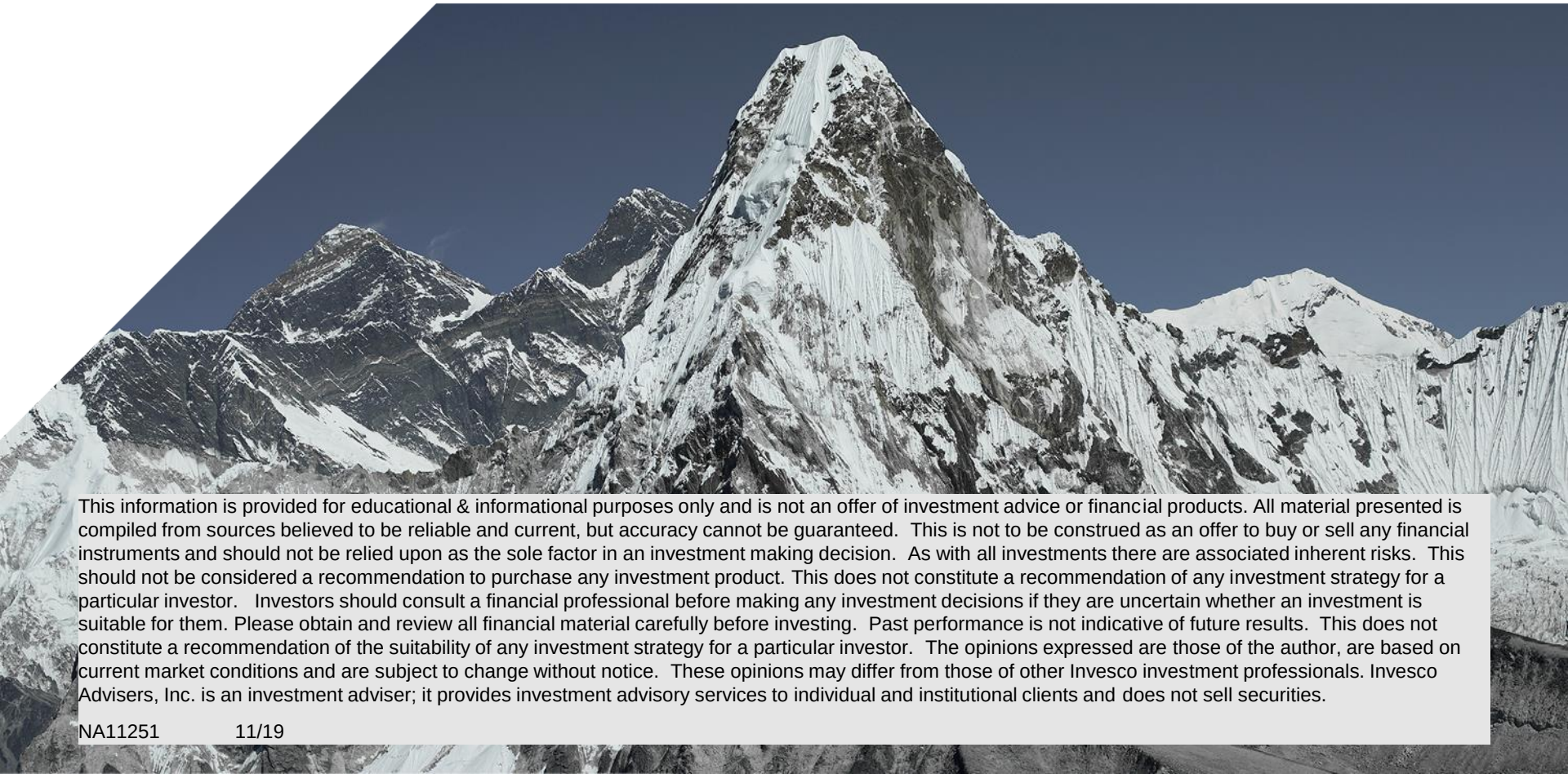
Fixed-Income Factors
Invesco Fixed Income

For institutional investor use only - not for further distribution



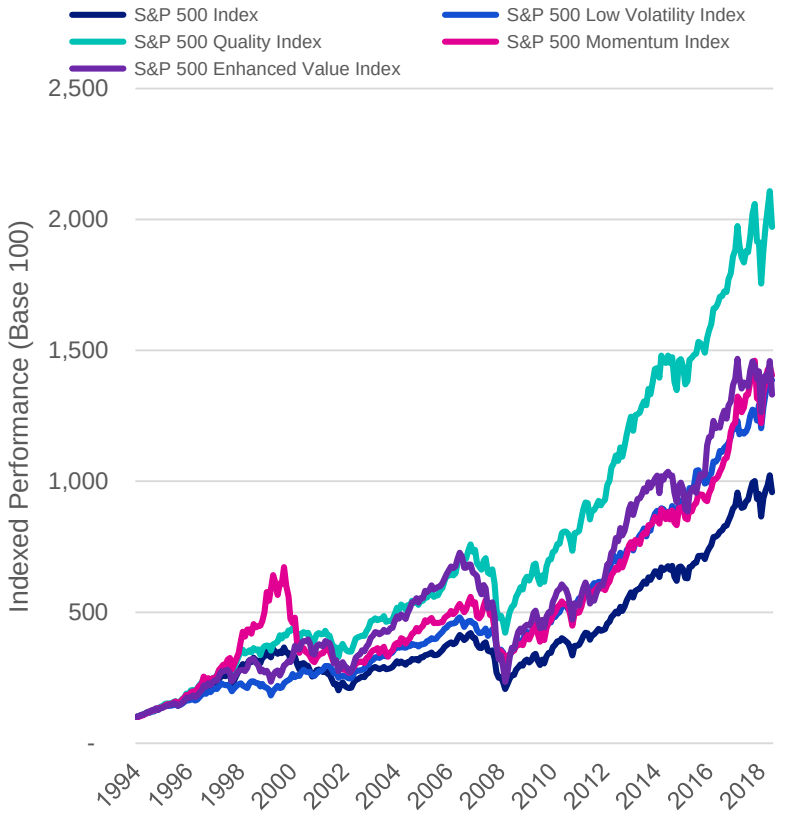
NA11251 11/19

An Example of Factor Investing in Equities

Factor-Based Strategies…

Value	Stocks that are relatively cheap
Low Volatility	Stocks that are more stable
Quality	Stocks that have higher earnings, lower leverage
Momentum	Stocks that have been trending higher

…Have Had Higher Returns in the Past



Source: Invesco, S&P as of 31 March 2019. Performance shows Total Return Net indices in USD. All of the factor indices shown have been created comparatively recently, and therefore, contain elements of hindsight and selection bias. Please note the x axis labelling denotes the end of each full year. For illustrative purposes only. The S&P 500 Quality Index incepted on 7/8/14, S&P 500 Low Volatility Index on 4/4/11, S&P 500 Enhanced Value Index on 4/27/15 and S&P 500 Momentum Index on 11/18/14. All information presented prior to the inception dates is back-tested. Back-tested performance is not actual performance, but is hypothetical. Although back-tested data may be prepared with the benefit of hindsight, these calculations are based on the same methodology that was in effect when the index was officially launched. Index returns do not reflect payment of any sales charges or fees. Past performance cannot guarantee future results. An investment cannot be made in an index.

What is Factor Investing?

The application of scientific research to investment strategies

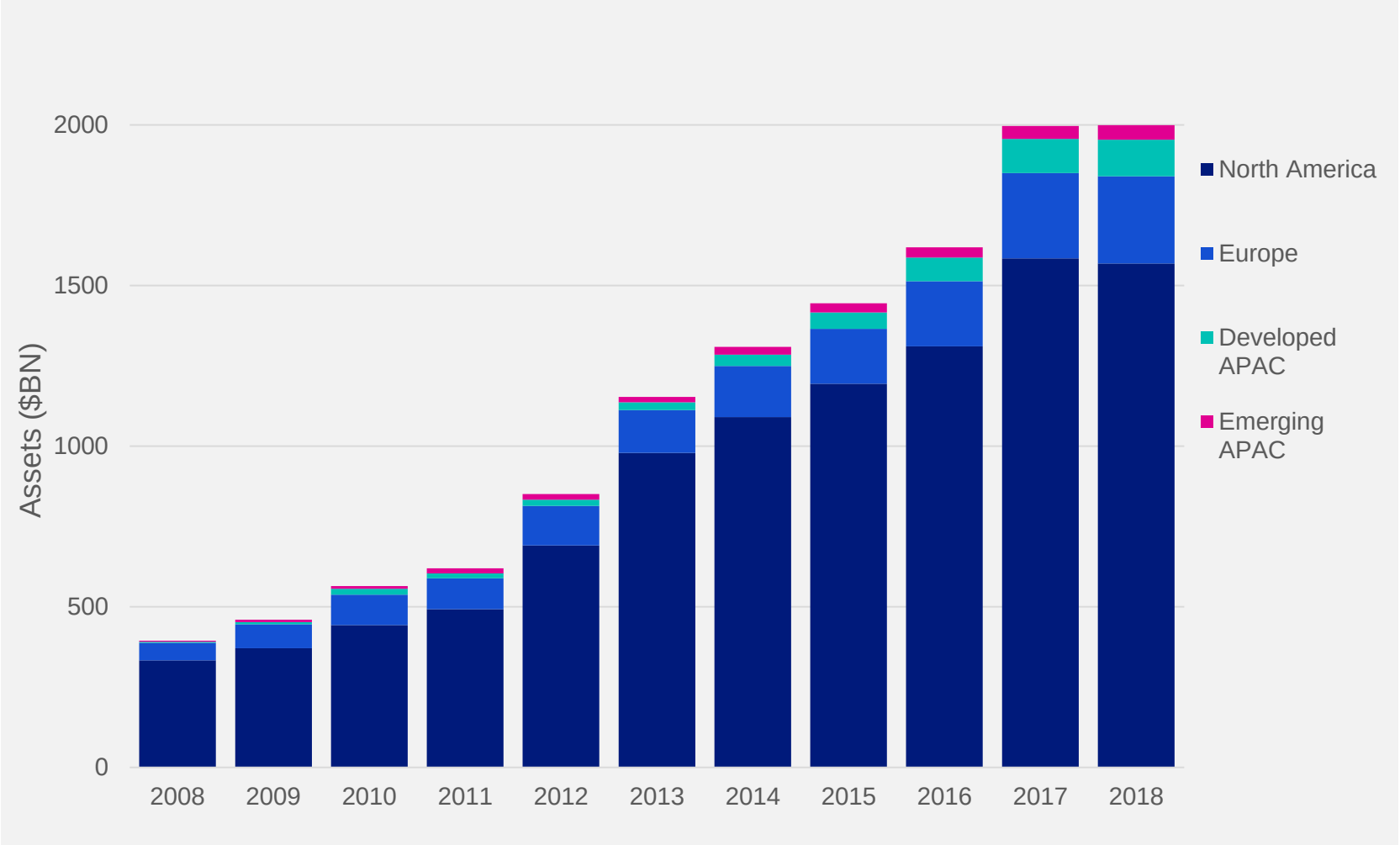
1) Supported by Scientific Research

2) Reasonable Rationale

3) Work Across Asset Classes

4) Investible Systematically

What is Factor Investing?
The application of scientific research to investment strategies



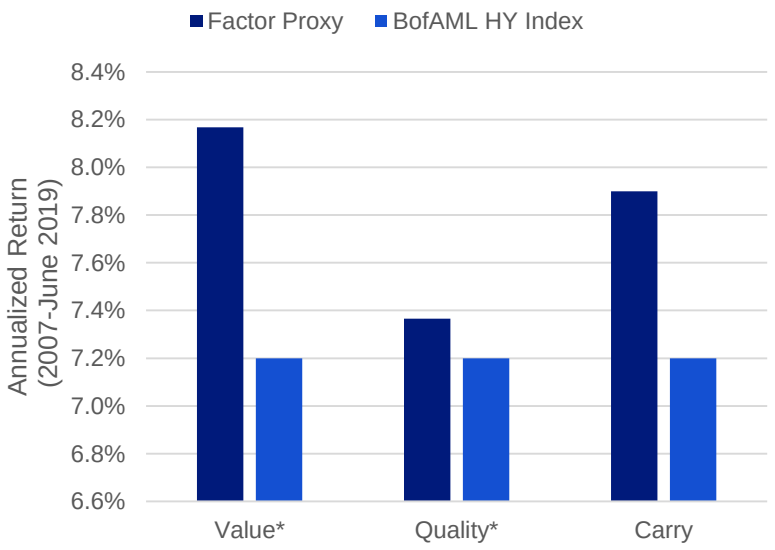
Source: McKinsey Performance Lens Growth Cube as of December 31, 2018; includes active mutual funds, passive mutual funds, ETFs, and assets from top quantitative managers, including mutual funds and segregated accounts.

Factor Investing in Credit

Factor-Based Strategies…

Value	Bonds that are Cheap Relative to Similar Securities
Quality	Bonds with Higher Credit Quality, Shorter Maturity, More Stability
Carry	Bonds with Wider Spreads

…Have Had Higher Returns in the Past



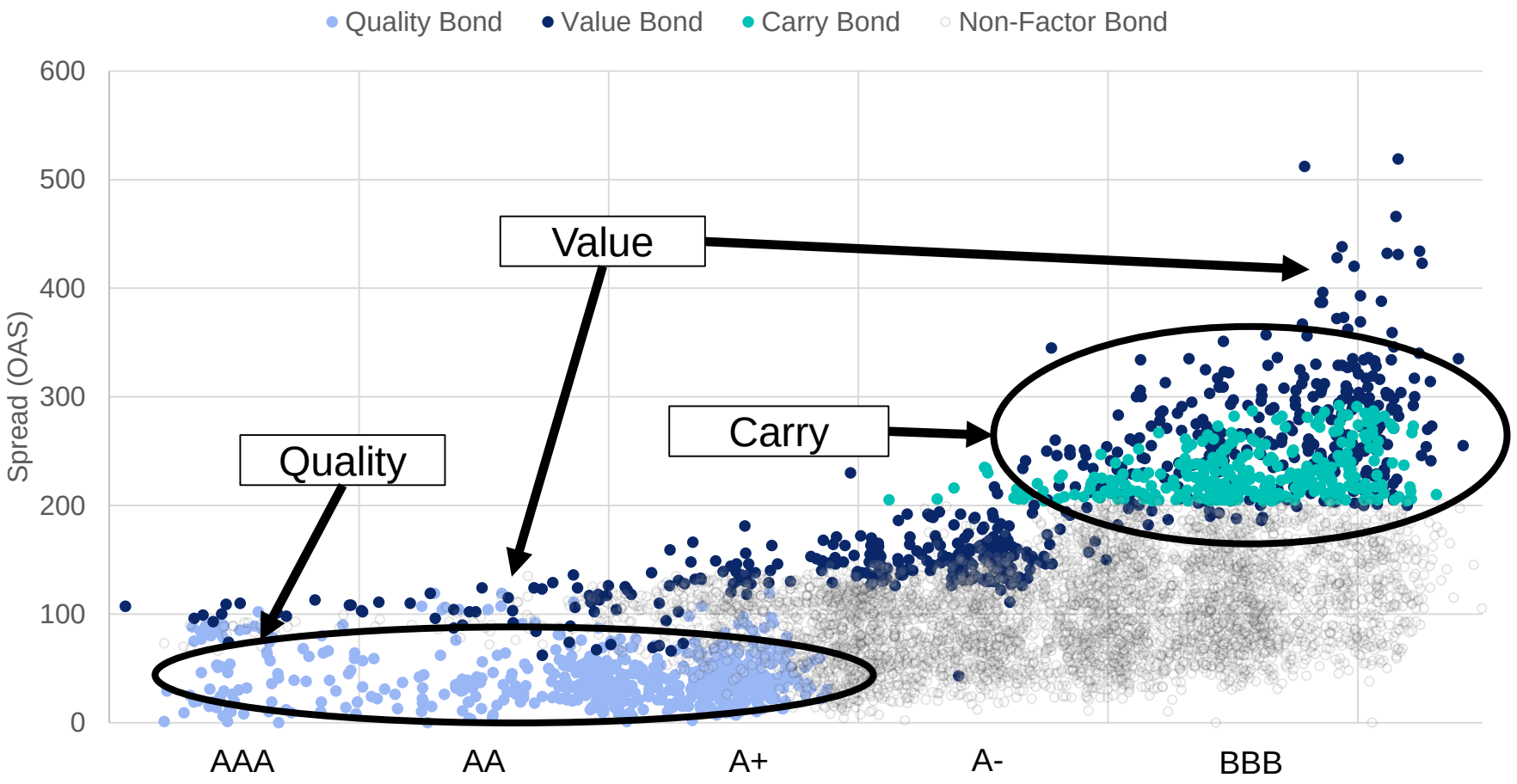
Source: Bloomberg L.P., Invesco. Time period: Jan 2007 – June 2019. The Factor proxy for Carry is given by the ICE BofAML CCC & Lower US High Yield Index.

*Please see Slide 29 in the appendix for more information on the mathematical process that underlies the hypothetical performance of Value and Quality.

The performance results shown are hypothetical (not real) and were achieved by means of the retroactive application of the statistical model. It may not be possible to replicate the hypothetical results. Past performance is not a guarantee of future results.

Visualizing Factors in Fixed-Income

Bonds in Each Factor Portfolio in the US IG Index



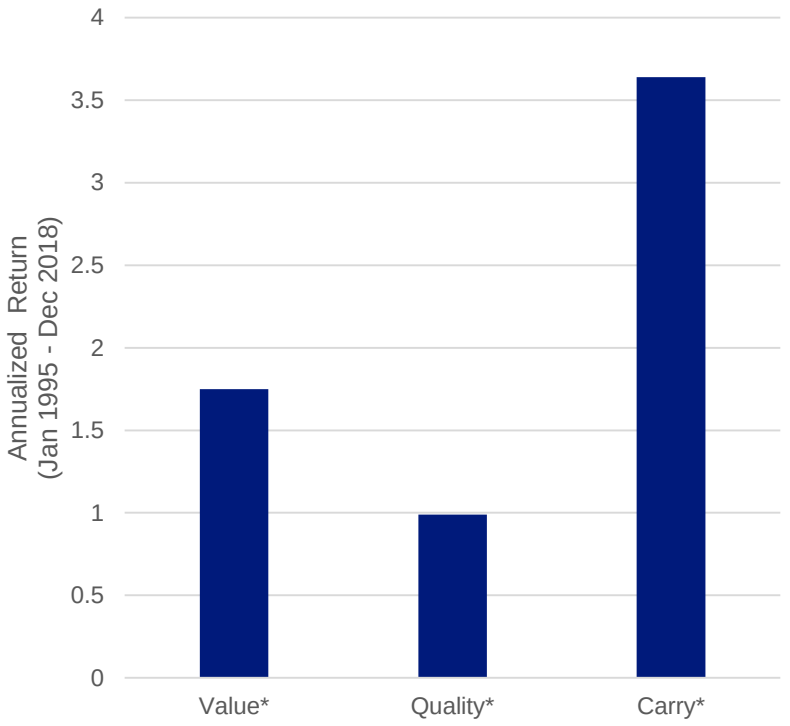
Source: Invesco, Bloomberg LP. As of October 2019.

Initial universe is the Bloomberg/Barclays Corporate Bond Index. Each group selects the bottom 10% of bonds with the best scores on each characteristic. 49% overlap between Value and Carry. If you exclude BBB-, there is a 23% overlap between Value and Carry. Rating is adjusted to take into account the average rating between the 3 major agencies – Moodys, S&P and Fitch. Non-Factor Bonds represent approximately 75% of the universe.

Factor Investing in Rates

Factor-Based Strategies…	
Value	Bonds with high real yield relative to inflation expectations
Quality	Bonds with low historic volatility
Carry	Bonds with Steep Yield Curves

…Have Had Higher Returns in the Past

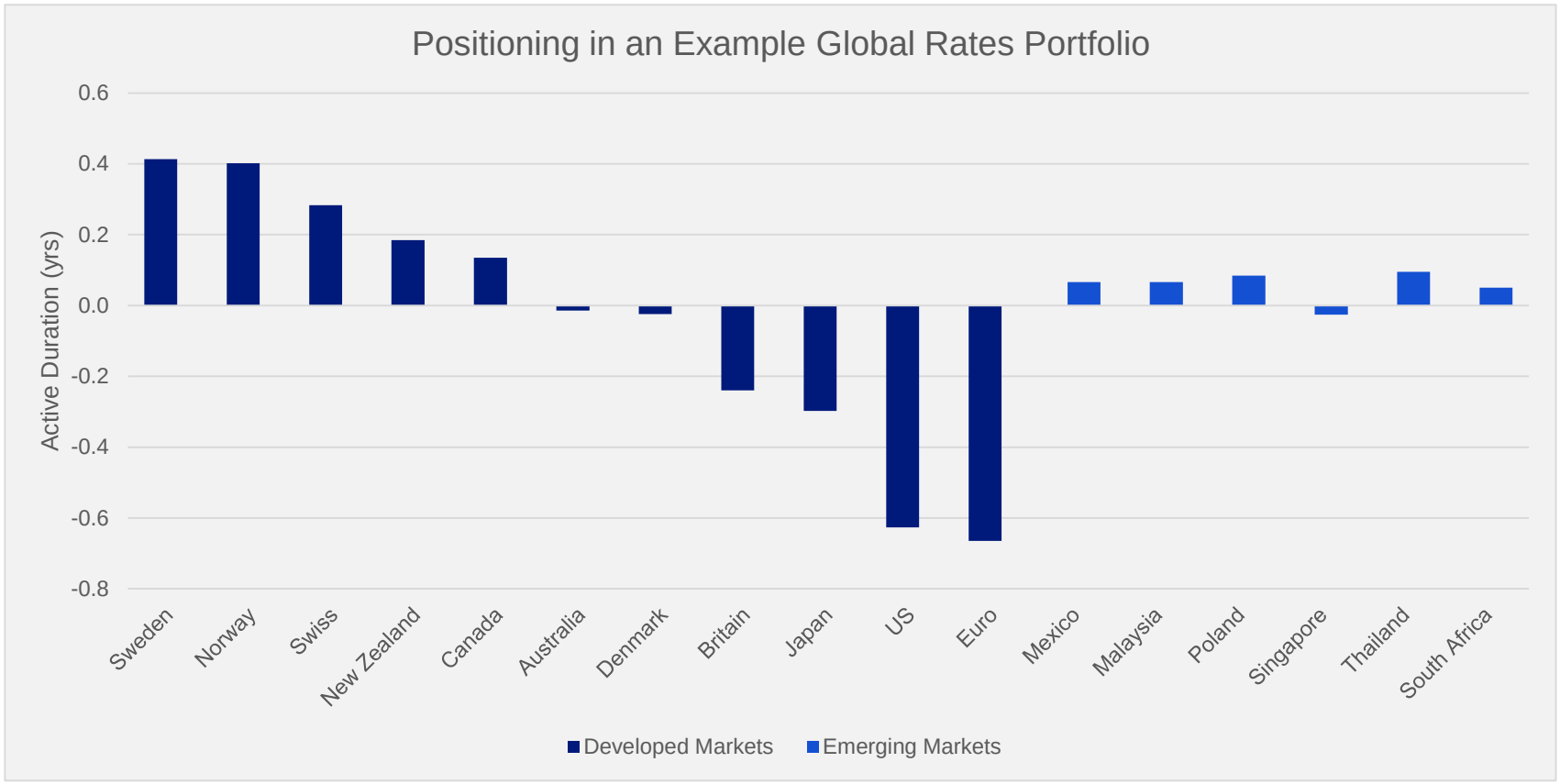


Source: Bloomberg LP.

*Please see slide 29 in the appendix for more information on the mathematical process that underlies the hypothetical performance.

The performance results shown are hypothetical (not real) and were achieved by means of the retroactive application of the statistical model. It may not be possible to replicate the hypothetical results. Past performance is not a guarantee of future results.

Factor Investing in Sovereign Bonds



The chart shows the active duration relative to the global aggregate bond index of an example sovereign bond portfolio. Data presented is provided for illustrative purposes

Contents

Advancements in financial theory improve understanding

True breakthroughs are rare and cause permanent change

Breakthroughs in financial science

Separation of beta and alpha
1964
Building on Markowitz's mean variance analysis Sharpe, Lintner and Mossin develop the Capital Asset Pricing Model (CAPM)

Low Volatility
1972
Haugen and Heinz find that low volatility stocks realise extra risk–adjusted returns

1973-1976
Robert Merton's Intertemporal Capital Asset Pricing Model and Richard Roll's Arbitrage Pricing Theory establish a theoretical framework for factor investing

Size
1981
Banz finds that small cap stocks outperform large caps

Value
1981
Basu shows that low PE stocks generate higher returns than high PE stocks

1981-1985
Shiller, DeBondt and Thaler start gathering evidence against market rationality

1983
Invesco launches its 1st quantitative strategy

Size and value
1992
Fama/French 3-factor model adds size and value to the market factor

Momentum
1993
Jegadeesh and Titman analyse a momentum factor

1997
Carhart finds that a 4-factor model including momentum improves performance

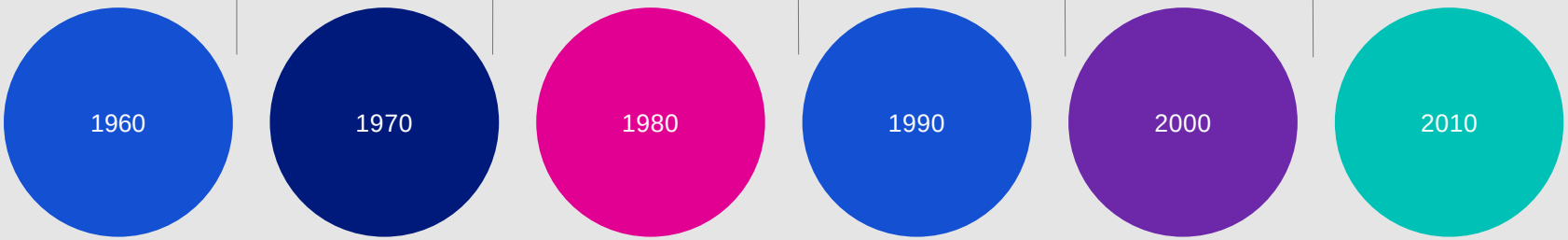
Asset Growth
2008
Cooper, Gulan and Schill find that asset growth predicts future returns

2009
Norges Bank Investment Management (NBIM) review approach to Active Management (Ang, Goetzman & Schaefer)

Profitability
2012
Novy-Marx shows that operating profitability predicts future returns.

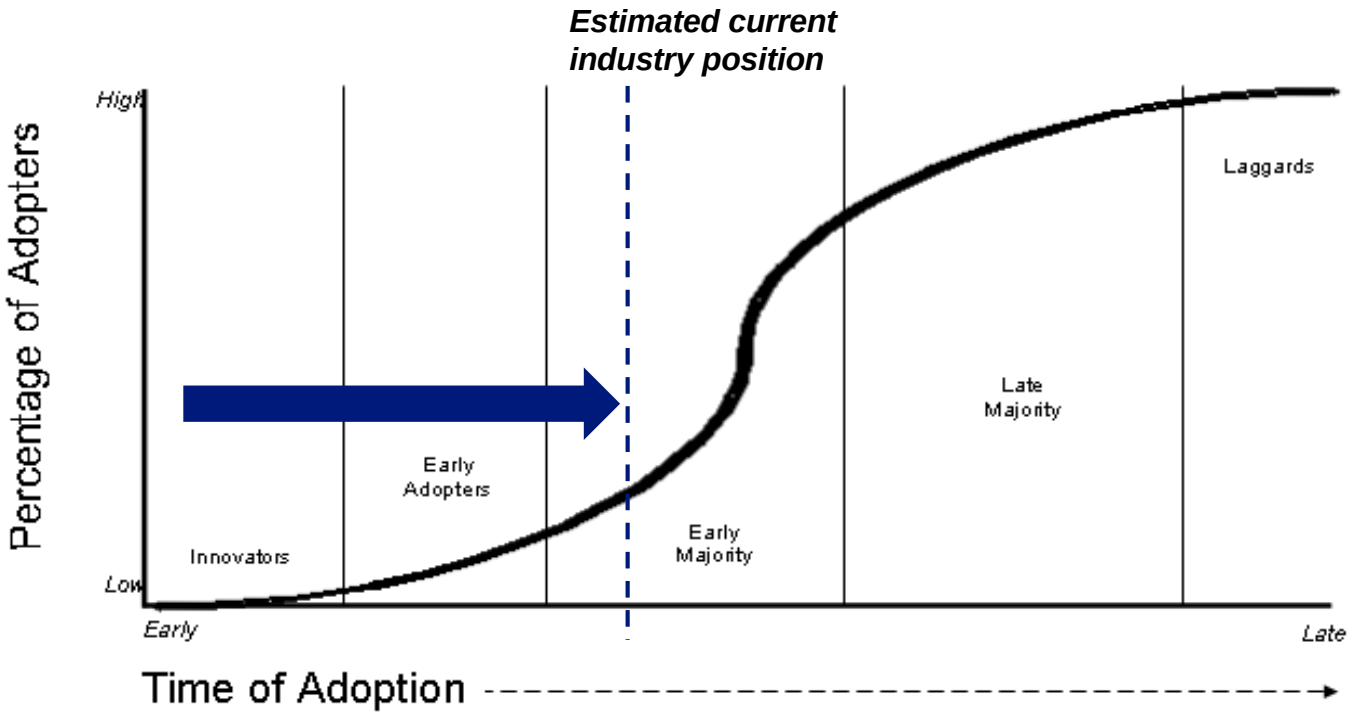
2015
Hou, Xue and Zhang's q-model based on profitability and asset growth dominates long-established ones.

2015
Fama and French add operating profitability and asset growth to their model, giving rise to the 5-factor model



For Illustrative Purposes Only

Factor investing adoption is likely to follow a predictable pattern, with the industry currently in the Early Majority phase

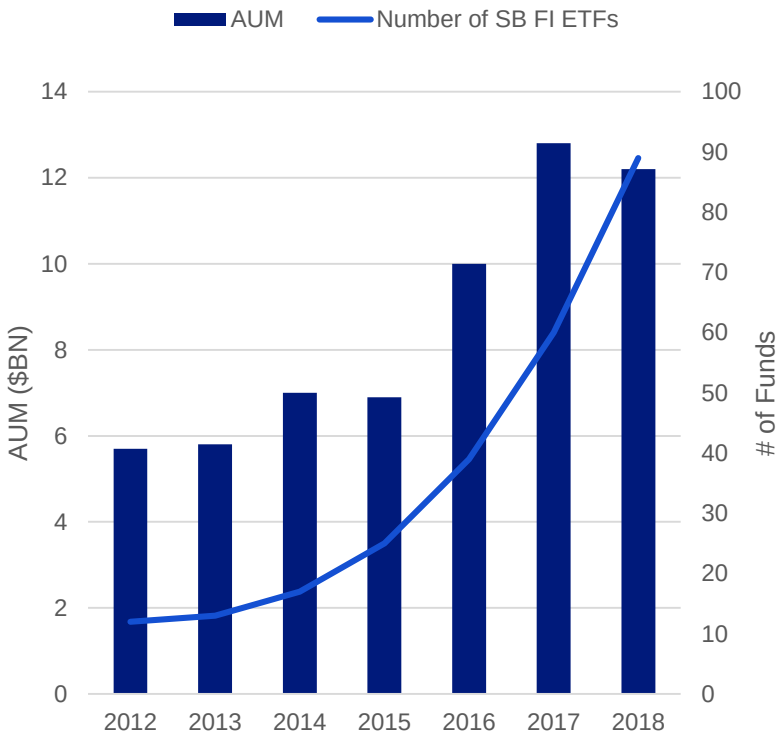


- Factor investing adoption is likely to follow a familiar S-curve pattern
  - Innovators (1960s+) and early adopters (1980s+, including Invesco) began to popularize the discipline
  - The industry is likely somewhere in the Early Majority phase, with accelerating growth rates and increased popularity
  - Factor Investing remains, however, a small minority compared to other global assets, with substantial room for accelerated growth in the coming years

For illustrative purposes only.

The Fixed-Income Factor Market

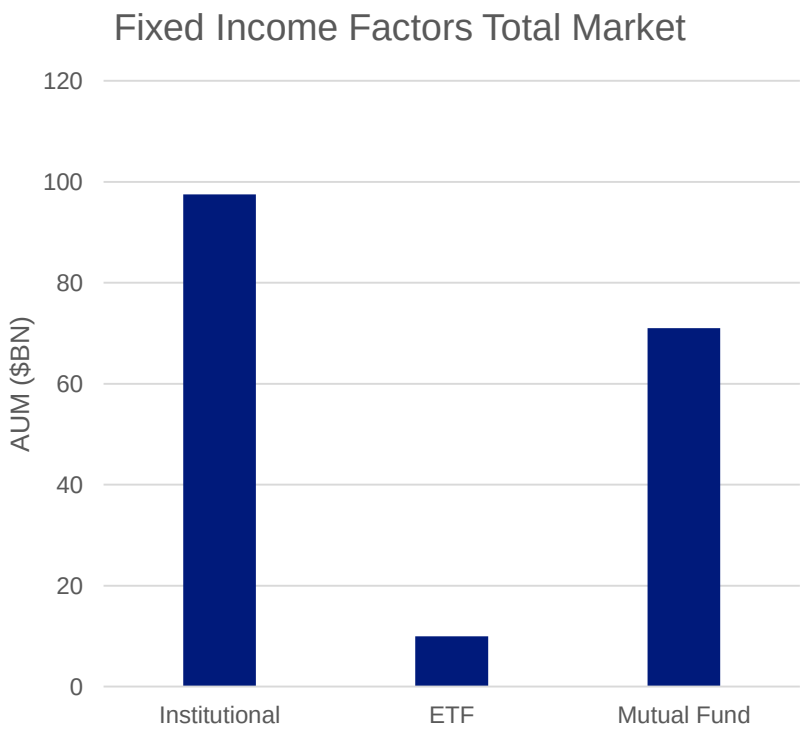
Fixed-Income Factor Market



Source: Morningstar Direct as of Dec. 31, 2018
Citi report "ETF Perspectives – Fixed Income Factorization", May 20, 2019.

Smart Beta represents an alternative and selection index based methodology that seeks to outperform a benchmark or reduce portfolio risk, both in active or passive vehicles. Smart beta funds may underperform cap-weighted benchmarks and increase portfolio risk.

Larger Fixed-Income Factor Managers Vehicle Comparison



Source: Invesco Estimates, Morningstar Direct as of December 31, 2019.
Institutional represented by BlackRock, DFA and AQR Fixed-Income AUM.
Mutual Fund is AUM from BlackRock and DFA. ETF represented AUM of all Smart beta ETFs from the chart on the left.

Beta, Factors and Alpha

Factor-based strategies compliment market-weighted and traditional active investment approaches

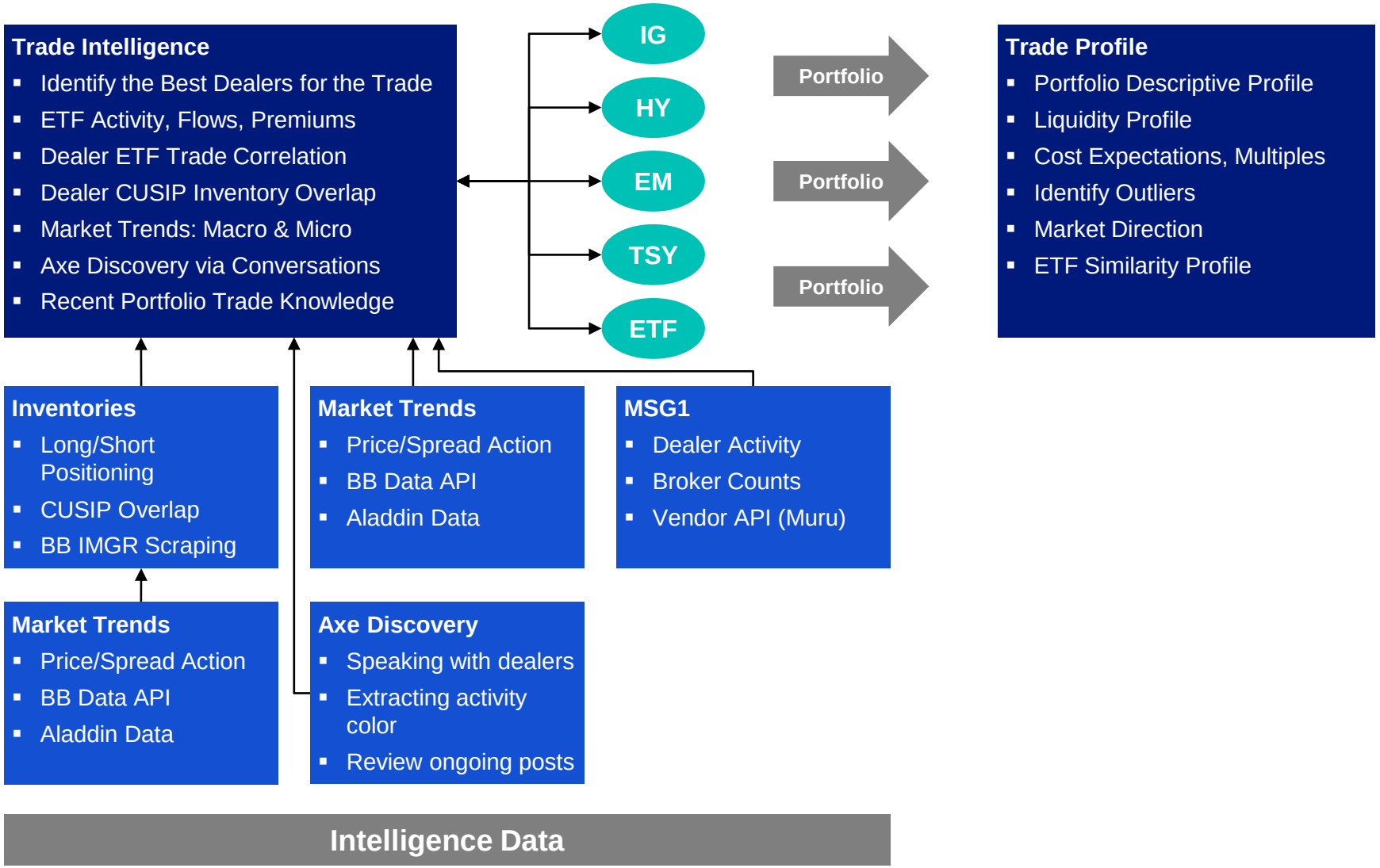
Market exposure	Value Added Strategies			
1 Traditional beta	2 Factor Investing		3 Traditional Alpha	
Transparent, low cost, highly scalable	Strategies constructed through active security selection to increase returns, control risk, or meet some desired objective. Expertise is required, and successful implementation is and always will be valuable			
Purely passive	**Factor index/ "smart" beta**	**Proprietary, dynamic, customized**	**Risk-controlled or benchmark-relative**	**High conviction idiosyncratic**
Minimal expertise Race to zero fees	Transparent, rules-based strategies that systematically apply factor insights to target specific risk/return expectations		Requires skill, expertise, or some advantage to outperform Zero-sum endeavor	

Market weighted → **Increasingly Active**

Factor investing (also known as smart beta or active quant) is an investment strategy in which securities are chosen based on certain characteristics and attributes that may explain differences in returns. **Factor investing represents an alternative and selection index based methodology that seeks to outperform a benchmark or reduce portfolio risk, both in active or passive vehicles**. Factor investing may underperform cap-weighted benchmarks and increase portfolio risk.

Contents

Fixed Income Portfolio Trading Process



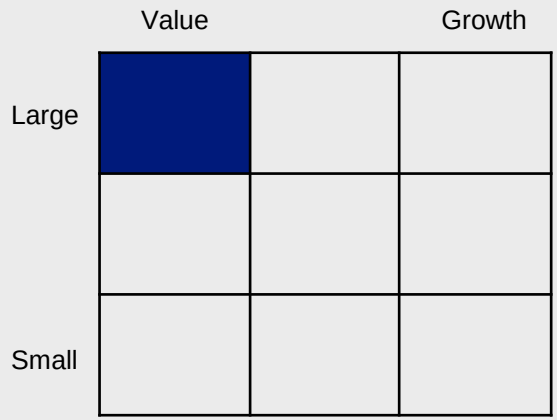
For Illustrative purposes only

Contents

Translating Styles to Factors

- Style box categories are blunt, only considering market capitalization and value/growth profile
- Factors provide investors with a multi-dimensional view of a strategy and allow for more precise targeting of specific drivers of risk and return

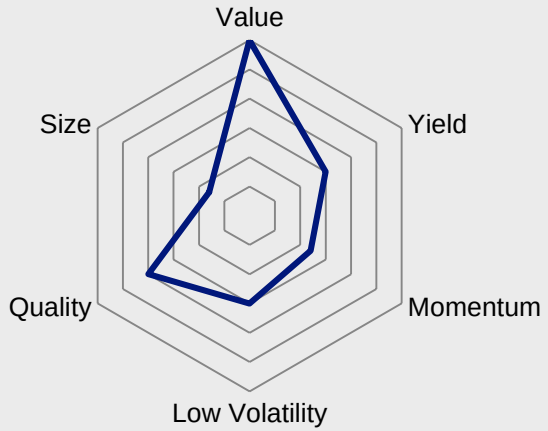
ABC Strategy Style Analysis



Large-Cap Value Strategy

While a strategy may sit in 1 style box, it will also have exposure to 6 factors

ABC Strategy Factor Analysis



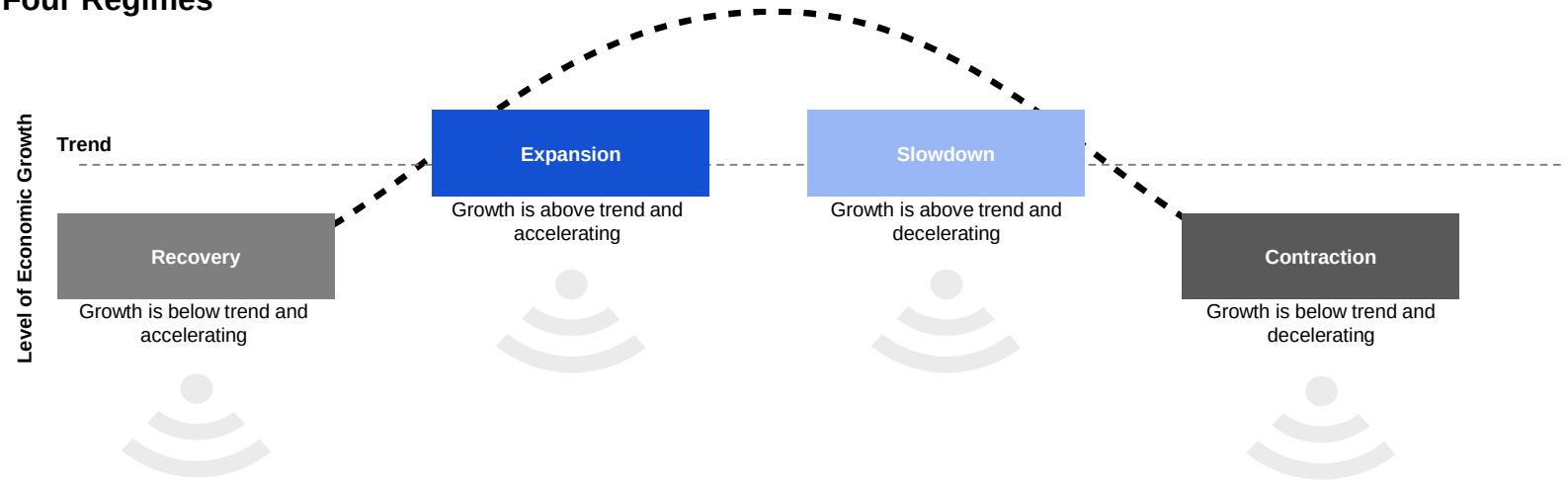
Large-Cap Value High Quality Strategy

Illustrative purposes only

Macro Regimes and Factor Cyclicality

Factor returns vary under different macro environments

Four Regimes



Emphasis on each factor is determined by the current environment.

Recovery	Expansion	Slowdown	Contraction
Size	**Size**	Size	Size
Value	**Value**	Value	Value
Momentum	**Momentum**	Momentum	**Momentum***
Low Volatility	Low Volatility	**Low Volatility**	**Low Volatility**
Quality	Quality	**Quality**	**Quality**

*Momentum combined with the quality and low volatility factors using a bottom-up framework has the potential to act defensively in contractionary periods.
For illustrative purposes only.

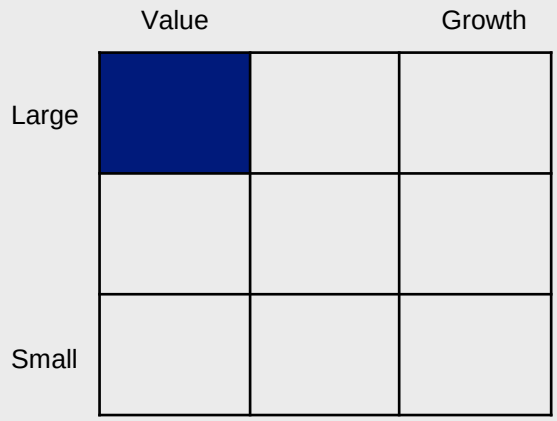
Contents

Implementation

Translating Styles to Factors

- Style box categories are blunt, only considering market capitalization and value/growth profile
- Factors provide investors with a multi-dimensional view of a strategy and allow for more precise targeting of specific drivers of risk and return

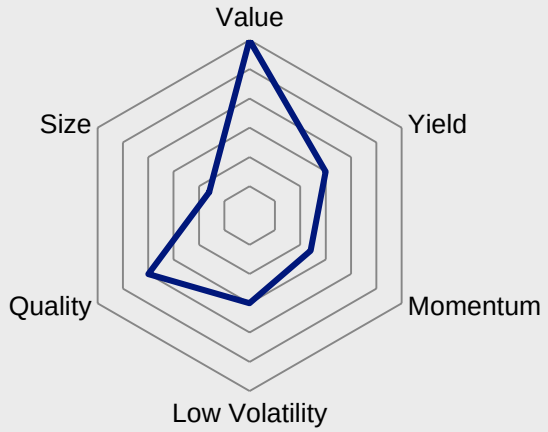
ABC Strategy Style Analysis



Large-Cap Value Strategy

While a strategy may sit in 1 style box, it will also have exposure to 6 factors

ABC Strategy Factor Analysis



Large-Cap Value High Quality Strategy

Illustrative purposes only

Case Study

Discussion

The Benchmark portfolio is market capitalization weighted indices.

The IBoxx High Yield Index is a large market capitalization weighted index targeting a liquid subset of the broader universe.

The Corporate Income Value Index targets a subset of the liquid portion of the high yield universe that is relatively inexpensive to bonds of similar rating and sector.

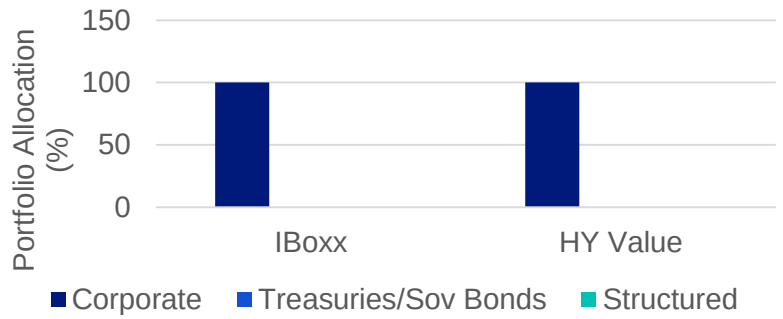
Portfolio Allocations

Fund/Benchmark	Benchmark	Client Allocation	Alternative Alocation
BBG/Barclays HY 2% Capped Index	100	-	-
ISHARES IBOXX HIGH Index	-	100	
Corporate Income Value Index	-	-	100
Weighted Avg Expense Ratio	-	N/A	N/A

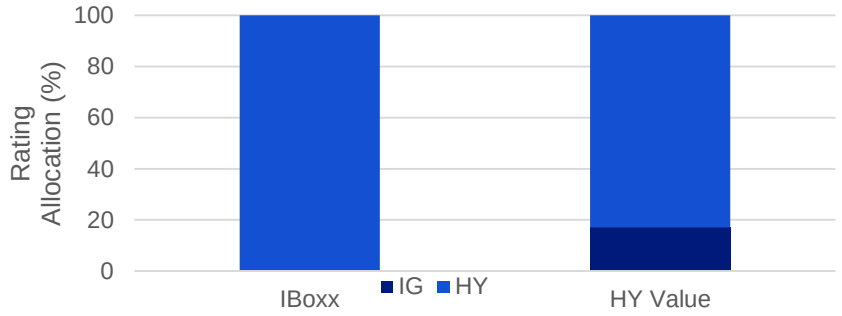
Fee is expense ratio from Bloomberg LP as of 9/30/2019.

Portfolio Analysis – High Level Results

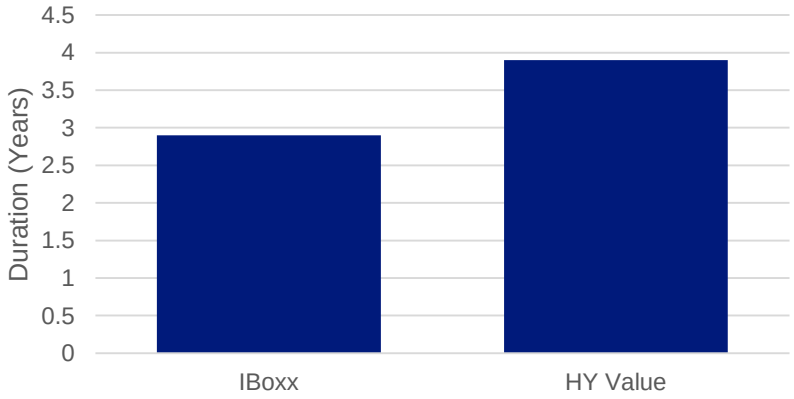
Asset Class Exposure



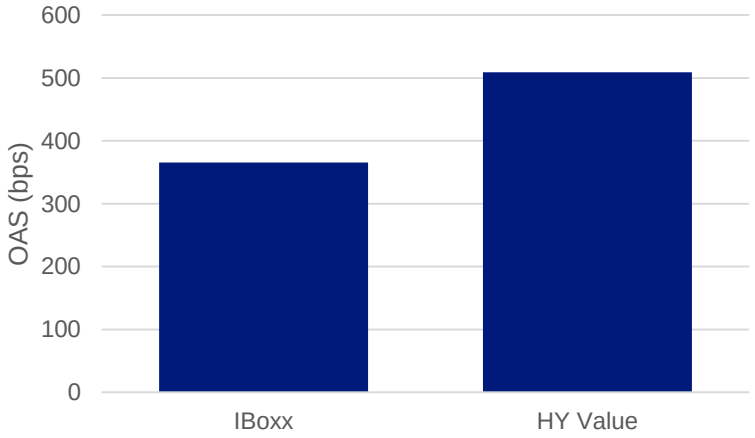
Rating Exposure



Duration Exposure



Option Adjusted Spread



Asset class exposure, Rating exposure and Regional Exposure represent the percent of the assets in the portfolio that are allocated to that region , rating or asset class. The duration/rates/credit exposure represent the total duration of the portfolio and the % of that duration that is derived from either credit or rate exposure. See prior page for Portfolio Allocations. As of Sept 30, 2019

Portfolio Analysis - Fund Analysis

Key Points

Overall – The High Yield Value index tilts towards value and carry. It has greater factor exposure than the iBoxx HY Index across every dimension.

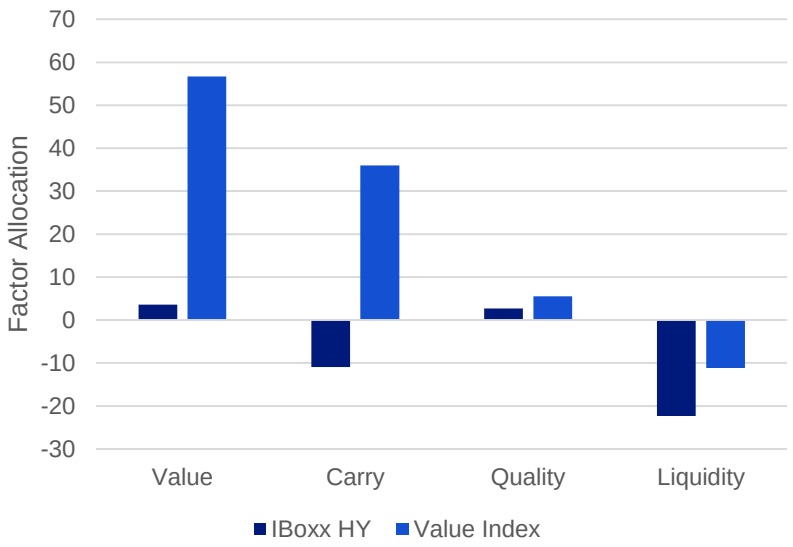
Value is an overweight to securities that have high OAS relative to other securities in the same rating and sector buckets.
- Bar > Zero, tilts towards higher value securities
- Bar < Zero, tilts towards lower value securities

Carry is an overweight to securities that have high OAS relative to the benchmark.
- Bar > Zero, tilts towards higher carry securities
- Bar < Zero, tilts towards lower carry securities

Quality is an overweight to securities that are considered high quality based 50% on credit quality (rating) and 50% duration relative to the benchmark.
- Bar > Zero, tilts towards higher quality securities
- Bar < Zero, tilts towards lower quality securities

Liquidity is an overweight to less liquid securities relative to the broad benchmark.
- Bar > Zero, tilts towards less liquid securities
- Bar < Zero, tilts towards more liquid securities

Factor Exposure



Source: Bloomberg LP. As of Sept 30, 2019. The criteria used to generate the charts above is as follows. The factor allocation represents the total percent of the portfolio that is in the bottom third of the benchmark in terms of its value or quality score. The value score is determined by the rank of the spread relative to other bonds in the same sector rating category. Defensive is based on a 50%/50% weighting between rating and duration. Carry is the % of the portfolio that is in the highest spread 1/3 of the index. Liquidity is the % of the portfolio in the least liquid 1/3 of the index.

Portfolio Analysis – Factor Analysis

Factor Allocation

Group	iBoxx Over/Under vs. Benchmark			
	Value Bucket	Carry Bucket	Quality Bucket	Liquidity Bucket
Low	-4.1	3.2	-0.2	10.5
Medium	4.6	4.4	-2.4	1.2
High	-0.6	-7.7	2.5	-11.8
Total	3.6	-10.9	2.7	-22.4

Group	HY Value Over/Under vs. Benchmark			
	Value Bucket	Carry Bucket	Quality Bucket	Liquidity Bucket
Low	-29.1	-22.5	-6.8	3.5
Medium	1.4	8.9	8.1	4.1
High	27.7	13.5	-1.3	-7.6
Total	56.7	36.0	5.5	-11.2

Positive is overweight to **more** liquid securities

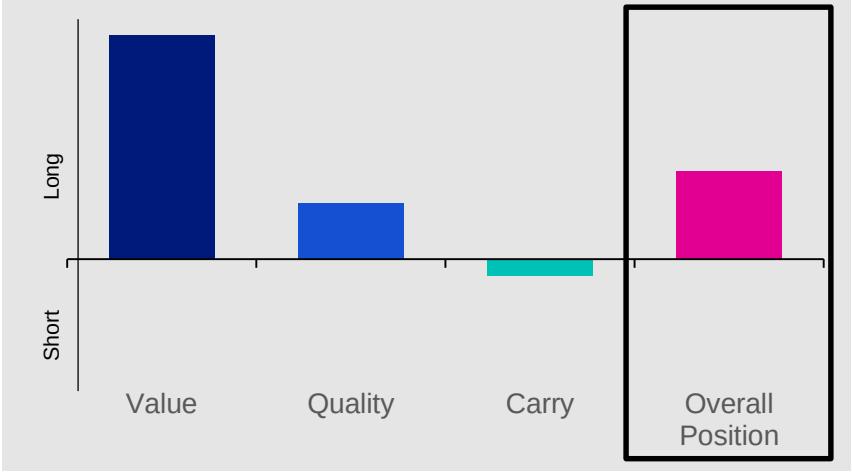
Positive is overweight to **less** liquid securities

Source: Bloomberg LP. As of Jul. 31, 2019. The criteria used to generate the charts above is as follows. The factor allocation represents the total percent of the portfolio that is in the bottom third of the benchmark in terms of its value or quality score. The value score is determined by the rank of the spread relative to other bonds in the same sector rating category. Defensive is based on a 50%/50% weighting between rating and duration. Carry is the % of the portfolio that is in the highest spread 1/3 of the index. Liquidity is the % of the portfolio in the least liquid 1/3 of the index.

Contents

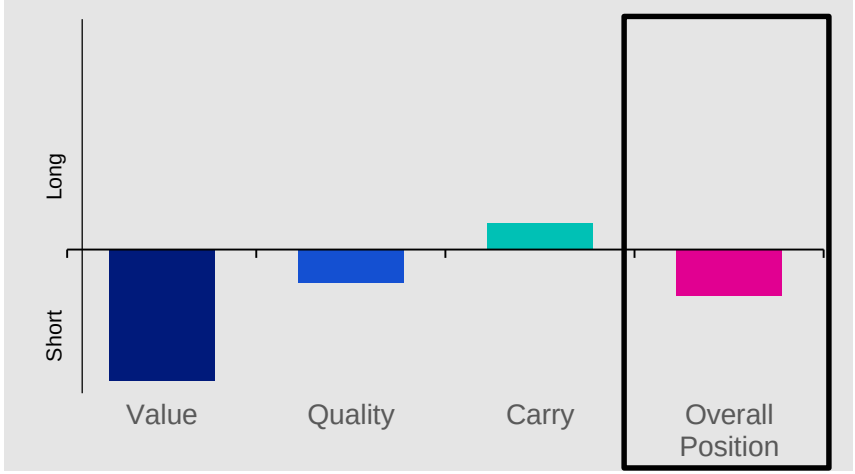
Illustrative example of Building a Factor Portfolio

Goldman Sachs Bond
Hypothetical Factor Exposures



- **Value –** The GS bond is ***cheap*** versus comparable bonds
- **Quality** – The GS Bond is ***more stable*** than the universe
- **Carry** – The GS Bond has a ***spread inline*** with the universe

Morgan Stanley Bond
Hypothetical Factor Exposures



- **Value –** The MS bond is ***rich*** versus comparable bonds
- **Quality** – The MS Bond is ***less stable*** than the universe
- **Carry** – The MS Bond has a ***spread greater*** than the universe

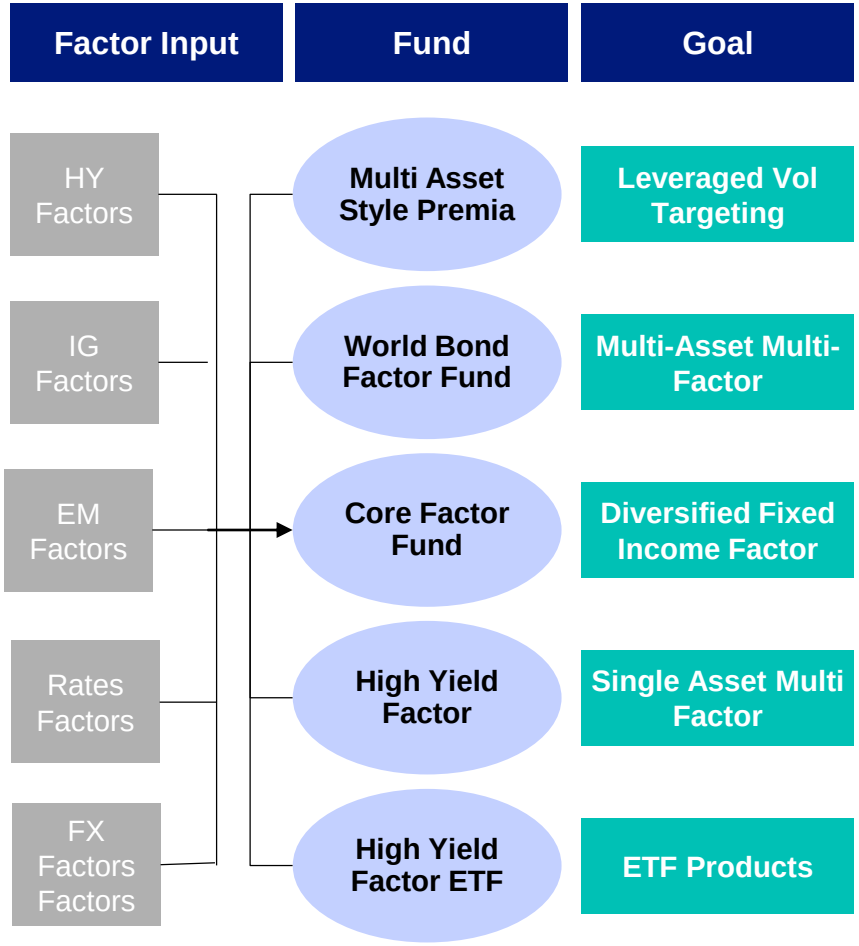
Does not represent actual fund positions. A hypothetical example to illustrate how we assess bonds from a factor perspective. This is not to be construed as an recommendation or offer to buy or sell any financial instruments.

Portfolio Construction

Goal: Take research results and transform them into portfolios that meet client needs in a scalable way.

Why: Pure factor results can lead to portfolios with unbalanced risk characteristics such high concentration in single names, sectors or maturity buckets.

Example: A portfolio that utilizes credit factors while delivering credit index-like duration with limited sector overweights.



For illustrative purposes only.

Contents

Appendix – Hypothetical Performance

Hypothetical Performance in Rates

- Universe –
  - Sweden, Norway, Swiss, New Zealand, Canada, Australia, Denmark, Britain, Japan, US, Euro.
- Period –
  - 1995-2019
- Value –
  - In the universe, determine the real yield and inflation expectations for each futures contact and country respectively. Create an equal weighted portfolio that is long the 3 futures contracts that have the highest real yield relative to inflation and shorts the 3 future contracts that have the lowest real yield relative to inflation expectations. Rebalance this long short portfolio on a monthly basis lagging data by one month.
- Quality –
  - In the universe, determine rolling 12 month volatility for each futures contact. Create an equal weighted portfolio that is long the 3 futures contracts that have the lowest volatility and shorts the 3 future contracts that have the highest volatility. Rebalance this long short portfolio on a monthly basis lagging data by one month.
- Carry –
  - In the universe, determine curve steepness for each futures contract in the universe. Create an equal weighted portfolio that is long the 3 futures contracts that have the highest curve steepness and shorts the 3 future contracts that have the lowest curve steepness. Rebalance this long short portfolio on a monthly basis.

Hypothetical Performance in Credit

- Universe
  - The Bloomberg Barclays US HY Index.
- Period
  - 2007-2019
- Value –
  - In the universe, determine option-adjusted spread for each bond in the universe. Filter out all but the largest bond from each issuer. Create buckets based on rating and sector. In each bucket, rank each bond based on its spread with high ranking bonds having the highest score and low ranking bonds having the lowest score. Create an equal weighted portfolio that buys the 300 bonds that have highest scores. Rebalance monthly.
- Quality –
  - In the universe, rank bonds based no maturity and rating with the highest ranking bonds having the shortest maturity and highest credit quality. Create an equal weighted portfolio buys the 300 bonds with the highest scores. Rebalance monthly.