2018 Investment Symposium

Session 4B: Using Factor Investing in Strategic Asset Allocation

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2018 Investment Symposium

BOB BASS

Session 4B: Using Factor Investing in Strategic Asset Allocation

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SOCIETY OF ACTUARIES®

A factor-based approach to asset allocation

Bob Bass

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BLACKROCK®

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What factors do I own?

Factor-based investing seeks to capture broad, persistent drivers of returns

Portfolio returns can be broken down into macro factors, style factors and pure alpha

Market Exposure	Active Non-Market Exposure	
Macro Factors	**Style Factors**	**Pure Alpha**
Explains 90% of asset class variation[1]	**Explains ~80% of returns within asset class[2]**	
Primary drivers of returns across asset classes and broad markets, historically rewarding investors for taking on non-diversifiable risks:	*Rewarded characteristics within asset classes – capturing a risk premium, behavioral anomaly or structural impediment*	*Idiosyncratic risks only consistently rewarded for managers with skill*

Economic growth
Bearing exposure to the business cycle

Inflation
Bearing risk to changes in prices

Rates
Bearing risk of rising rates

Credit
Bearing risk of company default

Emerging markets
Exposure to political and sovereign risks

Liquidity
Exposure of holding illiquid assets

Value
Buying cheap

Momentum
Taking on trends

Quality
Seeking stable earnings

Minimum Volatility
Flight to safety

Carry
Harvest income

Security selection

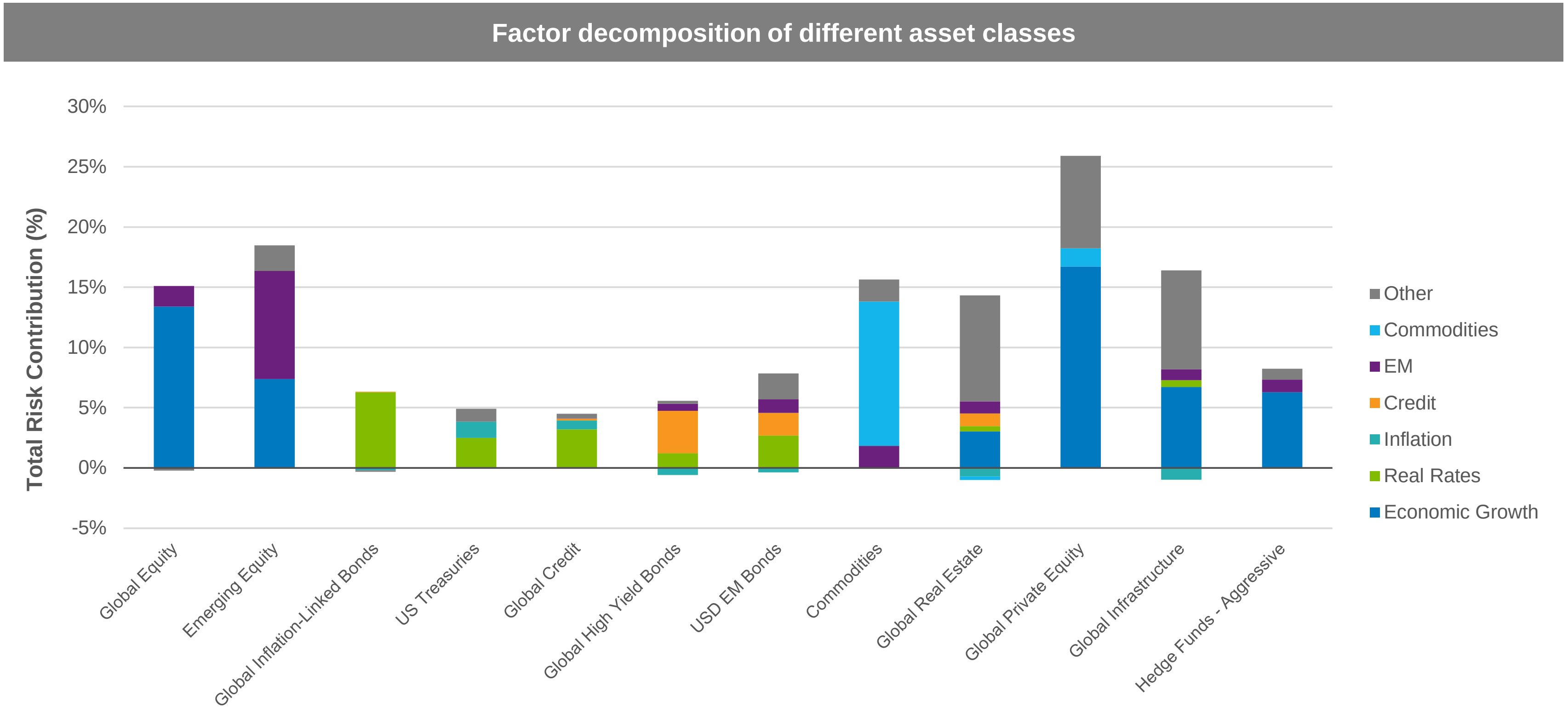
Country and industry selection

Market and factor timing

Source: BlackRock
1. Hogan, Ked, and Andrew Ang. "Introduction to Macroeconomic Factors."
2. Source: BlackRock. According to our principal components analysis ("PCA"), which is a statistical analysis that breaks down asset class returns into orthogonal components (or "factors") in an attempt to explain their variability, we found four factors explain 80% of the variability across asset classes.

Factors are the building blocks of traditional asset classes

Factors allow investors to examine all asset classes – public or private, traditional or alternative – using a common language

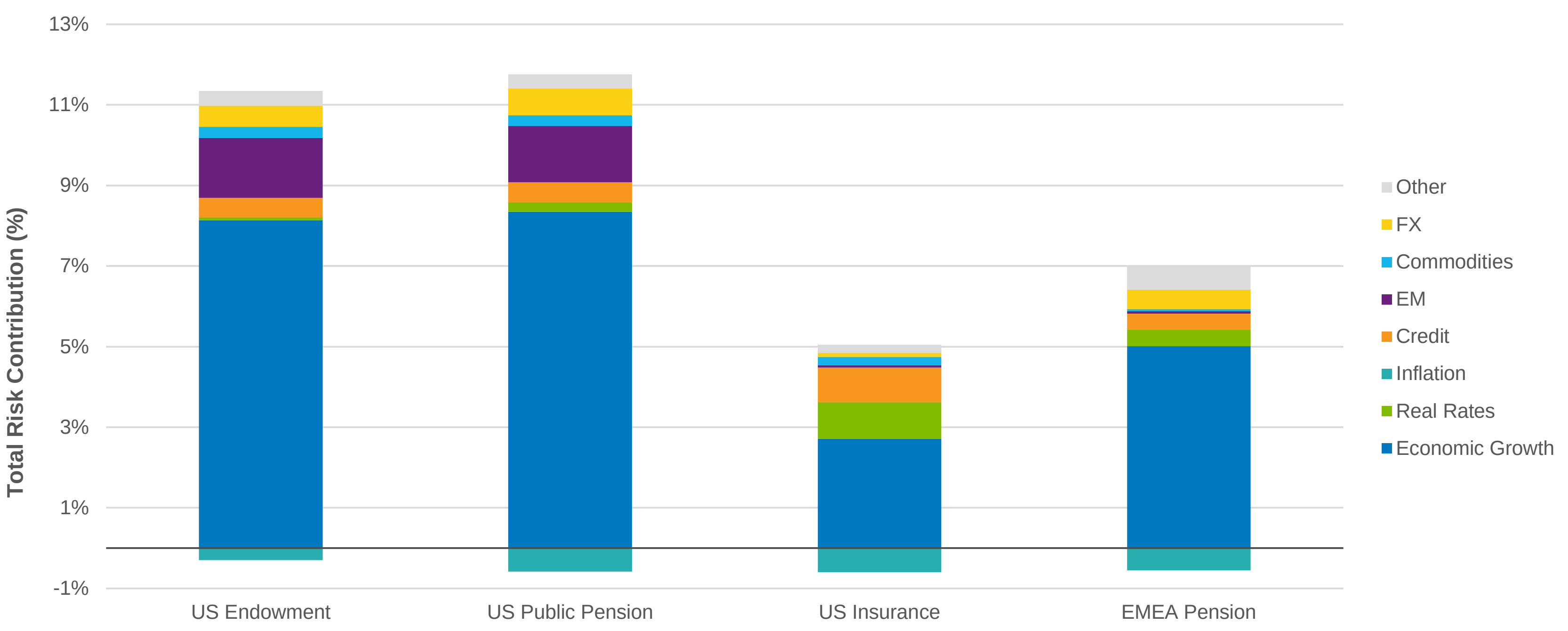


Source: Aladdin Factor Workbench. As of 30 June 2017. Global asset classes are all hedged to USD. Risk contribution is the risk decomposition of the portfolio by factor, taking into account the correlations between the factors and benefits of diversification, using a lookback period of 15-years. See appendix slide "Asset Class Proxies" for information on the underlying indexes.

Institutional client types are typically exposed to a common set of factors

Examining their total asset allocation—including alternatives and private assets— through a factor view, investors can gain new insights into their risk and diversification

Macro factor risks in institutional portfolios

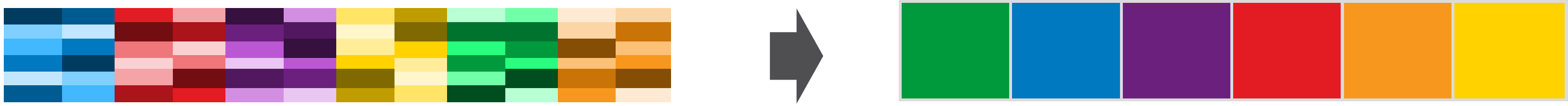


Source: Aladdin. As of 31 December 2016. Risk contribution is the risk decomposition of the portfolio by factor, taking into account the correlations between the factors and benefits of diversification, using a lookback period of 15-years. U.S. Endowment portfolio is based on the Nacubo Survey. U.S. Public Pension portfolio is based on the BlackRock Public Pension Peer Survey. U.S. Insurance portfolio is based on BlackRock FIG Study (SNL Data). EMEA Pension portfolio is based on a representative portfolio. "Other" includes risk contributions from style factor exposures and idiosyncratic risks. See appendix slide "Client Portfolios" for information on the underlying asset allocation.

Modeling factor exposures

Each asset class consists of hundreds or even thousands of underlying *securities*. Each of these securities can be mapped onto a set of granular *risk factors*, which can then be translated to *macro investment factors*

Granular Risk Factors **Macro Investment Factors**



- ➢ **Designed for *risk management***
- ➢ **Designed for asset allocation and portfolio insight**

Advanced technology and risk analytics allow us to translate individual security holdings into a holistic view of the portfolio at the enterprise level

- Reframe asset allocation, portfolio analysis and manager selection along factor dimensions
- Compare and contrast factor exposures through a variety of market scenarios
- Incorporate investor preferences to obtain the optimal allocation across factors

For illustrative purposes only

What factors do I want to own?

What's the right combination of factors?

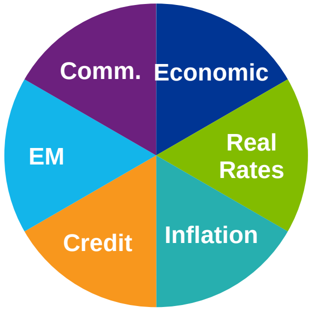
We utilize a factor framework to examine an institutional plan's investment goals and outline three potential approaches in adopting factor-based allocations to meet their goals.

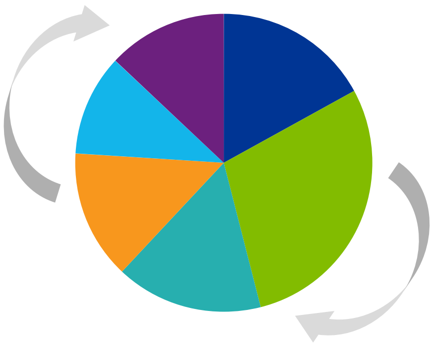
ABC Plan's Investment Objectives

- Total plan target risk of 10%
- Improve risk-adjusted returns
- Strong preference for liquid investments
- Sensitive to drawdowns over 2-year horizons

We examine three potential approaches

Equal Weighted Macro Factors	Targeted Macro Factors	Targeted Macro Factors + Styles





Portfolio and analysis provided for illustrative purposes only to demonstrate BlackRock's approach to factors. It is not representative of any actual client's portfolio.

Incorporating investor preferences

- The equal weighted portfolio is the simple and diversified straw man
- But not all factors are created equal. A more nuanced approach incorporates investor preferences and considers the characteristics of each factor

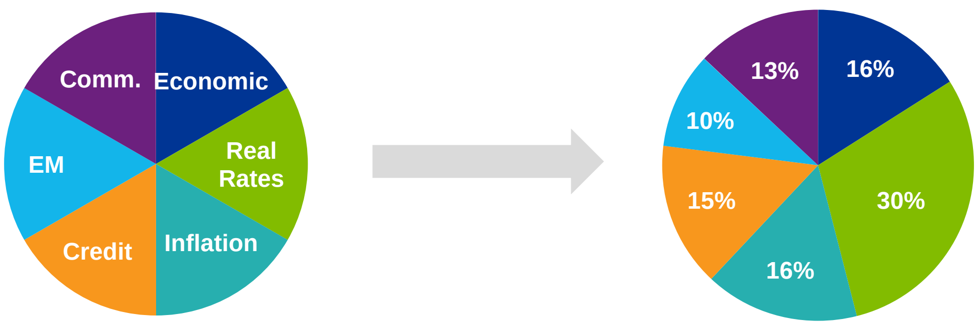
Consideration	Economic Growth	Credit	Emerging Markets	Real Rates	Inflation	Commodities
Drawdown Mitigation	−	−		+	+	
Return/Risk Ratio	+	+			−	−
Liquidity in Market Downturns				+	+	
Conclusion: Overweight/Neutral/Underweight? (relative to equal risk weighting)		−	−	+		−

Real Rates and Inflation can provide a natural hedge during downturns

Economic and Credit factors historically have higher expected return/risk ratios

Certain asset class representation of the factors may provide liquidity in times of stress

Incorporating these qualitative tilts and factor characteristics we arrive at the targeted portfolio:



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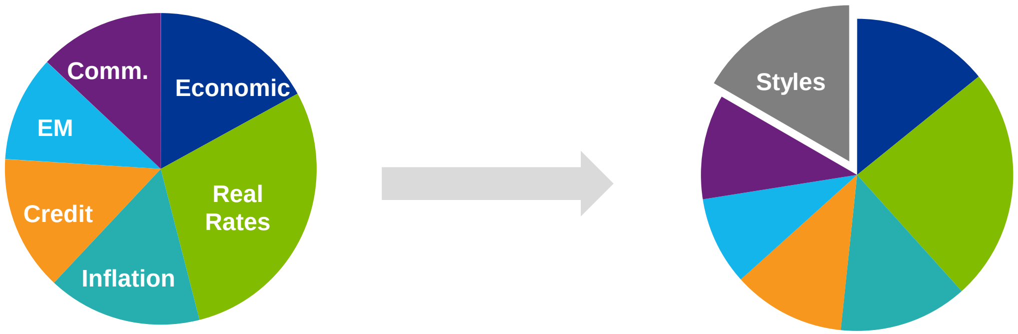
Incorporating long/short multi-asset style factors

Our targeted macro factor portfolio is well-diversified and incorporates the client's investment goals. ABC may consider complementary sources of return to further enhance risk-adjusted returns



With an average pairwise correlation of *zero* to macro factors, the addition of style factors is highly diversifying

	Carry	Momentum	Value	Quality	Min Vol	Economic	Real Rates	Emerging Markets	Credit	Inflation	Commodities
Carry	1	-0.2	0.2	-0.1	0.1	0.3	0.3	0.3	0.2	-0.2	0.4
Momentum		1	-0.4	0.1	0.0	-0.3	0.1	-0.6	-0.5	0.4	-0.5
Value			1	0.2	0.2	0.2	-0.1	0.2	0.2	-0.1	0.0
Quality				1	0.2	0.0	-0.1	-0.2	-0.1	0.1	-0.3
Min Vol					1	0.2	0.0	0.0	0.1	-0.1	0.0
Economic						1	0.3	0.3	0.7	-0.6	0.3
Real Rates							1	0.5	0.2	-0.2	0.1
Emerging Markets								1	0.5	-0.4	0.5
Credit									1	-0.7	0.6
Inflation										1	-0.6
Commodities											1

Source: BlackRock. Correlations are over a five-year period ending June 2017, using monthly returns. Macro factor returns are annualized returns that mimic each factor, adjusted to ex-ante annualized risk level of 10%. Style factor returns are adjusted to ex-ante annualized risk level of 5%. Factor returns are gross of all fees and transaction costs.

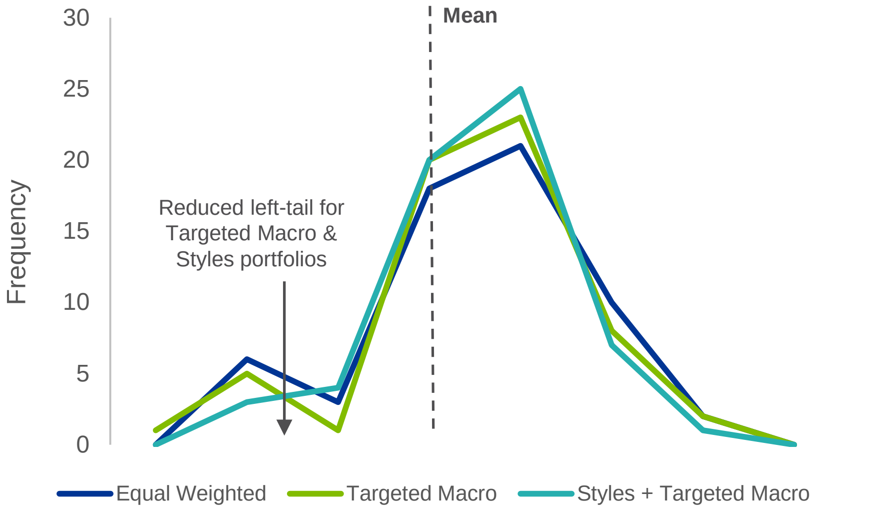
Seeking to meet client objectives

Each of our three factor portfolios is diversified across the most important drivers of return, considering ABC's investment objectives

Moving from the equal-weighted portfolio to the targeted one would modestly improve expected returns, and adding style factors would improve returns further while also reducing risk.

Expected risk & return profiles

Distribution of five-year monthly returns



For illustrative purposes only. The Targeted Macro & Equal Weighted portfolios are constructed to target 10% risk.

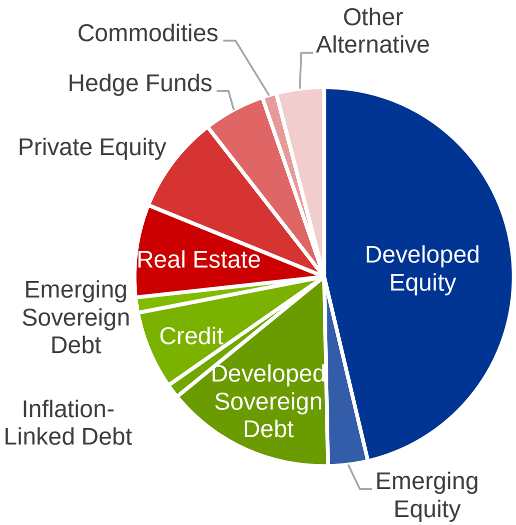
How to implement my desired factor view?

Implementing deliberate shifts in factor allocations in real-world portfolios

In reality, investors have well-ingrained asset allocation frameworks and cannot work from a blank slate. We consider incremental steps investors can take to help diversify portfolios away from economic growth, which dominates many institutional plans

- Using the average U.S. Public Pension as the starting portfolio we consider three allocation shifts, moving 20% from developed equities

U.S. Public Pension Asset Allocation



Expected Return: 5.81%
Expected Risk: 11.74%
Sharpe Ratio: 0.33

Potential Asset Allocation Shifts

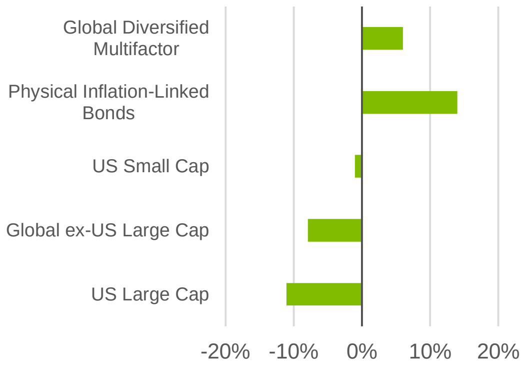
Start with physical exposures	✓ **Inflation-linked bonds** ✓ **Boost returns with smart beta**
Maintain returns with leverage	✓ **Developed bond futures** ✓ **Boost returns with smart beta**
Holistic factor-based approach	✓ **Macro & style factor strategies**

As of August 2017. U.S. Public Pension portfolio is based on the BlackRock Public Pension Peer Survey. See appendix slide "Client Portfolios Asset Allocation" for information on the underlying asset allocation.

Practical shifts to existing portfolio can help enhance diversification

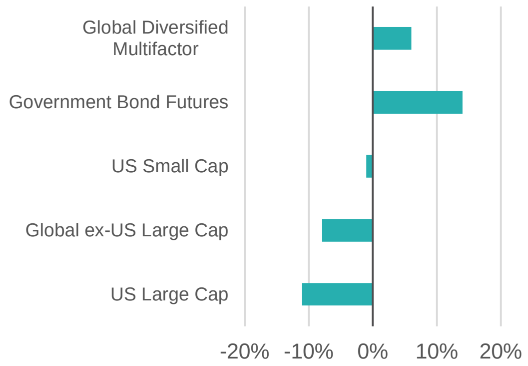
Asset Allocation Changes

Option 1 – Physical Exposures



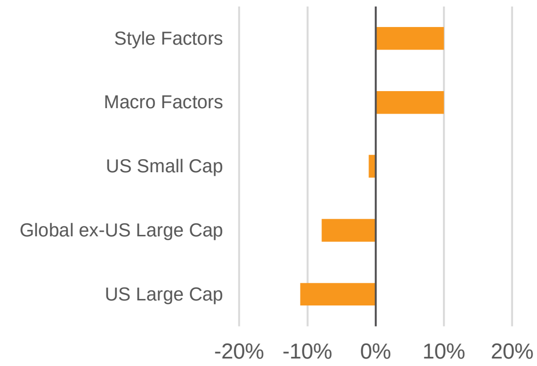
Change to:	
Expected Return	-0.4%
Expected Risk	-1.9%
Sharpe Ratio	+0.01

Option 2 – Bond Futures



Change to:	
Expected Return	-0.4%
Expected Risk	-2.0%
Sharpe Ratio	+0.02

Option 3 – Factor Strategies



Change to:	
Expected Return	+0.5%
Expected Risk	-2.0%
Sharpe Ratio	+0.11

Implementation points to consider:

- ✓ **Options 1 & 2 offer the most direct diversification benefit by explicitly increasing exposure to real rates and inflation factors, however require leverage to maintain the same level of expected total return**
- ✓ **Option 3 does not sacrifice return or require leverage at the plan level, and the task of managing factor exposures can be outsourced to manager**

Source: Aladdin Factor Workbench, BlackRock Investment Institute. See appendix slide "Capital Market and Modeling Assumptions" for more information.

Powering more informed investment decisions with factors

Factors provide a common language to uncover true drivers of risk and return

- Incorporate unique investor goals with the factor framework
- Inform modest shifts from existing portfolios to enhance diversification
- Macro or style framework can be used to position portfolios tactically or strategically

Appendix

Asset Class Proxies

AFW Asset Class	Representative Index
Global Equity	MSCI All Country World Index
Global Small Cap	MSCI World Small Cap
Emerging Market Equity	MSCI Emerging Markets
Global Infrastructure Equity	BlackRock Proxy
Global Aggregate Bonds	Barclays Global Aggregate Index
Global Credit	Barclays Global Aggregate Corporate Index
Global Inflation-Linked Bonds	BofA ML Global Governments, Inflation-Linked Index (W0GI)
Global High Yield Bonds	Barclays Global High Yield Index
Emerging Markets Bonds (Local Currency)	JP Morgan GBI-EM Index
Global Real Estate	BlackRock Proxy
Global Private Equity	BlackRock Proxy
Hedge Funds - Defensive	HFRI Relative Value Index
Hedge Funds - Aggressive	HFRI Equity Hedge Index
Global REITs	FTSE EPRA/NAREIT Global REITs Index Gross TR
Macro Factor	Macro Factor Allocation [see disclosure next page]
Style Factor	Style Factor Allocation [see disclosure next page]
US Diversified Multi Factor	MSCI US Diversified Multi Factor
Global Diversified Multi Factor ex-US	MSCI Global Diversified Multi Factor ex-US
Commodities	Bloomberg Commodity Index Total Return
Leveraged Loans	LSTA Leveraged Loan Index
US Treasuries	Barclays Government Index
US Treasuries (10+ Yrs)	Barclays Long Government Index
US Inflation-Linked Bonds	Barclays US Government Inflation-Linked Bond Index
US Inflation-Linked Bonds (15+ Yrs)	Barclays US Government 15Yr + Inflation-Linked Bond Index
US Credit	Barclays U.S. Credit Index
US Credit (10+ Yrs)	Barclays US Long Credit Index
US High Yield	Barclays US Corp High Yield 2% Issuer Capped Index
US Aggregate Bonds	Barclays U.S. Aggregate Bonds
US Taxable Municipal Bonds	Barclays Taxable Municipal Bond Index
US Tax Exempt Municipal Bonds	S&P Municipal Bond Investment Grade Index TR
US ABS	Barclays ABS Index
US Agency	Barclays Agency Index
US MBS	Barclays MBS Index
US CMBS	Barclays CMBS, Eligible for U.S. Aggregate
Global Govt Bonds ex-US	Barclays Global Aggregate ex-USD Hedged
Global Govt Inflation-Linked Bonds ex-US	Barclays Global Inflation Linked ex-US Index
Global Credit ex-US	Barclays Global Agg Credit Index ex USD
Global Aggregate Bonds ex-US	Barclays Global Aggregate Index ex USD Index
Emerging Markets Bonds (Hard Currency)	JP Morgan EMBI Global Diversified Index
US Large Cap	MSCI USA
Global Large Cap ex-US	MSCI World ex-US Index 100% USD Hedged Index
US Small Cap	MSCI USA Small Cap
US Preferred Stock	S&P Preferred Stock Index
UK Gilts	FTA All Stocks Gilt Index

AFW Asset Class	Representative Index
UK Gilts (15+ Yrs)	FTA All Stocks Gilts Index
UK Index-Linked Gilts (5+ Years)	FTSE Actuaries UK Index Linked Gilts Over 5 Years Index
UK Corporate Bonds	BofA ML Sterling Corporate Securities Index (UR00)
UK Corporate Bonds (10+ Yrs)	BofA ML Sterling Corporate Securities 10+ Yrs Index (UR09)
Global Govt ex-UK	BofA ML Global Government Ex UK Index
UK Large Cap	MSCI United Kingdom Index
Global Large Cap ex-UK	MSCI World ex U.K.
EUR Government	Barclays Global Aggregate Euro Treasury Index
EUR Government (15+ Yrs)	Barclays Euro Aggregate Treasury 15+ Yr Index
EUR Inflation-Linked Bonds	BofA ML EMU Direct Government Inflation Linked EG0I
EUR Corporate Bonds	BofA ML Euro Corporate Index (ER00)
EUR Corporate Bonds (10+ Yrs)	BofA ML EMU 10+ Yr Index (ER09)
Global Govt ex-EUR	BofA Merrill Lynch Global Government Bond II ex-EMU Index (N0Q1)
EUR Large Cap	MSCI EMU Net TR Index
Global Large Cap ex-EUR	MSCI World Ex EMU
Swiss Government Bonds	Swiss Exchange SBI Domestic Government TR Index
Swiss Government Bonds (10+ Yrs)	Barclays Swiss Government 10+ Yr Index
Swiss Corporate Bonds	Barclays CHF Aggregate Corporate Bond Index
Swiss Large Cap	Switzerland SPI Index
Global Large Cap ex-Swiss	MSCI Developed World ex Switzerland NET Index
Australian Equity	ASX 300
Global Large Cap ex-Australia	MSCI Developed World ex-AU
Australia Real Estate	FTSE EPRA/NAREIT Index
Australia Fixed Income	Bloomberg Australia Bond Composite
Australia Inflation-Linked Bonds	Barclays Australia Govt Inflation-Linked Bond Index
Canadian Large Cap	S&P/TSX Composite Index
Global Large Cap ex-Canada	MSCI World Ex Canada Index
Canadian Universe Bonds	FTSE TMX Canada Universe Bond Index
Canadian Long Bonds	FTSE TMX Canada Long Term Bond Index
Canadian Real Rate Bonds	FTSE TMX Canada Real Return Bond Index
Canadian Corporate Bonds	FTSE TMX Canada All Corporate Bond Index
Canadian Real Estate	FTSE EPRA/NAREIT Canada Index
Asia Equity ex-Japan	MSCI AxJ Equities
Asia Credit ex-Japan	JPMorgan Asia Credit Index
Asia Bonds ex-Japan	Markit iBoxx Asia Local Bonds Index
Japanese Equity	MSCI Japan Index
Global Large Cap ex-Japan	MSCI World ex Japan Index
Japanese Treasuries	Barclays Global Treasury Japan Index
Japanese Treasuries (10+ Yrs)	Barclays Japan Treasury Over 10 Year Index
Japanese Inflation-Linked Treasuries	Barclays Japan Government Inflation-Linked Bond Index
Japanese Corporate Bonds	BofA Merrill Lynch Japan Corporate Index
Japanese Aggregate Bonds	BofA Merrill Lynch Japan Broad Market Index
Global Aggregate Bonds ex-Japan	Barclays Global Aggregate Ex-Japan Index
Global Treasuries ex-Japan	Barclays Global Treasury ex Japan Index
Japanese REITs	S&P Japan REIT (JPY) Gross Total Return Index

Client Portfolios Asset Allocation

US Public Pension Asset Allocation	
US large cap	25.2%
Global ex-US large cap	18.0%
US small cap	2.3%
EM equity	3.3%
US government	1.1%
US government (10+ years)	0.2%
US inflation-linked government	1.2%
US credit (all maturities)	4.4%
US credit (long bonds)	0.7%
US high yield	1.4%
US aggregate bond index	11.7%
Global ex-US treasuries	1.2%
USD EM debt	1.0%
Local-currency EM debt (unhedged)	0.3%
US bank loans	1.1%
US cash	1.5%
US core real estate	7.8%
Global private equity	8.2%
Global infrastructure equity	0.8%
Hedge Funds (global)	5.2%
Commodities	1.2%
Global infrastructure debt	0.1%
Risk parity	0.4%
Real assets	1.6%

US Endowment Asset Allocation	
US cash	6.0%
US high yield	1.3%
US aggregate bond index	10.1%
Global ex-US treasuries	1.0%
USD EM debt	0.5%
US large cap	22.5%
Global ex-US large cap	14.4%
US small cap	3.5%
EM equity	5.6%
US core real estate	3.2%
Global private equity	9.5%
Global infrastructure equity	0.0%
Hedge funds (global)	18.9%
Commodities	1.8%
Global infrastructure debt	1.8%

US Insurance Factor Exposures	
Macro - USD	2.1%
Macro - GLB Commodity	2.0%
Macro - GLB Credit	18.2%
Macro - GLB EM	0.6%
Macro - GLB Economic Growth	18.2%
Macro - GLB Inflation	30.6%
Macro - GLB Real Rates	28.2%

EMEA Pension Asset Allocation	
EUR large cap	13.0%
Global large cap ex-EUR	21.0%
EUR government	47.0%
Global aggregate bonds	5.0%
Commodities	2.0%
Global private equity	3.0%
Global real estate	3.0%
Hedge funds - aggressive	4.0%
EUR cash	2.0%

Capital Market and Modeling Assumptions

Asset Class	Benchmark	Long-term Annual Expected Return
Global Diversified Multifactor	MSCI ACWI Global Diversified Multifactor Index	5.92%
Physical Inflation-Linked Bonds	Barclays US Government Inflation Linked Bond Index	2.81%
US Small Cap	MSCI USA Small Cap Index	6.05%
Global ex-US Large Cap	MSCI World ex-US Index	6.48%
US Large Cap	MSCI USA Index	5.92%
Government Bond Futures	Barclays Government Index	2.68%

- *Macro Factors: 100% allocation to a hypothetical long-only Macro Factor Portfolio* – 13.5% to Economic Growth; 35.9% to Real Rates; 16.7% to Inflation; 15.5% to Credit; 11.0% to Emerging Markets; and 4.0% to Commodities. Factors represent the following contributions to risk in the balanced macro factor portfolio: 3.59% from Economic Growth; 2.28% from Real Rates; -0.77% from Inflation; 1.42% from Credit; 1.98% from Emerging Markets; and 1.05% from Commodities. The balance of exposure and risk contribution are from FX and Other. This is modeled with a hypothetical Sharpe Ratio of 0.5.

- *Style Factors: 100% allocation to a hypothetical long/short Style Factor Portfolio* – 0.5% to Economic Growth; 0.1% to Real Rates; 0.0% to Inflation; 0.1% to Credit; -0.4% to Emerging Markets; and 0.0% to Commodities. Factors represent the following contributions to risk in the style factor portfolio: 1.33% from Economic Growth; -0.02% from Real Rates; 0.00% from Inflation; 0.09% from Credit; -0.04% from Emerging Markets; and -0.03% from Commodities. The balance of exposure and risk contribution are from FX and Other. This is modeled with a hypothetical Sharpe Ratio of 1.0.

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