



alpha architect

ALPHA ARCHITECT QUANTITATIVE MOMENTUM INDEXES (QM AND IQM INDEX)

We Empower Investors Through Education | Affordable Alpha

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IMPORTANT INFORMATION - DISCLOSURES

This document describes the technology behind our Indexes.

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Data is provided by FactSet and Alpha Architect. Attribution results are provided on a best-efforts-basis and are provided for informational purposes only.

We Educate Investors on Systematic Factor Investing



Wesley R. Gray, Ph.D.

PhD/MBA, University of Chicago
BS Economics, Wharton
Captain, Marine Corps

Wesley R. Gray, Ph.D. has been an active participant in financial markets throughout his career. He is the Founder, CEO and Co-CIO for Alpha Architect, an SEC-Registered Investment Advisor. Dr. Gray has published multiple academic articles and books, to include the co-authored books Quantitative Value, DIY Financial Advisor, and Quantitative Momentum.

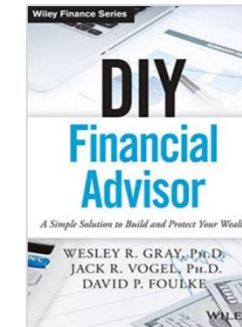
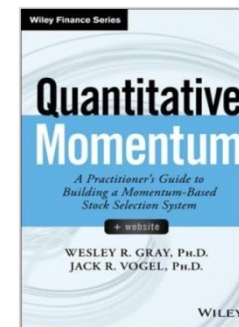


Jack R. Vogel, Ph.D.

PhD, Drexel University
MS Mathematics, Drexel Univ.
BS Mathematics, U. of Scranton

Jack Vogel, Ph.D., conducts research in empirical asset pricing and behavioral finance, and has collaborated with Dr. Gray on multiple projects. He is the CFO and Co-CIO for Alpha Architect, an SEC-Registered Investment Advisor. Dr. Vogel has published multiple academic articles and co-authored the books DIY Financial Advisor, and Quantitative Momentum.

Published multiple **research-focused** finance books



Published in leading, **peer-reviewed** academic journals

- "Why do Enterprise Multiples Predict Expected Stock Returns?" Journal of Portfolio Management (2019)
- "What Motivates Buy-Side Analysts to Share Recommendations Online?" Management Science (2018)
- "Do Fund Managers Identify and Share Profitable Ideas?" Journal of Financial and Quantitative Analysis (2017)
- "Enhancing the Investment Performance of Yield-Based Strategies," Journal of Investing (2014).
- "Analyzing Valuation Measures: A Performance Horse-Race over the Past 40 Years," Journal of Portfolio Management (2012).

Present in **major publications** + editor of academic website

- [Wall Street Journal](#) (multiple articles)
- [CFA Institute](#) (multiple articles)
- [Forbes](#) (multiple articles)
- [Alpha Architect](#) (editor)

Numerous **working papers** (more available upon request)

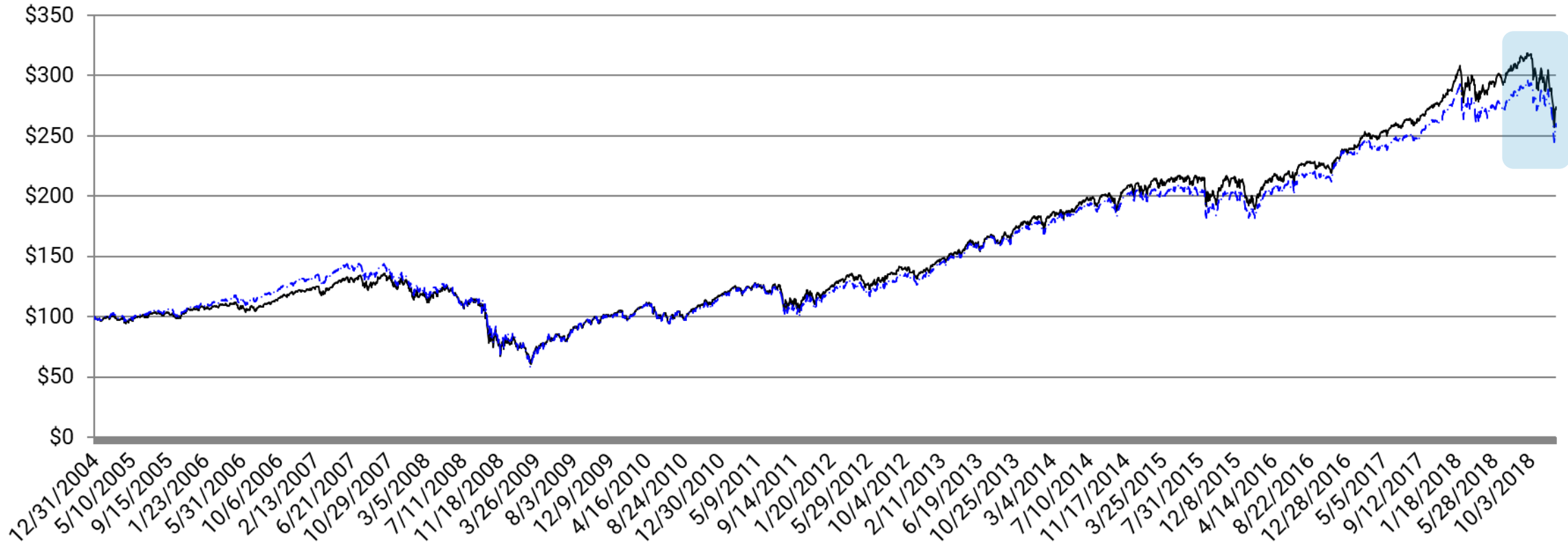
- "On the Performance of Cyclically Adjusted Valuation Measures"
- "Using Maximum Drawdown to Capture Tail Risk"
- "Does Complexity Imply Value? AAI Value Strategies from 1963 to 2013"
- "Limited Attention and Asset Price Efficiency"
- [Our SSRN working paper website](#)

Closet Indexes¹ May Deliver Passive Market Results

but they may not deliver academic factor results

Invested Growth of \$100 from 2005 to 2018

— SPY: SPDR S&P 500 ETF - - - VTV: Vanguard Value ETF

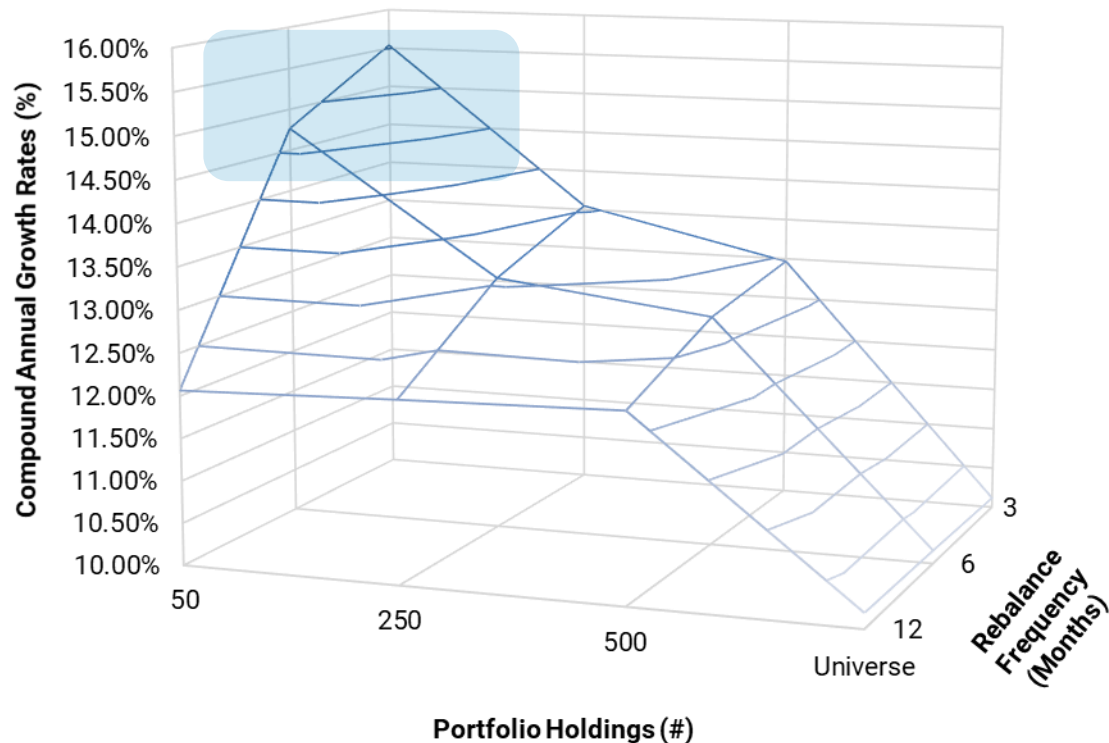


¹A "closet index" is generally considered to be a strategy that is marketed as being different than a broad passive index, but in reality, is closely related to a broad passive index with minimal deviations in the underlying holdings and performance profile. VTV was chosen because it is the largest "smart beta" ETF as per <https://www.etf.com/channels/smart-beta-etfs> (accessed June 1, 2019). Performance is measured from 1/1/2005 to 12/31/2018 and is based on total returns, including dividends and distributions. Performance figures contained herein are hypothetical, unaudited and prepared by Alpha Architect, LLC; hypothetical results are intended for illustrative purposes only. Past performance is not indicative of future results, which may vary. For more information see the following paper: K.J. Martijn Cremers & Quinn Curtis, Do Mutual Fund Investors Get What They Pay For? The Legal Consequences of Closet Index Funds (November 24, 2015) at 1, available at <http://ssrn.com/abstract=2695133> (last visited June 1, 2019).

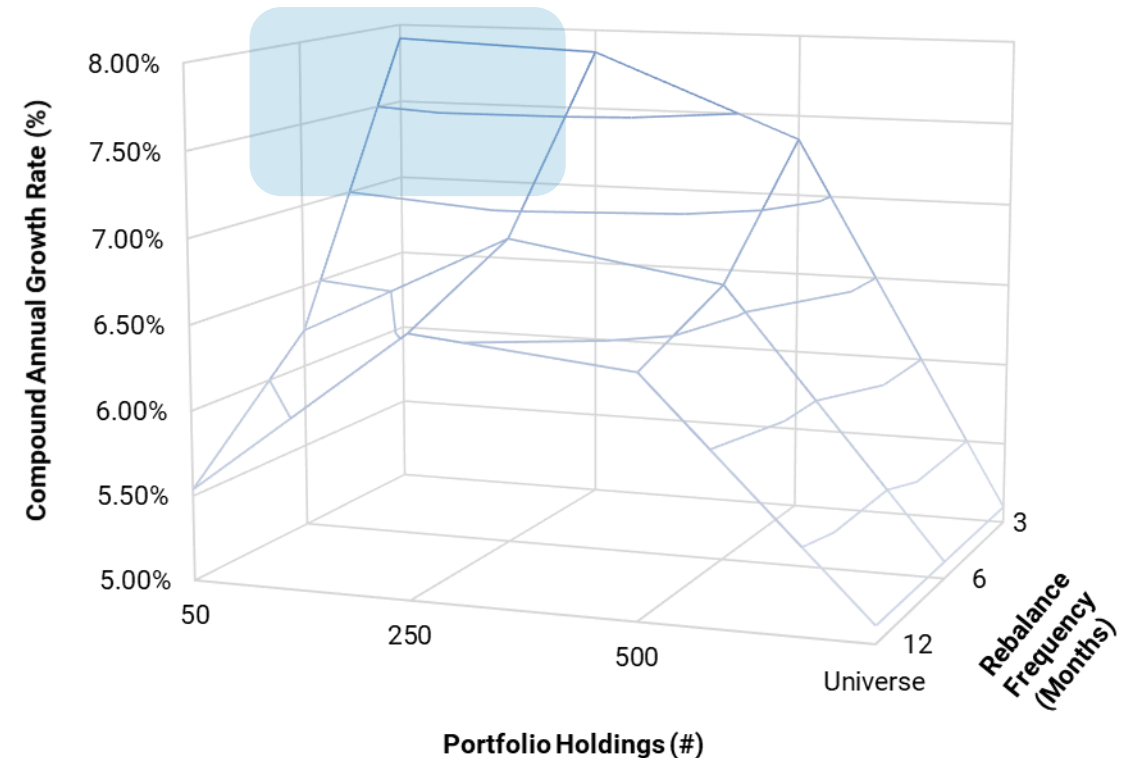
We Believe in Focused Academic Factor Premiums

Simulated momentum sorted portfolio compound annual returns by concentration and rebalance

Portfolio Construction and Historical Returns (US Stocks)



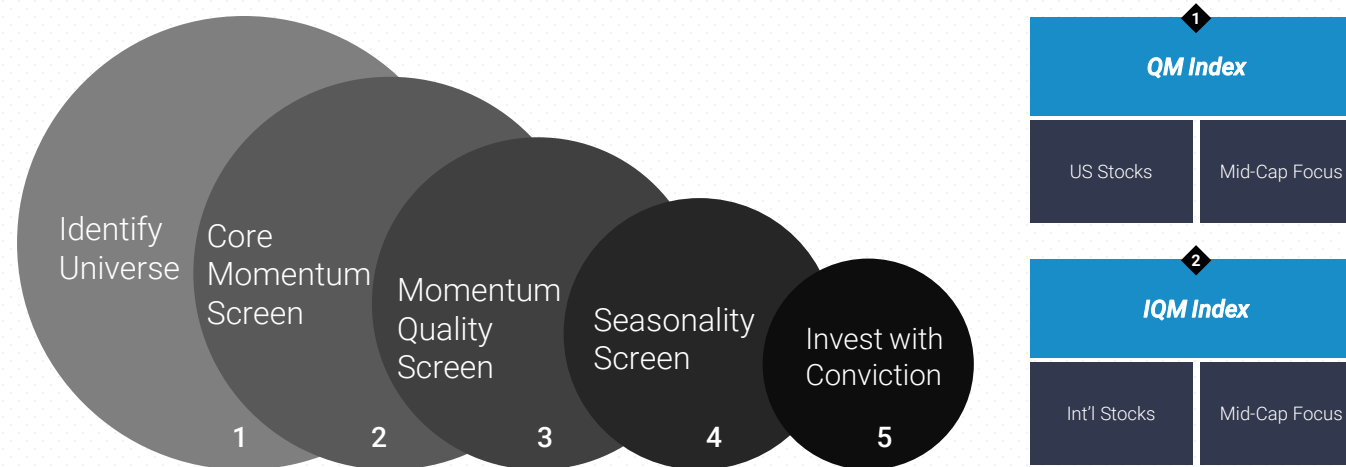
Portfolio Construction and Historical Returns (International Stocks)



Source: Factset. Universe is the largest 1000 U.S. or international developed firms by market capitalization and broken into portfolios of 50-, 250-, or 500-stocks based on the past 12 month returns (skipping the most recent month). The rebalance frequency is 3-, 6-, or 12-months. We average overlapping portfolio results and show the compound annual returns for the respective portfolios. The period is from 1/1/1990 to 3/31/2019. The results are hypothetical results and are NOT an indicator of future results and do NOT represent returns that any investor actually attained. Additional information regarding the construction of these results is available upon request. Indexes are unmanaged, do not reflect management or trading fees, and one cannot invest directly in an index. All returns are gross total returns and include the reinvestment of distributions (e.g., dividends).

Our Quantitative Momentum Index Lineup

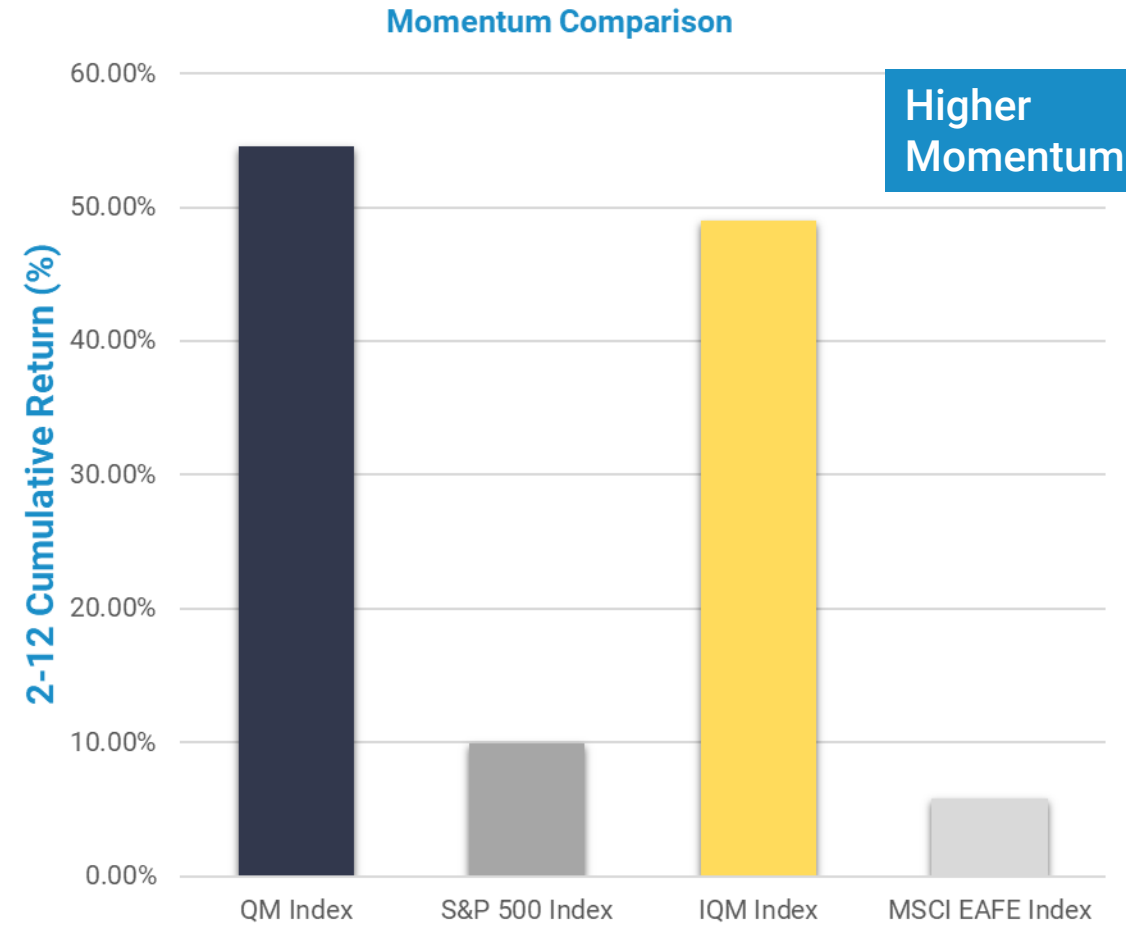
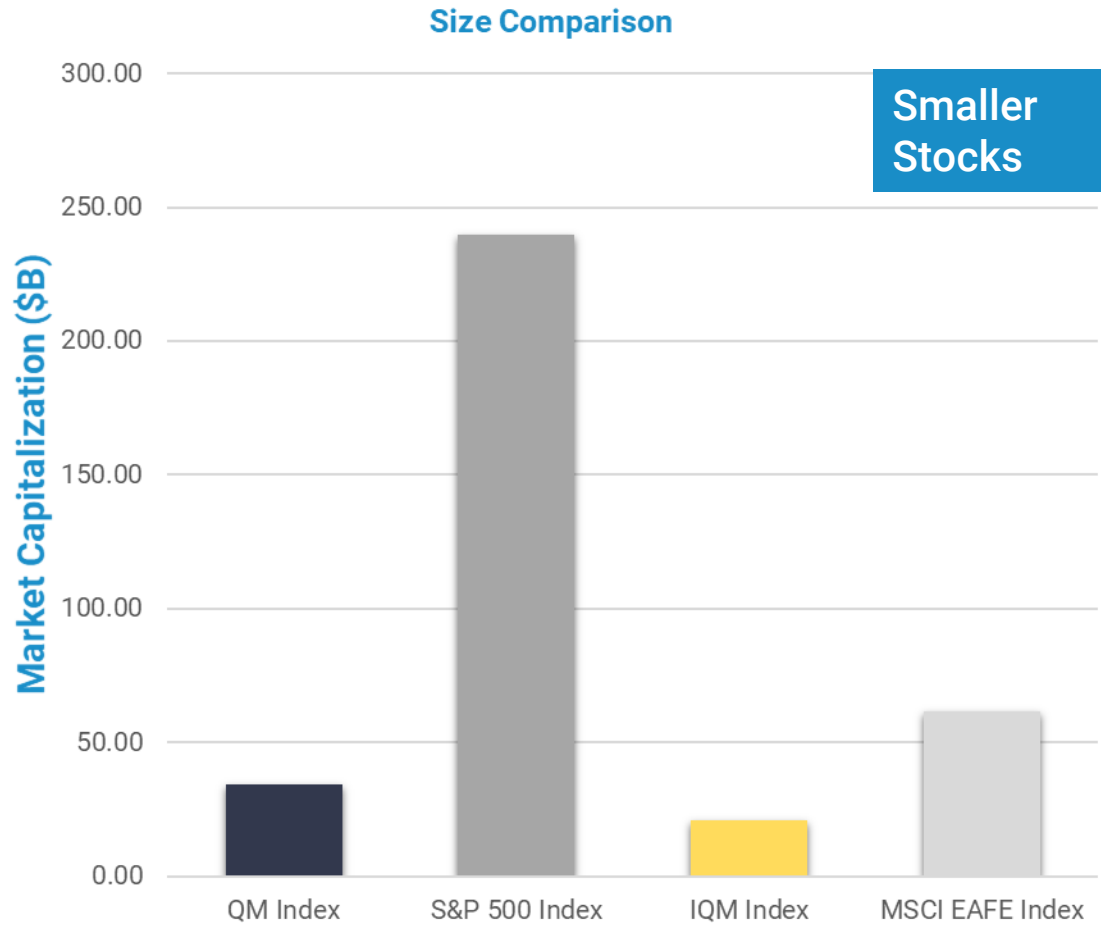
Index Name	Index Ticker	Index Inception Date	Factor Exposures	Strategy Overview	Weighting Methodology
U.S Quantitative Momentum Index	QM INDEX	1/1/1992	Focused Momentum	Top decile momentum, split by momentum quality	Equal-Weight
International Quantitative Momentum Index	IQM INDEX	1/1/1992	Focused Momentum	Top decile momentum, split by momentum quality	Equal-Weight



*Information on our Indexes are available at alphaarchitect.com/indexes or upon request.

Quantitative Momentum Index Characteristics

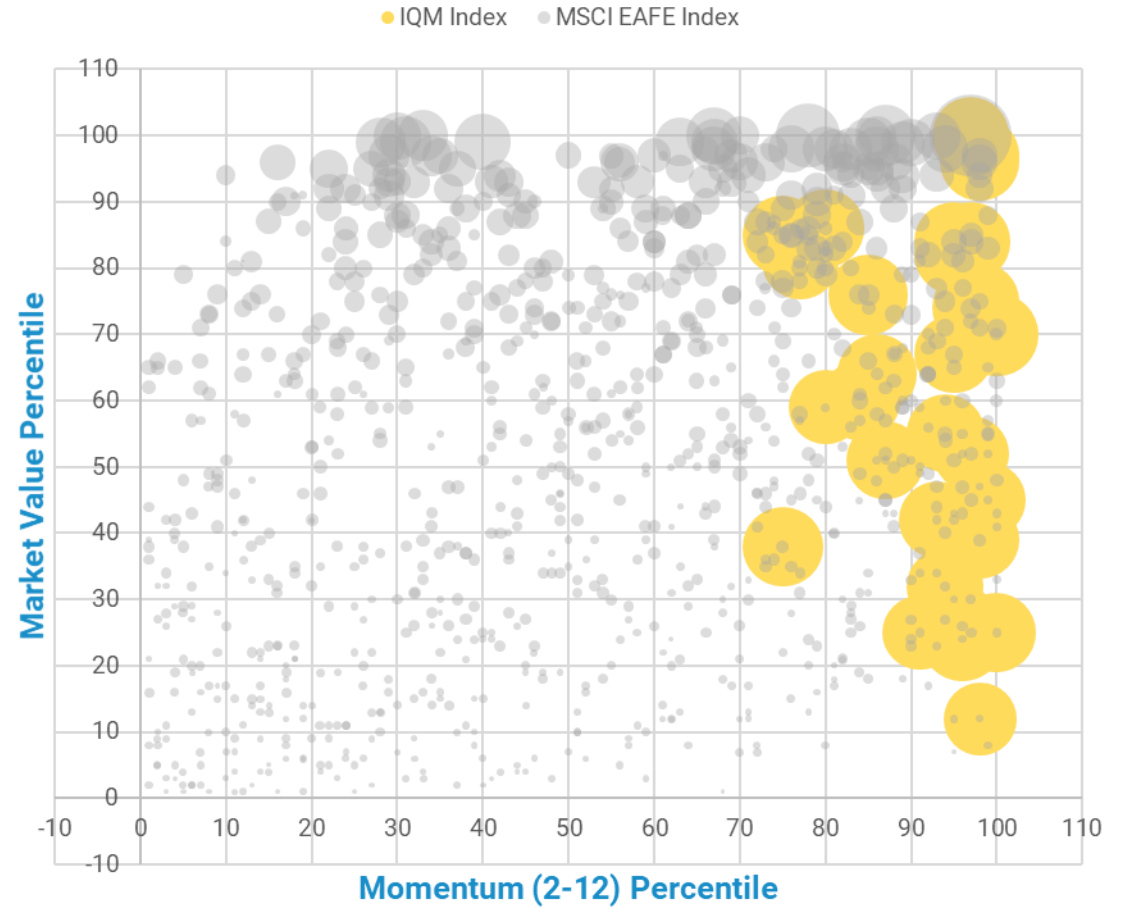
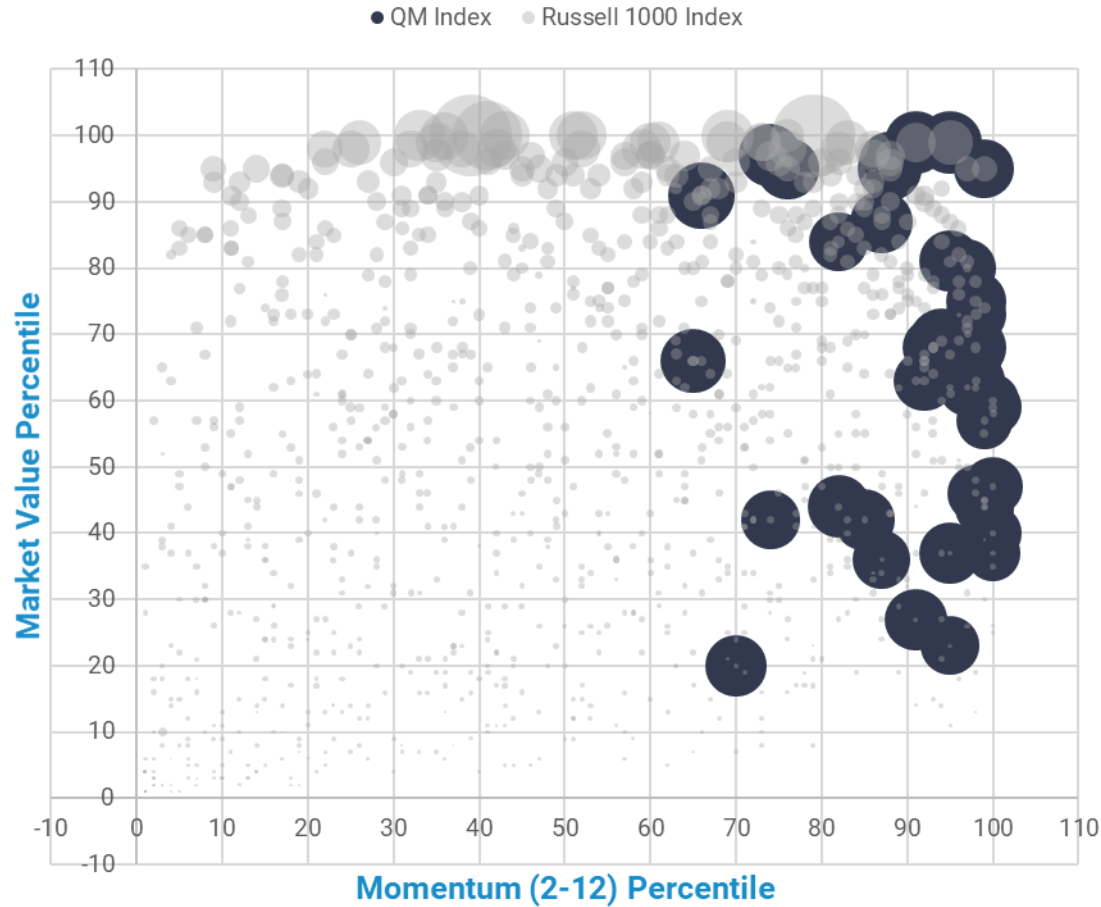
The Indexes seek to own smaller stocks with higher momentum



Source: Please see disclosures for additional information. Additional information regarding the construction of these results is available upon request. Indexes are unmanaged, do not reflect management or trading fees, and one cannot invest directly in an index. Characteristics are from FactSet and derived via the ETFs that track the respective Indexes. Characteristics are holdings-weighted. Momentum (2-12) is defined as the cumulative total return for the past 12 months, excluding the last (12th) month.

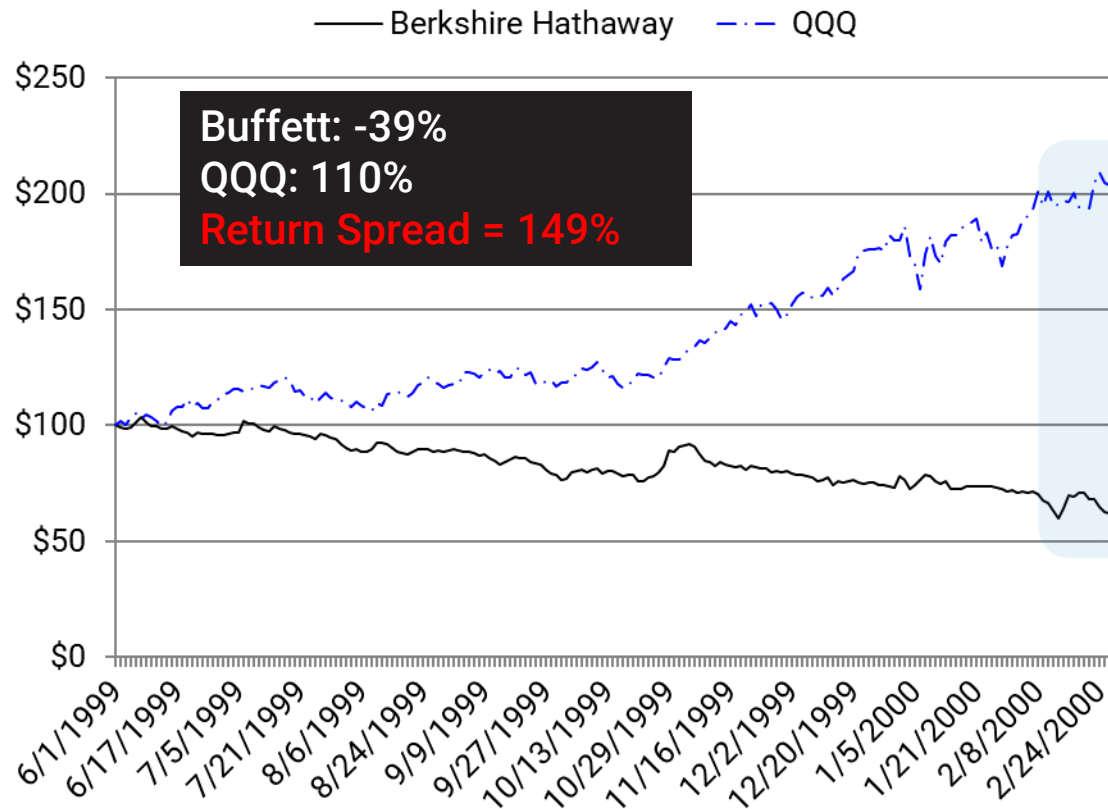
Quantitative Momentum Index: Characteristics

Quantitative Momentum Indexes are concentrated in high momentum stocks across the size spectrum



Important Reminder: Being Unique, Means Being Different

9-Months of Extreme Relative Performance Pain



Warren Buffett

“Charlie, should we buy tech?”

“Warren Buffett may be losing his magic touch.”

BARRON'S


Sustainable Investing
Requires Perspective

Source: Factset. 6/1/1999 to 2/29/2000. The results are hypothetical results and are NOT an indicator of future results and do NOT represent returns that any investor actually attained. Please see disclosures for additional information. Additional information regarding the construction of these results is available upon request.

Potential Costs and Benefits of Our Indexes

Goal	QM/IQM Index	Passive Index
Differentiated Momentum Exposure	High	Low
Factor Concentration	High	Low
Potential for Excess Return	High	Low

*Information on our Indexes are available at alphaarchitect.com/indexes or upon request.

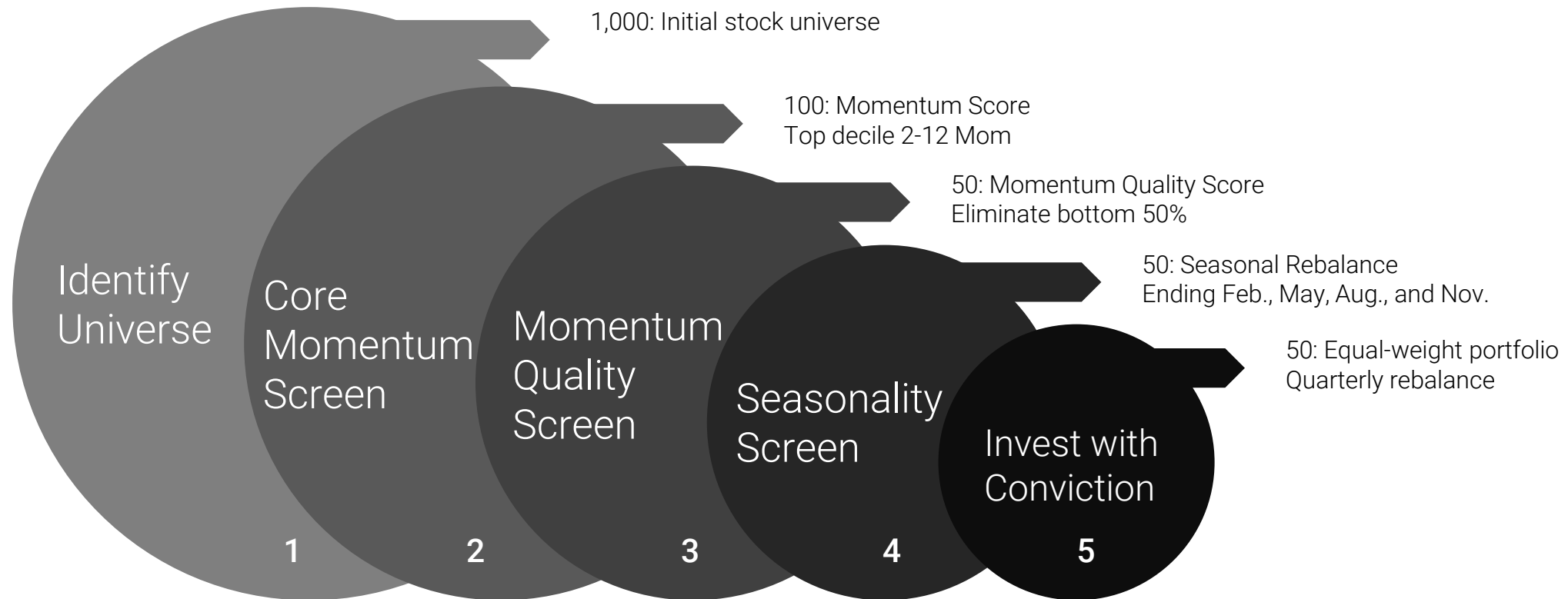


Quantitative Momentum Index Methodology

Quantitative Momentum Index Stock Selection Details

QM/IQM Index seeks to buy stocks with the highest quality momentum¹

- QM Index universe consists of mid and large-cap stocks
- IQM Index universe consists of developed international mid and large-cap stocks



¹This example is provided for illustration purposes only. The actual numbers may vary for the QM/IQM Index.

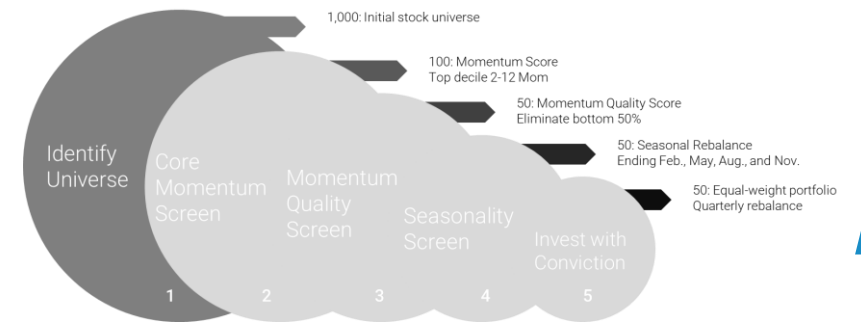
Step 1: Identify Universe

Liquidity Restrictions

- Mid- and large-cap universe

Universe Rules

- Operating companies only: no ADRs, REITs, ETFs, and CEFs
- 25% sector constraint



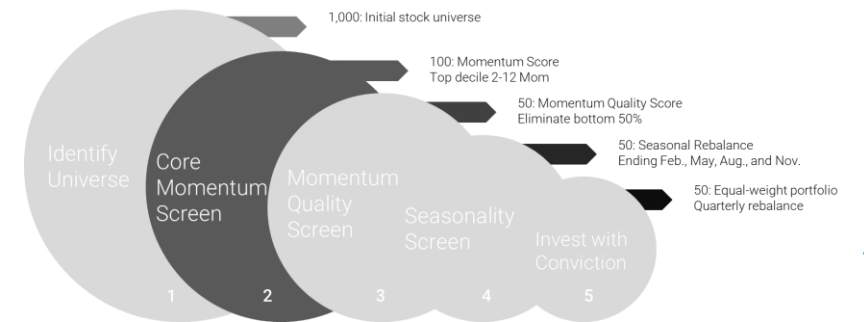
*Information on our Indexes are available at alphaarchitect.com/indexes or upon request.

Step 2: Core Momentum Screen

Even Eugene Fama and Ken French acknowledge the historical evidence

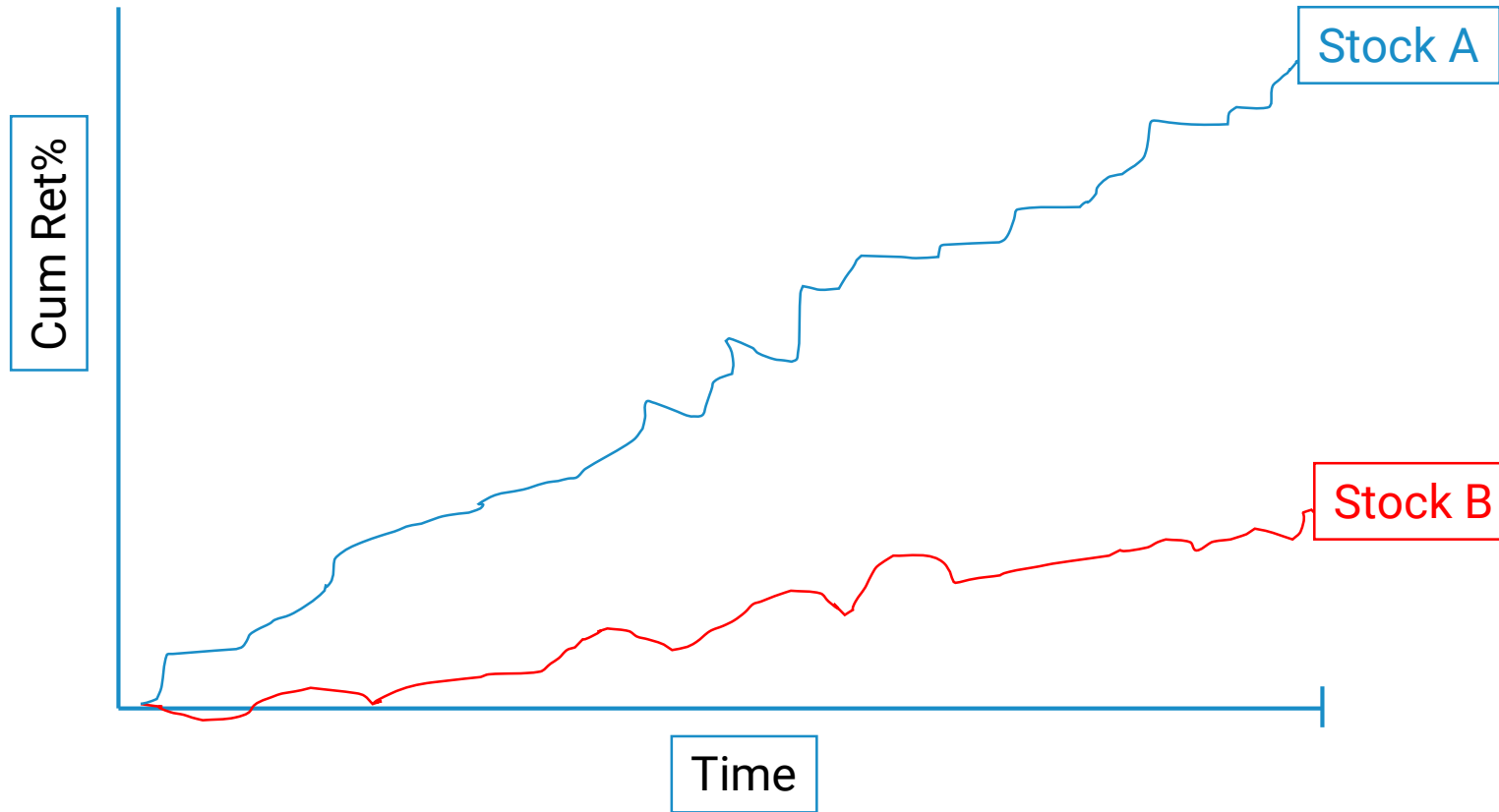


“The premier anomaly is momentum...”

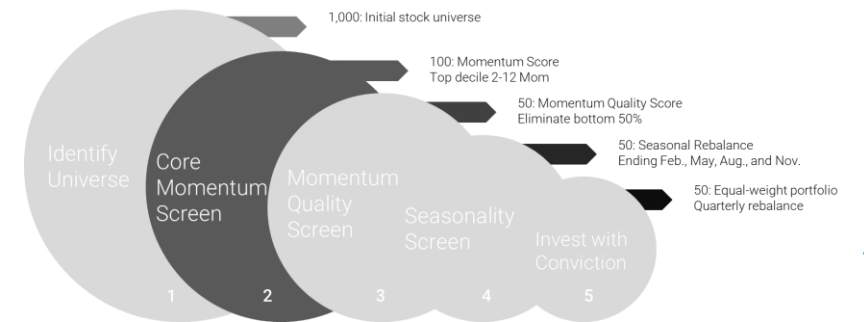


Step 2: Core Momentum Screen

Buy past winners (typically based on the past 12-month return, skipping the most recent month)

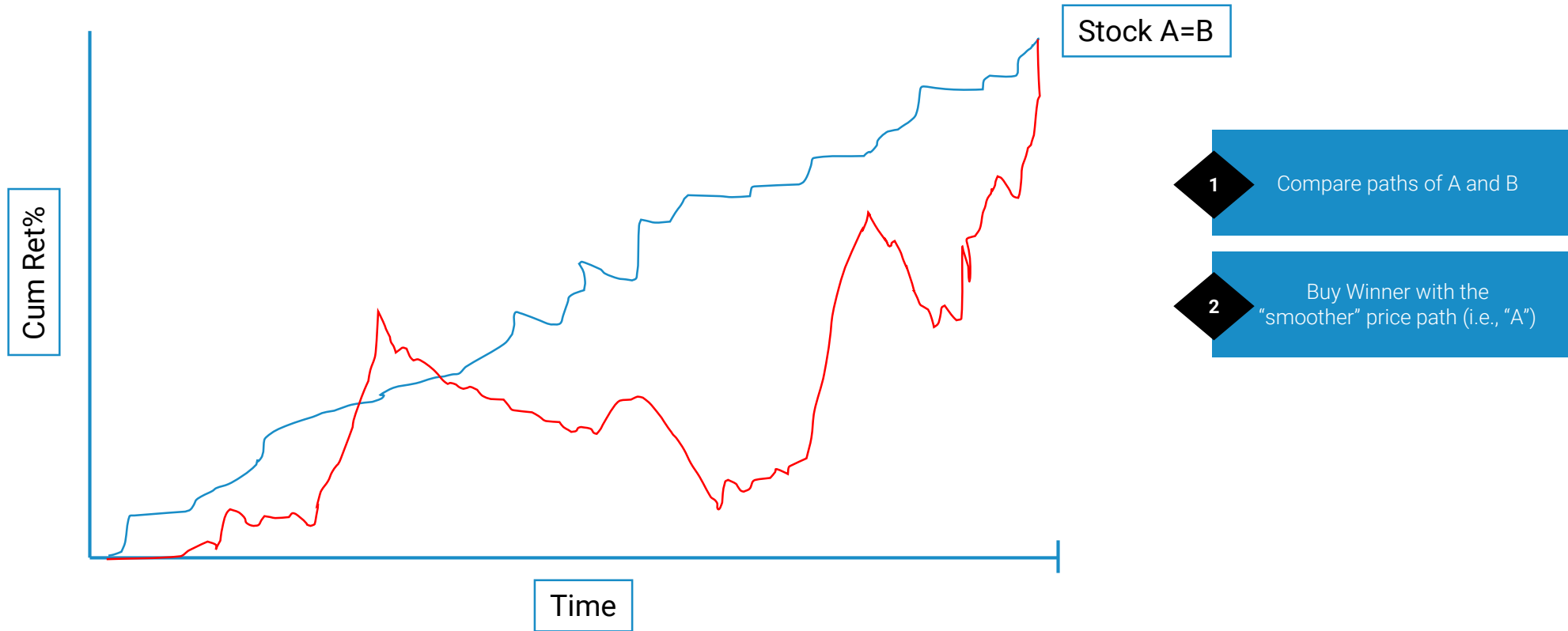


- 1 Compare A and B
- 2 Buy Winner (i.e., "A")

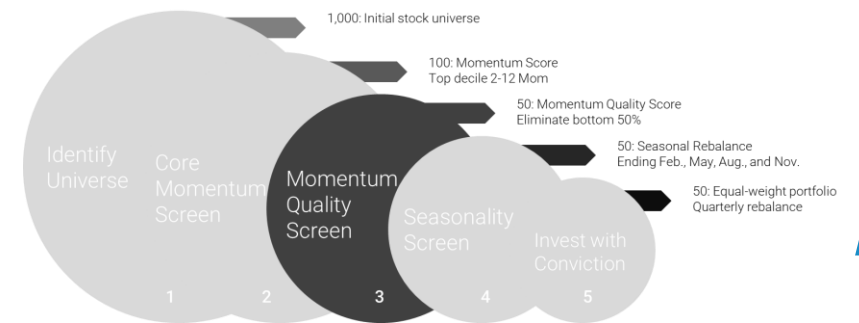


Step 3: Momentum Quality Screen

“Frog in the Pan” momentum has historically been priced inefficiently¹

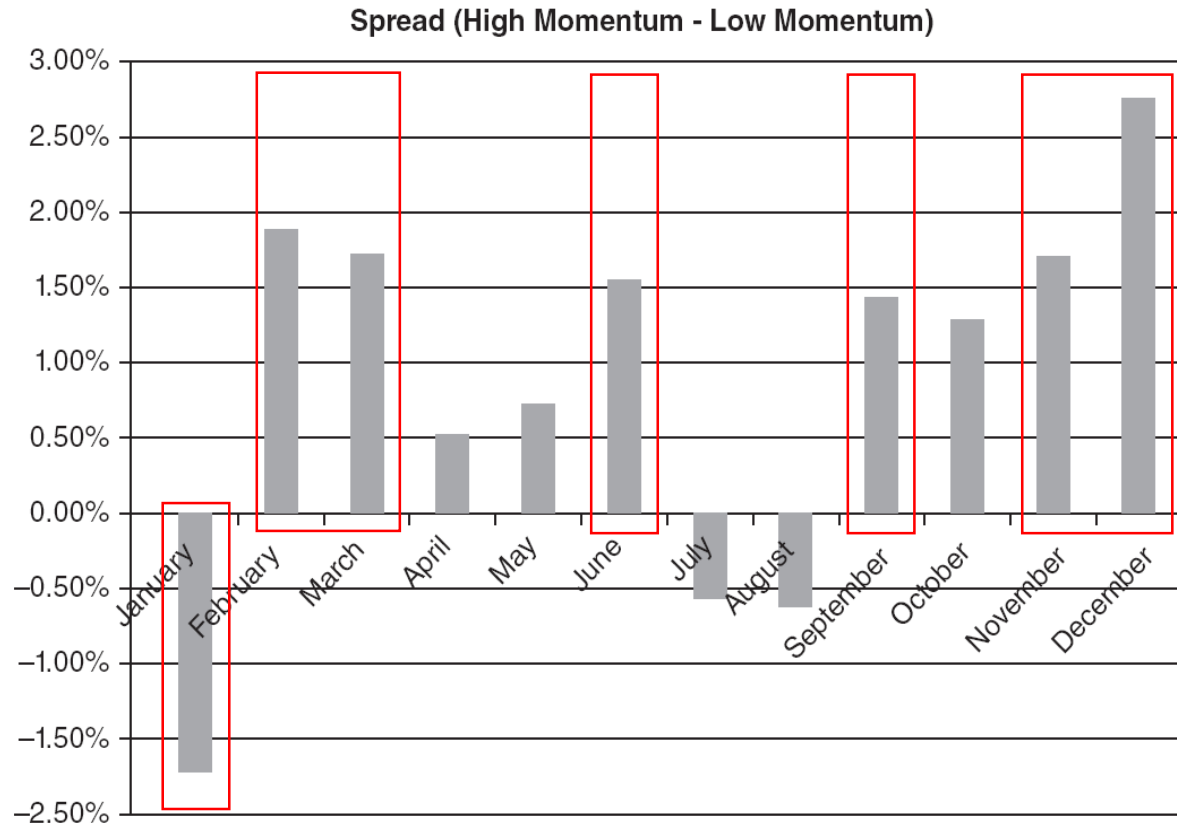


¹Da, Gurun and Warachka, 2013, "Frog in the Pan: Continuous Information and Momentum," Review of Financial Studies 27, pg. 2171-2218. Graphic is for illustrative purposes only. For illustration purposes only.

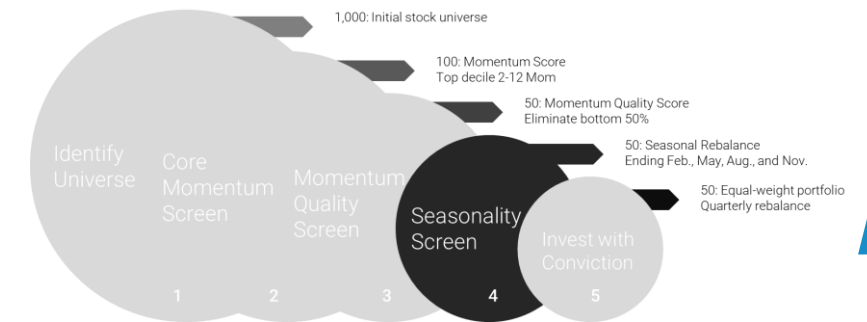


Step 4: Momentum Seasonality Screen

The momentum premium is highly seasonal, historically. Our rebalance schedule seeks to exploit seasonality.

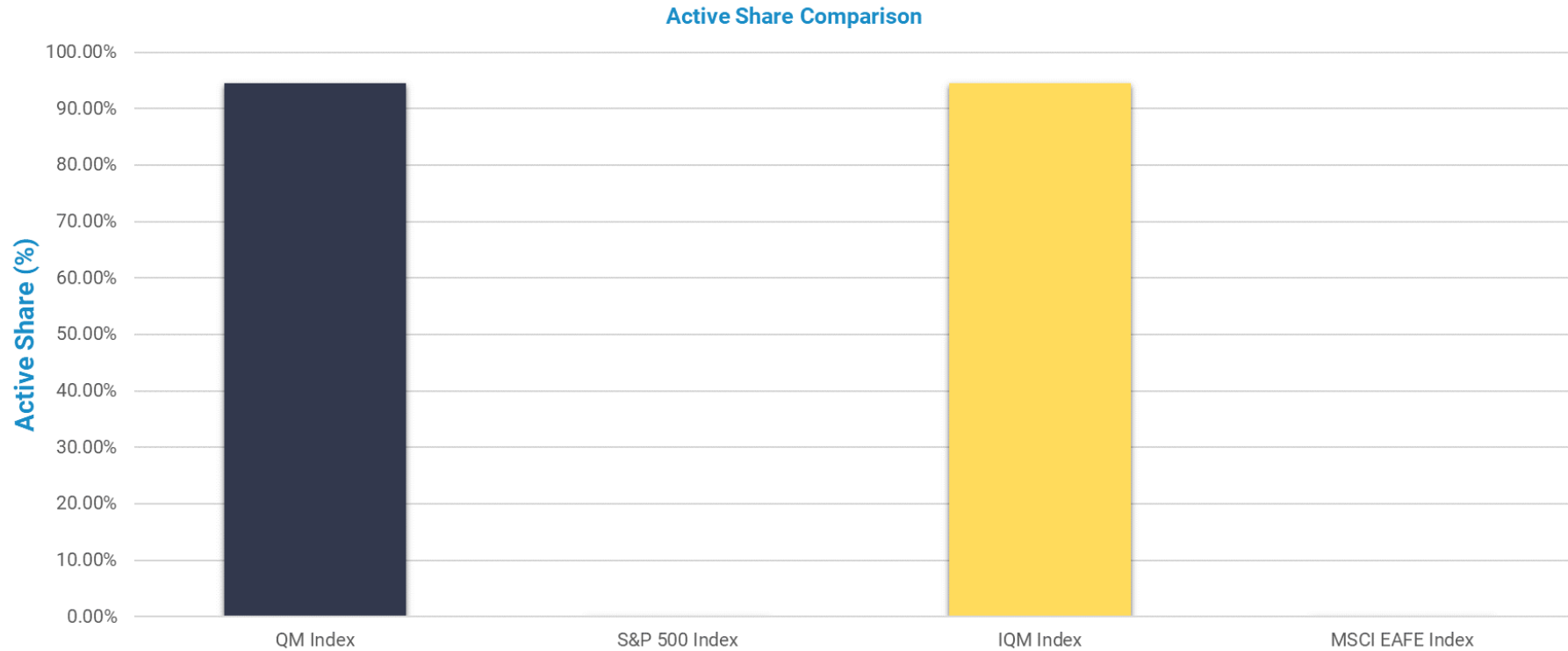


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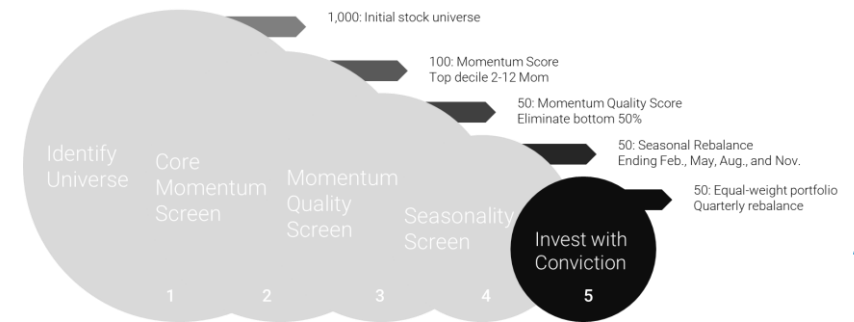


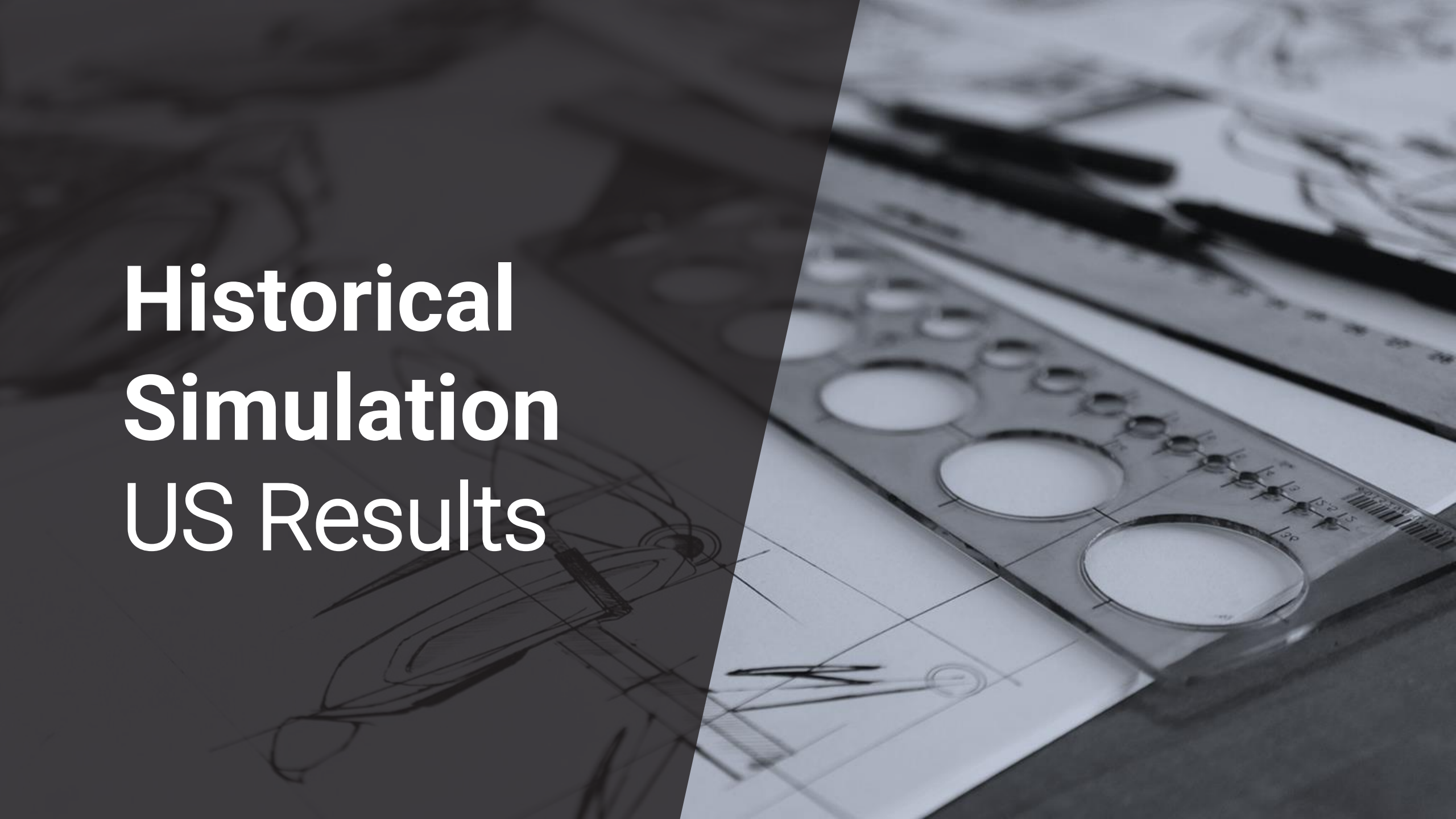
Step 5: Invest with conviction

Our Indexes have high active share relative to standard benchmarks



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The background of the slide is a grayscale photograph of a workspace. On the left, there are faint technical sketches of mechanical parts. On the right, a clear ruler with circular cutouts and a black pen are visible, resting on a surface with more technical drawings. The overall aesthetic is professional and technical.

Historical Simulation US Results

Simulated Strategy Background

- Simulated Historical Performance: 1/1/1992 to 12/31/2018
- Follows the first 5 steps of the Quantitative Momentum Index Methodology.
- Quarterly rebalanced at the end of February, May, August, and November and equal-weighted.
- QM Index results are net of 100bps management fee and 100bps transaction costs (2% total)
- Alpha Architect calculations through 12/31/2015; Solactive calculations thereafter
- All returns are total returns and include the reinvestment of distributions (e.g., dividends).
- Data sources include Alpha Architect and Bloomberg.
- Legend
 - QM_INDEX_Net = Quantitative Momentum (net of fees)
 - FF_MOM = Generic Momentum portfolio from Ken French's website
 - Top decile of momentum firms based on 12-2 month lookback, value-weighted
 - R1K Growth = Russell 1000 Growth Total Return Index
 - R1K = Russell 1000 Total Return Index
- Performance figures contained herein are hypothetical, unaudited and prepared by Alpha Architect, LLC; hypothetical results are intended for illustrative purposes only. Past performance is not indicative of future results, which may vary. Index returns are for illustrative purposes only and do not represent actual fund performance. Index performance returns do not reflect any management fees, transaction costs, or expenses, which would reduce returns. Indexes are unmanaged and one cannot invest directly in an index.
- Please see the disclosures at the end of this document for additional information.

Simulated Summary Statistics

Higher potential returns and higher potential risks

Summary Statistics	QM_INDEX_NET	FF_MOM	R1K GROWTH	R1K
CAGR	11.27%	13.23%	8.52%	9.18%
Sharpe Ratio (RF=T-Bills)	0.45	0.59	0.44	0.52
Worst Drawdown	-67.58%	-51.25%	-61.86%	-51.13%
1-Year Annualized Return	-12.26%	-1.01%	-1.51%	-4.78%
3-Year Annualized Return	0.99%	10.03%	11.16%	9.10%
5-Year Annualized Return	0.13%	9.92%	10.41%	8.22%
10-Year Annualized Return	8.28%	13.72%	15.30%	13.29%
Since Inception (1/1992)	11.27%	13.23%	8.52%	9.18%

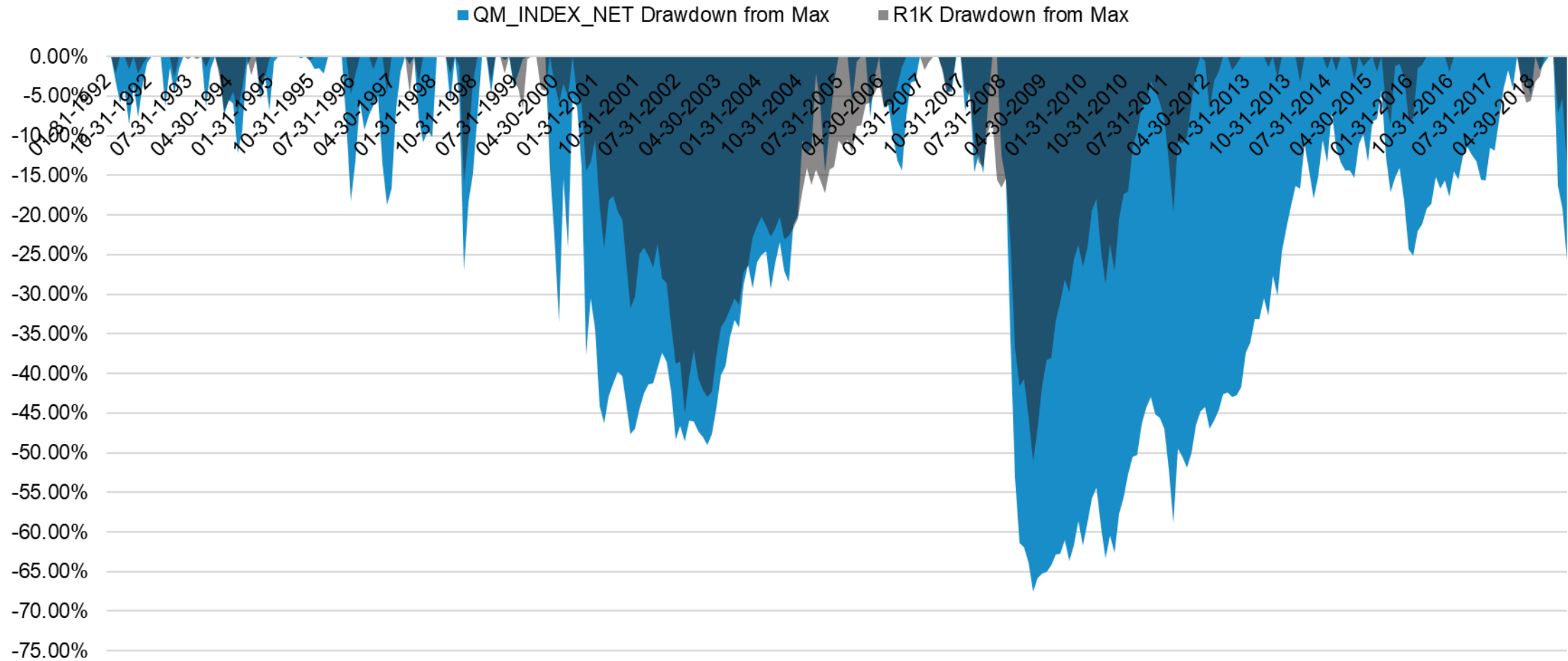
Correlation Matrix	QM_INDEX_NET	FF_MOM	R1K GROWTH	R1K
QM_INDEX_NET	100.00%	91.00%	73.67%	68.99%
FF_MOM	91.00%	100.00%	80.13%	76.43%
R1K GROWTH	73.67%	80.13%	100.00%	95.77%
R1K	68.99%	76.43%	95.77%	100.00%

**Bold denotes values less than |.5|

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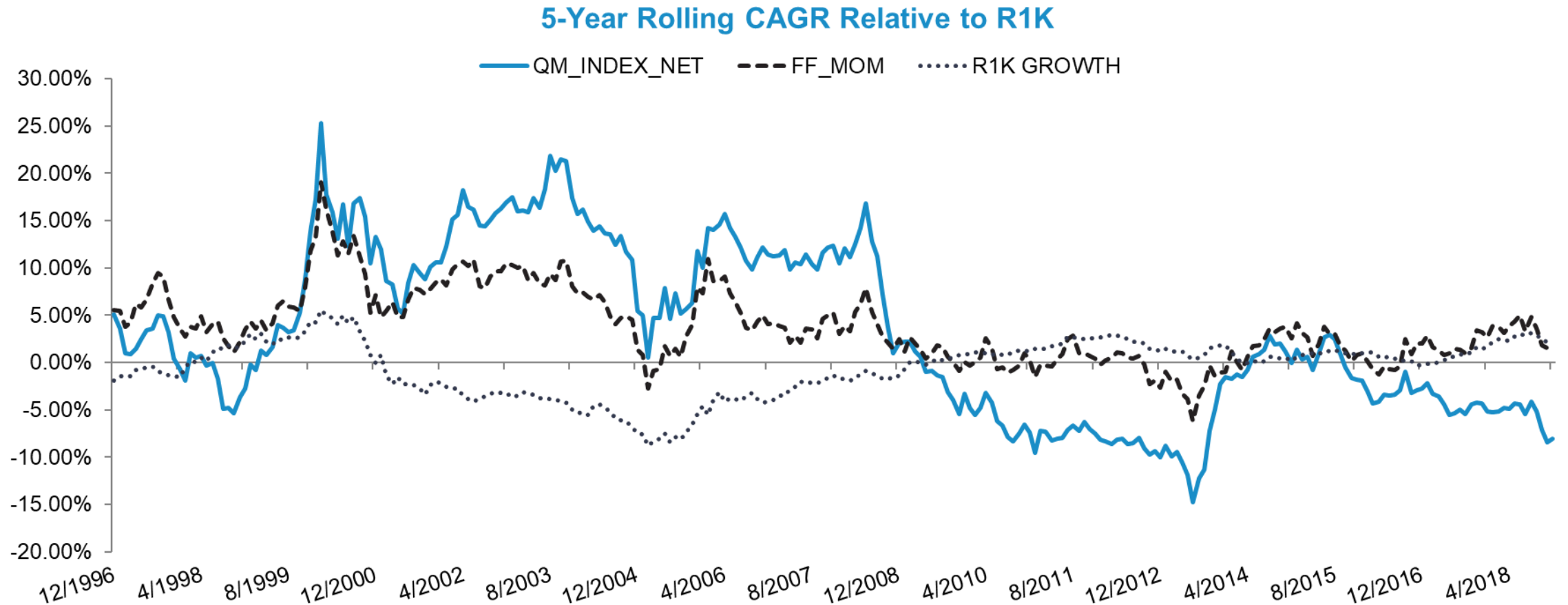
Simulated Drawdown Analysis

Potential for large losses



Simulated Relative Performance

Potential for large deviations from standard benchmarks



The background features a grayscale image of technical drawing tools. On the right, a ruler with circular cutouts and a pen are visible. The left side is a dark, semi-transparent overlay containing white text. The overall theme is engineering or design.

Historical Simulation International Results

Simulated Strategy Background

- Simulated Historical Performance: 1/1/1992 to 12/31/2018
- Adjusted Quantitative Momentum process for International stocks (primarily developed markets).
 - Quarterly rebalance and equal-weighted.
 - IQM Index results are net of 100bps management fee and 200bps transaction costs (3% total).
 - Alpha Architect calculations through 12/31/2015; Solactive calculations thereafter
 - All returns are total returns and include the reinvestment of distributions (e.g., dividends).
 - Data sources include Alpha Architect and Bloomberg.
- Legend
 - IQM_INDEX_Net = International Quantitative Momentum (net of fees)
 - FF_INT_MOM = Generic International Momentum portfolio from Ken French's website
 - Average of 3 top market-cap quintile portfolios with highest momentum (12-2 lookback), value-weighted
 - EAFE MOM = MSCI EAFE Momentum Total Return Index
 - EAFE = MSCI EAFE Total Return Index
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- Please see the disclosures at the end of this document for additional information.

Simulated Summary Statistics

Higher potential returns and higher potential risks

Summary Statistics	IQM_INDEX_NET	FF_INT_MOM	EAFE MOM	EAFE
CAGR	14.25%	9.26%	6.11%	4.87%
Sharpe Ratio (RF=T-Bills)	0.65	0.46	0.30	0.22
Worst Drawdown	-56.63%	-52.81%	-56.19%	-56.68%
1-Year Annualized Return	-23.54%	-16.08%	-13.14%	-13.79%
3-Year Annualized Return	-3.74%	3.88%	3.59%	2.88%
5-Year Annualized Return	-1.34%	2.46%	1.94%	0.53%
10-Year Annualized Return	7.93%	9.16%	6.72%	6.32%
Since Inception (1/1992)	14.25%	9.26%	6.11%	4.87%

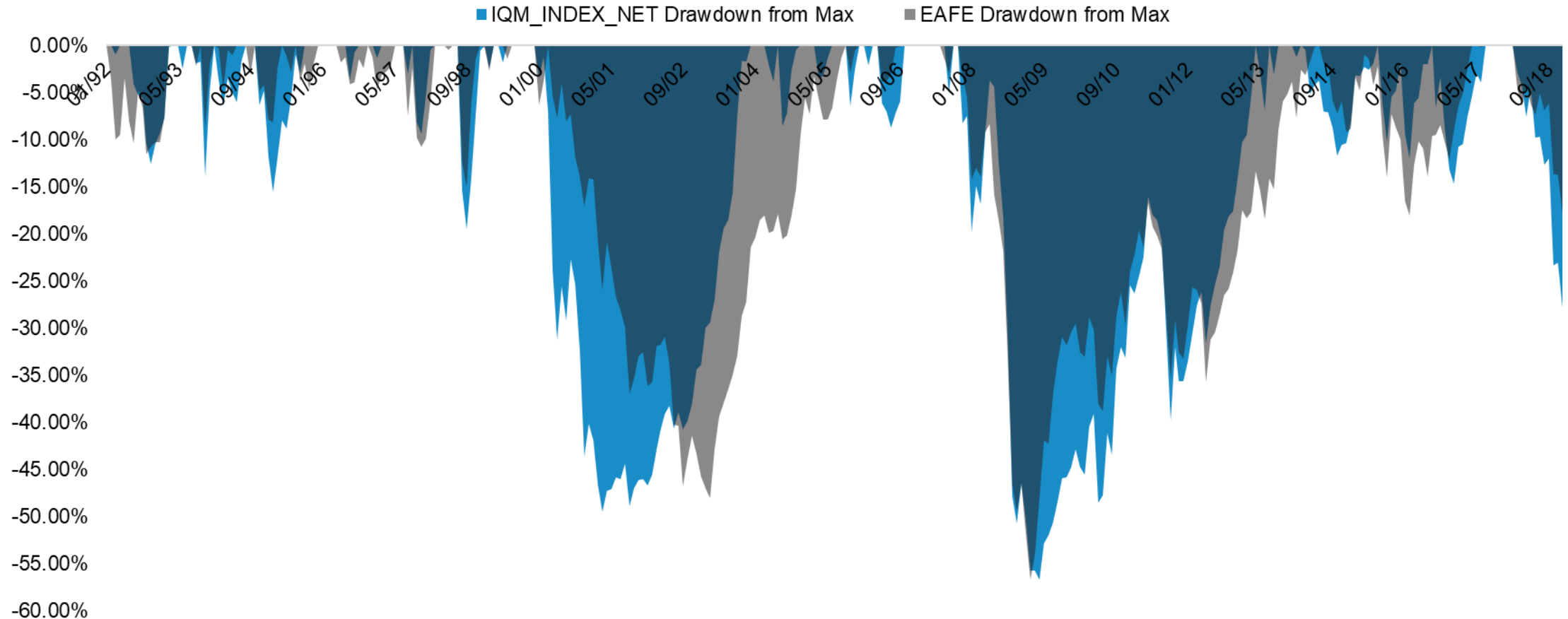
Correlation Matrix	IQM_INDEX_NET	FF_INT_MOM	EAFE MOM	EAFE
IQM_INDEX_NET	100.00%	91.47%	86.21%	76.26%
FF_INT_MOM	91.47%	100.00%	90.16%	85.67%
EAFE MOM	86.21%	90.16%	100.00%	85.88%
EAFE	76.26%	85.67%	85.88%	100.00%

**Bold denotes values less than |.5|

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Simulated Drawdown Analysis

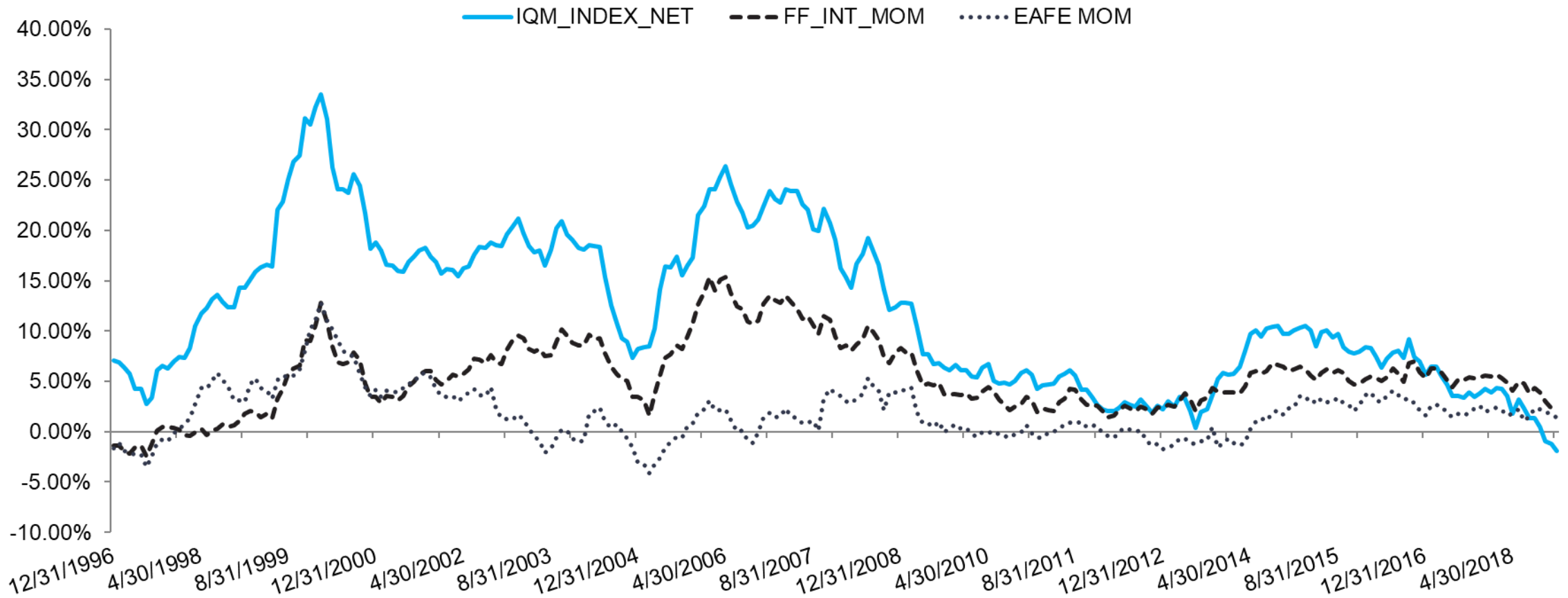
Potential for large losses



Simulated Relative Performance

Potential for large deviations from standard benchmarks

5-Year Rolling CAGR Relative to EAFE



Portfolio Applications

The image is a composite graphic. The left side is a dark, semi-transparent overlay containing the text 'Portfolio Applications' in a white, bold, sans-serif font. The right side shows a technical drawing on a grid background. It features a series of concentric circles and smaller circles arranged in a pattern, possibly representing a mechanical part or a design element. A ruler is visible at the bottom right, and a pen or pencil lies across the top right. The overall aesthetic is professional and technical.

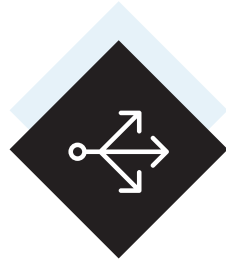
How to Use Our Indexes: Deployment Options



Core Satellite

Combine an aggressive factor portfolio alongside a core low-cost market beta portfolio.

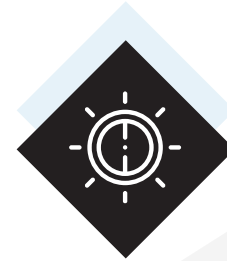
-
- +Potential for higher returns
 - Potential for tracking error



Factor Diversification

Deploy a focused factor allocation alongside a low-tracking error factor exposure.

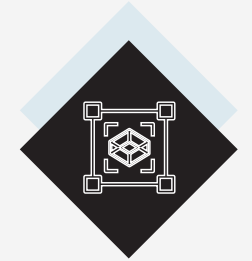
-
- +Potential factor diversification
 - Potential for tracking error



Alternative Exposure

Deploy the exposure in an alternative sleeve, where tracking error expectations are high.

-
- +Potential to diversify portfolio
 - Potential for tracking error



AA Model*

Deploy the exposures in accordance with custom Alpha Architect allocation models.

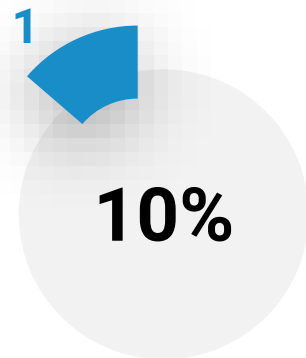
-
- +Max leverage on AA research efforts
 - Potential for tracking error

*Contact us for additional information.

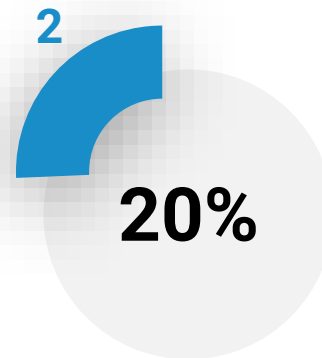
Core-Satellite Allocation: 3 variations for different objectives

Contact us for customized model solutions to minimize behavioral issues.

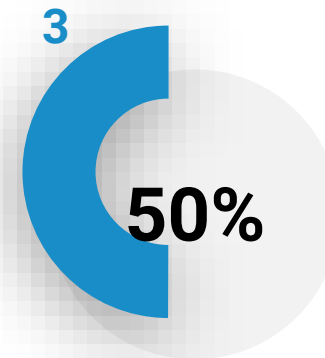
Examples below with different global (i.e., 50% QM Index/IQM Index) momentum factor exposure



Benchmark
Constrained



Benchmark
Aware



Focused
Factors

Simulated Strategy Background

- Simulated Historical Performance: 1/1/1992 to 12/31/2018
- **QM & IQM**
 - Adjusted Quantitative Momentum process for International stocks (primarily developed markets).
 - Quarterly rebalance and equal-weighted.
 - **QM & IQM** = Equal-weight across QM Net Index and IQM Net Index
 - QM Index results are net of 100bps management fee and 100bps transaction costs (2% total)
 - IQM Index results are net of 100bps management fee and 200bps transaction costs (3% total)
 - Alpha Architect calculations through 12/31/2015; Solactive calculations thereafter
- All returns are total returns and include the reinvestment of distributions (e.g., dividends).
- Data sources include Alpha Architect and Bloomberg.
- Legend
 - MSCI WORLD = MSCI World Net Total Return USD Index
 - WORLD + 10% **QM & IQM** = 90% in MSCI WORLD and 10% in **QM & IQM** Index, monthly rebalanced
 - WORLD + 20% **QM & IQM** = 80% in MSCI WORLD and 20% in **QM & IQM** Index, monthly rebalanced
 - WORLD + 50% **QM & IQM** = 50% in MSCI WORLD and 50% in **QM & IQM** Index, monthly rebalanced
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Simulated Summary Statistics

Adding focused factor exposure generates higher risk-adjusted return

Summary Statistics	MSCI WORLD	MSCI WORLD + 10% QM&IQM	MSCI WORLD + 20% QM&IQM	MSCI WORLD + 50% QM&IQM
CAGR	6.64%	7.37%	8.09%	10.14%
Sharpe Ratio (RF=T-Bills)	0.35	0.39	0.43	0.52
Worst Drawdown	-54.03%	-54.60%	-55.18%	-57.03%
1-Year Annualized Return	-8.71%	-9.62%	-10.53%	-13.27%
3-Year Annualized Return	6.31%	5.56%	4.82%	2.57%
5-Year Annualized Return	4.56%	4.08%	3.60%	2.13%
10-Year Annualized Return	9.67%	9.58%	9.48%	9.11%
Since Inception (1/1992)	6.64%	7.37%	8.09%	10.14%

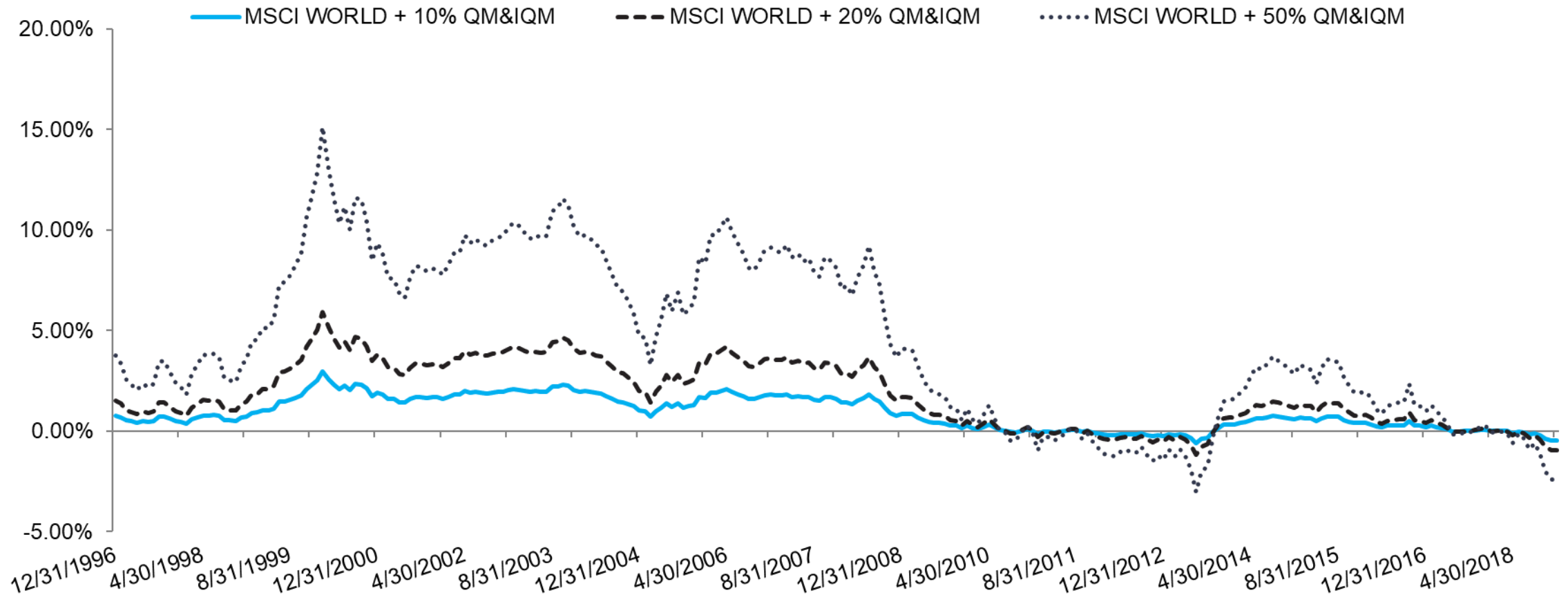
Correlation Matrix	MSCI WORLD	MSCI WORLD + 10% QM&IQM	MSCI WORLD + 20% QM&IQM	MSCI WORLD + 50% QM&IQM
MSCI WORLD	100.00%	99.56%	98.32%	91.16%
MSCI WORLD + 10% QM&IQM	99.56%	100.00%	99.59%	94.60%
MSCI WORLD + 20% QM&IQM	98.32%	99.59%	100.00%	97.13%
MSCI WORLD + 50% QM&IQM	91.16%	94.60%	97.13%	100.00%

**Bold denotes values less than |.5|

Simulated Relative Performance

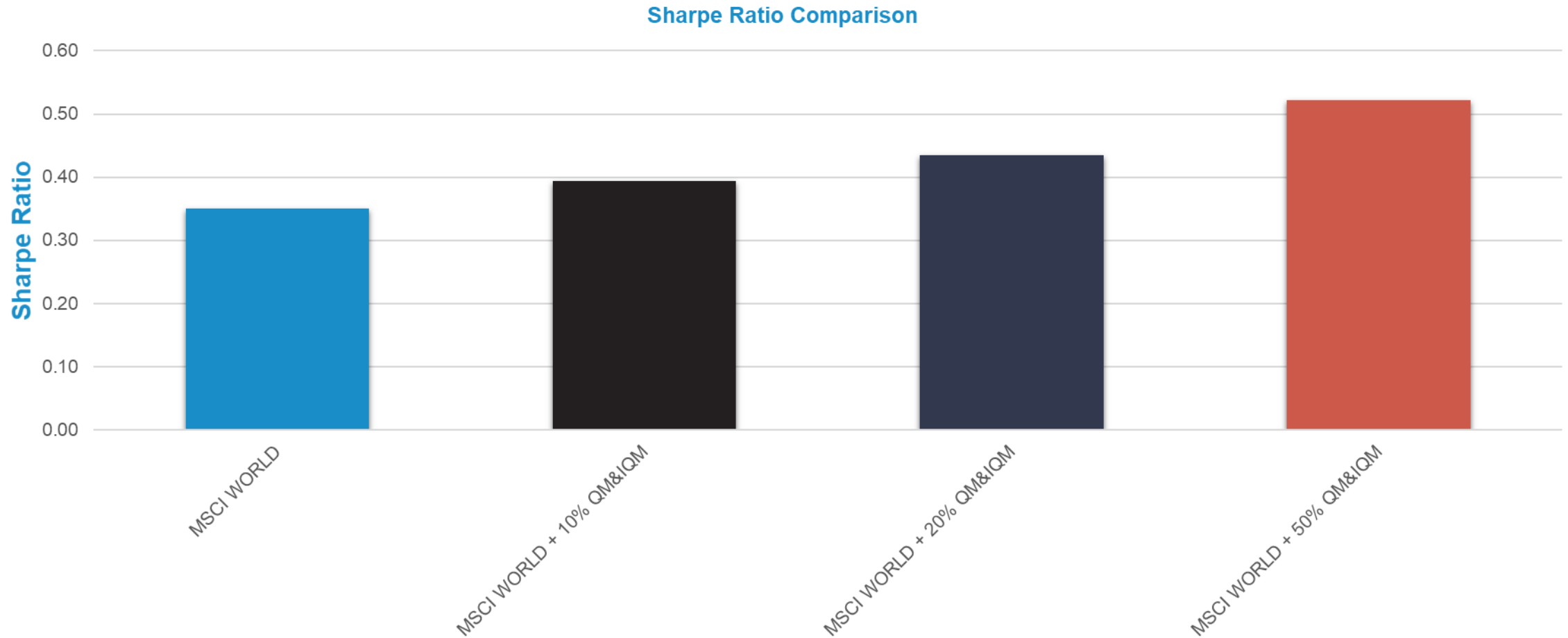
Potential for deviations from standard benchmarks

5-Year Rolling CAGR Relative to MSCI WORLD



Simulated Relative Performance

Potential to enhance risk-adjusted performance





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Appendix

A dark, moody photograph of a desk. In the upper right, a silver laptop is partially visible, showing its keyboard. In the center, a pair of round-rimmed glasses rests on a white notebook. The background is a dark, textured surface, possibly a desk or a wall. The overall lighting is low, creating a professional and focused atmosphere. The word 'Appendix' is overlaid in a clean, white, sans-serif font on the left side of the image.

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Annual performance is calculated based on monthly return streams, geometrically linked as of the end of the specified month end.

Results, unless cited otherwise, are shown gross of fees and do not reflect the effect of investment fees which would lower performance. Performance reflects the reinvestment of dividends and other earnings. The following hypothetical illustrates the compound effect fees have on investment return: For an account charged 1% with a stated annual return of 10%, the net total return before taxes would be reduced from 10% to 9%. A ten year investment of \$100,000 at 10% would grow to \$259,374, and at 9%, to \$236,736 before taxes. For a complete description of all fees and expenses, please refer to Alpha Architect's Form ADV Part 2A.

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IMPORTANT INFORMATION - DISCLOSURES

- Simulated Historical Performance: All returns are total returns and include the reinvestment of distributions (e.g., dividends).
- Index Characteristics Data Source: Characteristics are from FactSet and derived via the ETFs that track the respective Indexes. Characteristics are holdings-weighted. The data for the performance and factor attribution analysis are from Alpha Architect and Solactive.
- The S&P 500 Index (SP500) is a capitalization-weighted index that measures the performance of the broad U.S. equity market.
- The MSCI EAFE Index (EAFE) is a capitalization-weighted index that measures the performance of developed market equities, excluding the U.S. and Canada.
- The MSCI World Index is a capitalization-weighted index that measures the performance of developed market equities.
- EBIT/TEV is defined as earnings before interest and taxes divided by total enterprise value.
- Momentum (2-12) is defined as the cumulative total return for the past 12 months, excluding the last (12th) month.
- Size is defined as the total market value of the company's listed equity.
- Return on assets is defined as net income divided by total assets.
- Compound annualized growth rate, or CAGR, is defined as the annualized growth of an initial investment to the ending investment value if you assume that the investment has been compounding over the time period.
- Standard Deviation: Sample standard deviation
- Downside Deviation: Sample standard deviation, but only monthly observations below 41.67bps (5%/12) are included in the calculation
- Sharpe Ratio (annualized): Average monthly return minus treasury bills divided by standard deviation
- Sortino Ratio (annualized): Average monthly return minus treasury bills divided by downside deviation
- Appraisal Ratio (annualized): CAPM regression intercept estimate divided by regression residual volatility
- Worst Drawdown: Worst peak to trough performance (measured based on monthly returns)
- Rolling X-Year Win %: Percentage of rolling X periods that a strategy outperforms
- Sum (5-Year Rolling MaxDD): Sum of all 5-Year rolling drawdowns
- Down %: The Down Number Ratio is a measure of the number of periods that the investment was down when the benchmark was down, divided by the number of periods that the benchmark was down. The smaller the ratio, the better
- Up %: The Up Number Ratio is a measure of the number of periods that the investment was up when the benchmark was up, divided by the number of periods that the benchmark was up. The larger the ratio, the better
- Tracking Error: Tracking Error is measured by taking the square root of the average of the squared deviations between the investment's returns and the benchmark's returns
- Negative Correlation: Correlation of returns relative to benchmark returns when the benchmark is negative
- Positive Correlation: Correlation of returns relative to benchmark returns when the benchmark is positive
- Performance figures contained herein are hypothetical, unaudited and prepared by Alpha Architect, LLC; hypothetical results are intended for illustrative purposes only. Past performance is not indicative of future results, which may vary. Index returns are for illustrative purposes only and do not represent actual fund performance. Index performance returns do not reflect any management fees, transaction costs, or expenses, which would reduce returns. Indexes are unmanaged and one cannot invest directly in an index.