QUANTITATIVE MOMENTUM INDEXES (QMOM AND IMOM INDEX)

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Jack R. Vogel, PhD and Wesley R. Gray, PhD

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

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Thought Leadership on Systematic Momentum Investing

Wesley R. Gray, Ph.D.

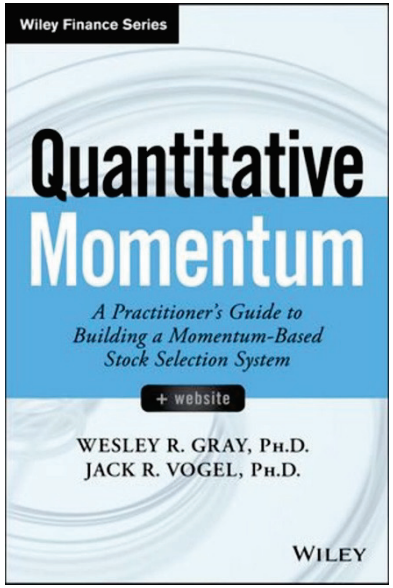
- PhD/MBA, University of Chicago
- BS Economics, Wharton
- Captain, Marine Corps

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.*



"Anyone interested in systematic investing should read this book…"
--**Cliff Asness, Ph.D.,** Managing and Founding Principle of AQR

"Anyone who is using, studying or incorporating momentum will find a wealth of information in the pages of *Quantitative Momentum*
--**Chris Geczy, Ph.D.,** Founder and CEO of Forefront Analytics

"*Quantitative Momentum* is the story of momentum-based stock selection algorithms. Wes and Jack lucidly explain how and why these systems work."
--**Narasimhan Jegadeesh,** Dean's Distinguished Chair in Finance at Goizueta Business School

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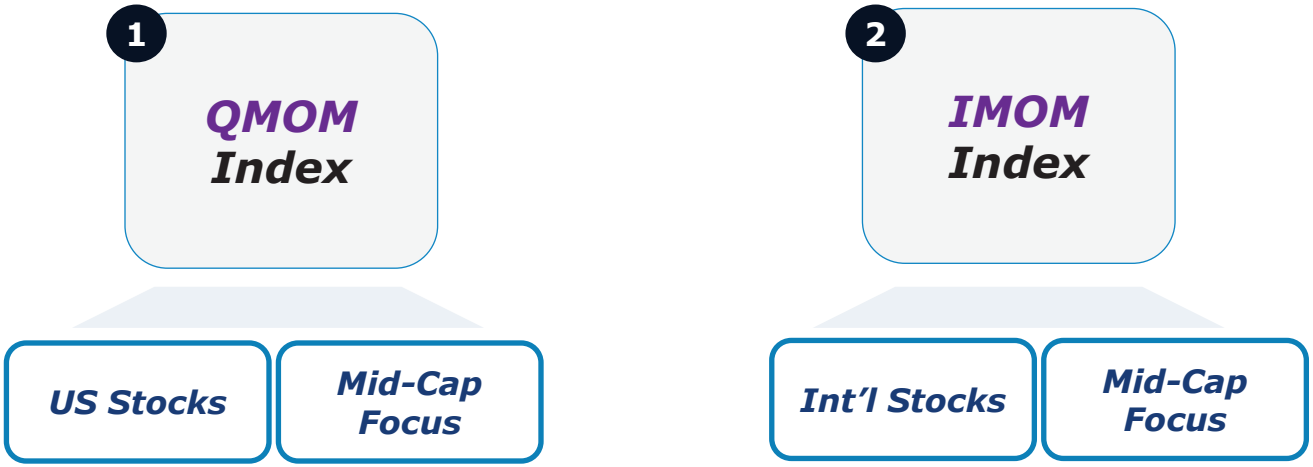
***The recommendations are directed towards the quality of the book and are not an endorsement of advisory services provided by Alpha Architect, LLC or affiliates. Alpha Architect does not know if the recommenders approve or disapprove of its services. The recommendations were chosen from a list of formal recommendations based on if the author had a PhD or not.

Our Quantitative Momentum Indexes



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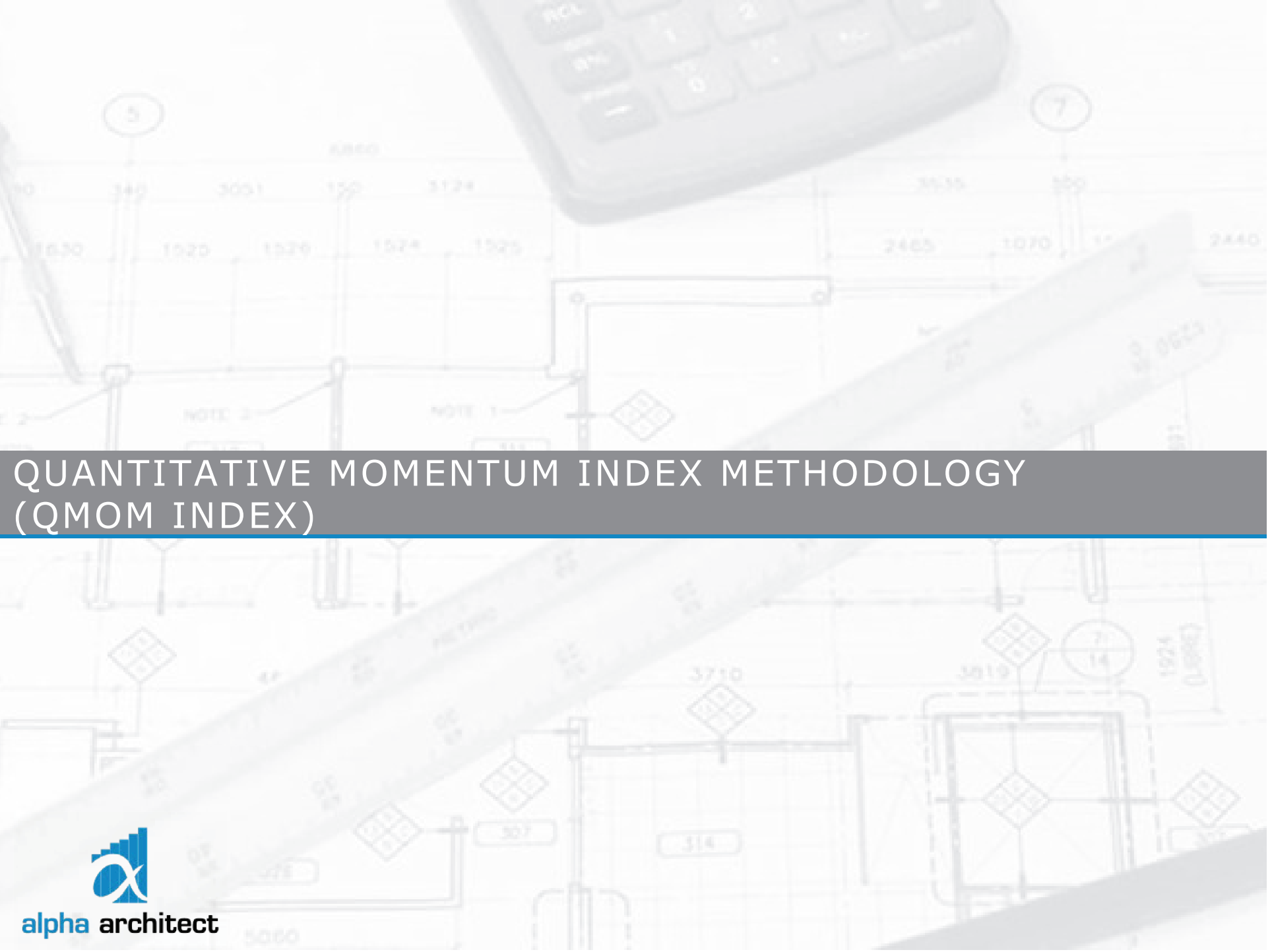
QUANTITATIVE MOMENTUM INDEX METHODOLOGY (QMOM INDEX)



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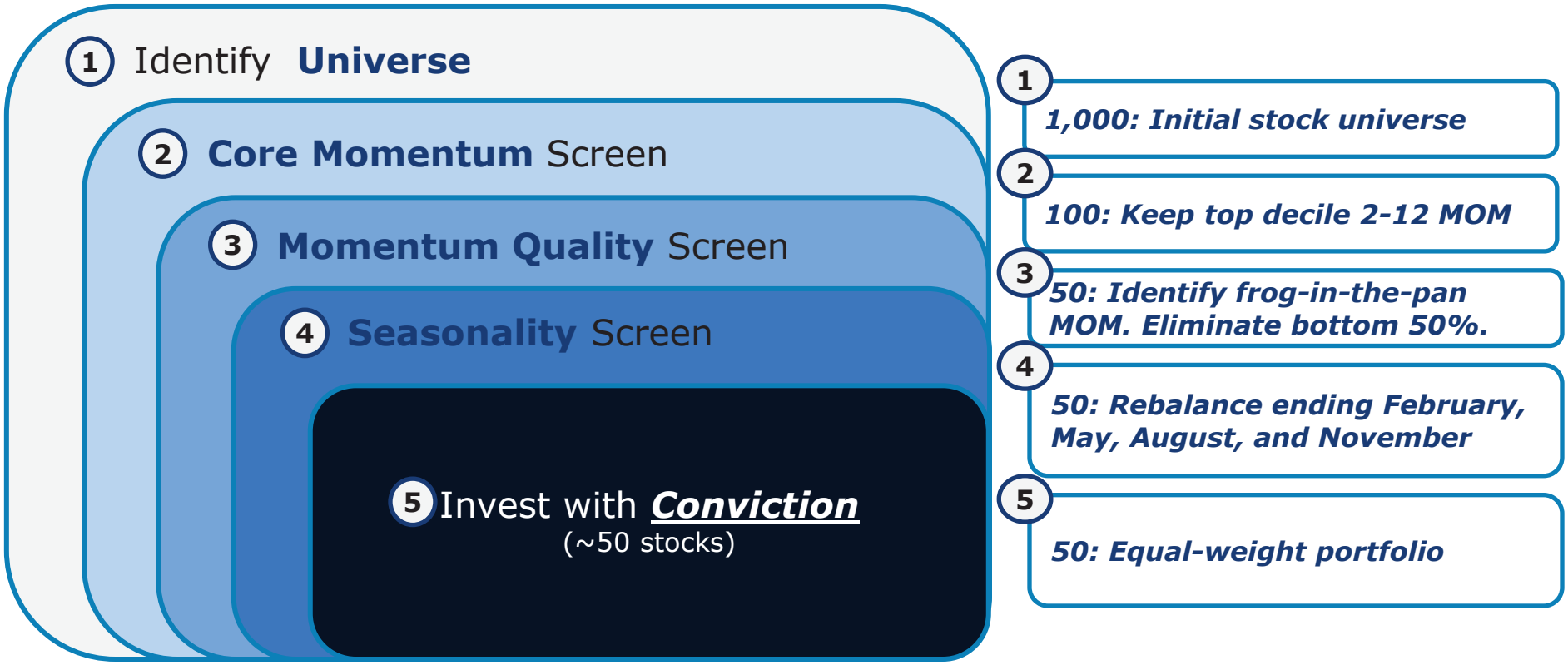
The QMOM Index Process: 1,000 Stock Universe Example[1]

- QMOM Index seeks to buy stocks with the **highest quality momentum**



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

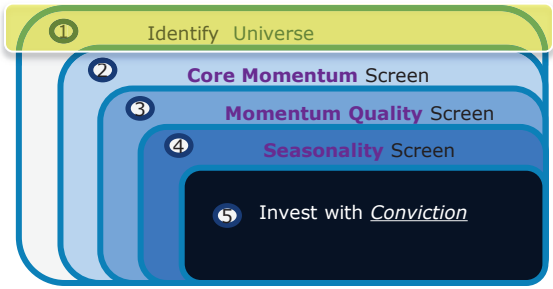
Step 1—Identify Universe: Mid- and Large-Cap

Liquidity restrictions

- ❑Mid- and large-caps

Universe rules

- ❑Operating Companies Only: Exclude from the data set specific securities, including ADRs, REITS, ETFs and CEFs.
- ❑No Sector Constraints



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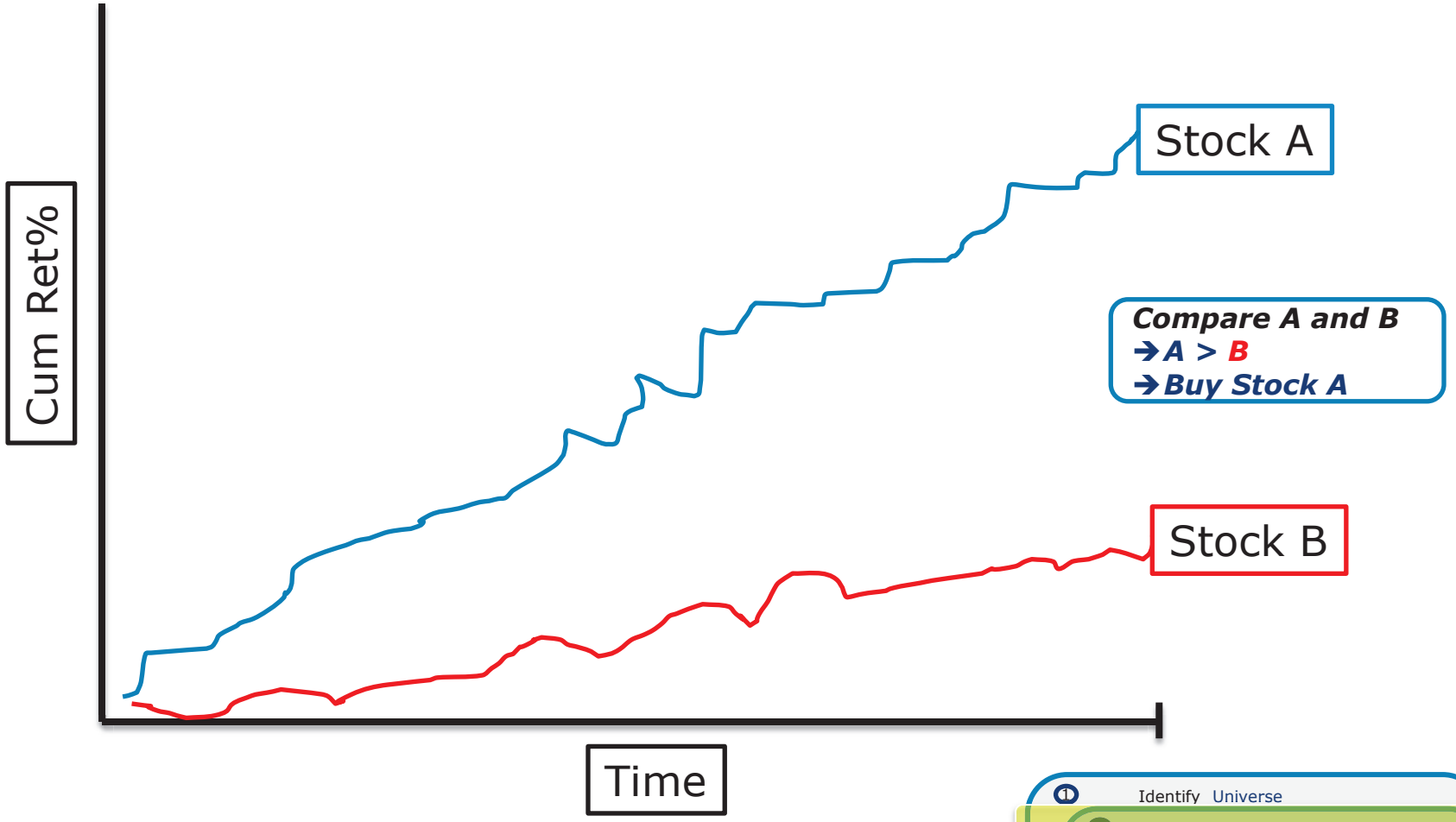
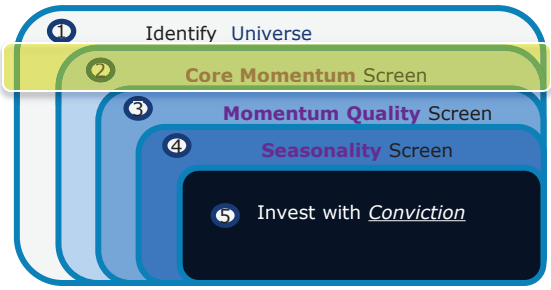
Step 2—Core Momentum Screen: Buy Past Winners





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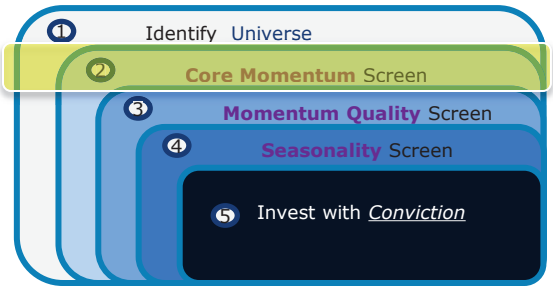
Step 2—Core Momentum Screen: Crazy Idea?

"The premier anomaly is momentum..."

Even Fama and French Acknowledge the Historical Evidence



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

Step 2—Core Momentum Screen: The Original Paper

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

- **J-month/K-month strategy:** select stocks based on past J months and hold the position for K months. → the most successful zero-cost strategy is the 12-month/3-month strategy

- Profitability of these strategies are not due to their systematic risk or to lead-lag effects, but rather due to delayed price reactions to firm-specific information.

		Panel A				Panel B → 1 week lag			
J	K =	3	6	9	12	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)

12-month/3-month *strategy yield the best results.*

Generic Stock Momentum is Not New

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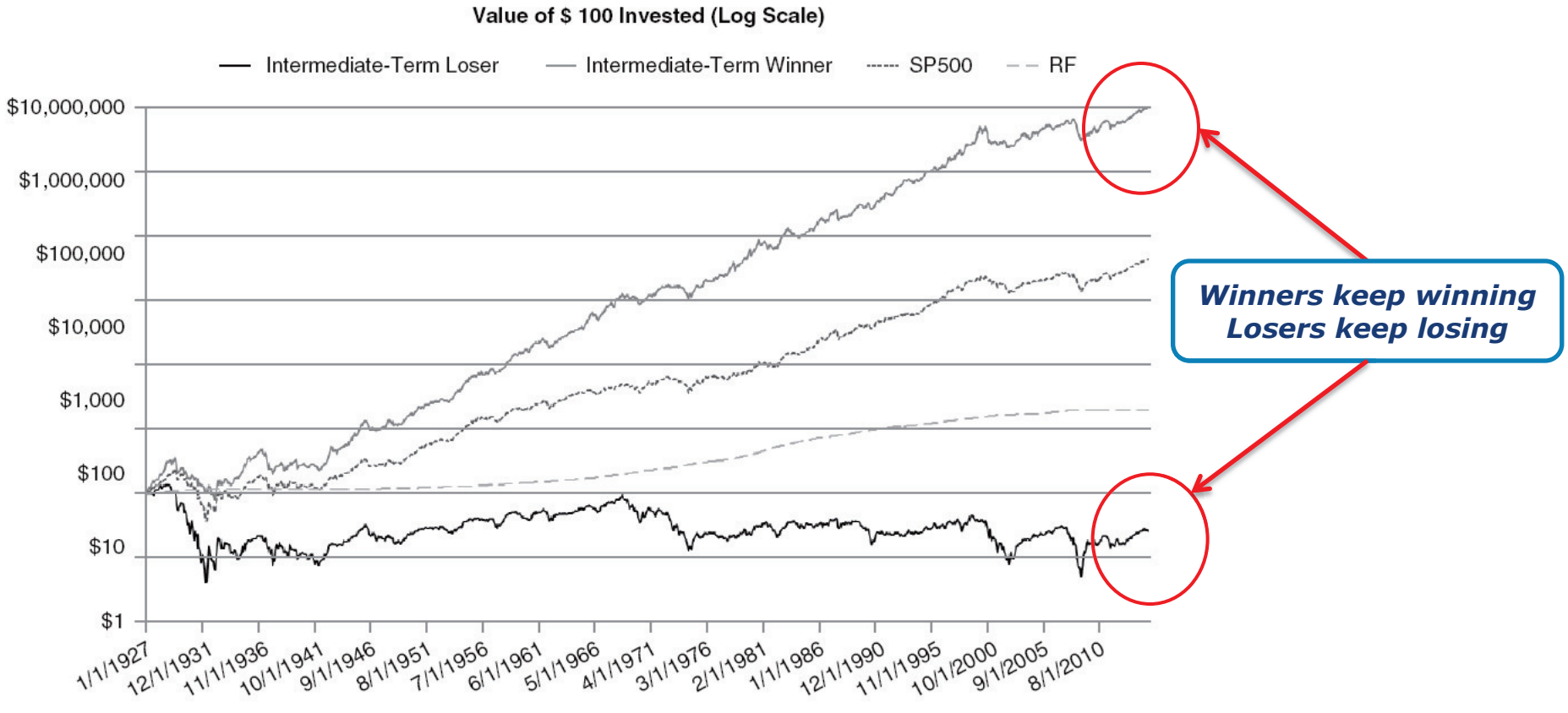
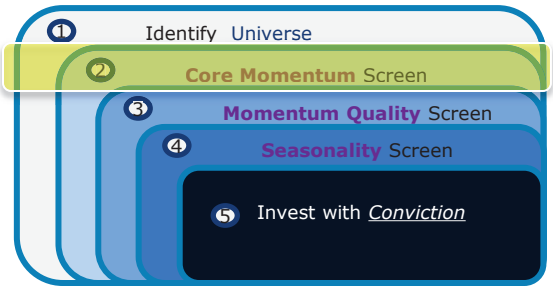
Source: "Return to Buying Winners and Selling Losers: Implications for Stock Market Efficiency," Jegadeesh and Titman, 1993, *Journal of Finance*.

Step 2—Core Momentum Screen: 1-year look-back

Portfolios formed on momentum (1-year look-back) have strong historical performance





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. Source: Gray and Vogel. Quantitative Momentum. Hoboken: John Wiley and Sons, 2015. Period is from 1927 to 2014.

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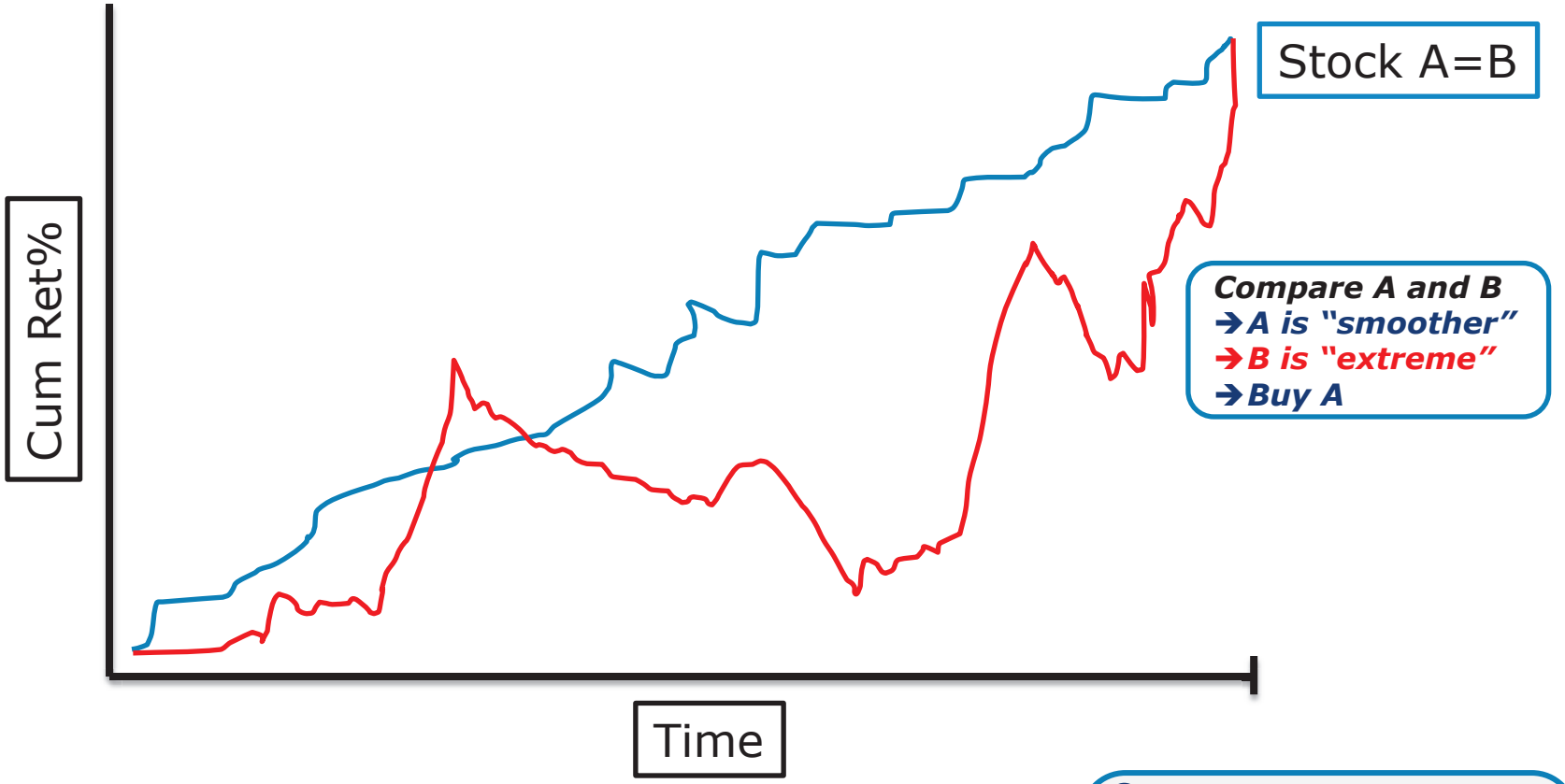
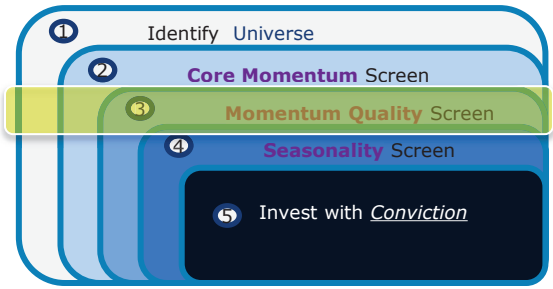
Step 3—Momentum Quality Screen: The Path Matters

"Lottery ticket" price paths attract more attention and are more likely to be efficient[1]



[1]Da, Gurun and Warachka, 2013, "Frog in the Pan: Continuous Information and Momentum," *Review of Financial Studies* 27, pg. 2171-2218. 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. Indexes are unmanaged, do not reflect management or trading fees, and one cannot invest directly in an index. Charts presented are for illustrative purposes only.



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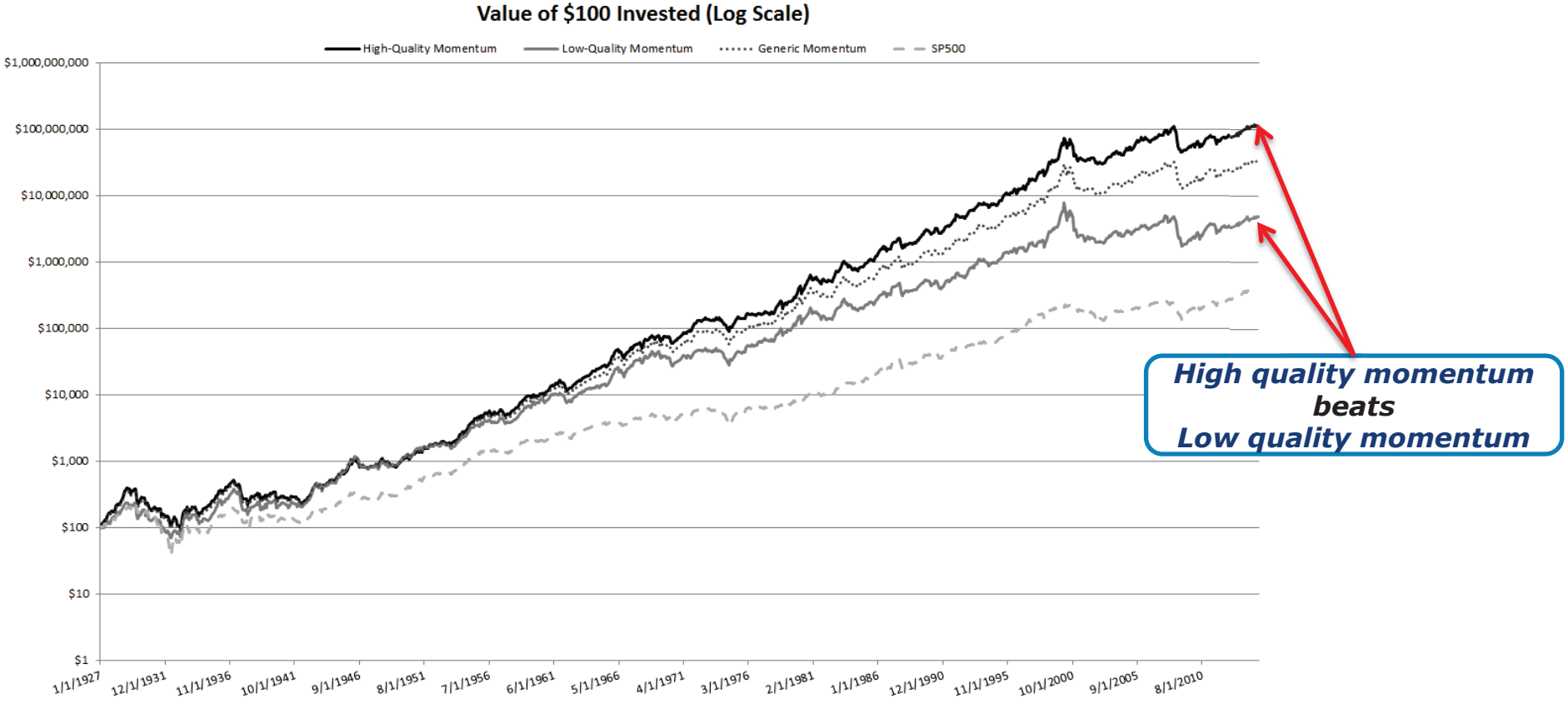
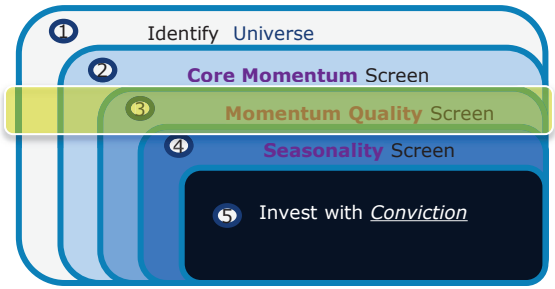
Step 3—Momentum Quality Screen: Frog-in-the-Pan

The "Frog-in-the-Pan" algorithm objectively identifies limited attention momentum paths





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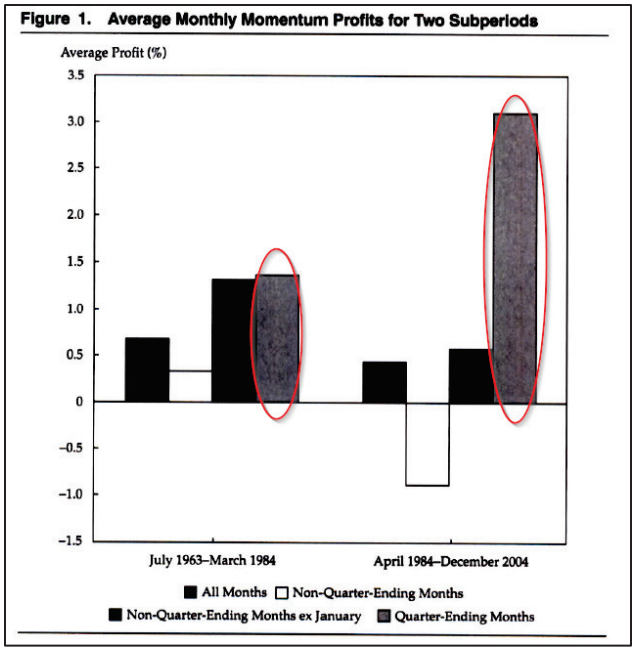
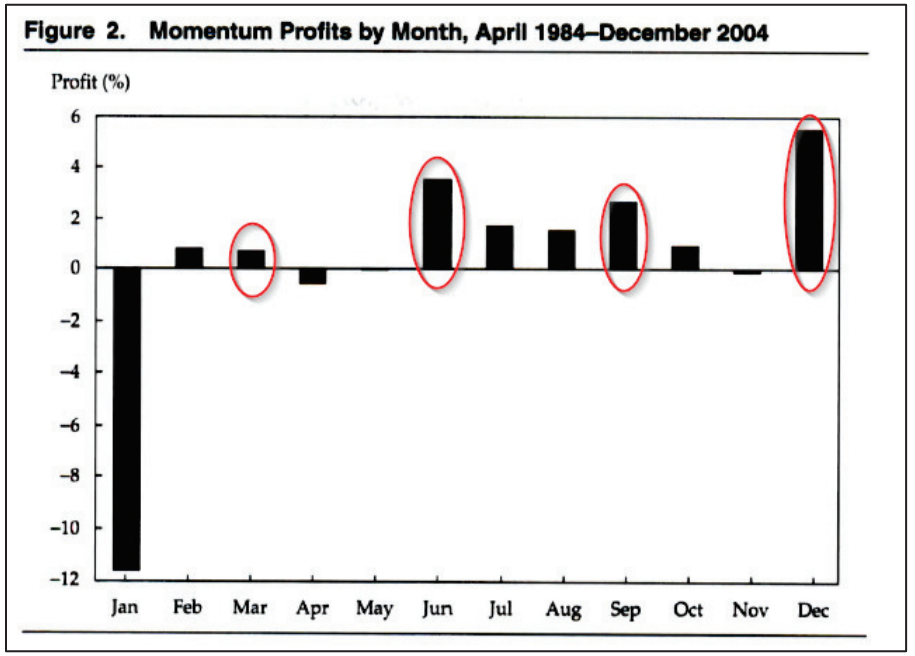
Step 4—Seasonality Screen: Premiums Vary Over Time

The momentum premium is highly seasonal. Window dressing and tax effects?

- Two hypotheses that may affect momentum investing:
  1. **Window dressing:** institutions want to abandon losers to avoid reporting "embarrassing" stocks, and appear to hold "winning" stocks. This results in larger momentum return in quarter-ending months.
  2. **Tax-loss selling:** Investors favor selling losers in December to realize taxable losses (as well as for "window dressing" purposes).
     - This may explain January effect (where momentum is negative), as many investors sell losers for tax reasons, and buy once the new year has begun.





Momentum Returns have Strong Seasonality

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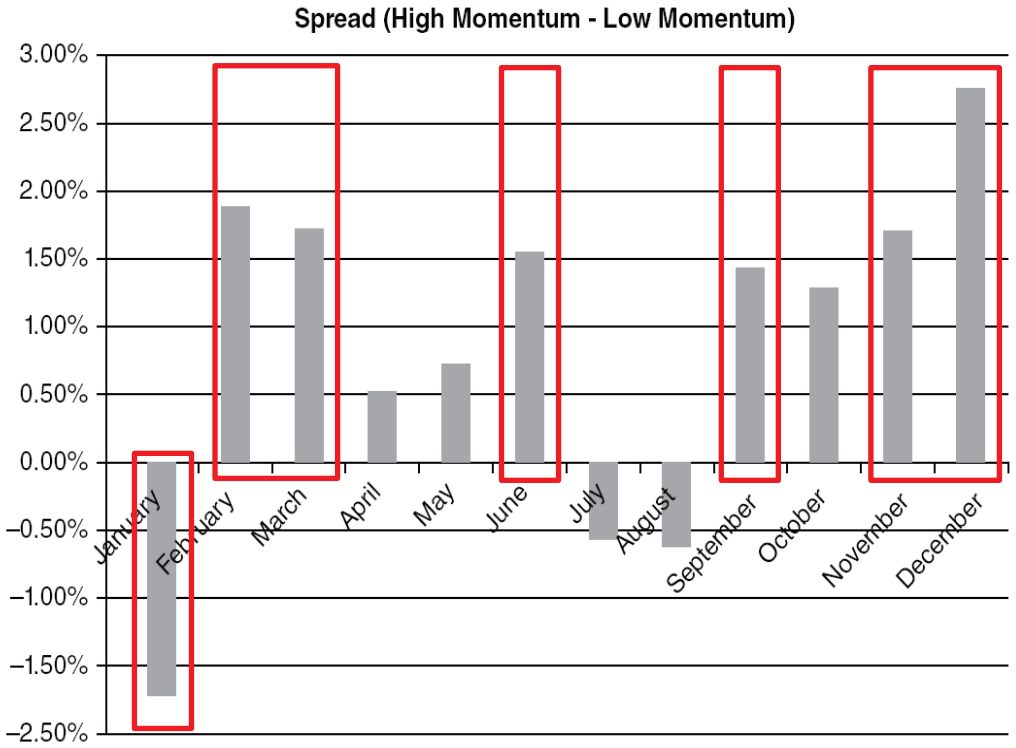
Source: "Causes and Seasonality of Momentum Profits", Financial Review, 2007, Sias

Step 4—Seasonality Screen: Premiums Vary Over Time

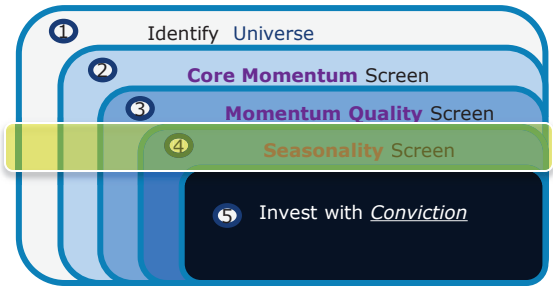
The momentum premium is highly seasonal. Window dressing and tax effects?



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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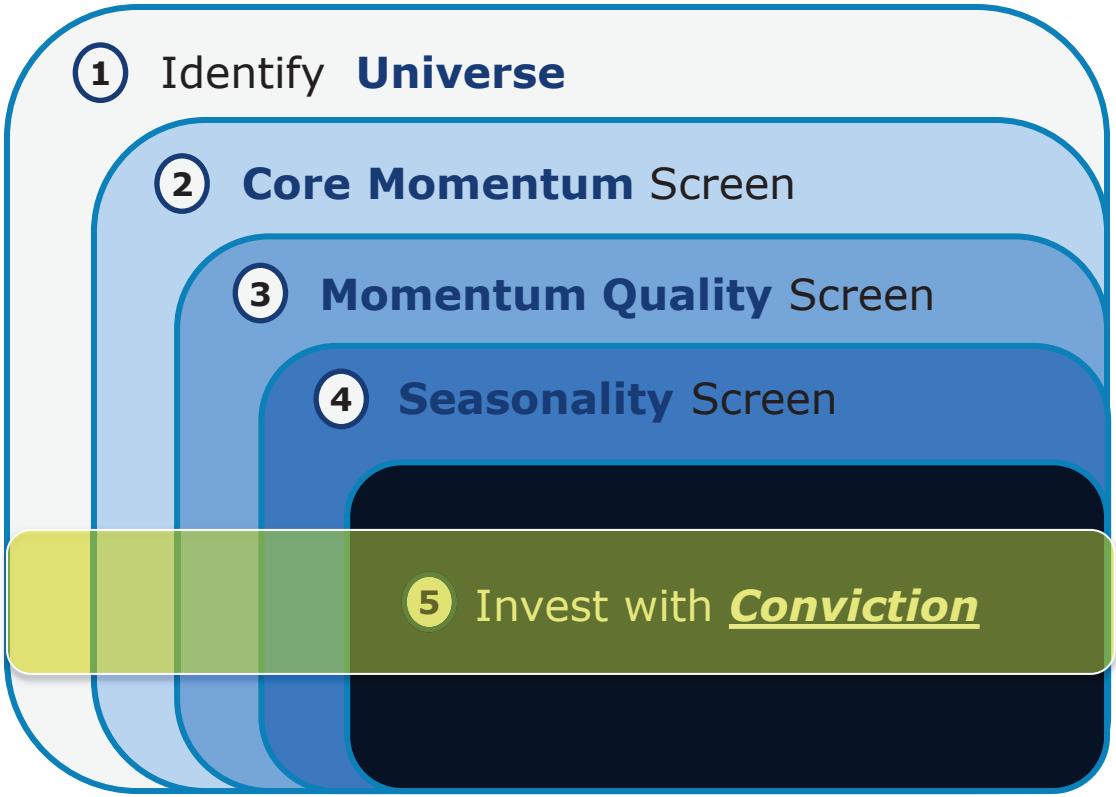
Step 5—Portfolio Construction



Portfolio Construction Parameters

- 50 stock portfolio (on average)
- Equal-weight construction
- Quarterly rebalance
- 25% sector/industry constraint
- Pre-trade liquidity model

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Step 5—Portfolio Construction

- Here we vary the portfolio construction across 2 variables, number of holdings and holding period.
- For holding periods over 1 month, we use overlapping portfolios; top N momentum firms are picked each month.
- Results → Less stocks and higher rebalance frequency yields the highest CAGRS.
  - Based on simple momentum screens from 1/1927 – 12/2014 (gross of any fees).

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%

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APPENDIX

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Statistics Descriptions

- **CAGR:** Compound annual growth rate
- **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

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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.

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.

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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There is no guarantee, express or implied, that long-term return and/or volatility targets will be achieved. Realized returns and/or volatility may come in higher or lower than expected.

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QUESTIONS?

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ir@alphaarchitect.com
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