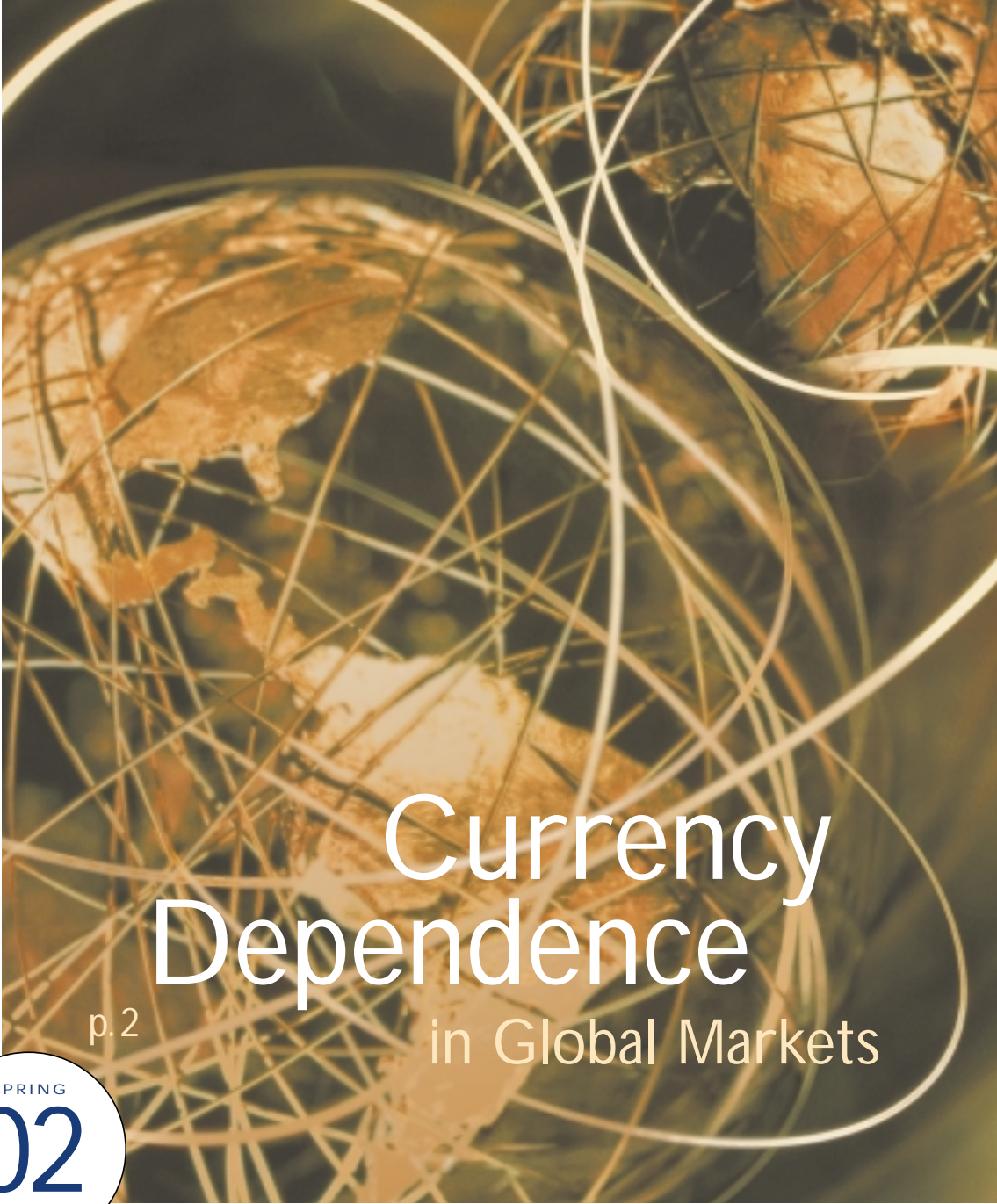


HORIZON

THE BARRA NEWSLETTER



Currency Dependence in Global Markets

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HORIZON

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Welcome to Horizon.

This issue of Horizon deals with the effects of globalization, industry consolidation, and the growth of fixed income spread products on the management and modeling of risk. These trends have given rise to new customer requirements for fixed income investing and multi-asset class, firm-wide risk management.

Recent years have shown a marked increase in non-government bond issues in Europe. In the first article in the Insights section, Lisa Goldberg examines the market dependency of European and U.K. spread factors and evaluates their effects on credit risk forecasting models.

The second Insights article looks closely at the importance of managing risk across the firm. This article is Part II of a series titled "Aggregating Risk Across Multiple Asset Classes" that first appeared in the Summer 2001 edition of Horizon. We continue to explore the need for aggregating risk across multiple asset classes and the role of firm-wide risk management in buy-side institutions.

In addition to our research articles, this issue of Horizon offers a practical approach to managing short and long portfolios. A case study, written by Dan Cashion and Rohtas Handa, outlines one approach to integrating long/short strategies into your investment process.

Finally, you will find a calendar of Barra events that we are hosting in the coming quarter. We invite you to join us at these events over the course of the year. More detail on Barra events, research and products can be found on our website at www.barra.com.

Amir Sheikh

Amir Sheikh, President, Barra Inc.





Currency Dependence in Global Markets

The Need for More Detailed Risk Models

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Global Fixed Income
Research and Data

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The global credit market consists of bonds exposed to credit risk relative to domestic treasury issues. These include corporate, agency, foreign sovereign, and supranational bonds as well as credit derivatives such as default swaps and credit spread products. This market has experienced rapid growth in the past few years. The size of the derivatives market reached \$800 billion by December 2000 and is forecast to reach \$1.5 trillion by the end of 2001¹. At the time of this writing, global corporate debt has reached U.S. \$3.4 trillion in outstanding issues². As a result, international bond portfolio managers are increasingly likely to include bonds other than domestic sovereigns and, therefore, are increasingly exposed to credit risk.

A central question is whether bond credit spreads can be considered market-independent. For example, if Toyota issues both sterling- and euro-denominated bonds, one might expect the credit risk of the bonds to be roughly equal. While most corporates are domestic issues rather than third market issues, it is still reasonable to wonder whether the component of bond risk due to credit depends only on the issuer or on factors such as its

sector and rating and not on currency. Empirical evidence indicates that this is not the case.

Risk Model and Data

We model credit risk using a multi-factor approach. For a portfolio of K bonds, the vector of credit spreads returns R can be written $R = XF + \Psi$, where X is the K by N matrix of bond exposures to the factors, F is the vector of N factor returns, and Ψ is the specific returns vector. We assume that factor and specific returns are uncorrelated so that the K by K covariance matrix of asset returns can be expressed as $C = X\Phi X^T + S$, where Φ is the covariance matrix of factor returns, and S is the (diagonal) covariance matrix of specific returns. The common factors capture fluctuations in the average spread of bonds with the same sector and rating. This piece is the market component of the risk of credit instruments.

The common factor model is augmented by a specific risk model that is based on the likelihood of rating migration or default. The focus of this article is the common factor piece. A rule of thumb is that the common factor component of credit risk is larger for bonds

* Contributing author: Alec Kercheval

¹ D. O'Kane, 2000. Credit Derivatives Explained, Lehman Brothers

² The Bond Market Associate, 2001. <http://www.bondmarkets.com/pages/investor.htm>

that are investment grade, the specific component is larger for below investment grade instruments.

Our euro and sterling data consist of bond prices for the constituents of the EuroBIG and EuroSterling investment grade indices (Salomon Smith Barney, 1999) as supplied by Salomon Smith Barney for the 25-month period May 28, 1999, to May 31, 2001. The U.S. data comprise the investment grade component of the Merrill Lynch U.S. Corporate/Government Master Index⁴.

Factor designations and the distribution of bonds into the factor buckets are shown in Table 1. Factors were excluded when fewer than five bonds were available in the return estimation. On average, this study made use of about 500 euro-denominated bonds, 200 sterling-denominated bonds, and 3700 U.S. dollar-denominated bonds.

Table 1	Euro	Sterling	U.S. Dollar
Factor designation	Agency	Financial	Canadian
	Financial	Industrial	Supranational
	Industrial	Sovereign	Transportation
	Sovereign	Supranational	Utility
	Supranational		Energy
	Utility		Telecommunications
	Pfandbrief		Industrial
			Yankee
			Financial
			Agency

Our question may now be restated as follows: Are the spread returns for factors present in any pair of the three markets sufficiently similar that their common value can be computed with a single estimation combining both sets of bonds? For example, is it statistically sound to combine all euro- and sterling-denominated Financial AA bonds into a single bucket?

If so, we would enjoy greater diversification of specific return, and a greater number of sector-by-rating factors would have sufficient data for return estimation. Empirical evidence demonstrates that the markets are, in fact, independent.

Factor Return Volatility and Correlations

Figure 1 shows a comparison of volatility estimates for factors common to the euro, sterling and U.S. dollar blocks computed over our study period. U.S. dollar volatilities are higher than euro volatilities, sometimes by a factor of three. The volatility of the sterling sectors consistently lies in between these two extremes, closer to the euro for the Financial sectors but closer to the U.S. dollar in the case of the Industrial sectors. This alone is sufficient to motivate the use of three separate models. Further motivation is found in the correlation analysis below.

The sample correlation matrix estimated from monthly returns in the study period is shown in Figure 2. The 52 factors give rise to 1,326 correlations. While it is difficult to absorb this many numbers at a glance, the “heat map” displayed in Figure 2 makes it plain that correlations within markets are generally high, while correlations across markets are generally low.

A set of graphs displaying Financial AA factor returns over the study period is shown in Figure 3. These graphs indicate that there is no significant correlation of Financial AA returns across the euro, sterling, and U.S. dollar markets. Returns for other factors behave similarly.

Financial sector correlations within and across markets are shown in Table 2. Correlations within each market are generally quite high. Across markets, however, the correlations are close to zero, especially those correlations that include

³ Salomon Smith Barney, 1999. Performance Indexes, pages 41–46

⁴ Merrill Lynch, 2000. Merrill Lynch Global Bond Indices, Rules of Construction and Calculation Methodology

Figure 1
Cross-market volatility comparison

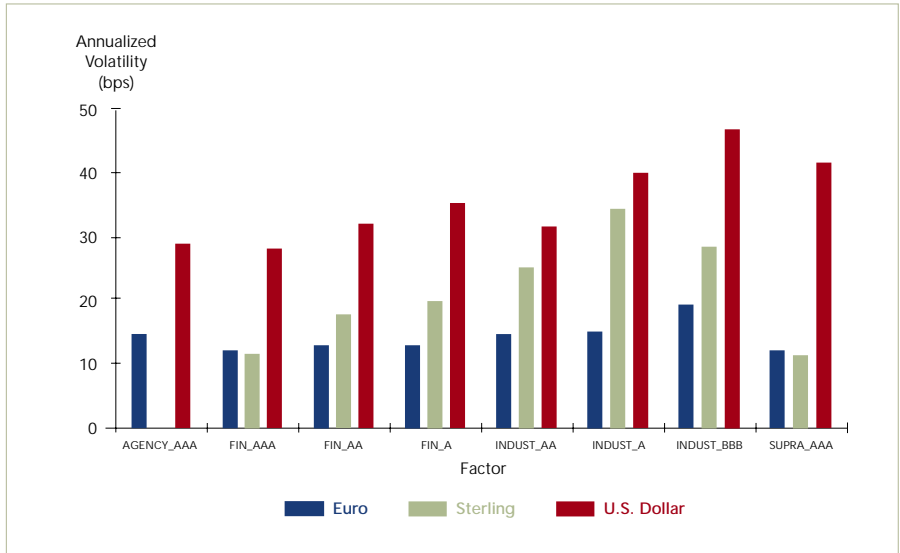


Figure 2

Spread return correlations for the euro, sterling and U.S. dollar markets.

These observations do not extend to bonds that are below investment grade. Empirical evidence shows that in the U.S. market, there is little correlation between below and above investment grade bonds in the same sector.

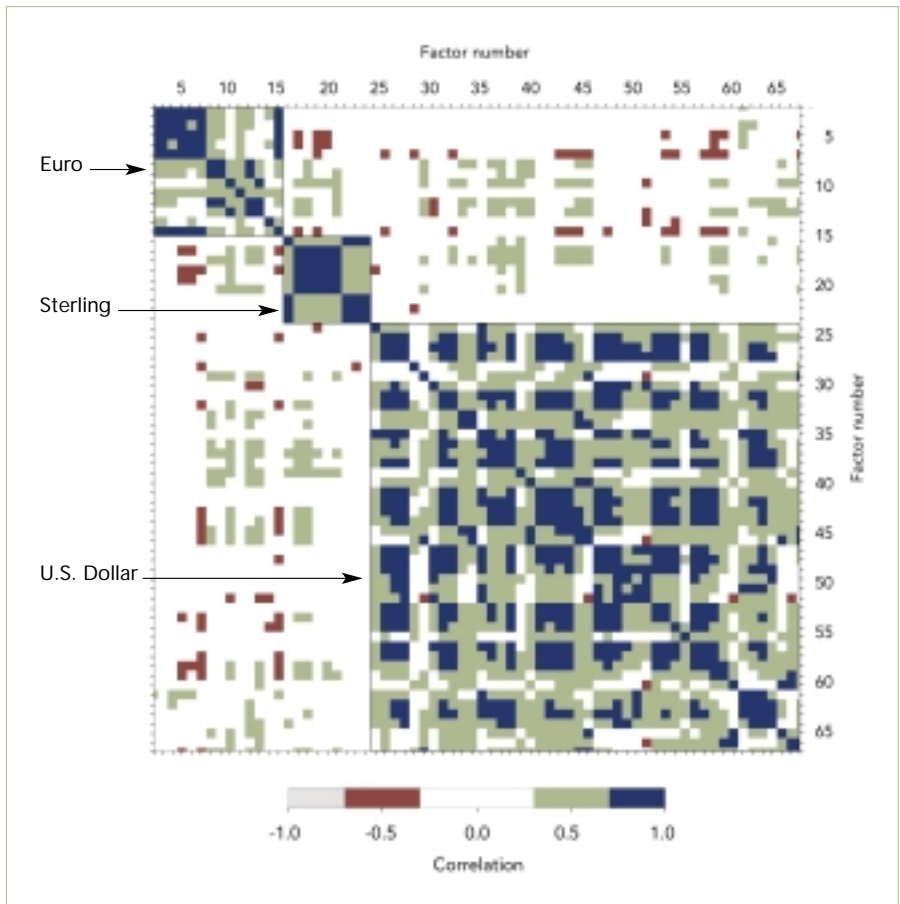
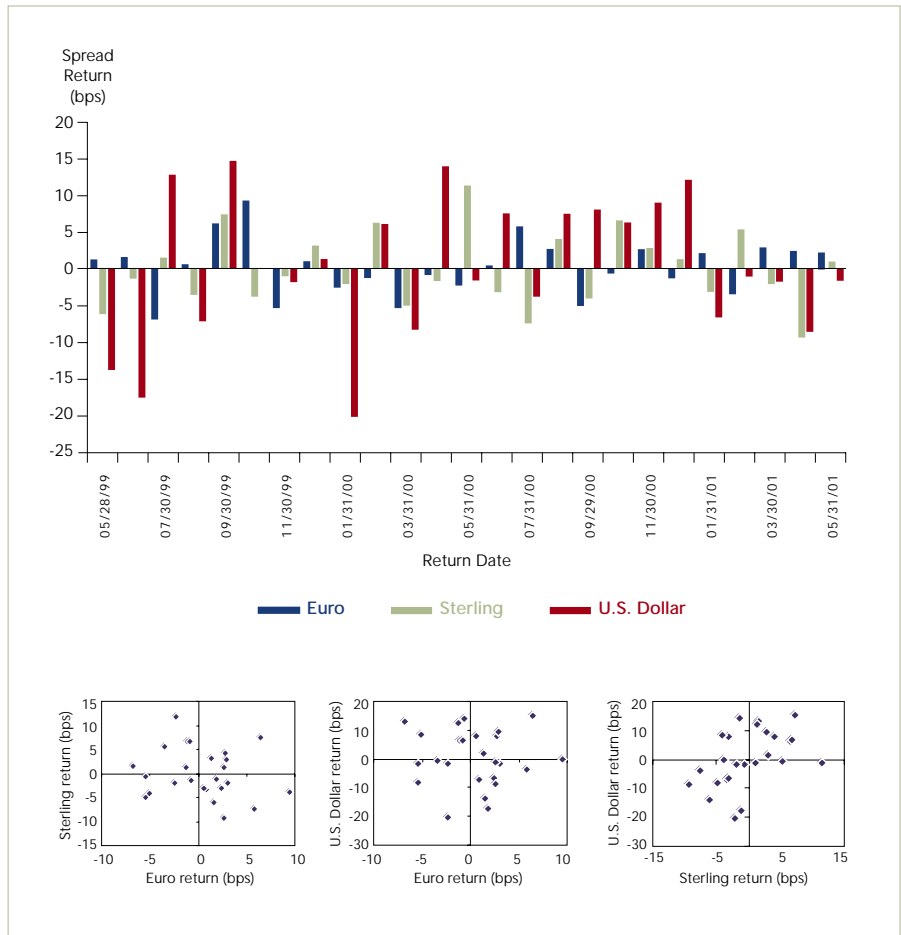


Figure 3
Cross-market comparison of
Financial AA spread factor returns



Financial sector correlations within and across markets as of May 31, 2001	Euro			U.S. Dollar				
	FIN_AAA	FIN_AA	FIN_A	FIN_AAA	FIN_AA	FIN_A	FIN_BBB	
	1.00	0.85	0.76	1.00	0.77	0.66	0.73	
		1.00	0.86		1.00	0.94	0.91	
			1.00			1.00	0.91	
							1.00	
	Sterling			Cross-market				
	FIN_AAA	FIN_AA	FIN_A	FIN_AAA	FIN_AA	FIN_A		
	1.00	0.61	0.65	Euro/Sterling	0.10	-0.18	-0.06	
		1.00	0.96	Euro/U.S. Dollar	0.11	-0.06	-0.05	
			1.00	Sterling/U.S. Dollar	0.12	0.44	0.51	

euro factors. The same is observed in other sectors, and indeed, correlations between factors that have a common rating also show an identical pattern: high correlations within markets and near-zero correlations across markets.

Issuer-level Data

Issuers in the euro, sterling or U.S. dollar markets tend to be substantially different. Hence, the lack of cross-market correlation observed at the sector-by-rating level could be partly due to issuer-specific factors not accounted for in the model.

In an attempt to test this hypothesis, we looked at sample issuers active in more than one market and computed the cross-market correlations of the spread returns. The correlations computed for four sample issuers are given in Table 3.

We found no significant correlation in all cases, which argues against the existence of an issuer-specific factor.

Hidden Factors

We finally searched for hidden factors to explain the spread return de-correlation across markets: coupon (which may influence tax-related behavior), duration, maturity, and amount outstanding (as a proxy for liquidity). The data show no strong trends linking these quantities to spread return, as is shown in Figure 4 for bonds issued by the European Investment Bank. Amount outstanding showed a mild inverse correlation with spread level, but not with spread return.

Conclusions


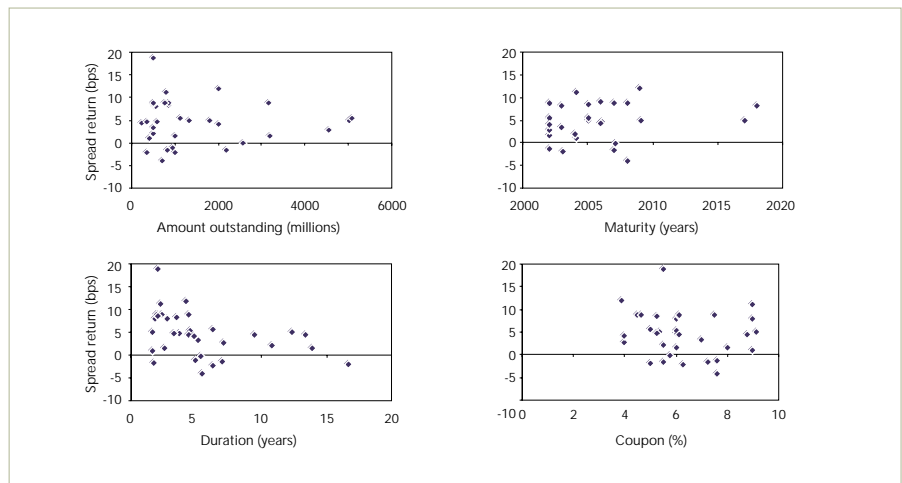
Our analysis shows that euro, sterling and U.S. dollar credit spreads have been largely uncorrelated during our study period of April 1999 to May 2001. Consequently, the current generation of credit risk forecasting models must have market-dependent factors. 

Table 3
Examples of cross-market correlations for individual issuers

Issuer	Euro/ Sterling	Euro/ U.S. Dollar	Sterling/ U.S. Dollar
Government of Canada	0.12	-0.10	0.07
Dresdner Bank	-0.51	-0.01	-0.03
European Investment Bank	0.17	-0.08	0.01
Toyota	-0.21	-0.19	0.23

Figure 4
Spread returns of bonds issued by the European Investment Bank





Aggregating Risk across multiple Asset Classes

Chapter Two

Andrew Rudd
Chairman

Aamir Sheikh
President

This is the second article in a two-part series. The first article appeared in our summer edition of Horizon and can also be found online at <http://www.barra.com/Newsletter/NI171/aggregate.asp>.

The first article in this series defined the business role of enterprise risk management and the need for consistency between the analysis on a small set of assets and an aggregated analysis across the enterprise. We concluded that a consistent analysis requires a covariance matrix for factors across many asset classes. This article will evaluate the two challenges presented by the business case. First, the length of the time series of factor realizations is frequently different for different asset classes. If all series are reduced to the length of the shortest series then we are effectively discarding information present in longer time series. A similar problem, that of missing observations, has a known solution in the EM algorithm. We apply this solution to estimate a preliminary factor covariance matrix across multiple asset classes.

The second challenge arises because the covariance matrix for any given asset class that is produced by the EM algorithm may not correspond to the covariance matrix that is produced when we consider that asset class alone. For

example, the volatility of the U.S. equity market has often been described using variants of GARCH models, which we can incorporate into a robust covariance matrix for U.S. equity factors. In general, however, this covariance matrix will differ from the covariance matrix for U.S. equity factors produced by the EM algorithm. The result of this difference is that risk predictions at the asset class level will be inconsistent with the risk predictions across asset classes.

Problem Definition

The problem is to forecast the risk of the enterprise's future revenues less costs, or assets less liabilities. Although the risk factors which impact the costs/liabilities are also typically those which influence the revenues/assets, the costs/liabilities are far more under the control of discretionary management. For the purpose of simplifying the discussion we will concentrate on forecasting the risk of the aggregate asset portfolio and leave the integration of assets and liabilities to a future discussion.

If the aggregate portfolio contains assets from a single asset class, then the problem is no more difficult than a single asset class portfolio analysis. The challenge arises, however, when the portfolio contains multiple asset classes. In this instance, one cannot simply analyze risk at

the portfolio level and again at the aggregate level, since potentially one has to manage risk at all levels within the organization. Moreover, there is a need to establish the optimal risk/reward tradeoff along other dimensions such as individual securities, factors, asset classes, industries, sectors, countries and regions. Each dimension represents a possible aggregation on a drill down basis. Because there are many levels within an organization where risk management is appropriate, the requirement for consistency is very important. Without consistency, there is potential for strong disagreement about risk information at different levels in the organization, with no agreement on the appropriate risk management steps.

The problem arises because each asset class is likely to be managed by a different team, with a different modeling paradigm and access to individual asset data. For example, Barra's U.S. Equity Model uses a flexible, organic industry scheme and an extended GARCH model for the S&P 500 to calibrate the factor covariance matrix. In contrast, the Barra U.K. Equity Model uses FTSE industries and a daily exponentially weighted volatility forecast for the FTALL. Yet how do we integrate different model types, each with a different number of parameters, into an aggregate model and preserve the consistency in the aggregation process?

The natural simplification, which eliminates the need for aggregating different model types, is to impose a common factor structure across all asset classes. For example, one could impose a single factor model so that the aggregation process requires only the estimation of the correlation between the various factors. This greatly simplifies the aggregation task but leaves the portfolio manager with an inferior model, or inconsistent results between the various levels within the firm hierarchy—neither result is necessary or desirable.

Similarly, one could identify “buckets” which span the aggregate portfolio space, and then assign each asset a single bucket. In this case the only classification data required is the bucket identifier. One can then proceed either by estimating a covariance matrix across the various buckets, where each bucket is representative of all assets within it, or use a returns-based analysis across the buckets. Unfortunately, this approach also yields considerable inconsistencies in the aggregation and leaves the portfolio manager without a quality set of tools to manage risk relative to his peers.

An alternative approach uses a returns-based analysis directly on the individual portfolios or asset classes. Within a multi-strategy organization this can be misleading, since historical returns reflect the interaction of historical holdings with the full history of changes in market conditions. If we choose to ignore that current holdings may not reflect the historical holdings and that current market conditions may not be representative of historical market conditions, then we are opening ourselves to considerable bias.

The best solution to this problem is to ensure that the most accurate tools are employed at the most detailed level of granularity. In the current state of development, this typically means the use of a factor model estimated across relatively homogeneous groups of individual asset data. At the most aggregated level, the risk manager and chief investment officer should get the same view of the risk sources and exposures as the portfolio managers and traders. If they don't analyze the same asset space with the same form of analytical tools, then the potential for mismeasurement and miscommunication will open the organization to losses. In short, there must be a consistent modeling paradigm throughout the organization, only made possible when the same models are used at all levels of aggregation.

Managing aggregate risk, therefore, requires the integration of risk models across asset classes while preserving the accuracy of single asset class models. The analytical issues are to efficiently use the factor realizations which may have different time histories, and to ensure that the risk model for a single group of assets is identical to that for the same group of assets when embedded into the aggregate analysis.

Integrating Across Asset Classes

Integration of risk across multiple asset classes equates to computing a cross-asset class factor covariance matrix. This cross-asset class factor covariance matrix should satisfy two conditions:

- For any portfolio that lies within a single asset class, we should obtain the same risk forecast whether we employ the cross-asset class covariance matrix or the covariance matrix corresponding to the single asset class.
- The cross-asset class covariance matrix has to be positive semi-definite. This is necessary to ensure that portfolio variances are non-negative.

There are, however, obstacles to achieving these goals. First, different asset classes inevitably have different lengths of time series data. For example, we have reliable U.S. equity data going back to January 1973, whereas reliable international fixed income data begin in January 1988. Using differing lengths of data will generally not result in a positive semi-definite covariance matrix. An alternative is to use the data corresponding to the shortest available time series. This, however, throws

away relevant information from the longer time series.

The EM algorithm provides a mechanism to bring together time series of different lengths by ensuring that the missing data are filled in an optimal manner.¹ This provides us with our first iteration at a cross-asset class covariance matrix and satisfies the requirement that this matrix be positive semi-definite. The off-diagonal blocks of the matrix are the cross-asset class factor covariances. The resulting diagonal blocks of the cross-asset class covariance matrix, however, will differ from the covariance matrices of the corresponding single asset classes. In other words, the EM algorithm disrupts the diagonal blocks. The diagonal block for U.S. equities will not incorporate the empirical regularities documented in the previous section.

Simply replacing the diagonal blocks with the single-asset class covariance matrices gives us consistency with single asset classes, but need not fulfill the requirement that the resulting cross-asset class covariance matrix be positive semi-definite. Replacing the block diagonals without changing the off-diagonal blocks of the cross-asset class covariance matrix is analogous to replacing variances without altering covariances in a scalar context. Replacing variances without altering covariances also generally does not lead to a positive semi-definite matrix. In a scalar context, however, we know that transforming a covariance matrix into a correlation matrix and then multiplying through with new standard deviations results in a positive semi-definite covariance matrix and the new variances along the diagonals.

¹ See, e.g., Johnson, R.A. and D.W. Wichern, 1988, *Applied Multivariate Statistical Techniques*, 2nd ed., Prentice Hall, Inc., New Jersey. In practice, using data where one time series is considerably longer than another need not result in meaningful results from the EM algorithm because a large part of the shorter series has to be filled in. Thus, in computing our first cut at the cross-asset class covariance matrix, we limit the amount of data that is used from the longer time series so that there are a large proportion of series with relatively few missing observations.

Table 1		Country Pair/Industry	Oil	Retail	Banking	Insurance	Metal
Predicted Cross Country Correlations between Industry Factors	Japan and U.K.	0.34	0.30	0.29	0.19	0.32	
	Japan and U.S.	0.34	0.26	0.26	0.39	0.17	
	U.S. and U.K.	0.60	0.36	0.55	0.47	0.49	

Table 2		Country Pair/Risk Index	Size	Value	Success	Trading Activity	Growth	Volatility
Predicted Cross Country Correlations between Risk Index Factors	Japan and U.K.	0.23	0.23	0.10	0.18	-0.03	0.26	
	Japan and U.S.	0.05	0.02	0.23	0.24	0.07	0.15	
	U.S. and U.K.	0.11	0.17	0.38	0.26	0.12	0.42	

Table 3		Country/Country	Japan	Sweden	U.K.	U.S.
Predicted Cross Country Correlations between Interest Rate Shift Factors	Germany	0.31	0.64	0.66	0.55	
	Japan	0.11	0.07	0.22		
	Sweden	0.56	0.43			
	U.K.	0.55				

Table 4		Country	Average Correlation	Largest Correlation	2nd Largest Correlation	3rd Largest Correlation	4th Largest Correlation
Predicted Correlations between Interest Rate Shift and Industry Factors (within Country)	Japan	-0.01	0.09	0.09	0.08	0.07	
	U.K.	0.32	0.41	0.41	0.39	0.39	
	U.S.	0.15	0.42	0.31	0.30	0.28	

This scaling of the scalar diagonal elements of a covariance matrix has a matrix analog.² We use this matrix analog to scale the cross-asset class covariance matrix that is produced by the EM algorithm to obtain a final covariance matrix that is both positive semi-definite and has the single-asset class covariance matrices on the block diagonals. In this manner, we are able to capture the covariances between different asset classes, while preserving the depth of analysis that is used in modeling any single asset class. This implies that risk forecasts obtained at any level of aggregation within an enterprise are consistent with those at the smallest level of disaggregation, substantially reducing the likelihood of miscommunication or measurement errors that may result in financial losses.

Empirical Results

A simple alternative to estimating cross-asset class correlations is to assume them to be zero. In this case, if the single asset class factor covariance matrices are positive semi-definite, then the estimated cross-asset class covariance matrix is also positive semi-definite. There are, however, good reasons to believe that a zero correlation assumption does not hold in practice. For example, assets in global industries are likely to be correlated across countries, and the within-country industry factors corresponding to the global industries will be correlated across countries. Similarly, changes in interest rates and spreads are likely to be correlated, given the tendency of markets to move

² This method was derived by Dan Stefek at Barra, Inc.

simultaneously toward and away from quality. For the same reason, interest rates and equity market factors are likely to be correlated.

Tables 1 through 4 provide sample-estimated correlations across different factors from different Barra single asset class models. These estimates are produced using the method outlined in the previous section. Tables 1 and 2 provide the correlations between equity industry and risk index factors across the U.S., Japan and U.K. equity risk models. As the tables show, there are strong correlations among industries that are intuitively global. For example, the correlation between the banking industry across the U.S. and U.K. is estimated as 0.55, and ignoring this correlation will have a significant impact on portfolios with a banking tilt.

Similarly, Table 2 shows that the correlations among risk indices, although smaller than correlations among global industries, are nevertheless of economic significance.

Table 3 provides the estimated correlations among interest rate factors across different countries, whereas Table 4 contains the largest estimated correlations between interest rate factors and industries for different countries. As Table 3 shows, there is significant positive correlation between interest rate shift factors for countries within developed Europe and also between the U.S. and developed Europe. Similarly, there is strong correlation between interest rate shifts and equity industries that we would expect to be correlated with interest rate changes.

The magnitude of the correlations indicates the importance of cross asset class risk estimation. The differences in the estimated correlations, moreover, indicate that simplifications based on index level analysis will lead to inaccurate risk predictions. For example, the average correlation between equity industries in the U.K.

and interest rate shift factors is 0.32. Using this average as an estimate for equity market and interest rate correlation and applying it to all types of equity and bond portfolios will lead to errors in risk prediction.

Testing the Methodology

This leads us to an evaluation of the accuracy of our methodology. Tables 5 through 7 contain the accuracy test results for portfolio level risk predictions of cross asset class portfolios. The Tables contain the realized bias statistic, which is the standard deviation of the period by period excess return of the portfolio divided by its predicted standard deviation. If our predictions of risk are, on average, accurate, then the bias statistic should not be significantly different from one. If we under-predict risk, then the bias statistics should be significantly larger than one. If we over-predict risk, the bias statistics should be significantly smaller than one.

Table 5 contains the bias statistics for equity portfolios that consist of equally weighted sub-portfolios of U.S., U.K., and Japan equities, and are based on a risk model that combines Barra's U.S., U.K. and Japan risk models. The sub-portfolios are:

- Index portfolios (the S&P 500, the FTSE 100, and the TSE1).
- Portfolios of the 100 largest stocks in each market.
- Portfolios that tilt on risk indices by including only those stocks that have an exposure between 1 and 2.5 to a given risk index.
- Portfolios that tilt on industries by including only those stocks that have an exposure greater than 0.5 to a given industry.

Active risks are computed by using the index portfolio within an asset class as the benchmark for that asset class, and constructing an aggregate benchmark that is an equally weighted portfolio of the single asset class benchmarks.

	Portfolio	Total Risk	Active Risk
Bias Statistics for Cross Asset Class Equity Portfolios	Index	0.91	NA
	Top 100	0.93	1.09
	Growth	1.08	1.49*
	Value	0.91	1.30*
	Size	0.98	1.06
	Oil	0.94	1.05
	Banking	1.12	1.39*
	Insurance	0.93	1.04
	Metal	1.09	1.16

* Significantly different from 1 at the 5% level.

	Portfolio	Total Risk	Active Risk
Bias Statistics for Cross Asset Class Fixed Income Portfolios	USAGG + ALLEUR	0.99	NA
	USAGG + ALLJAPAN	0.93	NA
	USCORP + ALLEUR	0.98	0.92
	USCORP + ALLJAPAN	0.93	1.02

	Portfolio	Total Risk	Active Risk
Bias Tests for Cross Asset Class Equity and Fixed Income Portfolios	S&P 500 + UASGG	0.96	NA
	USELECUTIL+USCORP	1.09	1.28*
	USELECUTIL + USCORP+ JPINSURANCE +ALLJAPAN	0.88	1.14
	USELECUTIL + USCORP+ UKINSURANCE +ALLUKI	0.83	1.12

* Significantly different from 1 at the 5% level.

The bias statistics are computed over the period from June 1996 through December 1999. As the table shows, portfolio risk predictions are generally accurate, with 14 out of 17 bias statistics being insignificantly different from one at the five percent level. The significantly larger bias statistics for active risk for growth, value, and bank tilt portfolios indicates that our method had, in the sample period, a tendency to under-predict the correlations between these factors and other factors across different countries.

Table 6 contains the results of tests on fixed income portfolios. The portfolios consist of equally weighted portfolios of sub-portfolios from the individual asset classes. For example, the portfolio USAGG+ALLEUR consists of an

equally weighted portfolio of an aggregate, cap-weighted portfolio of U.S. corporate and Treasury bonds (USAGG) and of the All Europe Government Bond Index. The bias statistics are computed by combining Barra's U.S. and Global Fixed Income risk models. The bias statistics are all insignificantly different from 1 at the five percent level, showing the cross asset class factor covariance matrix is accurate, on average, for fixed income portfolios.


Table 7 shows cross-asset class portfolios, constructed as equally weighted portfolios of sub-portfolios from the individual asset classes: The portfolio of U.S. Electric utilities (ELECUTIL) and U.S. corporates (USCORP) is an equally weighted portfolio of the U.S. electric utilities portfolio and a portfolio of U.S. corporate bonds. The bias statistics are based on risk predictions that combine Barra's U.S., U.K. and Japan Equity risk models, and U.S. and Global fixed income risk models. The results in Table 7 support the accuracy of the cross-asset class covariance matrix. Only one of the bias statistics, for active risk for Electric Utilities and U.S. Corporates, is significantly different from 1 at the five percent level.

Summary

Managing a modern asset management firm requires an understanding of how certain risks, such as market, liquidity and credit risks, impact its earnings capability. Interestingly, this knowledge base exists in the portfolio management function. Therefore, risk management at the enterprise level is a natural extension of portfolio management. However, while both the use and general acceptance of analytical tools for portfolio management are widespread, these same tools have only recently started being adopted at the enterprise level. If the management of enterprise risk exposures is not understood it may result in a general misallocation

of resources, a potential compounding of unintended bets, uncompensated exposures to risk, and either unwarranted over-diversification and opportunity loss or concentration and “blow ups”.

Given that the need for managing aggregate risk is accepted, it is important to uncover the principal contributors to risk and ensure that they are understood consistently across the organization: a portfolio manager cannot have one view of risk while the executive management has another.

Finally, integrating a comprehensive enterprise risk management capability does present challenges. There are substantial technology requirements for obtaining data, accessing legacy systems, aggregating risk models (frequently from different vendors), and employing different methodologies. The approach described here is one that has been successfully used by large global asset managers to satisfy the demands for a consistent, accurate and user-friendly risk management system. 



Long-Short Equity Investing

Daniel Cashion
Director, Global Accounts

Rohtas Handa
Director, U.S. Sales

With the burst of the technology bubble and private equity returns plummeting, it is no surprise that hedge funds have become an important asset class for high net worth individuals and institutional investors alike. Recently, cautious institutions such as CalPERS, a \$158 billion pension fund, and General Motors have announced their plans to allocate significant capital into this arena.¹ Of special interest to many institutions are long-short equity strategies.

In this article we will examine three popular construction techniques deployed by long-short equity portfolios: pairs trading, stratification and optimization. We will build portfolios using each of these methods and then evaluate their ability to achieve the following two goals:

- Maximize alpha by purchasing undervalued securities and shorting overvalued securities. This has a significant advantage over long-only equity strategies by allowing a manager to better exploit overpriced securities.
- Offer risk diversification by creating a short portfolio that reduces the long portfolio's risk. This feature enables the construction of popular "market neutral" strategies.

To evaluate the tradeoff between risk and return, we will use the Sharpe ratio, defined as the ratio of expected return to forecasted risk.

Portfolio Construction Methodology

Given that our goal is to test the validity of various construction techniques, we will use the same stock-level inputs to the process. For the purpose of selecting stocks we will rely on a commonly employed Estimate Revisions² strategy. We will assume initial dollar neutrality and a leverage ratio of 2 to 1 to construct a 60 stock portfolio from the S&P 500 universe.

Pairs trading—a technique where a manager matches long and short investments one pair at a time. For each company that is particularly outstanding, we seek a mate on the short side that is expected to perform marginally poorer and, equally important, that is most likely to swing in the same way in a volatile market. A good example would be to go long Compaq and short Dell.

We first ranked the stocks in the S&P 500 by our Estimate Revisions signal. We then chose the 30 highest ranked stocks from within the universe and attempted to separately hedge

¹ Financial Times, July 2nd, 2001

² This expected return signal ranks securities based upon their recent analyst's earnings revisions

each stock with a similar stock that ranked very poorly. Our resulting portfolio had 30 stocks long and 30 stocks sold short.

Stratification—a technique where the long and short side of the portfolio are matched along multiple dimensions in an effort to minimize the portfolio's exposures to these attributes. In contrast to Pairs Trading where the goal is to match stocks one pair at a time, Stratification attempts to match the overall characteristics of the long portfolio with the short portfolio.

Once again, we used the Estimate Revisions signal to rank the S&P 500 universe and constructed a long-short portfolio by selecting the highest and lowest ranked securities. We then changed the weights of the stocks so that the characteristics of the long portfolio matched that of the short along the following four attributes: Sector, Capitalization, P/E, and Earnings Growth.

Optimization—expands and enhances the previous techniques by running countless iterations of possible weightings of selected stocks. This creates a truly efficient portfolio with the

highest overall return expectation and the lowest predicted volatility. It has the added advantage of being the least costly method to implement. As an input into the optimization, we require a model to measure and quantify risk. It has been shown that a fundamental multiple factor model captures both the common characteristics that cause the movement of stock return as well as the correlation among these characteristics.

We used Barra's recently enhanced *Aegis Long-Short Optimizer* and the United States Equity Model's multiple factor model to construct a long-short portfolio. This construction technique simultaneously selects the long and short assets in a one-step process, balancing expected return and risk. The ranks from our Estimate Revisions model on the S&P 500 stocks were fed into the optimizer to construct an optimal 60-stock portfolio, targeting a 2 to 1 leverage. The resulting portfolio had 30 long and 30 short.

Figure 1

Aegis Optimizer settings for Estimate Revisions ranking

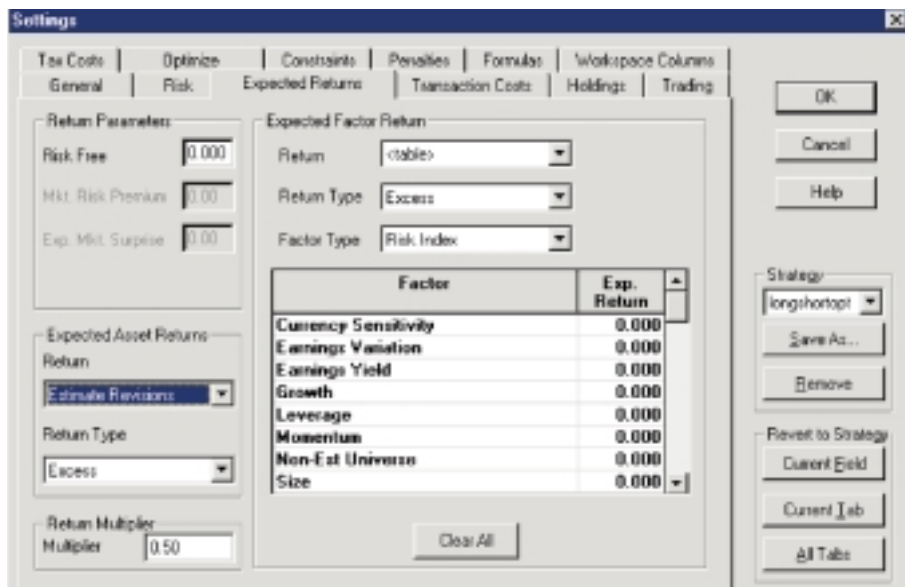


Figure 2
Aegis Optimizer settings for maximum number of stocks

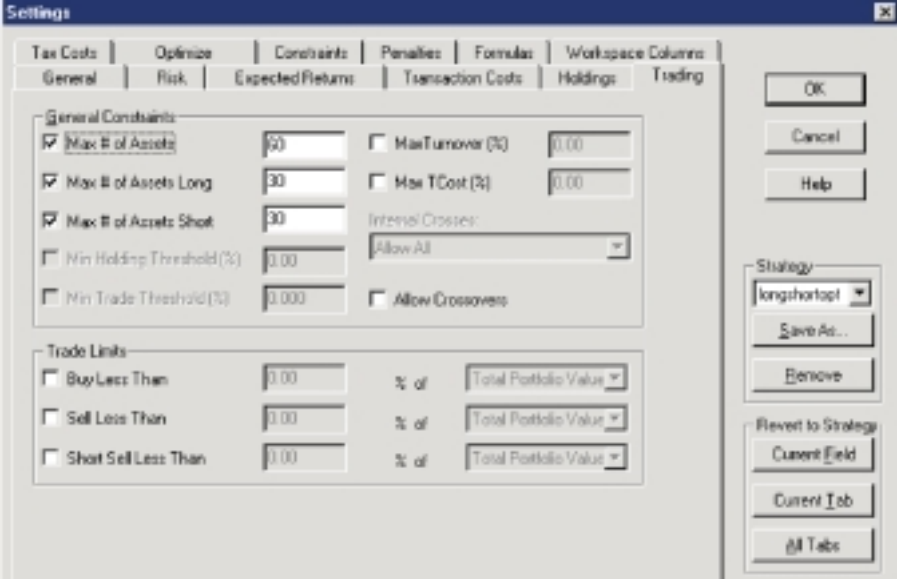
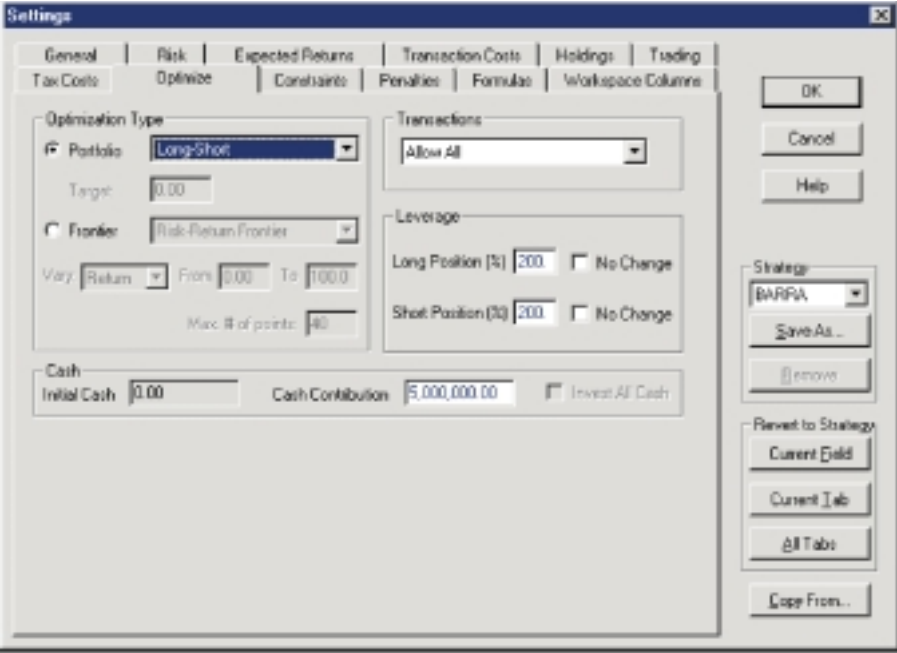


Figure 3
Aegis Optimizer settings for leverage



Results

The table below compares the risk, expected return and Sharpe Ratio.

Risk is measured by Barra's United States Equity Model. Expected returns are found by converting our Estimate Revisions ranks into Alphas.³

Table 1
Three long-short portfolio construction techniques

	Total Risk	Expected Return ³	Sharpe Ratio
Pairs Trading	9.87%	14.41%	1.46
Stratified	9.20%	13.92%	1.51
Optimization	7.99%	15.47%	1.94

As the results show, the portfolio built with the integrated optimizer produces the highest Sharpe Ratio. It achieves this by having both a higher expected return and lower forecasted risk.

The superior results of the portfolio constructed using the optimizer should come as no surprise to practitioners. While both the pairs trading and stratified techniques are easy to implement, both suffer because of some naive assumptions about the equity markets.

In the case of pairs trading, risk is assumed to be hedged by matching similar stocks in the same industry. Since it is very rare to find two stocks that are exactly similar, pairs trading is an inefficient solution given our stated goals. Further, it ignores the probable adverse effects to risk and return that result from aggregating pairs into a portfolio.

While stratified sampling does take into account the overall portfolio effect and tries to diversify the long-short portfolio on some common characteristics, it does not account for correlations that exist between these characteristics.

By ignoring the simple fact that factors are correlated, you limit your upside by not exploiting the interrelationships that will enhance your strategy.

An optimizer that incorporates a forward-looking multiple factor model can not only accurately measure risk, it can also capture the interrelations between the factors that influence return. The diversification offered is far superior as exhibited by the results above.

Summary

Due to the proliferation of hedge fund offerings, investors need to be certain that their managers provide additional value to the investment process. The skills needed by the manager include security selection, portfolio construction and cost efficient trading. Because risk control is the key to success in long-short management, a manager must have an efficient and disciplined way of combining the best stock picks into a portfolio. An integrated optimizer that combines all available information gives a long-short manager the best tool for achieving success. 

To learn more about Aegis, or to learn more about Barra's products for hedge funds or other risk management issues, contact Dan Cashion (daniel.cashion@barra.com) or Rohtas Handa (rohtas.handa@barra.com).

³ See Grinold, Kahn *Active Portfolio Management*



Barra Brain teaser

Alex Zheleznyak
Manager,
Risk Portfolio Analytics,

Bears for Bulls is a manufacturer of stuffed animals featured in corporate gift catalogs. Its best-selling line of teddy bears (which are dressed to resemble various professions in the financial services industry) has booked staggering profits and has made Bears for Bulls stock a favorite among Wall Street analysts. Recently, however, these profits have been called into question amid accusations of accounting irregularities. An investigation has been mounted by the toy industry's self-regulatory body, the Toy Ethics Commission (TEC). Preliminary TEC hearings have identified eight individuals suspected of being personally responsible for the mismanagement.

The TEC is certain that only one person was responsible for cooking the books at Bears for Bulls, and that he is among the eight suspects. Two forensic accountants from competing firms, Al and Ben, are assigned to narrow down the list of suspects. To assure impartiality, Al and Ben are strictly forbidden to communicate with each other. Working independently, each eliminates six of the eight suspects. Carl, a mutual friend of Al and Ben, reveals to them that they each have two prime suspects, and that one name appears on both lists. Pangs of conscience—and fear of TEC prosecution—prevent Carl from revealing any further information, particularly the name of the common suspect.

Al and Ben have justifiable confidence in their abilities and know that an individual whom they both suspect must be the real culprit. Each would like to enhance the reputation of his firm, and knows that his presentation to the TEC will be most persuasive if he, but not the TEC, knows in advance the culprit's identity. Tomorrow the commissioners will hear Al and Ben's evidence for the first time, according to the following schedule:

9:00 A.M. Introductory statement by Al

9:10 A.M. Introductory statement by Ben

9:20 A.M. Presentation of Al's evidence

1:00 P.M. Presentation of Ben's evidence

During the introductory statements, Al and Ben may present a list of all eight suspects, and announce the number who remain on their short lists, but they may make no statement that would allow a commissioner to deduce the culprit. Nevertheless, at 9:21 A.M. after Al speaks the first sentence of his presentation, both he and Ben know the culprit's name, and no one on the commission does. (Al can time the announcement of the culprit for maximum effect during his presentation.) With the exception of Carl's tip, Al and Ben have adhered to the rule that no communication is allowed outside of the hearing itself, even to third parties.

You may send solutions to the Barra Brainteaser to Erin Vosti. E-mail: erin.vosti@barra.com; fax: 510.548.4374; mail: Barra, 2100 Milvia Street Berkeley, CA 94704-1113 United States.

How is this possible?

Hint: Although the commissioners cannot be certain of the culprit, they may be able to eliminate suspects.

Bonus: Can a method be found if there were originally more than eight names, or fewer than eight names?

Brainteaser from Last Issue

Scott Scheffler
Vice President,
Risk Models

A fund manager and his high net worth client were in the midst of an acrimonious meeting. Recent downturns in both the market and the value of the client's portfolio had left the client upset with the manager's investment strategy. The client complained that for the manager's hefty \$1 million fee he should have been protected from severe losses. (In this puzzle you may assume that the fee was due to be paid in a lump sum on the day of the meeting.) The manager explained, explained, and then explained again why his strategy would ultimately do well.

Offer 1

The frustrated client, who was notorious for his tricky nature, eventually blurted out, "Talk, talk, talk! I will pay your \$1 million fee if and only if you truthfully answer my next question with a simple yes or no answer."

The manager accepted the client's terms. The client asked a question, the manager gave his answer (either yes or no), the client paid the fee, and the client walked out of the office \$1 million richer. How was this possible?

Offer 2

The next day a second client of the same strategy arrived in the manager's office furious at the poor performance of her portfolio. A remarkably similar discussion ensued, at the

end of which the client proposed, "I will pay your \$1 million fee if and only if you truthfully or falsely answer my next question with a simple yes or no answer." The manager, wary after having been bested the previous day, nevertheless could see no reason not to accept her offer. Can you?

The Answers

Of course the manager should not accept either offer—we would not have grounds for a puzzler if it made sense that he should. Here are the specific questions that would make the \$1,000,000 payment not the good deal it seems to be on face value.

Offer 1

"I will pay you \$1,000,000 to continue implementing your strategy only if you promise to truthfully answer my next question with a simple yes or no answer!"

To which the client asks, "Will you either

answer 'no' to this question

first condition

or pay me two million dollars?"

second condition

The manager cannot answer 'no'. By saying 'no', the manager would be answering untruthfully.

Answering 'yes' requires the manager pay the client the \$2,000,000 in order to have the answer be true—making the \$1,000,000 fee a loser.

Offer 2

On the surface, it seems like the manager can't lose. He could seemingly answer yes or no at random. However, the following question will again force the manager to pay two million to the client.

Brainteaser Winners

Each winner will receive a prize for solving the Barra Brainteaser:

Dan Xystus, CFA
Chicago Equity Partners

Marcus Hedbring
SEB Invest

Honorable mention:

Karolina Sygula
Guardian Capital
Advisors Inc.

“Will you either

truthfully answer ‘no’ to this question

first condition

or falsely answer ‘yes’

second condition

or pay me two million dollars?”

third condition

Now work through the cases and see what happens.

Case 1. Assume that ‘yes’ is a truthful answer.

Then at least one of the three conditions must be true:

- It cannot be the first one since ‘yes’ was answered not ‘no’.
- Nor can it be the second condition, by virtue of the assumption that ‘yes’ is a true answer to the client’s question.
- Therefore, the manager must pay the two million in order to have provided a truthful answer.

Therefore, it is costly to truthfully answer ‘yes’.

Case 2. Assume ‘yes’ is a false answer.

Note that at all three conditions are false, since the conditions are connected by an ‘or’.

- For the second condition to be false, it would have to be false that the manager falsely answered ‘yes’. This violates our assumption.

It is therefore impossible to falsely answer ‘yes’.

Case 3. Assume ‘no’ is a true answer.

- Then none of the conditions can be true.
- However, by assumption of this case, the first condition is true.

Therefore, we are lead to contradiction—the case is impossible.


Case 4. Assume ‘no’ is a false answer.

Therefore, at least one of the conditions must be true:

- The first cannot be true (by the assumption).
- The second can not be true (since ‘no’ has been answered).
- Therefore the third condition must be true—pay the two million.

In summary, it is either impossible to provide a yes/no answer that is neither contradictory (as opposed to either true or false) nor requires paying the client \$2,000,000.

Both of the Above

These are examples of ‘coercive logic’, a logic puzzle concept attributable to Raymond Smullyan. 

NEWS + EVENTS

Barra



MARCH
02
JUNE

Tradeshows

Risk 2002 Europe

April 23–24 | Paris, France

Sponsored By: RISK

Barra Speaker: Aamir Sheikh

Barra Exhibiting

Le Palais des Congres de Paris

Paris, France

2002 AIMR Annual Conference

May 12–15 | Ontario, Canada

Sponsored By: AIMR

Barra Speaker: Dan Stefek

Barra Exhibiting

Sheraton Centre Toronto Hotel

Toronto, Canada

Risk 2002 USA

June 11–12 | Boston, MA

Sponsored By: RISK

Barra Speaker: Aamir Sheikh

Barra Exhibiting

Seaport Hotel at the World Trade Center, Boston

Boston, Massachusetts

2002 SIA Technology Management Conference & Exhibit

June 19–21 | New York, NY

Sponsored By: SIA

Barra Exhibiting

Hilton New York

New York, NY

UNITED STATES

Aegis Portfolio Manager Workshop: Risk Analysis and Optimization

March 5 | New York, NY

March 12 | Chicago, IL

March 19 | Toronto, Canada

April 2 | New York, NY

April 16 | Los Angeles, CA

April 30 | New York, NY

May 7 | Boston, MA

June 4 | New York, NY

June 18 | Toronto, Canada

June 25 | Chicago, IL

This one-day workshop, designed to help you solve real-world investment problems, takes you through practical exercises in Aegis Portfolio Manager™. We emphasize hands-on exercises, case studies, and relevant theory to help you characterize your portfolio's risk and build more efficient portfolios.

Contact: Marsha Starr-Fairconeture

Tel: 1.212.804.1518

Email: marsha.starr@barra.com

Aegis Portfolio Manager Workshop: Performance Analysis

March 6 | New York, NY

March 13 | Chicago, IL

March 20 | Toronto, Canada

April 17 | Los Angeles, CA

May 8 | Boston, MA

June 5 | New York, NY

June 19 | Toronto, Canada

June 26 | Chicago, IL

This one-day workshop features Aegis Performance Analyst, the market-leading equity performance analysis tool. Use case studies to work through practical exercises and learn how to identify sources of return and risk in your portfolio over time.

Contact: Marsha Starr-Fairconeture

Tel: 1.212.804.1518

Email: marsha.starr@barra.com

How to Research Active Strategies

March 7 | New York, NY

April 9 | Carmel Valley, CA

May 9 | Chicago, IL

June 10 | Pebble Beach, CA

The investment community has acclaimed the book *Active Portfolio Management*, by Richard C. Grinold and Ronald N. Kahn, for its thorough management process. Now its authors' key insights are available in a one-day training course.

This course is based on the principle that investment management is both an art and a science. Generating new investment ideas will always be a creative art; we present a rigorous research process for testing, refining and implementing these ideas. Learn how to identify exceptional strategies by measuring their information content. Learn different approaches to forecasting returns and portfolio construction techniques that best exploit return and liquidity information.

Contact: Alysia Starbuck

Tel: 1.510.647.3946

Email: alysia.starbuck@barra.com

Equity Portfolio Management Seminar

April 7–10 | Carmel Valley, CA

This seminar lays the foundation for understanding Barra's principal equity services which are designed to help you achieve your three primary investment objectives: high return, low risk and cost control. We will build your understanding of multiple factor models, the key element behind Barra's analytics. We extend the theory to forecasting returns, constructing optimal portfolios and analyzing portfolio performance. This seminar is excellent preparation to attend more advanced Barra events.

The optional training course How to Research Active Strategies is offered in addition to the program.

Contact: Rosalie Javier-Estacio

Tel: 1.510.649.4568

Email: rosalie.javier@barra.com

26th Annual Research Seminar

June 9-12 | Pebble Beach, CA

Our Research Seminar presents our latest research in risk modeling and portfolio management featuring speakers from Barra's Research group, known worldwide for developing a wide range of modeling and analytical innovations. Topics include equity, fixed income and multiple asset-class models. These seminars are conducted at a high level of quantitative rigor, and typically include noted academics and practitioners as guest speakers.

Contact: Rosalie Javier-Estacio

Tel: 1.510.649.4568

Email: rosalie.javier@barra.com

INTERNATIONAL

Aegis Portfolio Management Workshop: Introduction to Equity Risk Analysis

March 6 | London, UK

April 3 | London, UK

May 1 | London, UK

June 5 | London, UK

This half-day workshop aims to give a basic introduction to the theory behind Barra's equity risk models. The program also demonstrates how Aegis Portfolio Manager can be used to analyze the risk of a U.K. portfolio.

Contact: Melanie Poole

Tel: +44.20.7618.2067

Email: melanie.poole@barra.com

Aegis Portfolio Management Workshop: Performance Analysis

March 7 | London, UK

May 2 | London, UK

This half-day workshop features Aegis Performance Analyst. Use case studies to work through practical exercises and learn how to identify sources of return and risk in your portfolio over time.

Contact: Melanie Poole

Tel: +44.20.7618.2067

Email: melanie.poole@barra.com

Return Forecasting and Optimization

June 7 | London, UK

This half-day workshop covers the theory behind valuation models, raw forecasts and alphas—refining returns, sensitivity analysis, optimization techniques and portfolio construction. An overview of the Barra Aegis System Optimizer will include an introduction to the optimizer's features (i.e., constraints and penalties), how to generate a minimum tracking error portfolio, and how to generate an efficient frontier of portfolios.

Contact: Melanie Poole

Tel: +44.20.7618.2067

Email: melanie.poole@barra.com

Introduction to Fixed Income Risk Analysis

March 14 | London, UK

This half-day course provides an introduction to the Barra Cosmos System™. You will gain insight into using multiple factor models to analyze a fixed income portfolio's risk from both local and global perspectives.

Contact: Melanie Poole

Tel: +44.20.7618.2067

Email: melanie.poole@barra.com

Equity Portfolio Management Seminar

April 21-23 | Paris, France

This seminar lays the foundation for understanding Barra's principal equity services which are designed to help you achieve your three primary investment objectives: high return, low risk and cost control. We will build your understanding of multiple factor models, the key element behind Barra's analytics. We extend the theory to forecasting returns, constructing optimal portfolios and analyzing portfolio performance. This seminar is excellent preparation to attend more advanced Barra events.

Contact: Lisa Fishenden

Tel: +44.20.7618.2046

Email: lisa.fishenden@barra.com

Calendar of Events

March

- 5 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
New York, NY
- 6 Aegis Portfolio Management Workshop
Equity Risk Analysis
London, England
- 6 Aegis Portfolio Management Workshop
Performance Analysis
New York, NY
- 7 Aegis Portfolio Management Workshop
Equity Performance Attribution
London, England
- 7 How to Research Active Strategies
New York, NY
- 12 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
Chicago, IL
- 13 Aegis Portfolio Management Workshop
Performance Analysis
Chicago, IL
- 14 Introduction to Fixed Income Risk Analysis
London, England
- 19 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
Toronto, Canada
- 20 Aegis Portfolio Management Workshop
Performance Analysis
Toronto, Canada

May

- 7 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
Boston, MA
- 8 Aegis Portfolio Management Workshop
Performance Analysis
Boston, MA
- 9 How to Research Active Strategies
Chicago, IL
- 12-15 How to Research Active Strategies
Chicago, IL

June

- 4 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
New York, NY
- 5 Aegis Portfolio Management Workshop
Performance Analysis
New York, NY
- 9-12 Barra's 26th Annual Research Seminar
Pebble Beach, CA
- 11-12 Risk 2000 USA
Boston, MA
- 18 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
Toronto, Canada
- 19 Aegis Portfolio Management Workshop
Performance Analysis
Toronto, Canada
- 19-21 2002 SIA Technology Management
Conference and Exhibit
Toronto, Canada
- 25 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
New York, NY
- 26 Aegis Portfolio Management Workshop
Performance Analysis
Chicago, IL

April

- 2 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
New York, NY
- 7-10 Equity Portfolio Management Seminar
Carmel Valley, CA
- 16 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
Los Angeles, CA
- 17 Aegis Portfolio Management Workshop
Performance Analysis
Los Angeles, CA
- 21-23 Equity Portfolio Management Seminar
Paris, France
- 23-24 Risk 2002 Europe
Paris, France
- 30 Aegis Portfolio Management Workshop
Risk Analysis and Optimization
New York, NY

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