ALPHA ARCHITECT QUANTITATIVE MOMENTUM INDEXES (QM AND IQM INDEX)

We Empower Investors Through Education | Affordable Alpha

Jack R. Vogel, PhD
T: +1.215.882.9983
F: +1.216.245.3686
ir@alphaarchitect.com
213 Foxcroft Road
Broomall, PA 19008

IMPORTANT INFORMATION - DISCLOSURES

This document describes the technology behind our Indexes.

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We Educate Investors on Systematic Factor Investing

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.

Wesley R. Gray, Ph.D.
PhD/MBA, University of Chicago
BS Economics, Wharton
Captain, Marine Corps

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.

Jack R. Vogel, Ph.D.
PhD, Drexel University
MS Mathematics, Drexel Univ.
BS Mathematics, U. of Scranton

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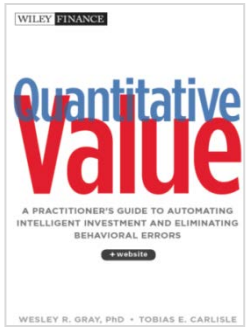
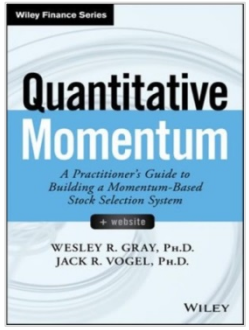
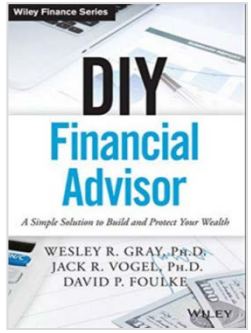
Published multiple research-focused finance books







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)

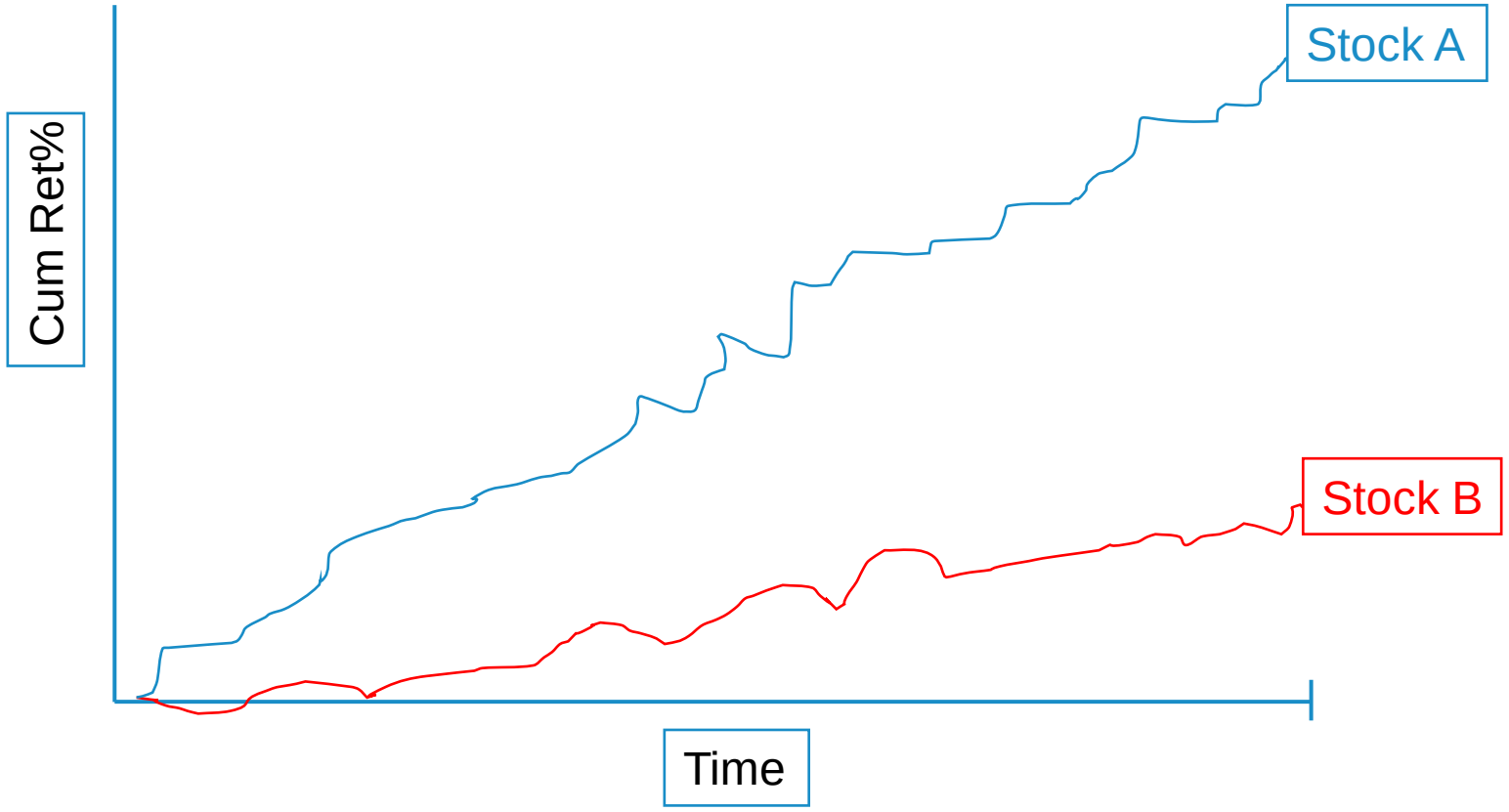
Numerous working papers (more available upon request)

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

What does “Momentum” mean?

Simple Momentum Example

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”)

*For illustration purposes only.

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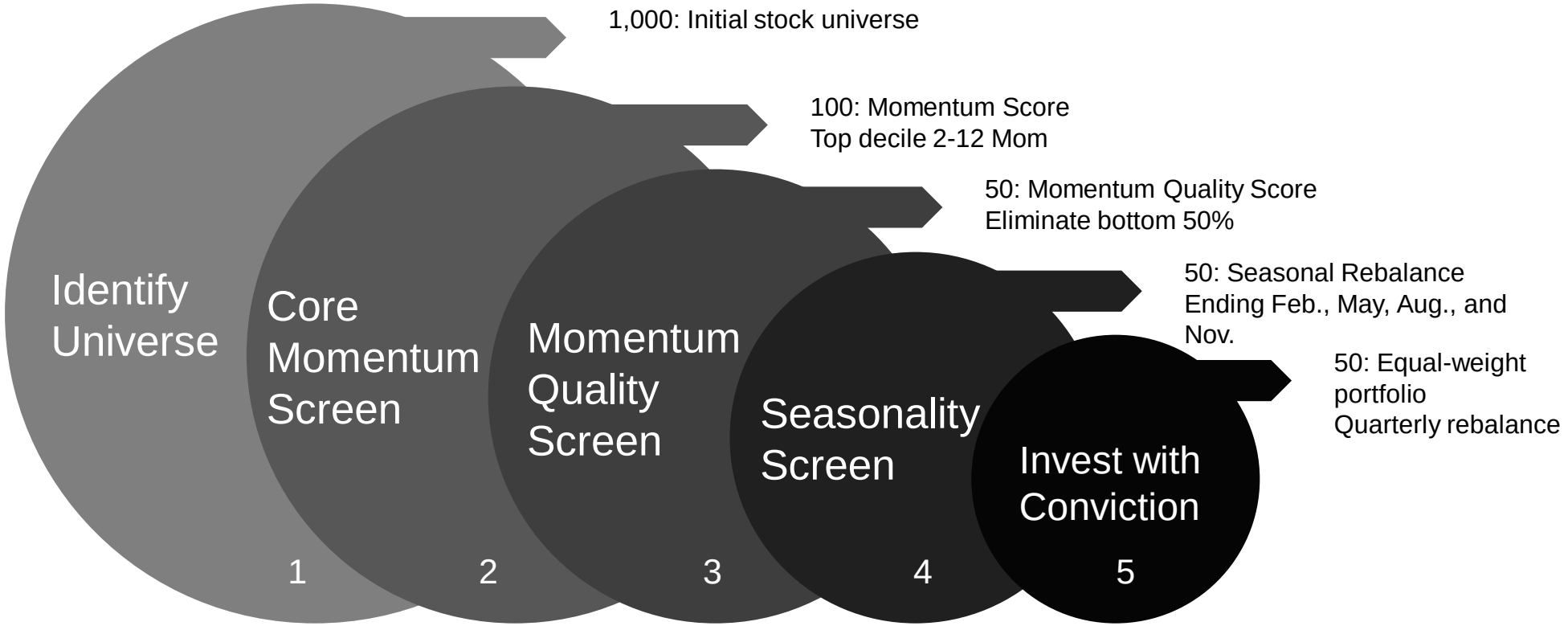
Quantitative Momentum Index Methodology

Quantitative Momentum Index Stock Selection Details

QM/IQM Index seeks to buy stocks with the highest quality momentum[1]

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



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

As of Date: 9/30/2019

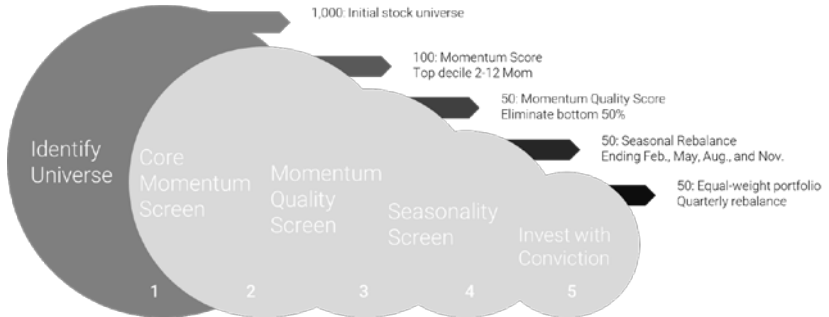
Step 1: Identify Universe

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.

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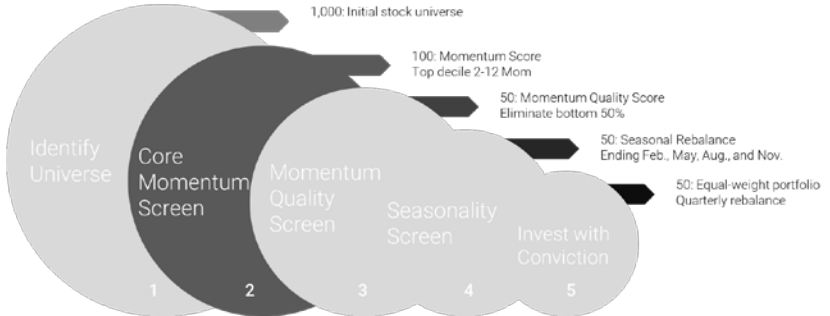
Step 2: Core Momentum Screen

Even Eugene Fama and Ken French acknowledge the historical evidence

"The premier anomaly is momentum..."

From "Dissecting Anomalies" by Kenneth French and Eugene Fama, 2008, Journal of Finance.



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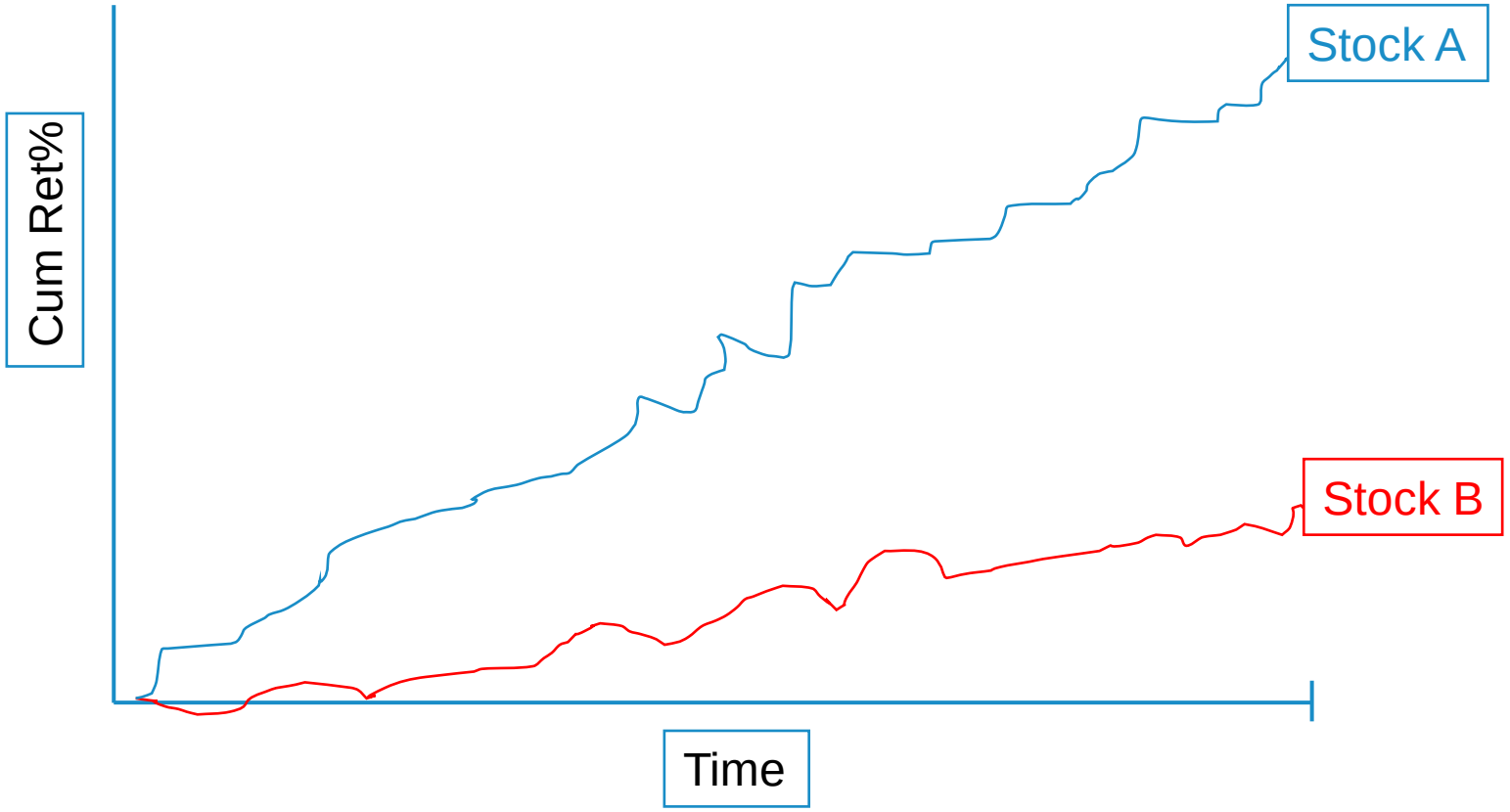

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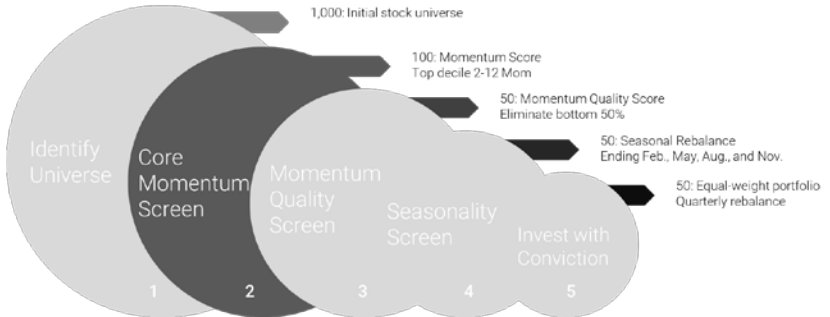

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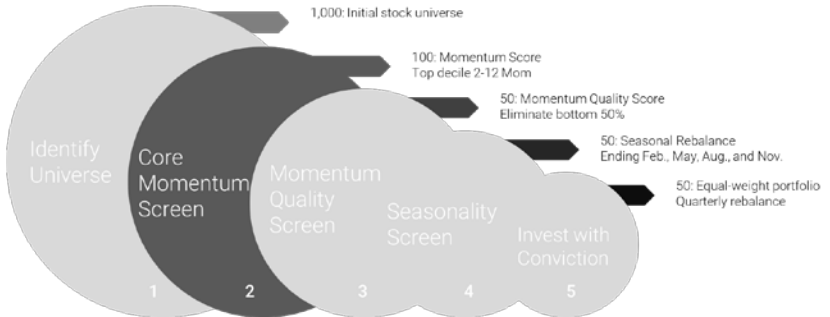
Step 2: Core Momentum Screen

"Return to Buying Winners and Selling Losers: Implications for Stock Market Efficiency"

J-month/K-month strategy: select stocks based on past J months and hold the position for K months.

		Panel A				Panel B → 1 week lag			
J		K = 3	6	9	12	K = 3	6	9	12
3	Sell	0.0108	0.0091	0.0092	0.0087	0.0083	0.0079	0.0084	0.0083
		(2.16)	(1.87)	(1.92)	(1.87)	(1.67)	(1.64)	(1.77)	(1.79)
3	Buy	0.0140	0.0149	0.0152	.0156	0.0156	0.0158	0.0158	0.0160
		(3.57)	(3.78)	(3.83)	(3.89)	(3.95)	(3.98)	(3.96)	(3.98)
3	Buy-sell	0.0032	0.0058	0.0061	0.0069	0.0073	0.0078	0.0074	0.0077
		(1.10)	(2.29)	(2.69)	(3.53)	(2.61)	(3.16)	(3.36)	(4.00)
6	Sell	0.0087	0.0079	0.0072	0.0080	0.0066	0.0068	0.0067	0.0076
		(1.67)	(1.56)	(1.48)	(1.66)	(1.28)	(1.35)	(1.38)	(1.58)
6	Buy	0.0171	0.0174	0.0174	0.0166	0.0179	0.0178	0.0175	0.0166
		(4.28)	(4.33)	(4.31)	(4.13)	(4.47)	(4.41)	(4.32)	(4.13)
6	Buy-sell	0.0084	0.0095	0.0102	0.0086	0.0114	0.0110	0.0108	0.0090
		(2.44)	(3.07)	(3.76)	(3.36)	(3.37)	(3.61)	(4.01)	(3.54)
9	Sell	0.0077	0.0065	0.0071	0.0082	0.0058	0.0058	0.0066	0.0078
		(1.47)	(1.29)	(1.43)	(1.66)	(1.13)	(1.15)	(1.34)	(1.59)
9	Buy	0.0186	0.0186	0.0176	0.0164	0.0193	0.0188	0.0176	0.0164
		(4.56)	(4.53)	(4.30)	(4.03)	(4.72)	(4.56)	(4.30)	(4.04)
9	Buy-sell	0.0109	0.0121	0.0105	0.0082	0.0135	0.0130	0.0109	0.0085
		(3.03)	(3.78)	(3.47)	(2.89)	(3.85)	(4.09)	(3.67)	(3.04)
12	Sell	0.0060	0.0065	0.0075	0.0087	0.0048	0.0058	0.0070	0.0085
		(1.17)	(1.29)	(1.48)	(1.74)	(0.93)	(1.15)	(1.40)	(1.71)
12	Buy	0.0192	0.0179	0.0168	0.0155	0.0196	0.0179	0.0167	0.0154
		(4.63)	(4.36)	(4.10)	(3.81)	(4.73)	(4.36)	(4.09)	(3.79)
12	Buy-sell	0.0131	0.0114	0.0093	0.0068	0.0149	0.0121	0.0096	0.0069
		(3.74)	(3.40)	(2.95)	(2.25)	(4.28)	(3.65)	(3.09)	(2.31)

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

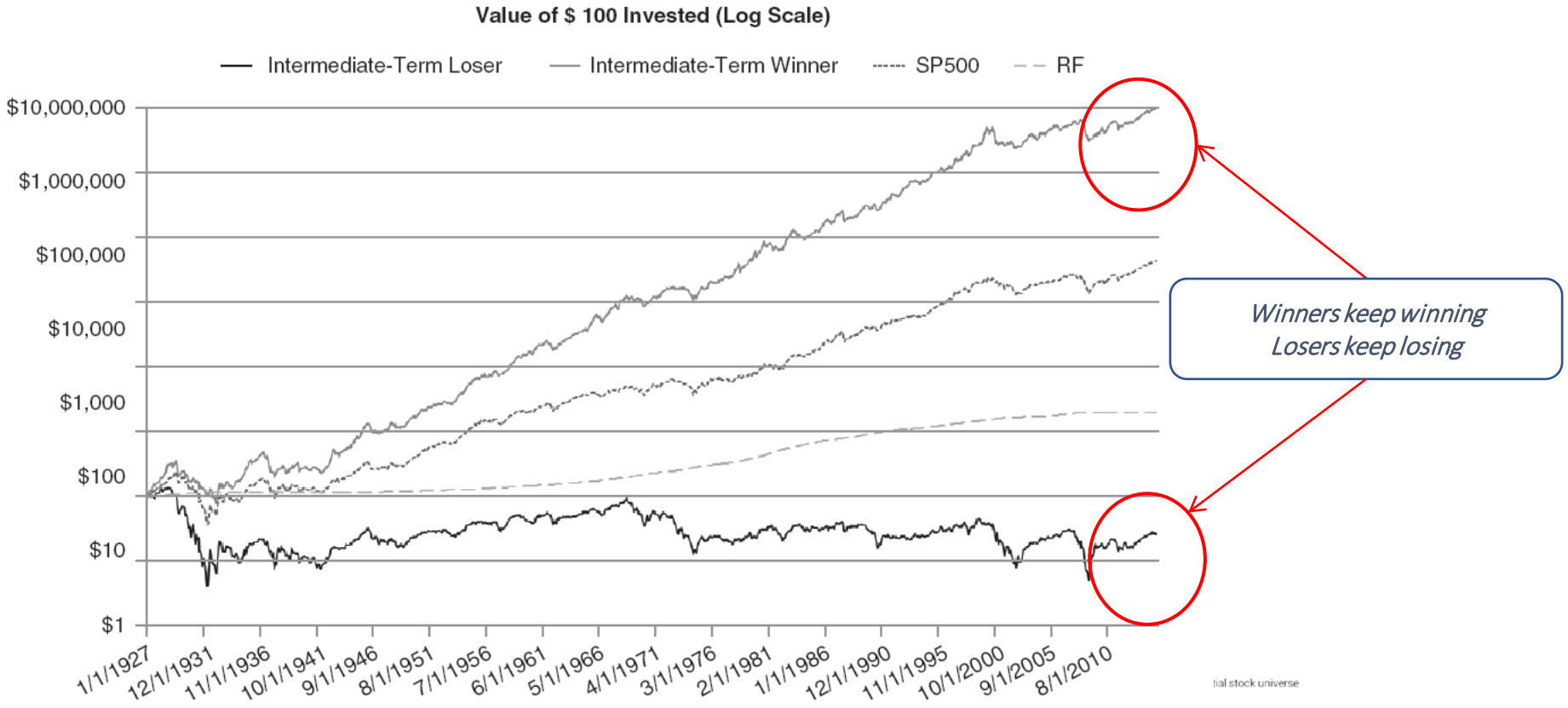


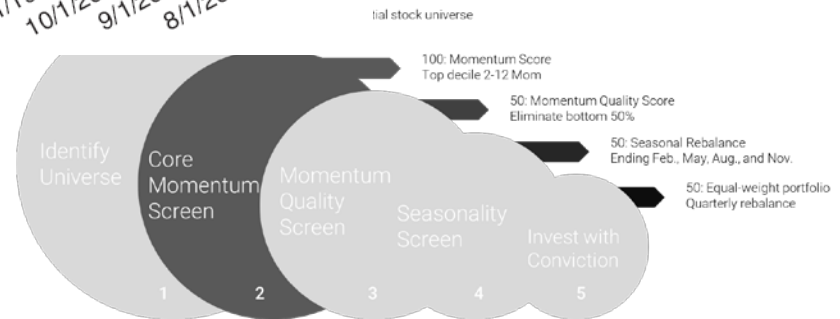
*Source: "Return to Buying Winners and Selling Losers: Implications for Stock Market Efficiency," Jegadeesh and Titman, 1993, *Journal of Finance*. .

As of Date: 9/30/2019

Step 2: Core Momentum Screen

Returns to the top decile “Winner” and bottom decile “Loser” when ranked on 12_2 momentum.





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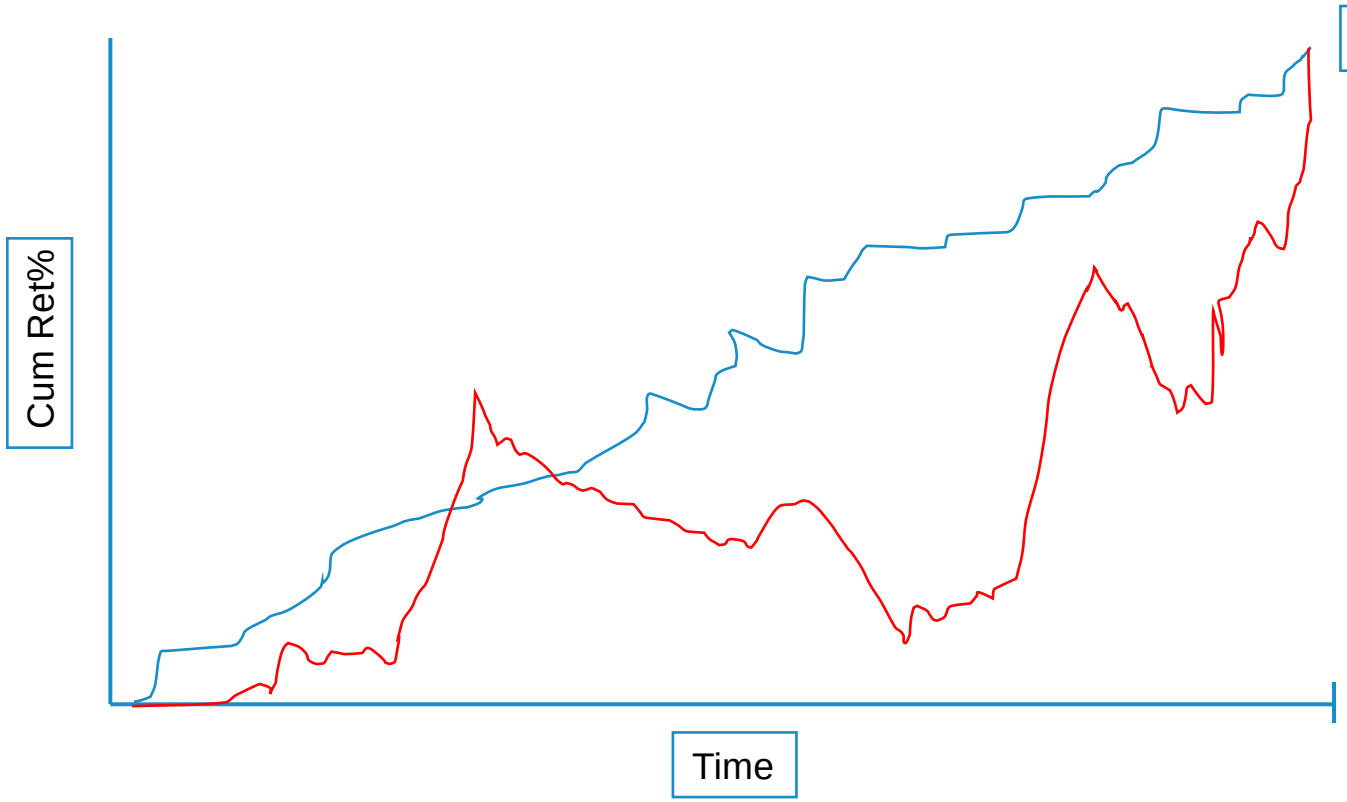
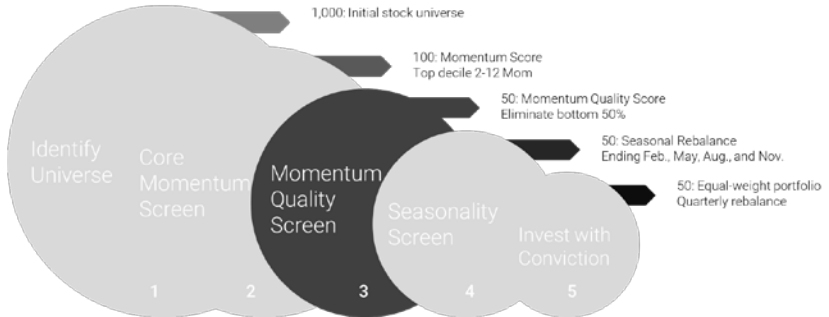
Step 3: Momentum Quality Screen

"Frog in the Pan" momentum has historically been priced inefficiently[1]



1. Compare paths of A and B
2. Buy Winner with the "smoother" price path (i.e., "A")



[1]Da, 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.

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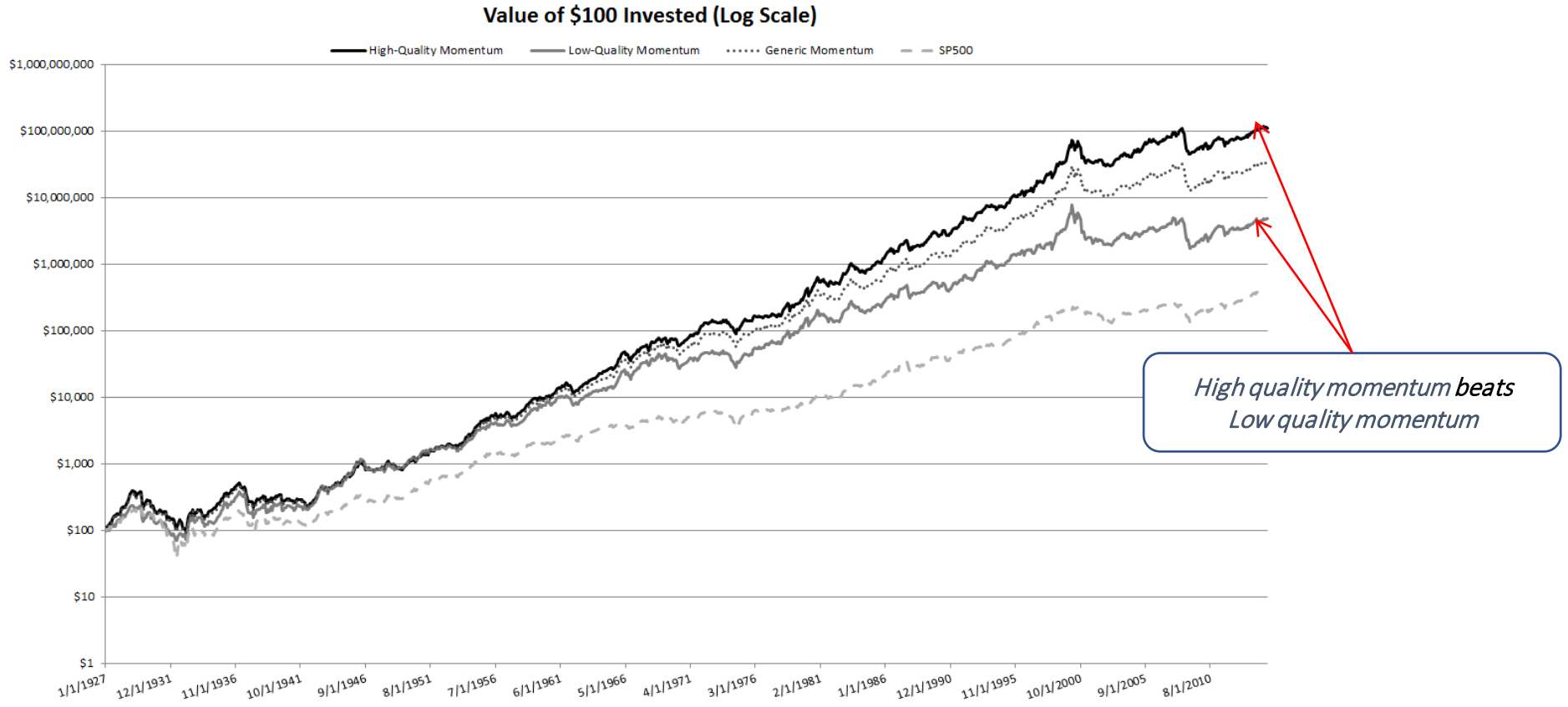

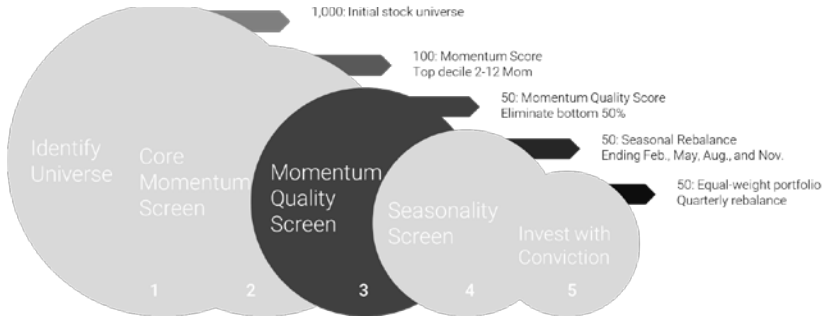

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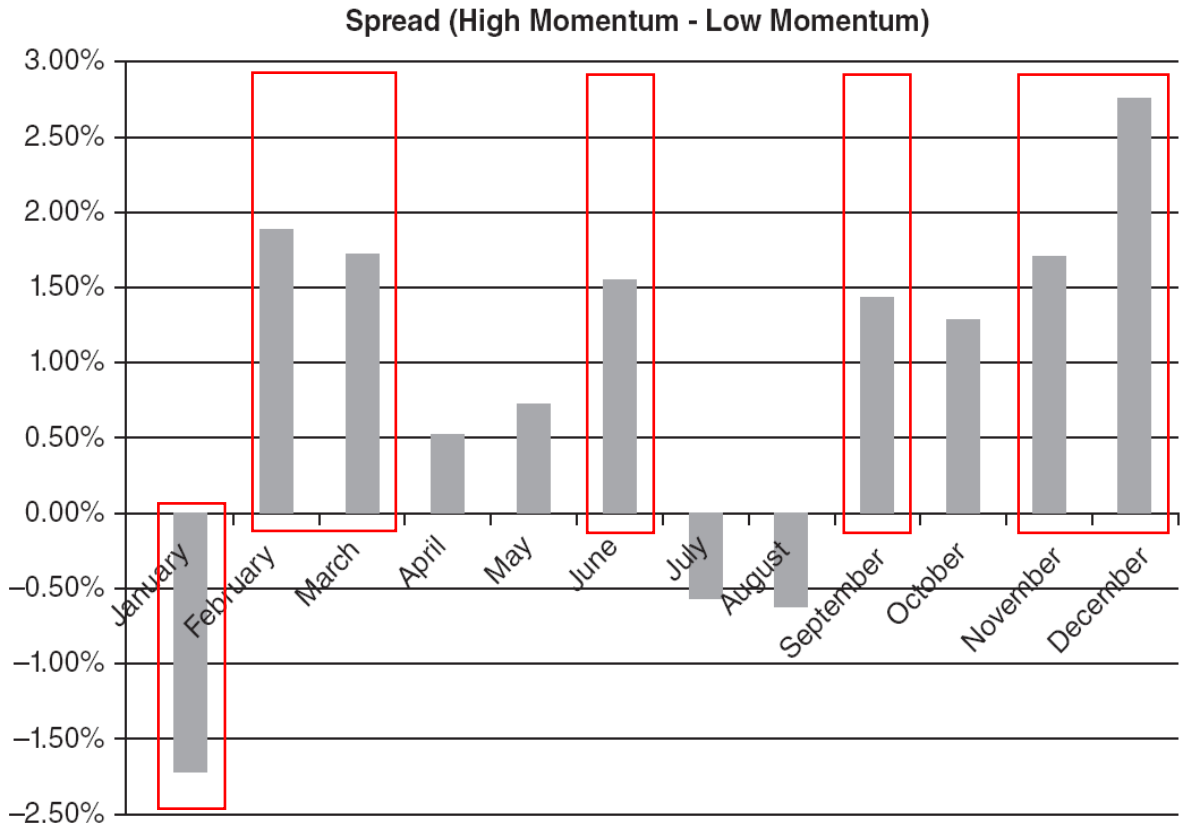
Step 4: Momentum Seasonality Screen

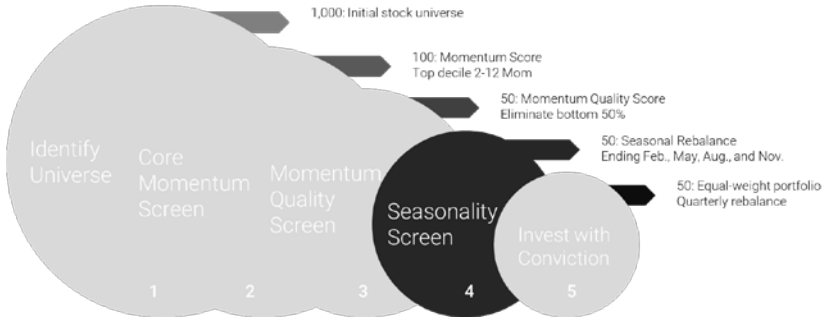
The momentum premium is highly seasonal, historically. Our rebalance schedule seeks to exploit seasonality.



Why Seasonality?

Year-End Tax Incentives

Window Dressing



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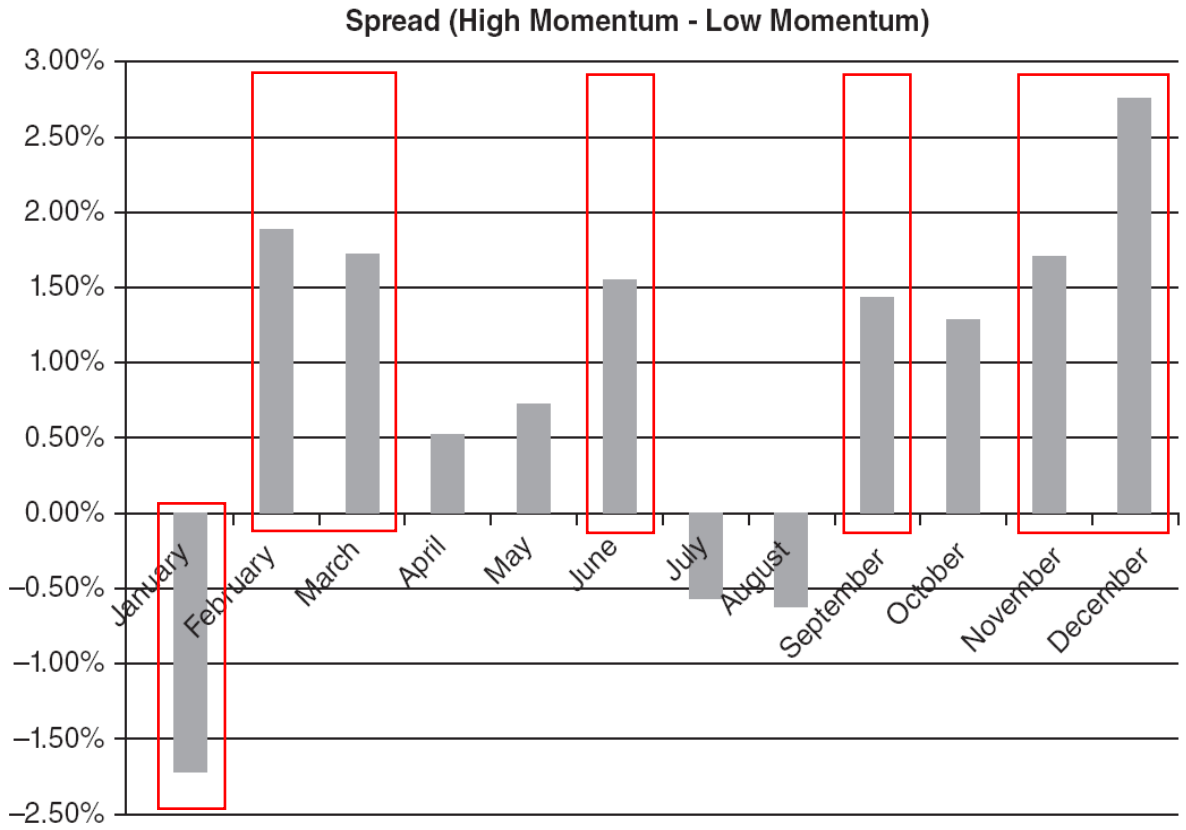

Performance Summary

Summary Statistics	Smart Rebalance	Dumb Rebalance
CAGR	15.97%	15.06%
Sharpe Ratio	0.60	0.57
Sortino Ratio	0.72	0.68

- **Smart** = Rebalance at the end of Feb., May, Aug, Nov.
- **Dumb** = Rebalance at the end of Dec., Mar., June, and Sept.

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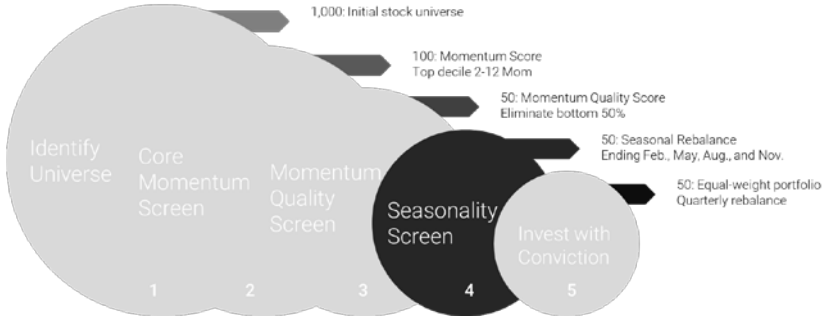
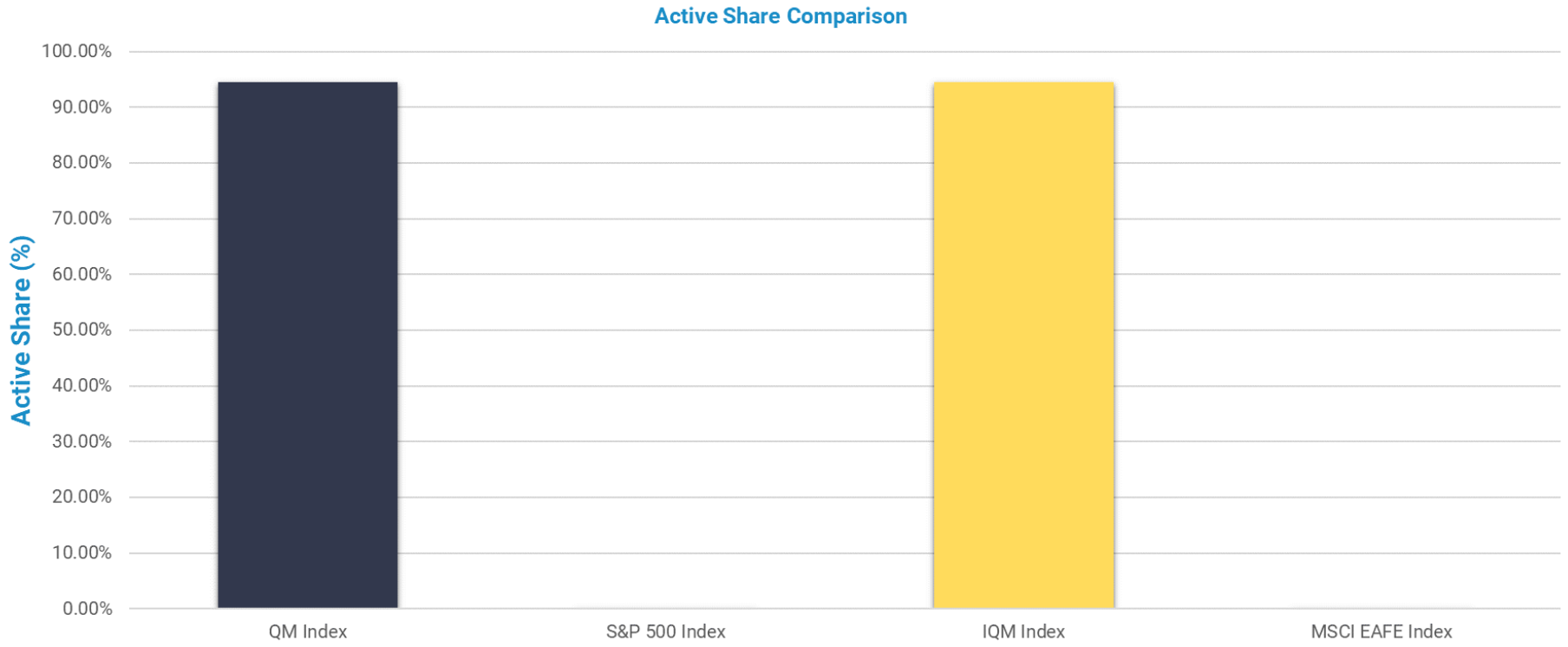


Step 5: Invest with conviction

Our Indexes have high active share relative to standard benchmarks



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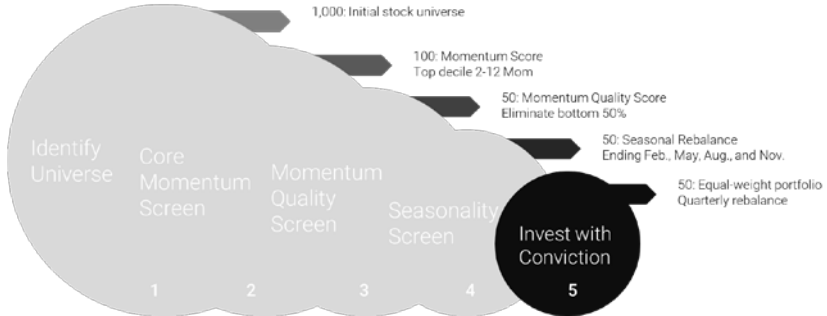
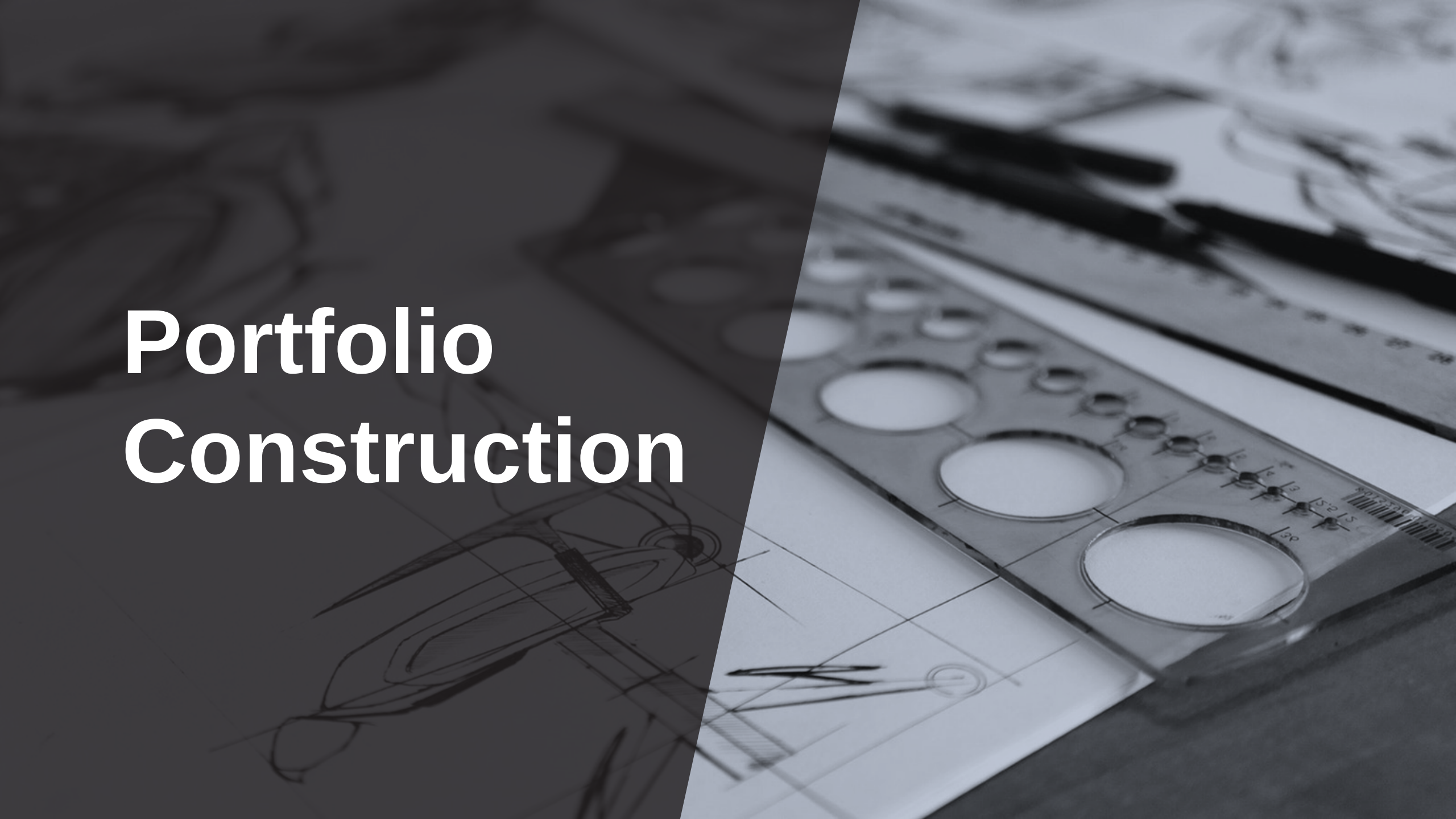
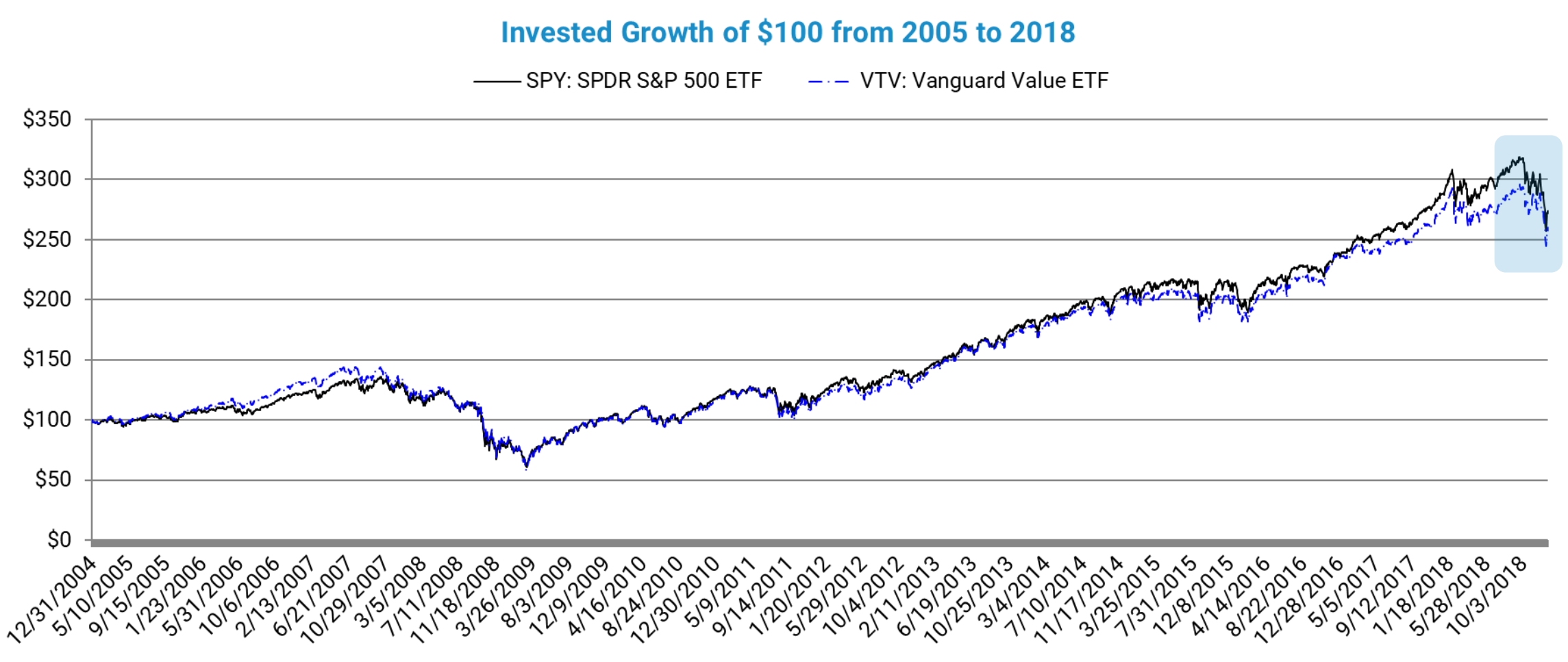


Portfolio Construction



Closet Indexes[1] May Deliver Passive Market Results

but they may not deliver academic factor results



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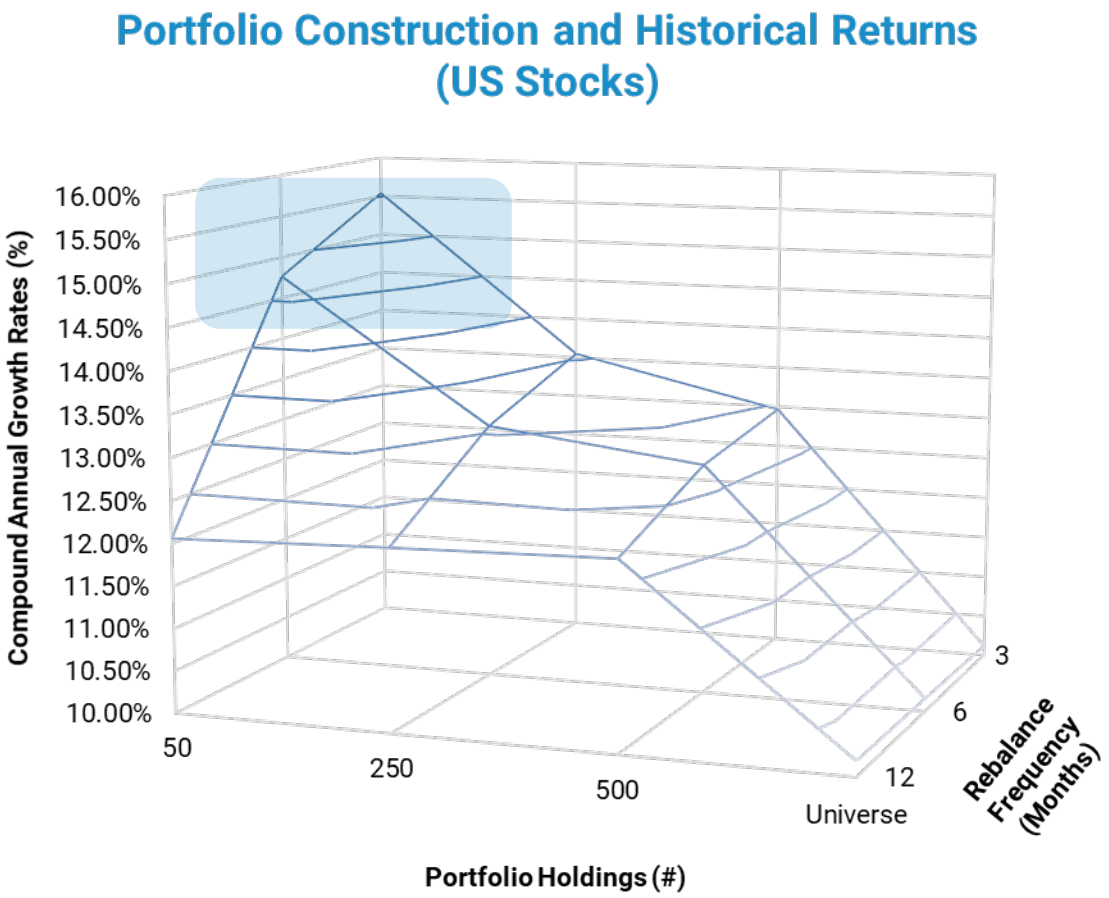
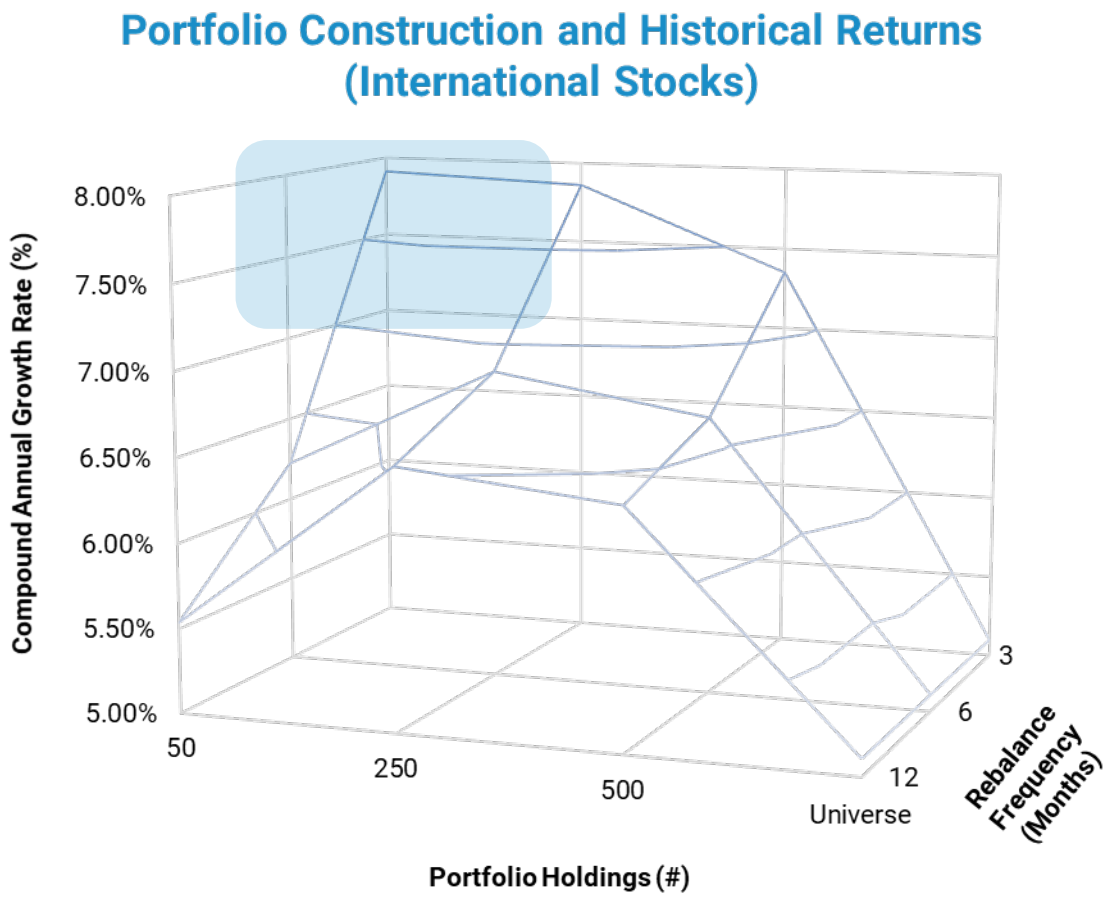
[1]A "closet index" is generally considered to be a strategy that is marketed as being different than a broad passive index, but in reality, is closely related to a broad passive index with minimal deviations in the underlying holdings and performance profile. VTV was chosen because it is the largest "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 distriutions. 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





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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).

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Simulated momentum sorted portfolio compound annual returns by concentration and rebalance

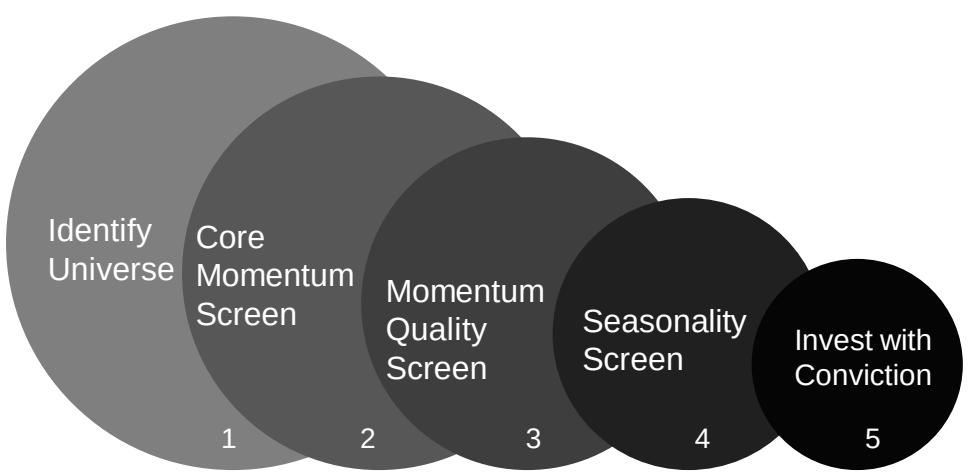
VW CAGRs								
		Number of Stocks Selected each month						
		50	100	150	200	250	300	500 (Universe)
Holding Period for each Stock	1	17.02%	14.40%	13.55%	12.69%	12.07%	11.50%	9.77%
	2	16.05%	14.17%	13.23%	12.59%	11.98%	11.43%	9.77%
	3	15.15%	13.81%	12.93%	12.25%	11.74%	11.23%	9.77%
	4	14.54%	13.53%	12.78%	12.11%	11.63%	11.21%	9.77%
	5	14.37%	13.31%	12.62%	12.04%	11.57%	11.17%	9.77%
	6	13.93%	13.05%	12.37%	11.88%	11.46%	11.10%	9.77%
	7	13.68%	12.80%	12.11%	11.66%	11.33%	10.99%	9.77%
	8	13.38%	12.58%	11.89%	11.48%	11.19%	10.90%	9.77%
	9	12.94%	12.24%	11.60%	11.23%	11.01%	10.77%	9.77%
	10	12.62%	11.93%	11.37%	11.03%	10.85%	10.66%	9.77%
	11	12.21%	11.61%	11.12%	10.81%	10.68%	10.52%	9.77%
	12	11.78%	11.27%	10.83%	10.58%	10.48%	10.36%	9.77%

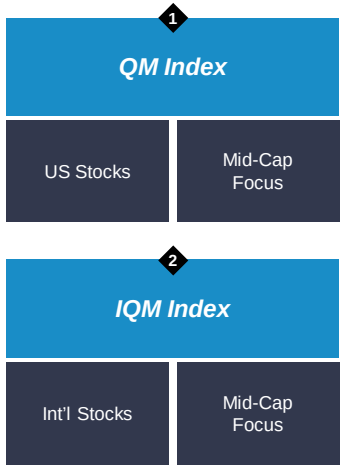
Source: Gray and Vogel. Quantitative Momentum. Hoboken: John Wiley and Sons, 2015. Period is from 1927 to 2014.. Universe is the largest 500 U.S. firms by market capitalization and broken into portfolios of 50-, 100-, …, or 500-stocks based on the past 12 month returns (skipping the most recent month). The rebalance frequency is 1-month, 2-months, …, or 12-months. We average overlapping portfolio results and show the compound annual returns for the respective portfolios. The period is from 1/1/1927 to 12/31/2014. 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).

As of Date: 9/30/2019

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.

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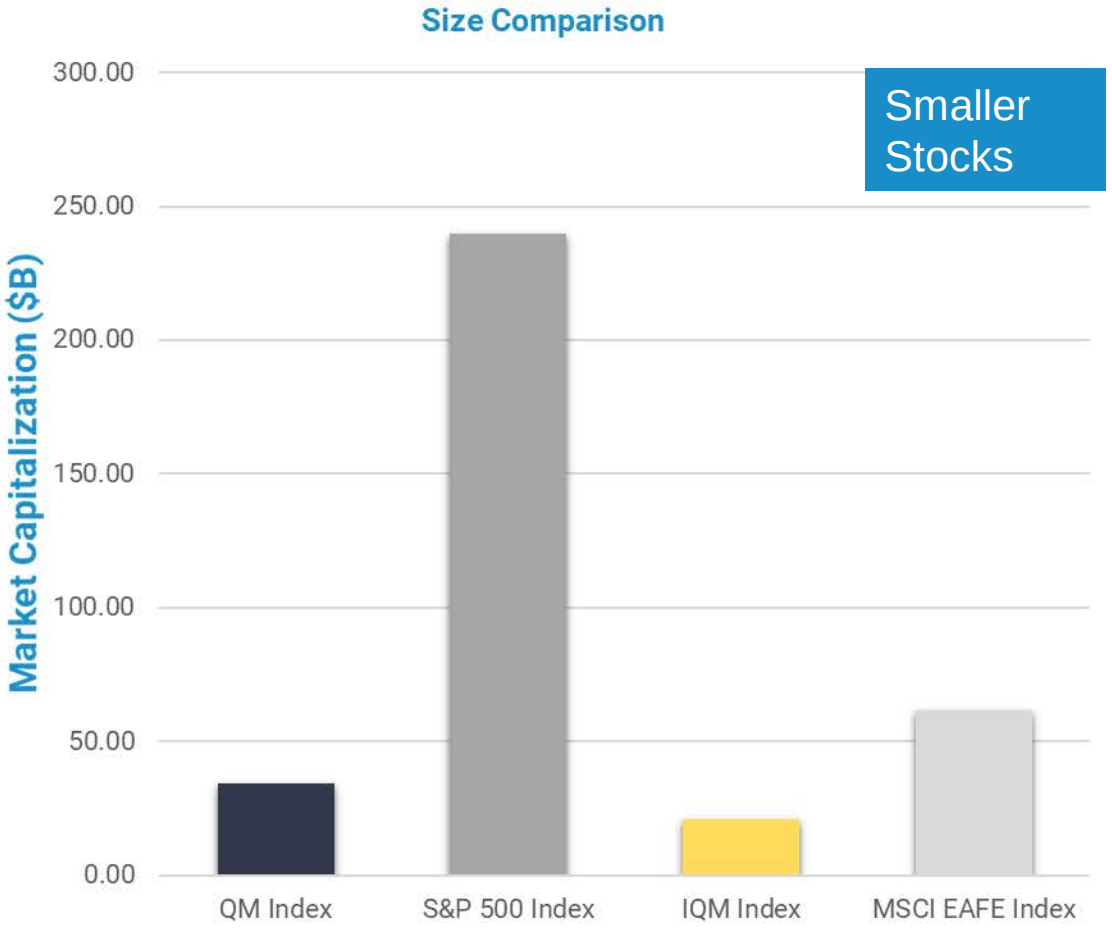
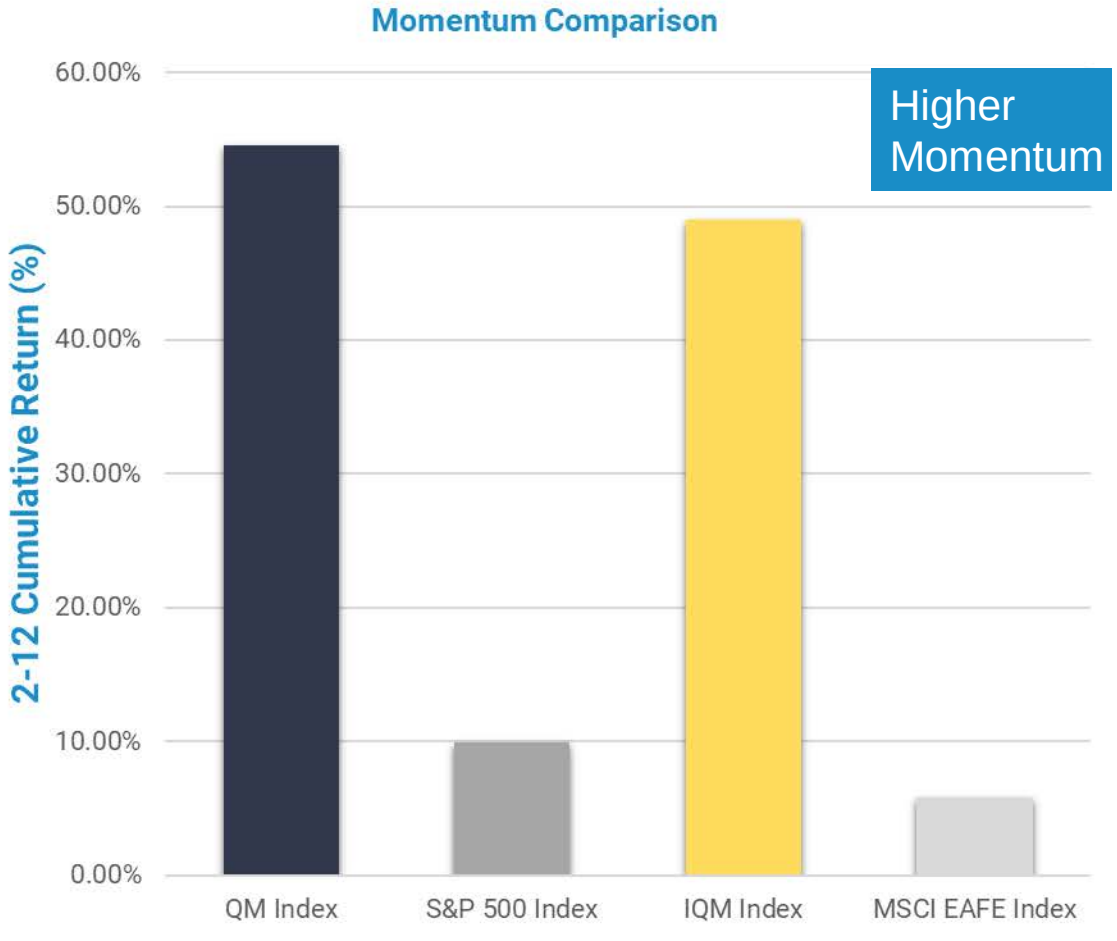
As of Date: 9/30/2019

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.

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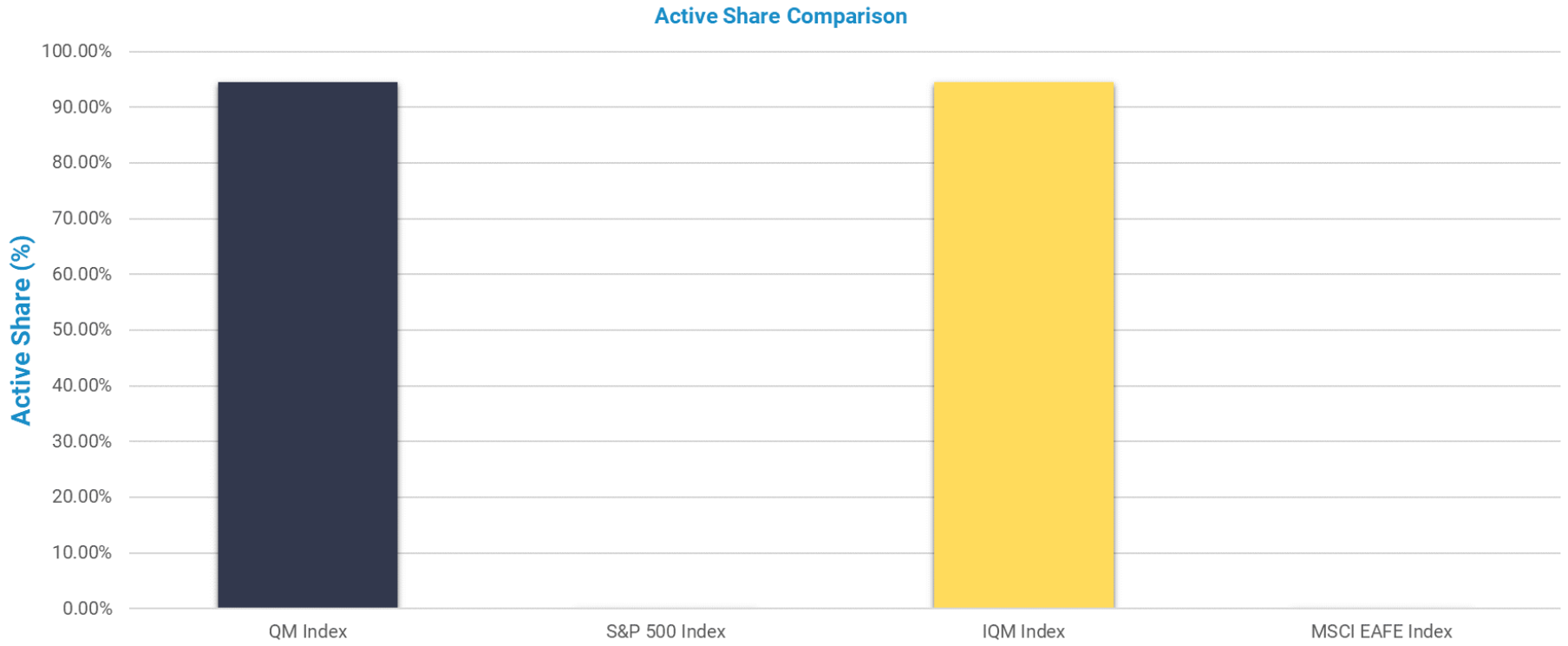
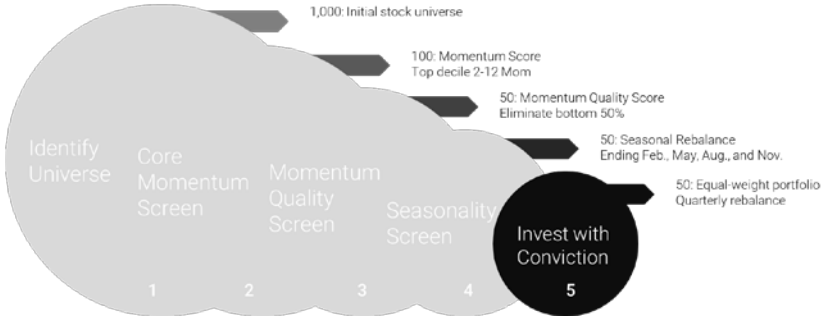
Step 5: Invest with conviction

Our Indexes have high active share relative to standard benchmarks





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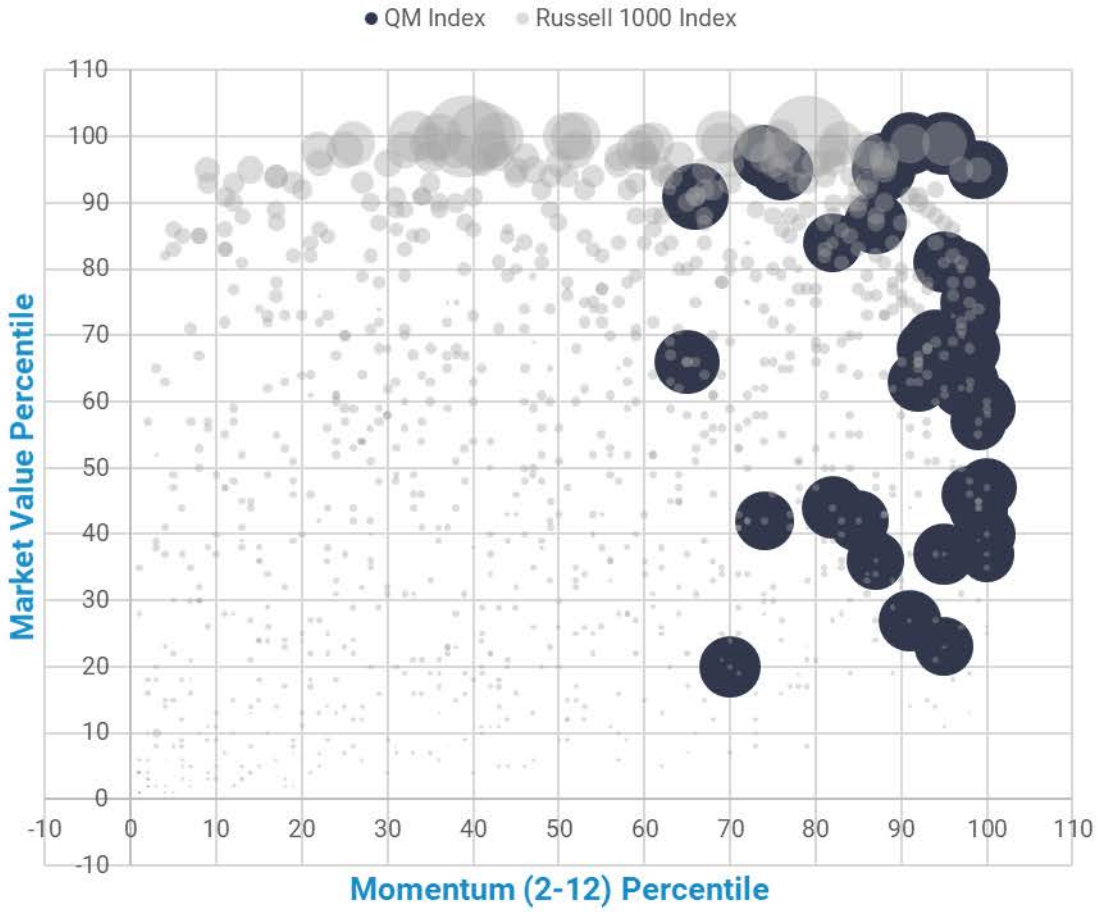
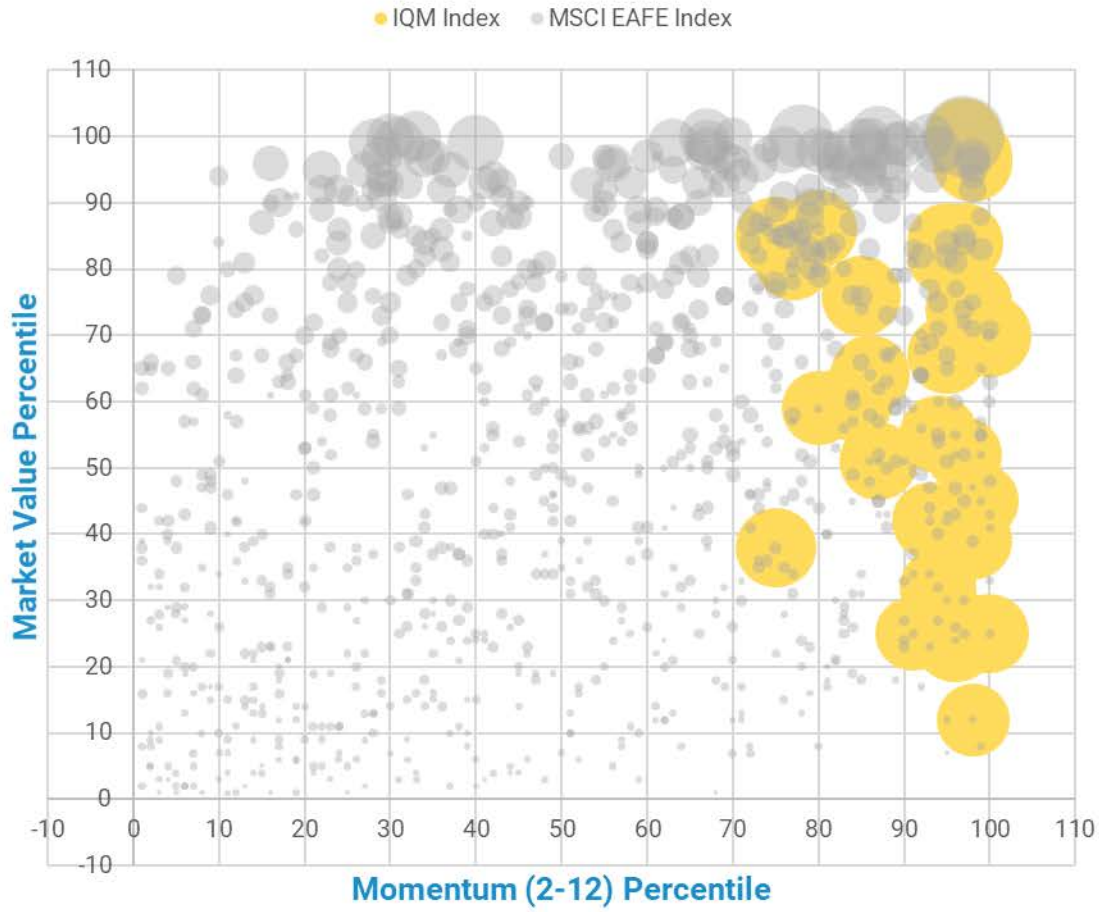
Quantitative Momentum Index: Characteristics

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





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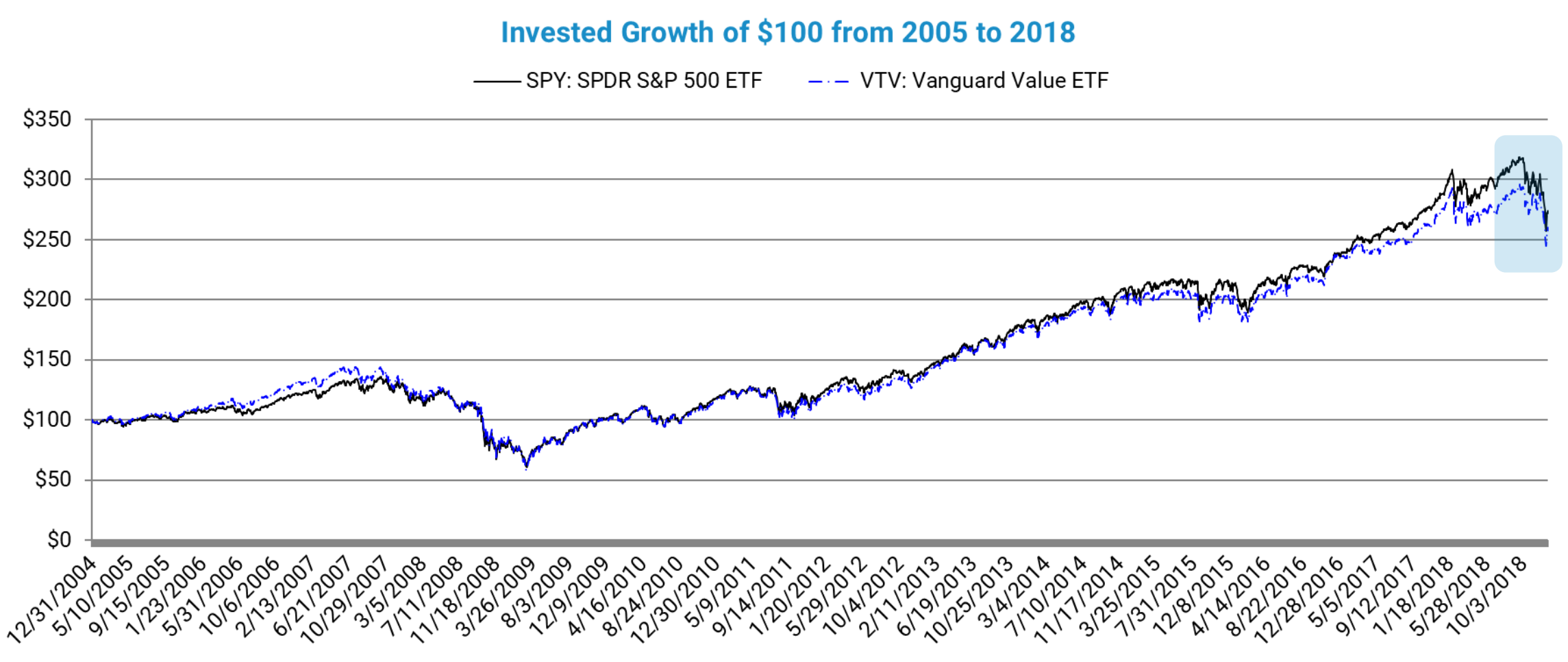
Source: FactSet. Characteristics are from FactSet and derived via the ETFs that track the respective Indexes. Holdings' characteristics are only displayed if they are held in the benchmark index (i.e., Russell 1000 or MSCI EAFE). The results are hypothetical results and are NOT an indicator of future results and do NOT represent returns that any investor attained. 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.

Downsides of building different portfolios

Closet Indexes[1] May Deliver Passive Market Results

but they may not deliver academic factor results



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[1]A "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 distriutions. 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).

Don’t Believe in Career Risks?

Case Study #1: Warren Buffett

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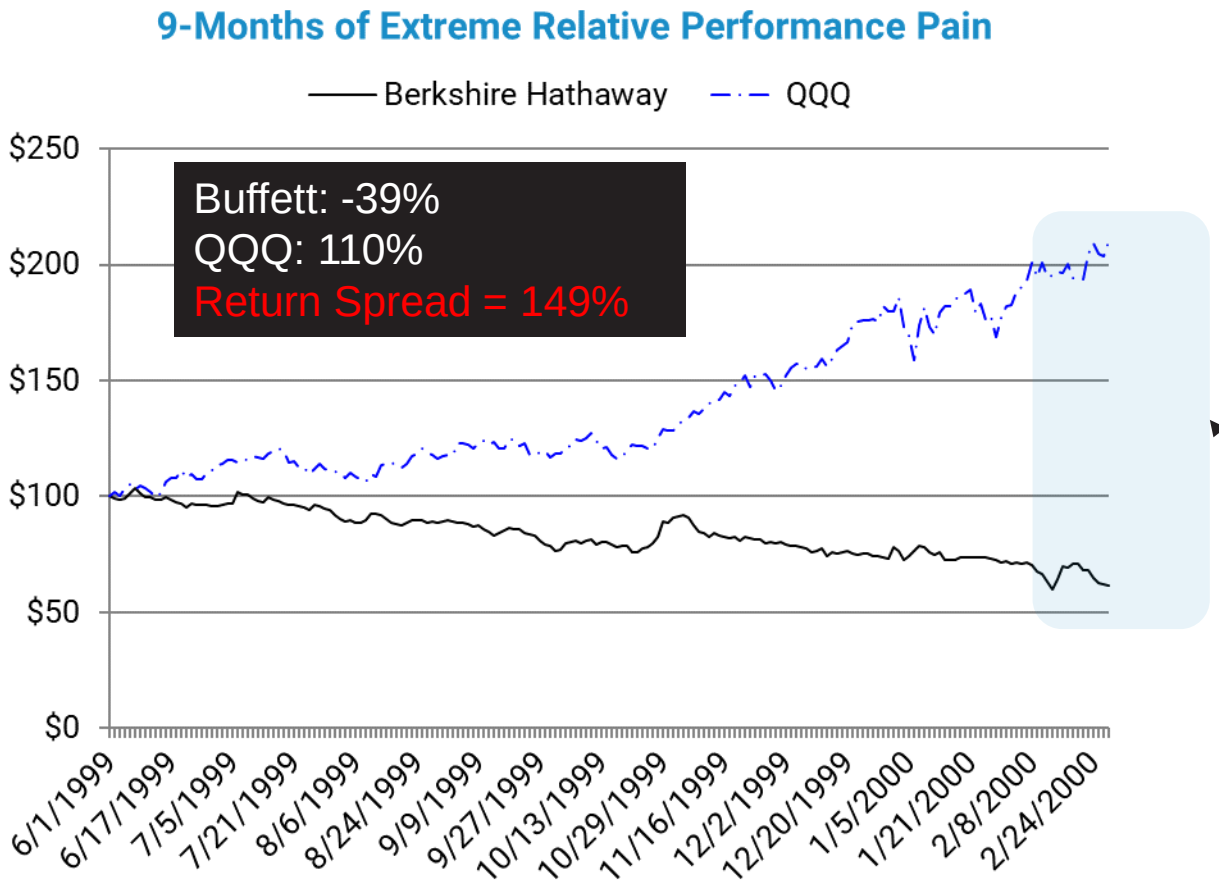
Buffett: “Tech is Mispriced. Have Fun, Losers!”



Warren Buffett

“Charlie, should we buy tech?”

“Warren Buffett may be losing his magic touch.”

BARRON'S

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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.

Don’t Believe in Career Risks?

Case Study #2: Factors

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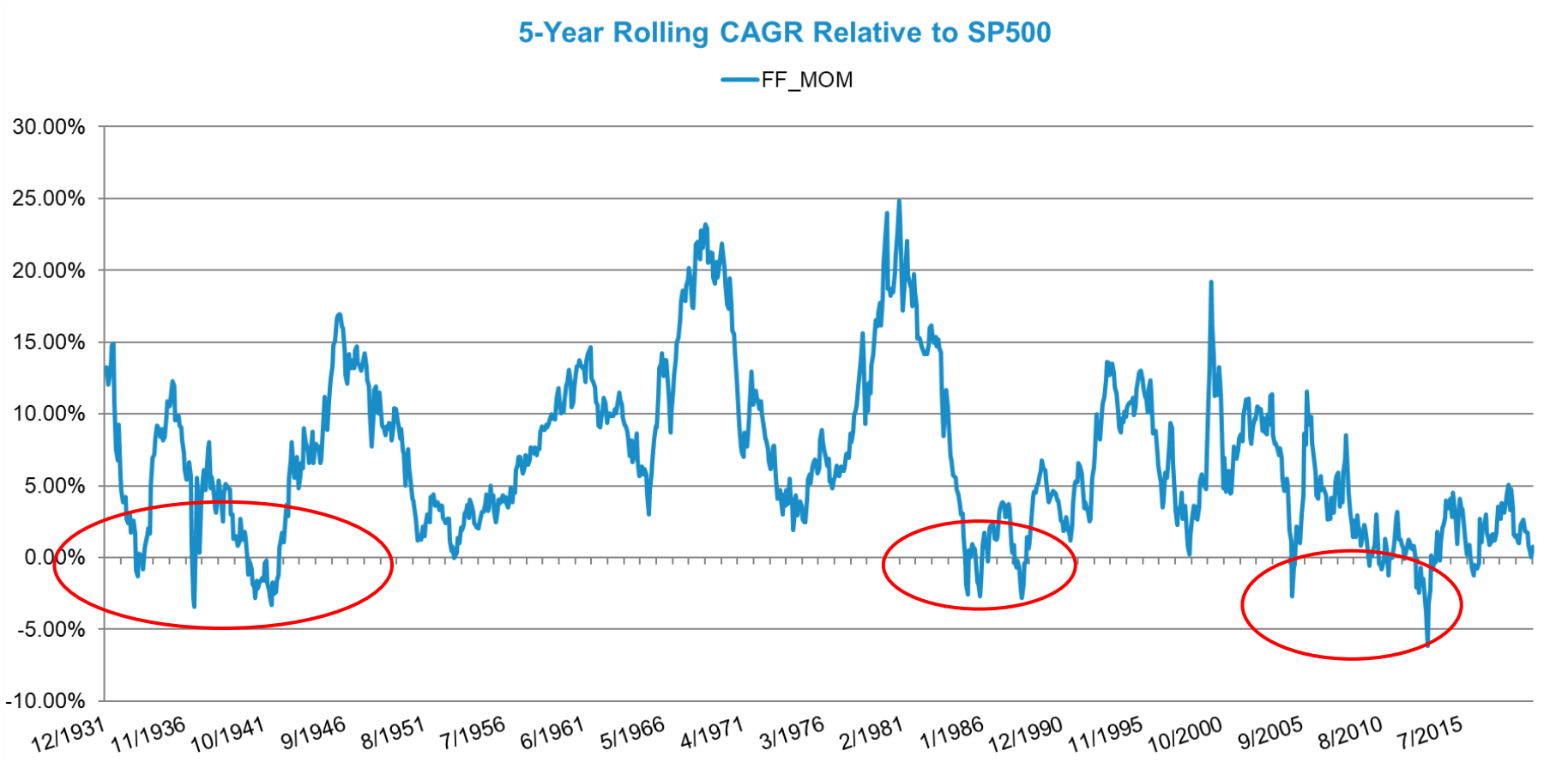
Multiple times a Momentum investor would lose over a 5-year period!



Factors Work for a Reason!

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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.

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Wesley R. Gray, PhD
T: +1.215.882.9983
F: +1.216.245.3686
ir@alphaarchitect.com
213 Foxcroft Road
Broomall, PA 19008

Appendix

IMPORTANT INFORMATION - DISCLOSURES

There are risks involved with investing, including loss of principal. There is no assurance that the objectives of any strategy or fund will be achieved or will be successful. No investment strategy, including diversification, can protect against market risk or loss. Current and future portfolio holdings are subject to risk. Past performance does not guarantee future results.

There is a risk of substantial loss associated with trading commodities, futures, options and other financial instruments. Before trading, investors should carefully consider their financial position and risk tolerance to determine if the proposed trading style is appropriate. Investors should realize that when trading futures, commodities and/or granting/writing options one could lose the full balance of their account. It is also possible to lose more than the initial deposit when trading futures and/or granting/writing options. All funds committed to such a trading strategy should be purely risk capital.

Certain economic and market information contained herein has been obtained from published sources prepared by other parties, which in certain cases have not been updated through the date hereof. While such sources are believed to be reliable, neither Alpha Architect nor its affiliates assumes any responsibility for the accuracy or completeness of such information and such information has not been independently verified by Alpha Architect.

Index returns are for illustrative purposes only and do not represent actual fund performance. References to an index do not imply that the portfolio will achieve returns, volatility or other results similar to that index. The composition of the index may not reflect the manner in which a portfolio is constructed in relation to expected or achieved returns, portfolio guidelines, restrictions, sectors, correlations, concentrations, volatility or tracking error targets, all of which are subject to change. 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. There are no active components of indexes; therefore, using them as a proxy can be of limited value because there is no guarantee that the portfolio would have been managed to match the index. Realized returns and/or volatility may come in higher or lower than expected.

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.

IMPORTANT INFORMATION - DISCLOSURES

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.

Hypothetical performance results (e.g., quantitative backtests) have many inherent limitations, some of which, but not all, are described herein. No representation is being made that any fund or account will or is likely to achieve profits or losses similar to those shown herein. In fact, there are frequently sharp differences between hypothetical performance results and the actual results subsequently realized by any particular trading program. One of the limitations of hypothetical performance results is that they are generally prepared with the benefit of hindsight. In addition, hypothetical trading does not involve financial risk, and no hypothetical trading record can completely account for the impact of financial risk in actual trading. For example, the ability to withstand losses or adhere to a particular trading program in spite of trading losses are material points which can adversely affect actual trading results. The hypothetical performance results contained herein represent the application of the quantitative models as currently in effect on the date first written above and there can be no assurance that the models will remain the same in the future or that an application of the current models in the future will produce similar results because the relevant market and economic conditions that prevailed during the hypothetical performance period will not necessarily recur. There are numerous other factors related to the markets in general or to the implementation of any specific trading program which cannot be fully accounted for in the preparation of hypothetical performance results, all of which can adversely affect actual trading results. Hypothetical performance results are presented for illustrative purposes only.

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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.