PORTFOLIO CONSTRUCTION DIRECTION

Michael Earley, JD, CFA
Americas Head of Client Solutions
ENTERPRISE STRATEGIC ASSET ALLOCATION

Comprehensive and customized

- Highly constrained investors
  - Insurance companies
  - Pension plans
  - Frequently funding a liability
  - Multiple objectives
    - Return
    - Income
    - Cash flow
    - Solvency
  - May or may not be a taxpayer
  - Frequently subject to regulation
  - Ongoing enterprises
RELATIVE EFFICIENCY ANALYSIS

Return versus volatility compared to yield versus volatility

Hypothetical based upon assumed market conditions. Actual market conditions may prove to be materially different. No assurance can be given that any forecast or target will be achieved. Please refer to Important Information at the end of this presentation for more details.

Source: DWS June 2018

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Impact of reallocating 1% of current portfolio into each asset class

Hypothetical based upon assumed market conditions. Actual market conditions may prove to be materially different. No assurance can be given that any forecast or target will be achieved. Please refer to Important Information at the end of this presentation for more details.

Source: DWS June 2018

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ASSET ALLOCATION

Traditional efficient frontier

DEMONSTRATES RISK/RETURN TRADEOFF
- Most common form of asset allocation analysis
- High level view of risk/reward trade off
- Limited to total return

ECONOMIC EFFICIENT FRONTIER
Return versus volatility

Source: DWS June 2018
ASSET ALLOCATION
Augmented efficient frontier

DEMONSTRATES RISK/RETURN TRADEOFF

- High level view of risk/reward trade off
- Incorporates yield concepts as well
- Optimal portfolios may not lie on the efficient frontier
ASSET ALLOCATION

Comparative efficient frontiers

DEMONSTRATES RISK/RETURN TRADEOFF

- High level view of risk/reward trade off
- Can show the cost of incorporating constraints
- Provides increased context to the allocation decision

ECONOMIC EFFICIENT FRONTIER
Return versus volatility with potential allocation solutions

Source: DWS, for illustrative purposes only
Additional perspectives on portfolio construction

**RISK FACTOR COMPARISON**
Contribution to volatility by asset class

- **Current Portfolio**
  - Tax-Exempt Muni: 3%
  - IG Credit/EM Debt: 6%
  - IG Structured: 3%
  - Alternative FI: 5%
  - Public Equity: 73%
  - Private Risk Assets: 9%

- **Illustrative Solution Portfolio**
  - Tax-Exempt Muni: 2%
  - IG Credit/EM Debt: 9%
  - IG Structured: 6%
  - Alternative FI: 9%
  - Public Equity: 57%
  - Private Risk Assets: 15%

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**Source:** DWS, for illustrative purposes only

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PORTFOLIO CONSTRUCTION DIRECTION

Scott Ladner
Head of Investments, Horizon Investments, LLC
Why goals-based?

While diversification and risk management are critical components of investment management, the goals-based approach and the traditional approach differ greatly in how advice is delivered and product selected.

Some highlights of these differences:

**TRADITIONAL** Investing

- Centered on institutions
- Product selected by risk profile
- Focus: Benchmark performance
- Single-risk awareness

**GOALS-BASED** Investing

- Centered on the individual
- Product selected by goals
- Focus: Progress toward reaching goals
- Multi-risk awareness

Where are we going?  How do we get there?
INVESTMENT JOURNEY

The path investors commonly encounter along their financial journey.

- **wealth curve**
- **lifespan**

BEGIN GROWING WEALTH

BEGIN SPENDING WEALTH
STAGES OF THE JOURNEY
Horizon has identified three major stages along this journey.

- BEGIN GROWING WEALTH
- BEGIN SPENDING WEALTH

lifespan
wealth curve
WEALTH OBJECTIVES

The investor seeks a specific outcome for their wealth within these stages.
KNOW THE OBJECTIVE

Each stage has a specific objective – or goal. The current stage’s objective always remains the primary focus, even as it builds upon the prior stage’s objective/goal.
IDENTIFY THE RISK

Each stage has its own unique risk, requiring a strategy designed specifically for that risk without losing focus on or compromising the main objective.
Overview, Assumptions & Limitations

The holding, performance and factor analysis is conducted using Bloomberg (function PORT), based on the underlying holdings of Mutual Funds in the Portfolio and Indices in the Benchmark. These underlying holdings are accessed and fed into PORT in 2 main ways: For Mutual Funds, Bloomberg is already the repository for such data and PORT only requires the ISIN of those Mutual Funds. For Indices there are two different possibilities, via Bloomberg using the index ticker, or holdings are gathered from the index provider directly and then fed to PORT.

Analysis is performed through the PORT tool in Bloomberg, using the Bloomberg Global Risk Model. All analysis is at the holding level.

The Bloomberg Global Risk Model is built upon the second-generation Bloomberg Multi-Asset Class risk model (MAC2), the successor to the first-generation Bloomberg Multi-Asset Class risk model, denoted MAC1. The Bloomberg MAC2 Model provides investors with a powerful new tool for risk management and portfolio construction. The model is designed to address the full range of investment risk applications, ranging from large pension funds managing risk across multiple asset classes, to specialized managers constructing portfolios within a narrow segment of a given market. Notable highlights of the Bloomberg MAC2 Model include:

- Introduction of an innovative methodology to robustly estimate the high dimensional factor covariance matrices intrinsic to multi-asset class risk models
- New specialized factor models for hedge funds and private equity that leverage extensive proprietary Bloomberg data sets
- Introduction of the Bloomberg Industry Classification Scheme (BICS) for equity industry factors
- Expanded asset coverage to include non-agency CMOs, caps, floors, swaptions, and inflation-linked bonds (for 13 additional countries)

The Bloomberg Global Risk Model combines the Global Equity Fundamental Model, the Fixed Income Model, and others depending on the types of instruments in the portfolio.

Full whitepapers for each model are available on request.

Please see next page for modified portfolio.
RELATIVE EQUITY SECTOR WEIGHTS

GICS SECTOR EXPOSURES

Port

Bench

ACTIVE WEIGHTS

Consumer Discretionary
Consumer Staples
Energy
Financials
Health Care
Industrials
Information Technology
Materials
Real Estate
Telecommunication Services
Utilities

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For illustrative purposes only. Please see glossary for definition of the Bloomberg Risk Model.

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VaR COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>Bloomberg Risk Model (Global)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizon</strong></td>
<td>1 month (22 days)(scaled 1D)</td>
</tr>
<tr>
<td><strong>Confidence Level</strong></td>
<td>95%</td>
</tr>
<tr>
<td><strong>Reporting Units</strong></td>
<td>Returns (%)</td>
</tr>
</tbody>
</table>

For illustrative purposes only. Please see glossary for definition of the Bloomberg Global Risk Model.

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SCENARIO ANALYSIS

RISK MODEL: BLOOMBERG GLOBAL RISK MODEL

Scenario analysis

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Uncover potential risks using Bloomberg’s industry leading tools
Perform Scenario Analysis and measure Value at Risk
Identify performance drivers
Optimize portfolios
# GLOSSARY

Definitions provided by Bloomberg LP

<table>
<thead>
<tr>
<th>Short Name or Acronym</th>
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<tbody>
<tr>
<td>Closing Price</td>
<td>The close price of yesterday (last business day), depending on the user’s default settings for today, is returned. If there was no price for that business day, the field will return ‘N.A.’. Unlike Closing Mid/Trade Price (PR376, PRIOR_CLOSE_MID), which follows financial day logic, this field includes holiday for day count.</td>
<td></td>
</tr>
<tr>
<td>Ticker</td>
<td>Ticker is a specific identifier for a financial instrument that reflects common usage. Tickers are not, however, unique to specific exchanges or specific pricing sources. Tickers may change in conjunction with Corporate Actions.</td>
<td></td>
</tr>
<tr>
<td>% Weight</td>
<td>Percentage weight of the stock in the index. The field will return the weight of the security in its relative index. To find the relative index for a security you must refer to Relative Index (PR240, REL_INDEX). To find the weighting of the security in an index other then the relative index, Relative Index must be overridden with a different index. If the return value is N.A., use Index List (DS428, INDEX_LIST) to see a list of indices the security is a member of, which can be used to override Relative Index (PR240, REL_INDEX).</td>
<td></td>
</tr>
<tr>
<td>Expense Ratio</td>
<td>The amount investors pay for expenses incurred in operating a mutual fund (after any waivers).</td>
<td></td>
</tr>
<tr>
<td>GICS Sectors</td>
<td>A standardized classification system for equities developed jointly by Morgan Stanley Capital International (MSCI) and Standard &amp; Poor’s. The GICS methodology is used by the MSCI indexes, which include domestic and international stocks, as well as by a large portion of the professional investment management community. The GICS hierarchy begins with 10 sectors and is followed by 24 industry groups, 67 industries and 147 sub-industries. Each stock that is classified will have a coding at all four of these levels.</td>
<td></td>
</tr>
<tr>
<td># of Instruments</td>
<td>A count of the number of instruments in the portfolio and benchmark.</td>
<td></td>
</tr>
<tr>
<td>Div Yld</td>
<td>The annual dividends per share divided by the price per share, expressed as a percentage.</td>
<td></td>
</tr>
<tr>
<td>ROE</td>
<td>A measure of how well a company used reinvested earnings to generate additional earnings. It is equal to a fiscal year’s after-tax income divided by book value. For stockholders, it is their net income divided by their equity.</td>
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</tbody>
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<tr>
<td>Debt/Equity</td>
<td>Debt-to-Equity Ratio</td>
<td>1) A company’s total liabilities divided by total shareholders’ equity. This reveals the extent to which owner’s equity can absorb creditor claims in the event of liquidation. 2) Total long-term debt divided by total shareholders’ equity. The result is a measure of a company’s leverage. 3) Long-term debt and preferred stocks divided by common stock equity. This differentiates between securities with fixed charges and those without.</td>
</tr>
<tr>
<td>Market Cap</td>
<td>Market Capitalization</td>
<td>The company’s worth calculated by multiplying the shares outstanding by the price per share. For companies with multiple shares, the market cap is equal to the market capitalizations of all common stock classes. For indices, this equals the sum of the current market values of the securities used to compute the index.</td>
</tr>
<tr>
<td>Active Risk</td>
<td>Active Risk or Tracking Error</td>
<td>Expressed as the standard deviation of portfolio active returns. Active risk is also known as tracking error.</td>
</tr>
<tr>
<td>Total Active Risk</td>
<td>Measures risk from factors and non-factors. Total risk is expressed in standard deviation of % return.</td>
<td></td>
</tr>
<tr>
<td>Factor Risk</td>
<td>Measures risk from all factors and is expressed in standard deviation of % return.</td>
<td></td>
</tr>
<tr>
<td>Non-Factor Risk</td>
<td>Measures risk that does not come from factors and is expressed in standard deviation of % return.</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Country Risk Factors</td>
<td>Country Factors The Global Equity Model utilizes 44 country factors defined by 44 country groups. The list of these country groups and their corresponding constituent countries are reported in Appendix C of the Bloomberg Global Equity Whitepaper. Each equity is assigned unit exposure to its corresponding country factor, and zero exposures to other countries. As with industries, the country factor exposures are exactly collinear with the market factor. As a result, we must impose an additional constraint to obtain a unique regression solution. Similar to the case with industries, we set the capweighted sum of country factor returns equal to zero in each period.</td>
</tr>
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<tr>
<td>Industry</td>
<td>Industry Risk Factors</td>
<td>Industry Factors: The Global model employs a bespoke set of 39 industry factors based on a combination of BICS Level 1, 2, and 3 industry groupings. These industry factors give a detailed yet parsimonious representation of the industry structure of the global equity market. We list in Appendix B the 39 industry factors and the corresponding BICS codes. If a security belongs to a given industry, its exposure to that industry is set to one, while its exposures to the other industries are set to zero. Every stock belongs to one and only one industry, and the 39 industry factors form a complete and disjoint classification of all the stocks. By definition, the 39 industry exposures sum to one for each stock, which implies that the market factor exposure can be expressed as the summation of the 39 industry exposures. This introduces the perfect multicollinearity issue into the regression in Equation (2.1), and we need to impose certain linear restriction(s) to obtain a unique regression solution. In particular, the regression is run with the restriction that the capweighted industry factor returns sum to zero.</td>
</tr>
<tr>
<td>Equity</td>
<td>Equity Risk Factors</td>
<td>Returns the simple five year average of the Price to Book Ratio (RR903, PX_TO_BOOK_RATIO). If the quarterly or semiannual periodicity is selected the ratio will return the average of the last five periods (quarters or semiannuals). Unit: Actual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measures risk from all equity factors and is expressed in standard deviation of % return.</td>
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GLOSSARY (continued)
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<tr>
<td>Style</td>
<td>Style Risk Factors</td>
<td>Style factors are the type of factors that are related to securities’ fundamental characteristics. Each style factor consists of one or multiple “atomic” descriptors. The advantages of using multiple descriptors are more robust calculations of factor exposure and better explanatory power. Precise definitions and formulas for style factors and descriptors as well as the descriptor combination weights can be found in Appendix A. Bloomberg detects outliers in the descriptor data and apply rigorous checks to the underlying data to uncover data errors. To further guarantee the model estimation is not adversely influenced by outliers, we apply “winsorization limits” specific to each descriptor. For example, dividend yield is only allowed to vary between 0 and 100%. Because different raw descriptors have different units and scales, we standardize them before combining them into a single style factor. To standardize a given descriptor, we first subtract the cap-weighted mean within each country/country group, and divide by the equal-weighted standard deviation across the entire estimation universe. Standardized values outside of the -3.0/+3.0 bounds are capped at -3.0 or +3.0. This process is repeated multiple times until the mean and the standard deviation converge to zeros and one numerically. Note that using the cap-weighted mean guarantees that the market portfolio within a given country will have zero exposures to the style factors. Once descriptor values are calculated and standardized, a weighted combination of these standardized descriptors within the same category forms the exposure to the factor in question. For example, to form the Size factor, we combine three standardized descriptors: logarithm of market-cap, logarithm of sales, and logarithm of total assets. We explain in the next section how the combination weights assigned to descriptors are determined. Style factor exposures are designed to be relatively stable through time, as can be seen in Table 3.1, which reports the average Spearman autocorrelations for each style factor. Most factor exposures, except momentum, maintain relatively high correlations with their past values even after one year.</td>
</tr>
<tr>
<td>Momentum</td>
<td>Momentum (style factor)</td>
<td>Momentum separates stocks that have outperformed over the past year and those that have underperformed. Cumulative return over one year (averaged), skipping the most recent two weeks to mitigate the price reversal effect:</td>
</tr>
<tr>
<td>GICS</td>
<td>The Global Industry Classification Standard (GICS) is a standardized classification system for equities developed jointly by Morgan Stanley Capital International (MSCI) and Standard &amp; Poor's. The GICS methodology is used by the MSCI indexes, which include domestic and international stocks, as well as by a large portion of the professional investment management community. The GICS hierarchy begins with 11 sectors and is followed by 24 industry groups, 68 industries, and 157 sub-industries. Each stock that is classified will have a coding at all four of these levels.</td>
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</table>
| **Value**             | Value     | Value is a composite metric that differentiates “rich” and “cheap” stocks. Bloomberg combines fundamental and analyst consensus data to calculate this factor. Combination of the following descriptors:  
  - Book to Price (13%)  
  - Earnings to Price (19%)  
  - Cash Flow to Price (18%)  
  - Sales/EV (10%)  
  - EBITDA/EV (21%)  
  - Forecast Earnings to Price (19%)  

Note1: EV (Enterprise Value) is given by: EV = Market Cap + LT Debt + max(ST Debt – Cash, 0), where LT (ST) stands for long (short) term  
Note2: Forecast Earnings are calculated from Bloomberg earnings consensus estimates data. We focus on the 1-year and 2-year forward earnings because data coverage drops off for longer horizons. |
| DivYld                 | Dividend Yield | Dividend Yield is another dimension of value, but distinct enough to be a standalone factor. Most recently announced net dividend (annualized) divided by the current market price (100%) |
| **Size**               | Size       | Size is a composite metric distinguishing between large and small stocks. Combination of the following descriptors:  
  - Log (Market Capitalization) (31%)  
  - Log (Sales) (34%)  
  - Log (Total Assets) (35%) |
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<tbody>
<tr>
<td>Trading Activity</td>
<td>Trading Activity (style factor)</td>
<td>Trading Activity is a turnover based measure. Bloomberg focuses on turnover which is trading volume normalized by shares outstanding. This indirectly controls for the Size effect. The exponential weighted average (EWMA) of the ratio of shares traded to shares outstanding: In addition, to mitigate the impacts of those sharp short lived spikes in trading volume, Bloomberg winsorizes the data: first daily trading volume data is compared to the long-term EWMA volume (180 day half-life), then the data is capped at 3 standard deviations away from the EWMA average.</td>
</tr>
</tbody>
</table>
| Earnings Variability | Earnings Variability (style factor) | Earnings Variability gauges how consistent earnings, cash flows, and sales have been in recent years. Combination of the following descriptors:  
  - Earnings Volatility to Total Assets (34%)  
  - Earnings Volatility over the last 5 years/Median Total Assets over the last 5 years  
  - Cash Flow Volatility to Total Assets (35%)  
  - Cash Flow Volatility over the last 5 years/Median Total Assets over the last 5 years  
  - Sales Volatility to Total Assets (31%)  
  - Sales Volatility over the last 5 years/Median Total Assets over the last 5 years |
| Profitability        | Profitability (style factor) | Profitability studies firms’ profit margins to differentiate between money makers and money losers. Combination of the following descriptors:  
  - Return on Equity (26%)  
  - Net Income/Book Value  
  - Return on Assets (28%)  
  - Net Income/Total Assets  
  - Return on Capital Employed (28%)  
  - Net Income/Capital Employed  
  - EBITDA Margin (18%)  
  - EBITDA/Sales  
  Note: Net Income is that before extraordinary items. |
### GLOSSARY (continued)

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| Volatility            | Volatility (style factor) | Volatility differentiates more volatile stocks and less volatile ones by quantifying "volatile" from several different angles. Combination of the following descriptors:  
  - Rolling Volatility = Return volatility over latest 252 trading days (29%)  
  - Rolling CAPM Beta = Regression coefficient from the rolling window regression of stock returns on local index returns (18%)  
  - Historical Sigma = Residual volatility from the rolling window regression of stock returns on local index returns (28%)  
  - Cumulative Range = The ratio of maximum and minimum stock price over the previous year (25%)  
  Note: Bloomberg adjusts the volatility factor exposure by regressing it on the rest of factor exposures, and standardizes the regression residual the usual way. This does not change the explanatory power of the model, but it makes the volatility factor more distinct by significantly reducing its correlation with other factors. |
| Growth                | Growth (style factor) | Growth aims to capture the difference between high and low growers by using historical fundamental and forward-looking analyst data. Combination of the following descriptors:  
  - Total Asset Growth (23%)  
    5-year average growth in Total Assets/Average Total Assets over the last 5 years  
  - Sales Growth (25%)  
    5-year average growth in Sales/Average Total Assets over the last 5 years  
  - Earnings Growth (18%)  
    5-year average growth in Earnings/Average Total Assets over the last 5 years  
  - Forecast of Earnings Growth (14%)  
    2-year forecast EPS/1-year forecast EPS  
  - Forecast of Sales Growth (20%)  
    2-year forecast Sales/1-year forecast Sales |
### GLOSSARY (continued)

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</table>
| Leverage              | Leverage (style factor) | Leverage is a composite metric to gauge a firm’s level of leverage. Combination of the following descriptors:  
  - Book Leverage (34%)  
  - Market Leverage (33%)  
  - Debt to Total Assets (33%)  
  Note: LT (ST) stands for long (short) term |
| Currency              | Currency Risk Factors | Measures risk from all Bloomberg currency factors and is expressed in standard deviation of % return. |
| Commodity             | Commodity Risk Factors | Measures risk from all commodity factors and is expressed in standard deviation of % return. |
| Alternative           | Alternative Risk Factors | Measures risk from all alternative factors and is expressed in standard deviation of % return. |
| Fixed Income          | Fixed Income Risk Factors | Measures risk from all Bloomberg fixed-income factors and is expressed in standard deviation of % return. |
| Yield Curve           | Yield Curve Risk Factors (fixed-income factor) | Measures risk from all Bloomberg Yield Curve factors and is expressed in standard deviation of % return. |

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<tbody>
<tr>
<td>Spread</td>
<td>Spread Risk Factors (fixed-income factor)</td>
<td>Measures risk from all Bloomberg spread factors and is expressed in standard deviation of % return.</td>
</tr>
<tr>
<td>VaR</td>
<td>Value at Risk</td>
<td>Measured as a % of market value, VaR measures the maximum loss projected given inputs for the time horizon and confidence level. The can be measured on the portfolio, benchmark, or active/difference portfolio.</td>
</tr>
<tr>
<td>Confidence Level</td>
<td></td>
<td>A measure of the degree of confidence for a random variable of interest. A confidence interval of X is defined as the probability that, given the underlying distribution of the random variable, the set of possible outcomes lies in a range greater than or equal to a pre-determined value. For example, a confidence level of 95% means that you are 95% confident that the portfolio will be subject to no more than the maximum loss indicated by the VaR computation.</td>
</tr>
<tr>
<td>MC</td>
<td>Monte Carlo Simulation</td>
<td>Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models.</td>
</tr>
<tr>
<td>CVaR</td>
<td>Conditional VaR</td>
<td>A risk assessment technique often used to reduce the probability a portfolio will incur large losses. This is performed by assessing the likelihood (at a specific confidence level) that a specific loss will exceed the value at risk. Mathematically speaking, CVaR is derived by taking a weighted average between the value at risk and losses exceeding the value at risk. This term is also known as &quot;Mean Excess Loss&quot;, &quot;Mean Shortfall&quot; and &quot;Tail VaR&quot;.</td>
</tr>
<tr>
<td>Short Name or Acronym</td>
<td>Full Name</td>
<td>Definition</td>
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<td>----------------------</td>
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<tr>
<td>Scenario Analysis</td>
<td></td>
<td>The process of estimating the expected value of a portfolio after a given period of time, assuming specific changes in the values of the portfolio’s securities or key factors that would affect security values, such as changes in the interest rate.</td>
</tr>
<tr>
<td>Bloomberg Risk Model (Regional)</td>
<td></td>
<td>Combines individual regional risk models; full whitepapers available on request</td>
</tr>
</tbody>
</table>
| U.S. Equity Fundamental Risk Model | | The model employs a multiple factor modeling approach, which allows a responsive yet stable assessment of major risk factors affecting U.S. Equity assets and portfolios. The main characteristics of the Bloomberg U.S. Model are:  
- Coverage of over 20,000 U.S. equity securities with model start date 1999.  
- Dynamic estimation universe updated weekly to ensure the model is responsive to the changing market environments; additionally, a gatekeeping system is designed to smooth out the estimation universe changes.  
- 40 industry factors based on Bloomberg Industry Classification System (BICS).  
- 10 style factors: Momentum, Value, Dividend Yield, Size, Trading Activity, Earnings Variability, Profitability, Volatility, Growth, and Leverage.  
- Idiosyncratic risk modeling based on a separate structural factor model which incorporates additional variables useful for forecasting non-factor risk.  
The full whitepaper is available on request |
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<tbody>
<tr>
<td>Global Equity Fundamental Risk Model</td>
<td>The model employs a multiple factor modeling approach, which allows a responsive yet stable assessment of major risk factors in the Global equity markets. The broad universal coverage makes this model suitable for clients whose portfolios span multiple countries and regions and for those who prefer to take a global perspective on risk factors. The main characteristics of the Bloomberg Global Model are:</td>
<td>Coverage of over 100,000 Global equity securities with model start date 1999. Dynamic estimation universe updated weekly to ensure the model is responsive to the changing market environments; additionally, a gatekeeping system is designed to smooth out the estimation universe changes. 39 industry factors based on Bloomberg Industry Classification System (BICS). 10 style factors: Momentum, Value, Dividend Yield, Size, Trading Activity, Earnings Variability, Profitability, Volatility, Growth, and Leverage. 44 country/group factors covering over 100 countries Idiosyncratic risk modeling based on a separate structural factor model which incorporates additional variables useful for forecasting non-factor risk. The full whitepaper is available on request</td>
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<td>Fixed Income Risk Model</td>
<td>The Bloomberg fixed income model covers sovereign, agency (quasi government) and corporate bonds in both investment and high yield grades denominated in 38 currencies. Traditionally, most fixed income indices are organized primarily based on the currency denomination, rather than the country of the issuer. For fixed income risk model purpose, Bloomberg groups the whole world into two categories: the developed markets, and the emerging markets. So Bloomberg would have four different combinations as illustrated in the following chart: developed countries issue bonds in developed currencies (or hard currencies hereafter), emerging countries issue bonds in hard currencies, emerging countries issue bonds in local emerging currencies and developed countries issue bonds in emerging currencies. For risk model purpose, Bloomberg groups the last two together since there are very limited data for bonds in emerging market currency denominated bonds. For the first case of developed countries issue bonds in developed currencies, Bloomberg has developed what it will refer to as the “G7 models”: the USD, EUR, JPY, GBP, CAD, AUD and CHF. In this category, Bloomberg will add other markets such as NOK, DKK soon. For the case of emerging countries issue bonds in developed currencies, Bloomberg developed the EM hard currency model. For bonds denominated in emerging market currencies, Bloomberg has the EM local currency model. In the whitepaper, Bloomberg focuses on the G7 model. For the EM models, Bloomberg defers the details to the white paper on fixed income emerging market factor model. The full whitepaper from Bloomberg is available on request.</td>
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### Bloomberg Global Risk Model

The Bloomberg Global Risk Model is built upon the second-generation Bloomberg Multi-Asset Class risk model (MAC2), the successor to the first-generation Bloomberg Multi-Asset Class risk model, denoted MAC1. The Bloomberg MAC2 Model provides investors with a powerful new tool for risk management and portfolio construction. The model is designed to address the full range of investment risk applications, ranging from large pension funds managing risk across multiple asset classes, to specialized managers constructing portfolios within a narrow segment of a given market. Notable highlights of the Bloomberg MAC2 Model include:

- Introduction of an innovative methodology to robustly estimate the high dimensional factor covariance matrices intrinsic to multi-asset class risk models
- New specialized factor models for hedge funds and private equity that leverage extensive proprietary Bloomberg data sets
- Introduction of the Bloomberg Industry Classification Scheme (BICS) for equity industry factors
- Expanded asset coverage to include non-agency CMOs, caps, floors, swaptions, and inflation-linked bonds (for 13 additional countries)

The Bloomberg Global Risk Model combines the Global Equity Fundamental Model, the Fixed Income Model, and others depending on the types of instruments in the portfolio.

Full whitepapers for each model are available on request.

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**Short Name or Acronym** | **Full Name** | **Definition**
--- | --- | ---
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