Methodology and assumptions used to build
the World CAPM, JP Morgan and Bank of America models

World CAPM

To build the world CAPM model, we start with the traditional CAPM relationship which states that the expected return on a security should be commensurate to its systematic risk. As described by the formula below, the expected return is equal to the risk-free rate + the country beta times the equity risk premium.

$$Ke \quad = \quad Rfw \ + \ \text{ßem} \ [E(rw) – Rfw]$$

The annual expected return on the equity is calculated over a period of 6 years, from December 1992 to November 1998.

Rfw   for the risk-free rate, we use the 10 year US Treasury yield, updated monthly over the period of analysis

E(rw)   Expected return on the world portfolio.

E(rw) – Rfw   Equity risk premium. We make the assumption that this measure remains constant over our period of analysis. We use the April 1998 value of 9.35% for the return on the world portfolio, which was used by Paul Gibbs in a presentation made in an internal JP Morgan presentation July 1998. We use the November 1998 risk free rate of 4.73% and thus a constant risk premium of 4.62%. Although an argument can be made that the risk premium should vary over this period, making it vary generates extremely low risk premia during various periods within our data. In practice, the risk premium is generally not updated regularly and we concluded that it would be better to keep it as a constant. Paul Gibbs noted in an email that while we could make the risk premium vary, it was acceptable to keep it as a constant.

ßem   Beta is a measure of sensitivity to the risk of the world portfolio. It is equal to the covariance of the country's returns with the world returns divided by the variance of the world's returns:

$$\beta_c = \text{covar} \ (r_c, r_w)/\sigma_w^2$$

We first calculate the monthly standard deviation, defined as the squared sum of the monthly returns on the country's stock market index minus the average of these returns over a rolling period of 60 months of returns. For instance, the December 1992 monthly standard deviation is calculated using the monthly returns between January 1988 and December 1992.

Monthly $\sigma_w = [(\quad (x - \text{average }(x)))^2 / (n-1)]^{\wedge}0.5$

We then translate the monthly standard deviation into an annualized standard deviation by multiplying it by the square root of 12 and square the result to get the annualized variance of world returns.

Annual $\sigma_w = $ Monthly $\sigma_w * (12)^{\wedge}0.5$

Annual $\sigma_w^2 = ($Annual $\sigma_w)^2$

The covariance of the country's returns with the world returns is equal to the square root of the product of the country's variance with the world's variance times the correlation of the country's returns with the world's returns.

$\text{covar }(r_c, r_w) = \text{Correl }(r_c, r_w) * (\sigma_w^2 * \sigma_c^2)^{\wedge}0.5$

We define the predicted excess return as the total expected return minus the risk-free rate.

JP Morgan Modified World CAPM

JP Morgan's Modified World CAPM uses the same framework as the World CAPM and makes an adjustment to the beta:

$$Ke \quad = \quad Rfw \; + \; \text{adj } \text{ß}c \; [E(rw) - Rfw]$$

$$\text{adj } \beta_c \text{ (JPM)} = \text{SQRT } ((41\% * \sigma_c^2)/ \sigma_w^2)$$

As for World CAPM, annualized predicted returns are calculated for the period December 1992 – November 1998, and updated on a monthly basis. The equity risk premium, the risk-free rates and the variances are the same as those that were calculated for the World CAPM predicted returns.

41% is the average level of systematic risk over total risk for developed countries. In our calculations, we use an IF function for every month of our period of analysis. If the ratio of systematic risk over total risk is below to 41%, we use 41% to calculate the beta. If it is higher than 41%, we use the actual ratio to calculate the beta.

We define the predicted excess return as the total expected return minus the risk-free rate.

Bank of America "Total Risk" Method

Bank of America's model is also a variation on the World CAPM model. As we showed in the first part of this PAE, it is very close to JP Morgan's Modified World CAPM model. The adjusted beta is calculated as the ratio of an individual country's equity volatility to that of the US market. The adjusted beta is reduced by 40%, based on a study that found that 40% of the variation in equity volatility could be explained by variations in credit quality, which suggests that the equity premium may be overstated by 40%. As opposed to JP Morgan methodology which uses the world market as its benchmark, the Bank of America methodology uses the US market as a benchmark. A sovereign spread is also added to the risk-free rate.

$$Ke \quad = \quad Rfw + SovSpread + \text{ adj } ßc \text{ } [E(rw) - Rfw]$$

$$\text{adj } \beta_c \text{ (BoA)} = 0.60 * \sigma_c/\sigma_{usa}$$

As for World CAPM, annualized predicted returns are calculated for the period December 1992 – November 1998, and updated on a monthly basis. The risk-free rates and the variances are the same as those that were used for the World CAPM predicted returns.

The risk premium is set as a constant 5.5%, as described in the article written by Stephen Godfrey and Ramon Espinosa in the *Journal of Applied Corporate Finance* article (Fall 1996).

We define the predicted excess return as the total expected return minus the risk-free rate.