 constraints are of higher importance and a hierarchy exists within the constraints as follows:

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1) Asset level constraints.
2) Group constraints such as industry or sector constraints.
3) Constraints set on the Northfield factors such as size, beta, etc.
4) Variables which the user supplies as an attribute.

Class 2 Constraints are constraint which are applied to entire positions and cannot be expressed as a liner combination. These constraints are of less importance than Class 1 constraints and are applied using a heuristic approach. Class 2 constraints are of equal magnitude and in no particular order include:

- Maximum number of assets
- Maximum turnover
- Minimum trade sizes
- Maximum realized capital gain
- Holding threshold

If a constraint conflict exists the optimizer seeks a reasonable compromise based on the objective function. Constraint violations are more likely to occur within Class 2 constraints if they drive the portfolio too far away from the unconstrained optimal state.

For additional information please see "Technical Support Tip: Constraints," http://www.northinfo.com/Documents/435.pdf.

Maximizing Utility (MU):

Inputs into the utility function affect the portfolio construction process through the use of Marginal Utility. By definition Marginal Utility is the partial derivative of the utility function with respect to an asset's weight.

$$MU = \partial U / \partial w_i$$

The impact is based on the sign of the component within the utility function. For example, alpha and tax losses provide positive impact to utility while risk, transaction cost, tax gains, and penalty cost provide a negative impact.

During an unconstrained optimization, assets are compared in a pairwise fashion trading those assets providing relative improvements to utility with assets which are relatively detrimental to utility.

For more information please see "Technical Support Tip: Marginal Utility (MU)", http://www.northinfo.com/Documents/472.pdf.

Summary:

The portfolio optimization process is highly dependent on the quality of inputs. Users must identify the inputs which best represent portfolio objectives and ensure the quality of those inputs within the optimization setup. Understanding the necessary units, the possibility of estimation error and rational constraints can better translate a user's investment objectives into a superior optimal portfolio. The Northfield Optimizer provides tools to better incorporate adequate information into the utility function:

1) Softening the impact of alpha errors and appropriately scaling alpha to better represent the user's information.
2) Scaling risk cost to conform to user appetite for risk and to mitigate errors in the risk estimates.
3) Implementation cost can take the form of known transaction costs or price impact due to trading. Accounting for tax consideration can make some trades more or less efficient.
4) Penalties provide a soft constraint nudging the portfolio characteristics in a particular direction while still allowing for maximization of utility.

Utility maximization may be subject to constraints. Constraint misuse is the greatest contributor to failed optimizations. Users should be particularly cognizant of the economic impact of such constraints (Scherer, 2007).

With these inputs, pairwise trade decisions are made at the asset level using Marginal Utility to direct the Optimizer to the path of increasing utility After analyzing the various possible pairwise trades and when there is no longer a trade that add additional utility, an optimal portfolio has been achieved.

Since supplying economically rational settings will provide a superior optimal portfolio, having a better understanding of the various inputs, constraints and the process by which these are implemented provide the user insight into the portfolio construction process.

References:

Scherer, Bernd and Xiaodong Xu. "The Impact of Constraints on Value-Added". The Journal of Portfolio Management, Summer 2007. pp 45-54.

Major Revision of the Everything Everywhere Model Methodology

By Emilian Belev, CFA

Northfield's team has been committed to a continual effort of enhancing our methodology and incorporating the latest ideas and research into the tools and models that we offer. As part of this commitment, we have released a major revision of the Everything Everywhere model. The revision concerns the approach to credit risk of corporate bonds.

Our new methodology is based on the corporate sustainability framework as described by Dan diBartolomeo in the Journal of Investing[1]. This framework uses as premise that credit risk is brought about by the fact that stockholders hold an implicit call option which the bondholders are short, which has a strike price equal to the level of the firm debt and where the underlying is the total of the firm's assets. The put-call parity further implies that for the de facto owners of the portfolio consisting of the firm's assets, and a short position in the firm debt [i.e. the stockholders], there is a corresponding put option, the exercise of which is essentially the event of default. The idea of using this implicit firm option has existed in prior work in this area, notably by Merton[2] and Leland and Toft[3], and implemented by firms like KMV[4], later acquired by Moody's, to infer default probabilities.

Northfield's contribution in this area has a couple of aspects. The first one is advancing the idea of "market implied expected life of firms," which views the stockholder option as a perpetual American put "default" option and solves for the optimal time of exercise of this option. In an elegantly tractable way this approach incorporates both probability and severity of default, and can be used to effectively measure the credit-worthiness of firms, demonstrated among other places in Northfield's newsletter article of March 2011, **http://www.northinfo.com/Documents/413.pdf**. The article also describes interesting empirical results for equity investors where strategies are framed using the expected life concept. It should be noted that our work on the expected lives of firms is a downward biased estimate of our true expectation for firm survival. This is because the option pricing process assumes that the asset values of firms moves randomly. In the real world, actions of corporate managements should (we hope) reduce the potential for severe declines in values of a firm's assets.

Our next contribution is the application of the implied default option in a factor risk model. We derive a solution of corporate bond's credit factor exposures which are directly related to the factor exposures of the associated company's stock. The relation has the form:

Factor Exposure Bond = -(E/B) * (delta put/delta call) * Factor Exposure Of the Stock of the Bond Issuer

Where E is the market capitalization of the firm, B is the market value of the firm's debt, and the put and call are calculated with respect of the time horizon of the particular bond tranche.

This expression is appealing to intuition. First, it states that, everything else the same, the closer the firm is to default (deeper into junk status) the higher the delta of the put will be relative to the delta of the call. Given that option gamma is the same for puts as for calls the approach to junk status will tend to proportionately increase the ratio of two deltas more than it will decrease the ratio E/B per unit of decline in the firm asset value. That will make the bond's factor exposures more similar to that of the stock and this reflects the empirical evidence that junk bonds behave like equities.

The relation also reveals some properties of bond credit volatility that are somewhat surprising but important and intuitive upon review. It can be demonstrated that apart from volatility due to movements in the risk-free yield curve, short term bonds of the same company can be more volatile than the longer term bonds of the same firm. Algebraically this translates into the statement that the puts of shorter dated option having the same strike can be higher (and call deltas are respectively lower) than those of longer dated options. This statement is provable using most conventional option pricing models. This resonates with the conventional logic that the longer term provides more room than short term towards unbounded improvement than bounded decline. Despite that simple logic, the anecdotal bias in the industry has is that longer term bonds are necessarily more credit risky than shorter term ones, partly due to bond duration vis-à-vis spread considerations, and confusion of higher periodic volatility with higher total premium charged for default risk (firm put option value). Our finding sets the record straight and is one of the contributions of the model to a better accord of mathematical rigor and conventional intuition in the area of finance.

While the analytical framework of the model has changed, we made sure that the structure of the data delivery and format is going to remain the same. This would entail that no system or programmatic changes would be required on the side of the risk model user due to the model enhancement.

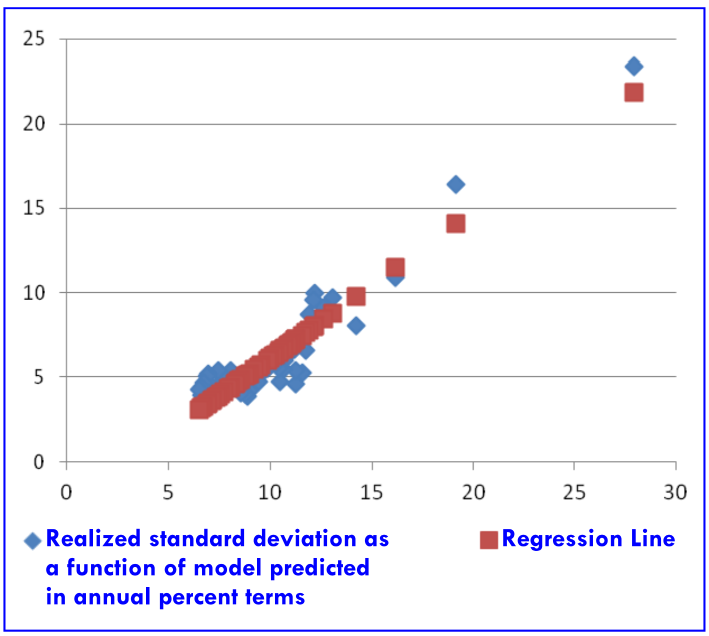
(EE Revision, Continued on page 9)

(EE Revision, continued from page 8)

Bond Modeling in the Everything Everywhere Risk Model: Test Results

It is our pleasure to present the EE model's test results. They are a product from our extensive testing on a universe of the 27 thousand most actively traded bonds around the world, as well as portfolios thereof, in which we benchmarked their predicted and realized risk performance in the first half of this year, specifically February to June 2011. The realized (or observed) risk performance was based on bond prices sourced from one of the largest and most respected commercial bond data providers in the industry.

There were four tests performed. In the first test we took 50 random portfolios of 100 bonds each and compared model predicted risk with realized volatility over the period. Each portfolio was picked so that it is biased towards a particular bond duration band. Given the dominant role of interest rate sensitivity on bond risk this should be considered as the most appropriate broad test for the model. Here is what we found:



The predicted vs. realized variance correlation is **0.97**. The R-squared of the same relationship is **0.94**.

The slope regression coefficient in the graph above is 0.87 and it has a very high statistical significance with a t-statistic of 18.6[5].

As an issue of high importance, in the same regression we also found that there is a statistically significant intercept (t-statistic = -5.13) of -2.6%. **It can be rashly interpreted as an upward bias in the model risk prediction, but we want to assert that this is not the case**. The rationale for our assertion is as follows.

There are three facts of importance to our argument. First, each of the random portfolios on which the test was performed was biased towards a different duration level. Second, the amount of the difference between predicted and realized risk across portfolios is approximately constant. Third, the predicted risk for all portfolios consists of exclusively factor risk, with negligible specific risk, the reason being that each portfolio is comprised of hundreds of bonds from various issuers and is fully diversified.

We would first argue that most commercially accessible bond pricing processes are prone to have one disadvantage when it comes to estimating volatility– an element of smoothing. Bonds, as a vast majority, are not traded continuously as stocks, and the gaps in traded prices need to be filled. The data provider's business is to furnish prices on a daily basis, even in the absence of trades for a particular bond. In the absence of a model of risk drivers, it is hard to come up with a rigorous way to fill in the gaps. The tool at disposal generally lean towards interpolation. This is understandable - the pricing source prime purpose is to come up with a price, and in the common sense thing to do is to look at the neighboring values. And this does not undermine the practical accuracy of the daily price value. However, when one utilizes such prices to estimate bond return volatility, one in essence is compounding this smoothing effect to an ostensible level. Smoothing, of course, means less volatility of the reported time series.

The key to understanding this issue is that we, at Northfield, are not trying to explain the pricing source's observed return volatility, but actually both we and the pricing source, in different ways are trying to estimate an unobservable variable – the "what if" continuous bond return volatility. Many bonds are not traded every day, but we would like to know what it will be if they did – i.e. what is the risk inherent if we try to sell this bond today. The only way we differ is that Northfield and the pricing source try to accomplish this estimation in different ways – we create a risk model, and the pricing source hand collects values, interpolates where needed, and enters values in a database.

The immediately good news for both us and the pricing source is the perfect correlation between our estimate and theirs. Given the complete independence of the sources and methods of data derivation, the maximum likelihood inferences is that both organizations are doing a good job.

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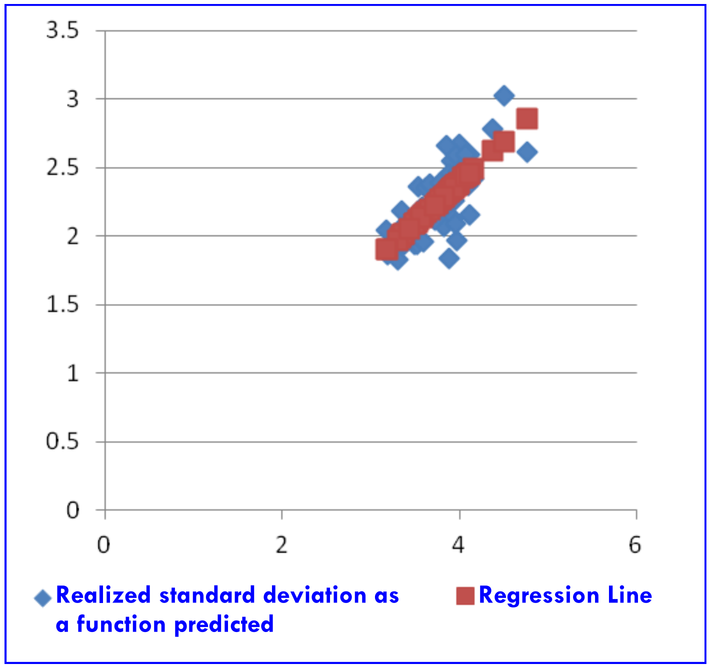
We take this line of analysis further. If the difference between our estimate of standard deviation and pricing source's estimate was risk "bias" contributed by Northfield, then it will necessarily be factor risk error, because we report no specific risk for those test portfolios, and so it will likely be a different difference for the different portfolios as the different test portfolios have different factor exposures (notably durations). But the difference is [almost] constant across portfolios which contradicts the hypothesis that this is factor risk. And since Northfield estimate has nothing but factor risk this also contradict the hypothesis that our estimate is the one contributing to the difference. Since we call in broad concepts from the financial world (EE factors), which in essence are easier to accept as epitomizing the forces driving risk, than the demonstrably idiosyncratic nature of a data collecting methodology of the pricing source, it is sound statistical logic to state that our estimate is more likely to be right. In that sense we would assert that our estimates are right and the so called "realized" volatility has a downward bias.

Another contributor with equal importance to this uniform difference is the survivorship bias. Bonds that are priced over the test period are necessarily bonds in good standing over the same period, i.e. they have not defaulted. The ex-ante prediction of risk however, assumes that default for those bonds is possible. In that sense the "liquid bond" group is a biased sample towards "survivors" of the odds. This creates a divergence between the unbiased view of the risk model, and the biased sample. Moreover, the liquid bond group is biased towards higher credits, which potentially cannot improve much but potentially but can go to default. This makes the sample even more biased, enlarging the difference between model predicted and realized bond and portfolio risk.

As a continuation of our test sequence, **(see top of next column)** a variation of the 50 portfolio test was also performed, this time with completely random broad portfolios. Those portfolios being big samples of a population have very similar characteristics, and the quality of the results are dominated by the sameness. Yet, even in this setting the high correlation between realized and predicted risk of 0.73 and regression explanation (slope of 0.6 with t-statistic of 7.5), prove the ability of the model to discern risk within a narrow range of risk values.

Another test was performed to look at credit risk in isolation. The test takes the credit buckets from the new model, where in essence each synthetic record is an equal-weighted portfolio of the bonds in that bucket, and aggregates the buckets per credit rating over sectors and region. The resulting "total" risk was only credit induced risk – currency and treasury factor exposures were removed. Effectively, the test is based on a pool of close to a hundred thousand bonds.



As can be intuitively expected, the volatility goes clearly from higher to lower as we go from lower to higher credit quality, as defined by the rating agencies. The only marked exception is the lowest rating C - it has a lower credit volatility than the next rating up. This make sense, given that such debtors are practically in default and for them the certainty of the debt dues demanded dwarf any business level uncertainty from the non-performing economic assets.

Rating	Credit Volatility - Annual stdev %
AAA	0.260628455
AA	0.420209
A	1.393854161
BBB	2.060612143
BB	3.9441636
B	5.623509565
CCC	4.817308667
CC	6.447296667
C	4.323928

The last test was at the individual bond level. As we did initially for random portfolios, we compared the realized and predicted risk of individual bonds. The vast majority (60%) of bonds came in within 1% realized historic standard deviation **under** predicted. About 90% of the bonds came within 3% realized historic standard deviation **under**

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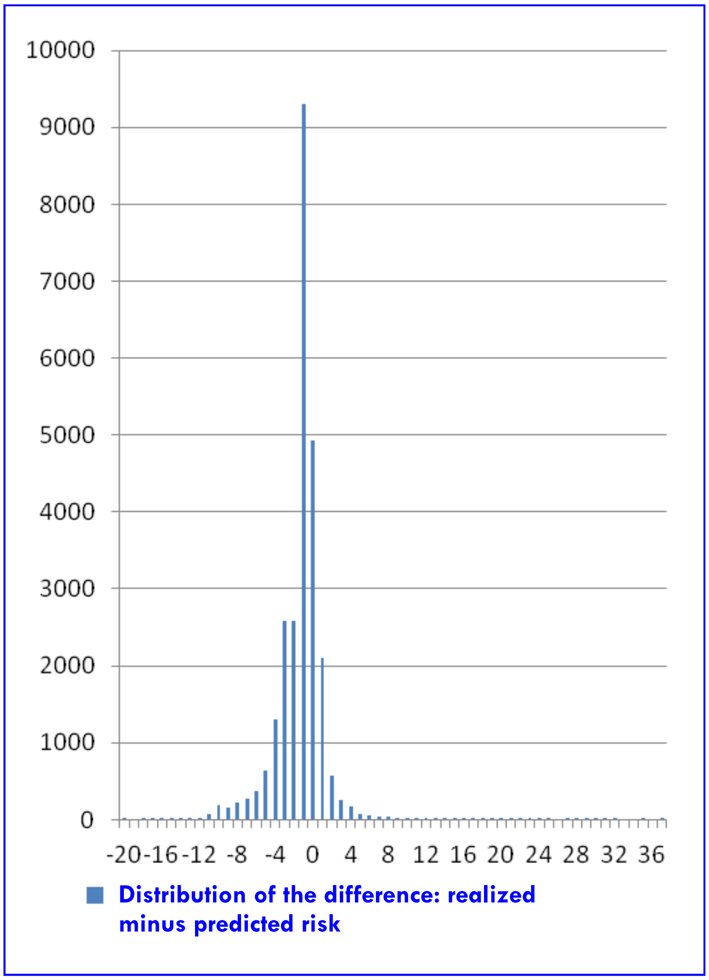
predicted. We have to remember the smoothing component of "observed" bond volatility revealed by the portfolio level analysis, and the survivorship bias of liquid bonds mentioned earlier. Undoubtedly, both play a role here and we should necessarily explain those constant level differences between the risk model results and the results derived from the data from the pricing source with these two phenomena.



Conclusion

All the result presented here are even more impressive in view of the fact that the model that produced them builds on the very basic economics of the instruments, not from a statistical technique that starts off with the modeled data (regressions, PCA, etc.) Statistical techniques often guarantee, at least at the individual instrument level, that the breakdown in risk sources will sum up to the modeled variable. On the other hand, working the modeled variable up from the very fundamental characteristics of the financial instrument offers no such guarantee, unless such methodology is the right one. The excellent agreement between our model results and those of the pricing source's are a credit to our sustained endeavor for harmonizing statistical methodology and economic intuition.

Endnotes

[1]diBartolomeo, Dan, "Equity Risk, Credit Risk, Default Correlation, and Corporate Sustainability", *The Journal of Investing*, Winter 2010, Vol. 19, No. 4: pp. 128-133

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

[3]Leland, Hayne, and Klaus Bjerre Toft, "Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads", *Journal of Finance*, 51 (1996), pp 987-1019

[4]Zeng, B., and J. Zhang, "An Empirical Assessment of Asset Correlation Models.", Moody's KMV Working Paper, 2001.

[5]Note that in the version of the EE model prior to the firm sustainability credit was introduced, when the same type of regression was performed, the slope coefficient was 0.74 with a t-statistic of 16 and an R-squared of 0.84 - all values a somewhat lower than the current ones. Hence, the firm sustainability credit approach introduced a moderate but marked improvement in the ability of the model to predict risk accurately.

Staff Speaking Engagements

Northfield President Dan diBartolomeo presented "Five Simple Steps to Fixing the Rating Agencies," at the November 29th New York City QWAFAFEW meeting.

At the November 30th Philadelphia CFA Society meeting Dan presented "Applying Sustainability Strategies for Equities and Corporate Bonds."

On December 1st, Dan was a panelist at the same CFA Society meeting. The topic was "Should Private Wealth Investors Control 'Left Tail' Risk."

Dan presented "Understanding Risk Parity Asset Allocation" at the December 7th Maine CFA Society meeting.

Dan will be discussing "Socially Sustainable Portfolios: A Quantitative Framework," at the upcoming New York Society of Securities Analysts meeting on February 27, 2012.

Northfield Partner Update

Northfield and S-Network Global Indexes LLC have entered into a joint development and marketing agreement with the intention of developing one or more Index(es) based on the Northfield US Macroeconomic Equity Risk Model. S-Network will use the Northfield name to create, market, and promote a system of market indexes (the "Index(es)"), including sublicensing the use of the Northfield name by third parties in connection with the issuance, trading, marketing and/or promotion of financial products based on the Index (es). The derived financial products are targeting investors that want to hedge their bets against oil prices, interest rates and other macro economic factors that are recognizable, readily available and understood by the general public. Please contact Richard Phillips at S-Network for more information, rphillips@snetworkllc.com, 646.467.7926.

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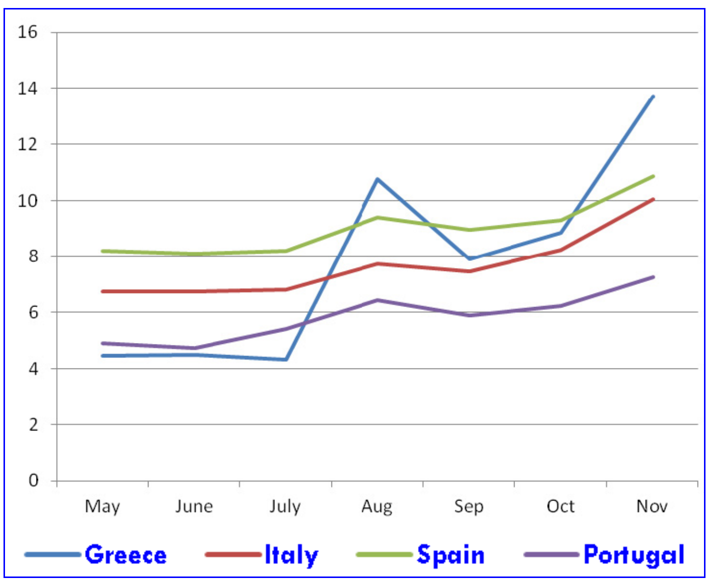
framework was made available only at the end of October, we are looking into a period of six months prior. We had to utilize the current factor exposures of the government bonds, and to transpose the associated credit synthetics (vector of credit exposures) at the times when rating downgrades occurred. In the end section of this article, we validate the appropriateness of this procedure, and demonstrate that we are not simply clairvoyants in hindsight. What this procedure allows us to do, stated in simplest terms, is to turn on the time machine and see what our EE model would have shown us for these portfolios, had the latest methodology been available to us a few months ago, when the Euro zone crisis started to notably accelerate. In this respect, it has to be noted that in each of those test period points we used the contemporaneous covariance matrices of the EE model, as adjusted by our near horizon adaptive risk model process.

The results from our experiments are presented below.



	Greece	Italy	Spain	Portugal
05/09/2011	4.48	6.74	8.22	4.9
06/09/2011	4.49	6.74	8.11	4.75
07/08/2011	4.32	6.81	8.2	5.41
08/09/2011	10.76	7.73	9.39	6.45
09/09/2011	7.91	7.46	8.96	5.9
10/07/2011	8.85	8.24	9.31	6.22
11/09/2011	13.73	10.06	10.85	7.25

* Note: the reported figures are in annual standard deviation percent terms

Before we deliver our interpretation, we need to make a note. None of the portfolios were adjusted for the effect of interest rate risk, and the different sovereign portfolios have different treasury yield curve factor exposures (and hence durations). In this sense, a government that traditionally borrows in longer term commitments, would have higher duration bonds, and thus show higher risk, as yield curve risk accounts normally for the predominant portion of risk. As a result, what is of interest in our experiment results would be more the dynamics of change rather than levels of risk.

Our immediate observation is the consistent increase of risk over the period, for all sovereign portfolios. In this setting, the non-credit component of risk - term structure interest rate volatility - has not increased, leaving the ostensible change attributable only to a credit risk increase.

We also do notice another general pattern across portfolios. In the period May to August risk is increasing, while the period August - September partially mitigates this trend, and finally in the period September - November the risk predictions exponentially increase. While we state the following developments in a correlative rather than causation sense, we have always believed that the statistical representations of financial market phenomena has to resound with economic logic, so a degree of association asserts itself.

The period of May to August was the period when the events in Greece evolved in a way that exposed the weakness of the country's public finances due to the rigid popular resistance to any austerity measures to allow for any notable improvement of the credit outlook there. In this period, the increased scrutiny over the national accounts of other debtor countries like Italy, Spain, and Portugal, and the resulting realization of fiscal irregularities and unsound fiscal commitments, triggered investor anxiety prompting a contagion effect with sovereign Euro denominated debt. A number of authoritative figures in the world of finance and economics intensified criticism of the disparate state of the economy at the center and periphery of the Euro-zone and openly suggested the imminent death of the Euro currency.

These developments precipitated a massive political effort at the top of European governments and at major financial institutions like the ECB, IMF, and the Fed to avert the spread of the crisis. This led to a number of positive developments that, if not saving the drowning economies, could offer a fallback and a sense of measured stability to investors. Among those effects were the strengthening of the euro rescue fund and other viable monetary measures to prevent a sovereign debt market meltdown that could derail

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the global banking system, inflicting a liquidity driven recession like the one in 2008. The moderate decrease on our graph coincides with these stabilizing developments.

The final exponential increase of risk across the analyzed portfolios overlaps with a line of alarming events. It covers de-stabilizing political maneuvering by the Greek government and its eventual demise, closely followed by a tumble at the top of Italy, and increasing political divergence at the summit of Europe. Those tensions were brought about by the fact that the brunt of the rescue had to be met most ostensibly in countries of Europe with the best economic performance, while the immediate beneficiaries of such rescue (banks) were concentrated in other countries. Disillusionment and an increased sense of uncertainty also set in during this period after International Swaps and Derivatives Association's determinations committee did not reckon a 50% write-off on the Greek sovereign debt as a CDS triggering event, leaving investors with the impression that the intended purpose of these instruments as a credit hedge had eroded. This fed back into the underlying debt market, not only for Greece but for other default-suspect countries as well.

As we are writing this article the crisis is intensifying with no clear resolution in sight and a resurgence of the danger for a break-up of the common currency and ensuing global economic recession. The onus is now on the European and world leaders to coordinate a massive rescue effort of proportions much larger than previously envisioned.

It is revealing to observe the timing of credit downgrades of these sovereign entities and juxtapose against the trend on our graph. The sharp increase in the Greece risk plot coincides with the downgrade from CCC to CC (Standard & Poor's) in the latter half of July. The relative increase of risk for Italy occurs in October when it was downgraded to A from AA. The relatively more pronounced increase of risk on the Portugal plot coincides with the downgrade to BB level from BBB at the start of July. It is interesting to observe that Greece was downgraded from B level to CCC in June without a corresponding increase in the risk schedule, possibly implying that markets have already priced in the credit uncertainty at the onset of tumultuous events in Greece, before the official rating downgrade took place.

Nature of the Test Procedure

Apart from the fact that the results resound with intuition, we want to make sure that the procedure to obtain these results is sound. Below is our rationale.

First, we have to mention that in its current version, the credit framework for sovereign entities is intertwined with the aggregate credit outlook of financial institutions (a group dominated by banks) from the same countries. The rationale for this is that the fortunes of fixed income obligations from governments and banks from such countries are inextricably connected. This is easier seen for countries that cannot monetize their debt at will. If a government is unable to meet its fiscal obligations, it directly affects its ability to ascertain the stability of its banking system. In reflection, should the banking system have a prevailing difficulty with credit, it undermines the country economy as a whole and dries up government revenues. Usually in a crisis, both effects feed into each other, Greece being a prominent example.

For countries that can monetize government debt at will, it will take us just an extra step to uncover the same Siamese connection between the credit standing of governments and the banks. As a recent example since the crisis in 2008, the United States has been involved in an unprecedented and coordinated effort over a number of stages to provide short term liquidity and long term support for interest rates and bank balance sheets. This was achieved by the Fed through an increase of the money in circulation via various channels. Viewed by the markets as a lifeline for the troubled banking sector and the economy, this had the effect of both propping the credit standing of the banks, as well as that of the government. It was imminently obvious at the beginning of that crisis that had the banks been brought to financial ruin, so would the sovereign debt, eventually, with tax revenues from an economy with stagnant capital circulation running to depletion.

As an example on the other side of the credit scale is Zimbabwe. Since the mid-2000s the government of that country lost all credibility regarding the debt issued in its own currency. Their story is simple: the government started printing money out of control to fund out of control spending, which resulted in hyperinflation. The local economy and global markets viewed Mugabe's government as unwilling and incapable of withdrawing the excessive liquidity through taxation and central bank intervention. At the same time his government lost all prospects to justify the big spending, which did not increase productivity or procure resources. The pace of daily inflation hit in the triple digits. An expensive diamond conflict with military involvement in Congo failed to produce the promised public benefit. With these events, the Zimbabwean banking system came to a stall, as no one saw any reason to save and deposit during hyper-inflation.

The distinction with the US is that the extreme monetary

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expansion in Zimbabwe did not aim to prop up the fabric of the economy or avert panic. It simply addressed immediate public budget problems with short-sighted means. The similarity is that even in the presence of the monetary tools, the credit standing of a government in its own currency is intimately connected with the credit reliability of its banking system.

In addition to this emphasis on the connection between the credit standing of a sovereign government and the banks, we should remember how the EE credit framework calculates the factor exposures of a bond. For full details please refer to the article Major Revision of the Everything Everywhere Model Methodology starting on page 8 of this newsletter.

Factor Exposure Bond = -(E/B) * (delta put/delta call) * Factor Exposure Of the Stock of the Bond Issuer

Where E is the market capitalization of the underlying equity, B is the market value of the firm's debt, and the call and the put refer to the stockholders' option to default when conditions for this dictate this is the exit minimizing their loss. On close inspection, the exposures of the underlying equity are very stable over time. The deltas of the default options depend largely on two variables - the level of the underlying equity value, and the time to expiration option - time coinciding with the maturity of the debt. If we assume that we roll over the debt with the same maturity each month (constant duration portfolios), then the ratio of the deltas will increase as the firm moves more into default and the options move closer to "the-money." The ratio (E/B) will have also increased for reasons explained in the prior article.

In the experiment we conducted, we used the latest available factor exposures and used them back in time. It is obvious that for the debt of all these entities, the potential for default increased over those few months, meaning that in this test procedure, the further back in time we move, the more inflated the risk estimates will be vis-a-vis the current one. In reality, had we the latest revisions of the EE model methodology in place at each of those points, the graph for each portfolio would have been steeper.

In this sense, the intuitive results are also a conservative rendition of the development of sovereign debt risk over the last few months. This should assuage any concern that the test was merely guessing the lottery numbers after seeing them in the press.

(Risk Modeling, Continued from Page 3)

tier markets, such liquidity adjusted risk estimates are sensitive to portfolio value as well as portfolio composition by weight, automatically making large portfolios riskier in illiquid markets.

Corporate Interdependencies

Excluding Japan, it is fairly uncommon in developed markets for large corporations to own substantial long term equity stakes in other publicly traded companies. In emerging and frontier markets such arrangements are more common as the local economy may be dominated by enterprises controlled by a few wealthy families. As previously mentioned in this newsletter, future versions of Northfield software will include facilities for keeping proper account of *issuer risks*. For example, all factor models assume an "asset specific" portion of risk that is assumed to be orthogonal across securities. This assumption fails when multi-asset class portfolios are evaluated. For example, the "asset specific" risks of IBM stock and an IBM bond are clearly not uncorrelated. This same software capability can be used to reflect less complete interdependencies as often arise in markets such as Japan, Korea and in many frontier markets.

Northfield Website Update

Northfield President Dan diBartolomeo has written a new essay titled "Five Easy Steps to Fixing the Rating Agencies." The essay has been posted to the Essays and Commentary section of the Northfield website. To read the essay, visit **http://www.northinfo.com/Documents/489.pdf.**

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

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