

BEWARE OF GEEKS BEARING FORMULAS

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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



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Who Can Predict Market Trends?



Presentation Outline

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 - ❑ [Basic Asset Classes](#)
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TACTICAL ASSET ALLOCATION

DEFINITIONS

Working Definition

➤ Allocation

- ❑ Our baseline allocation to our asset universe
- ❑ E.g., 50% Stocks, 50% Bonds, rebalanced annually

➤ Asset

- ❑ Financial assets that can be traded with reasonable liquidity
- ❑ E.g., Stocks, Bonds, Commodities, Alternatives (if liquid)

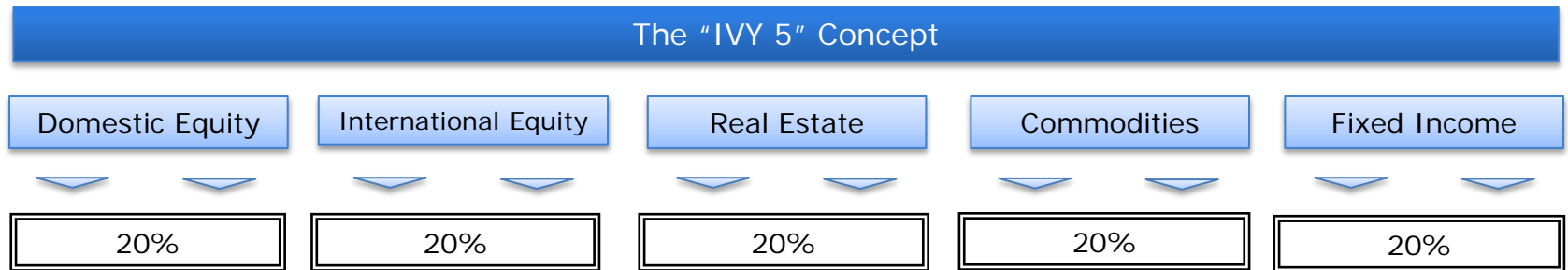
➤ Tactical

- ❑ Changing our baseline allocation
- ❑ E.g., 50% Stocks, 50% Bonds → 30% Stocks, 70% Bonds

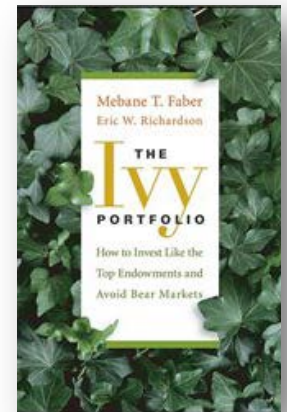
The background of the slide features a faded architectural drawing of a building floor plan. Overlaid on the drawing are a calculator in the upper right and a ruler running diagonally from the bottom left towards the upper right. The text 'BASIC ASSET CLASSES' is positioned on the right side of the slide, partially overlapping the ruler and the blueprint.

BASIC ASSET CLASSES

The Basic Diversified Portfolio



1. **SP500** = SP500 Total Return Index
2. **EAFE** = MSCI EAFE Total Return Index
3. **REIT** = FTSE NAREIT All Equity REITS Total Return Index
4. **GSCI** = GSCI Index
5. **LTR** = Merrill Lynch 7-10 year Government Bond Index

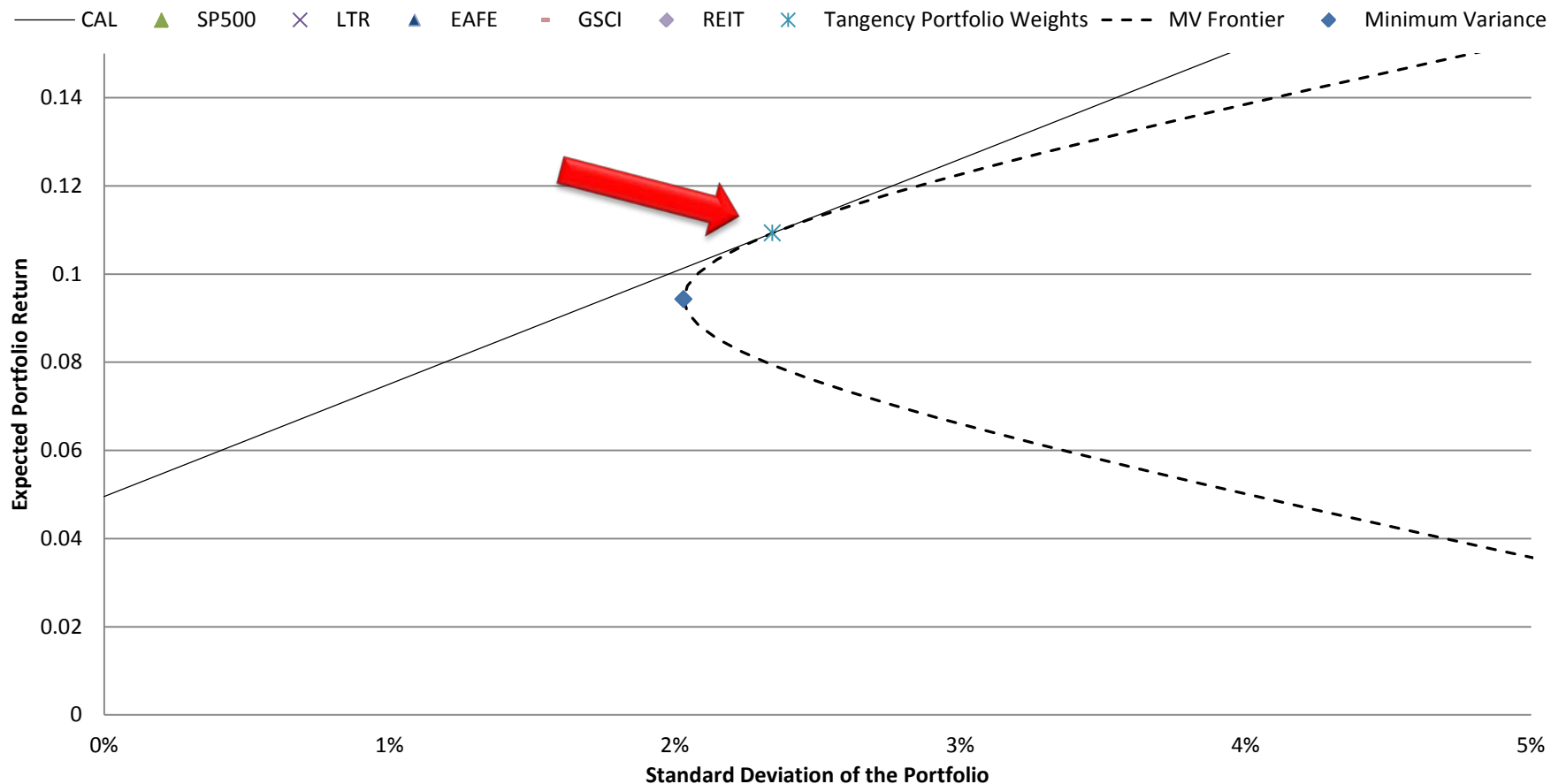


The background of the slide features a faded architectural blueprint with various lines, numbers, and symbols. Overlaid on the blueprint are a calculator in the upper right and a ruler running diagonally across the middle. The title text is centered over the ruler.

COMMON ASSET ALLOCATION TECHNIQUES

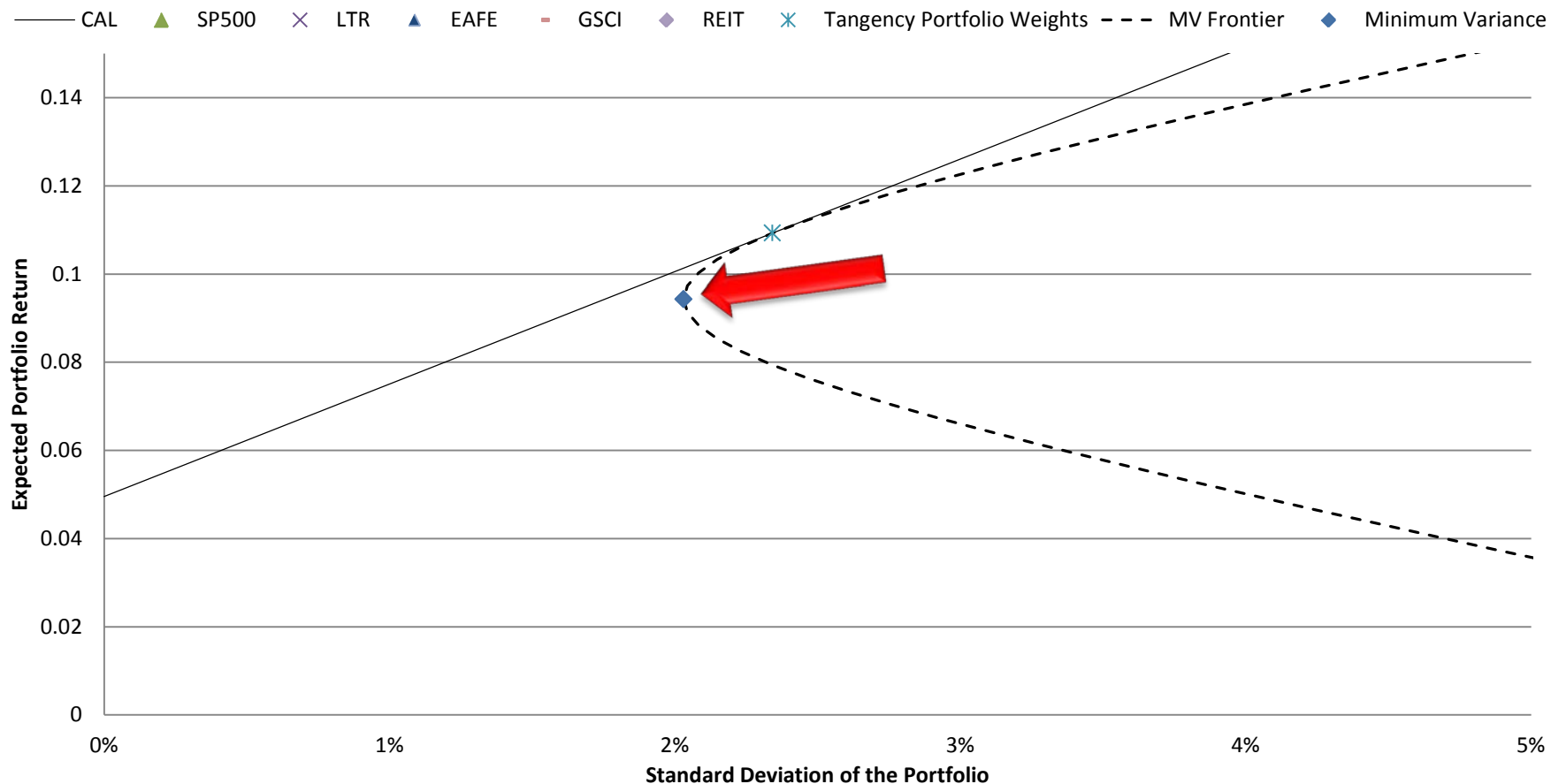
Tangency Portfolio or Max Sharpe Portfolio

- Tangency (Max Sharpe) Portfolio → value-weight portfolio of all risky assets
- Identify weights that maximize Sharpe Ratio



Minimum Variance Portfolio

- Identify weights that minimize portfolio variance



Risk Parity

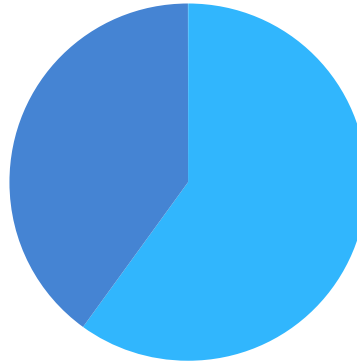
- Identify weights that equalize "risk" across asset classes

BUY T-Bonds...
With Leverage!

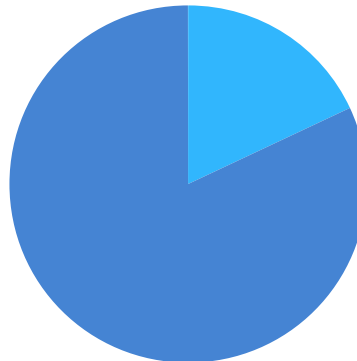


Allocation

■ Stock ■ Bond

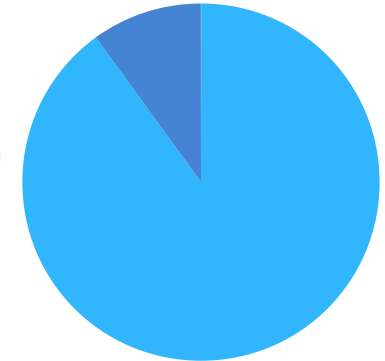


■ Stock ■ Bond

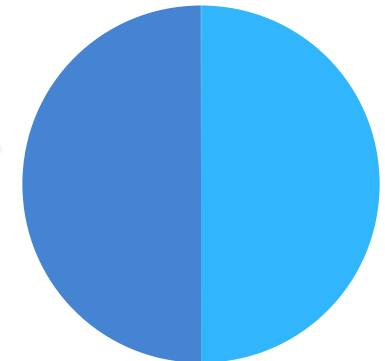


Risk Contribution

■ Stock ■ Bond



■ Stock ■ Bond



Traditional

Risk Parity

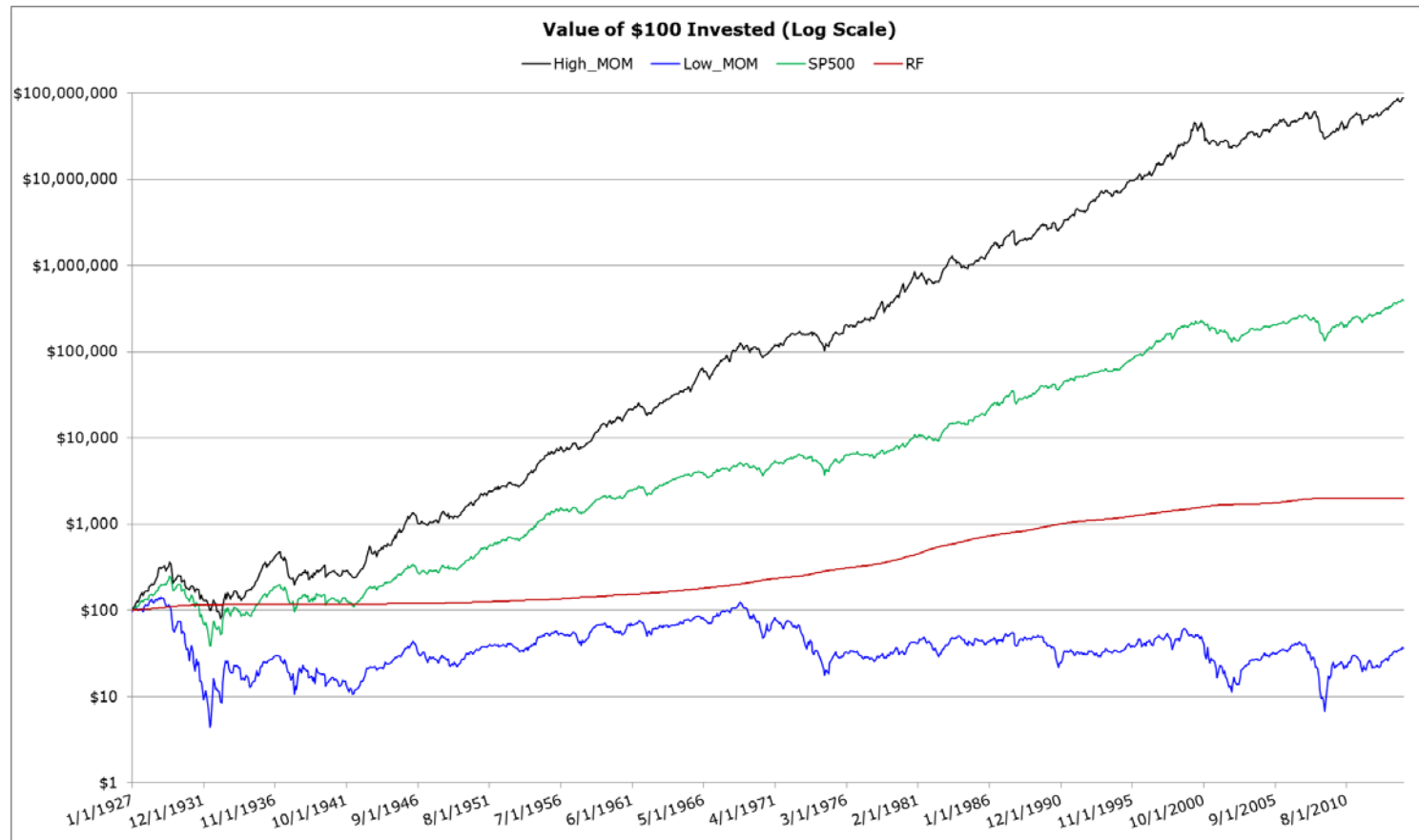


Momentum Portfolio

➤ Quotes from Eugene Fama and Ken French

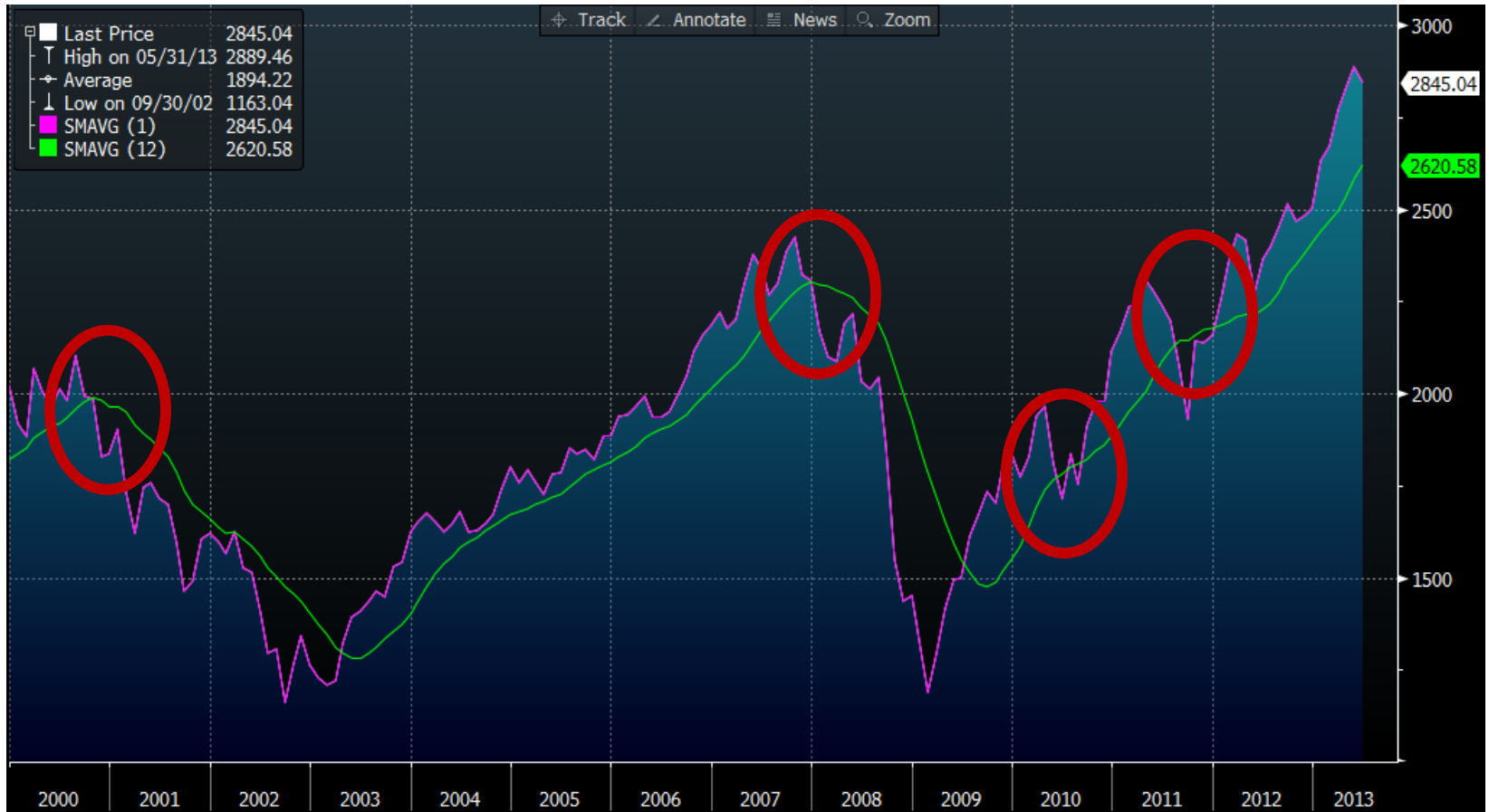
"...momentum is pervasive."

"The premier anomaly is momentum..."



Moving Average Rule Portfolio

- Classic Trend Following Strategy
 - ❖ IF MA rule triggered, buy risk, else, cash out.
 - ❖ E.g., Compare current price to the Average (past 12 months)





ACADEMIC EVIDENCE





Is Mean Variance...

For Practitioner Use?

or...

For Academic Journals?

"The Motivation behind my dissertation was to apply mathematics to the stock market."

Harry Markowitz, intellectual founder of Mean Variance Analysis

"This is not a dissertation in economics, and we cannot give you a PhD in economics for this."

Milton Friedman, Markowitz dissertation advisor

The background of the slide features a faded architectural drawing of a building floor plan. Overlaid on the drawing are a calculator in the upper right and a long ruler angled across the center. The text 'OUT-OF-SAMPLE PERFORMANCE' is centered in the right half of the image.

OUT-OF-SAMPLE PERFORMANCE

Academic Model Performance

- “Of the 14 models we evaluate across seven empirical datasets, **none is consistently better than the 1/N rule in terms of Sharpe ratio, certainty-equivalent return, or turnover**, which indicates that, out of sample, the gain from optimal diversification is more than offset by estimation error...”

Table 3
Sharpe ratios for empirical data

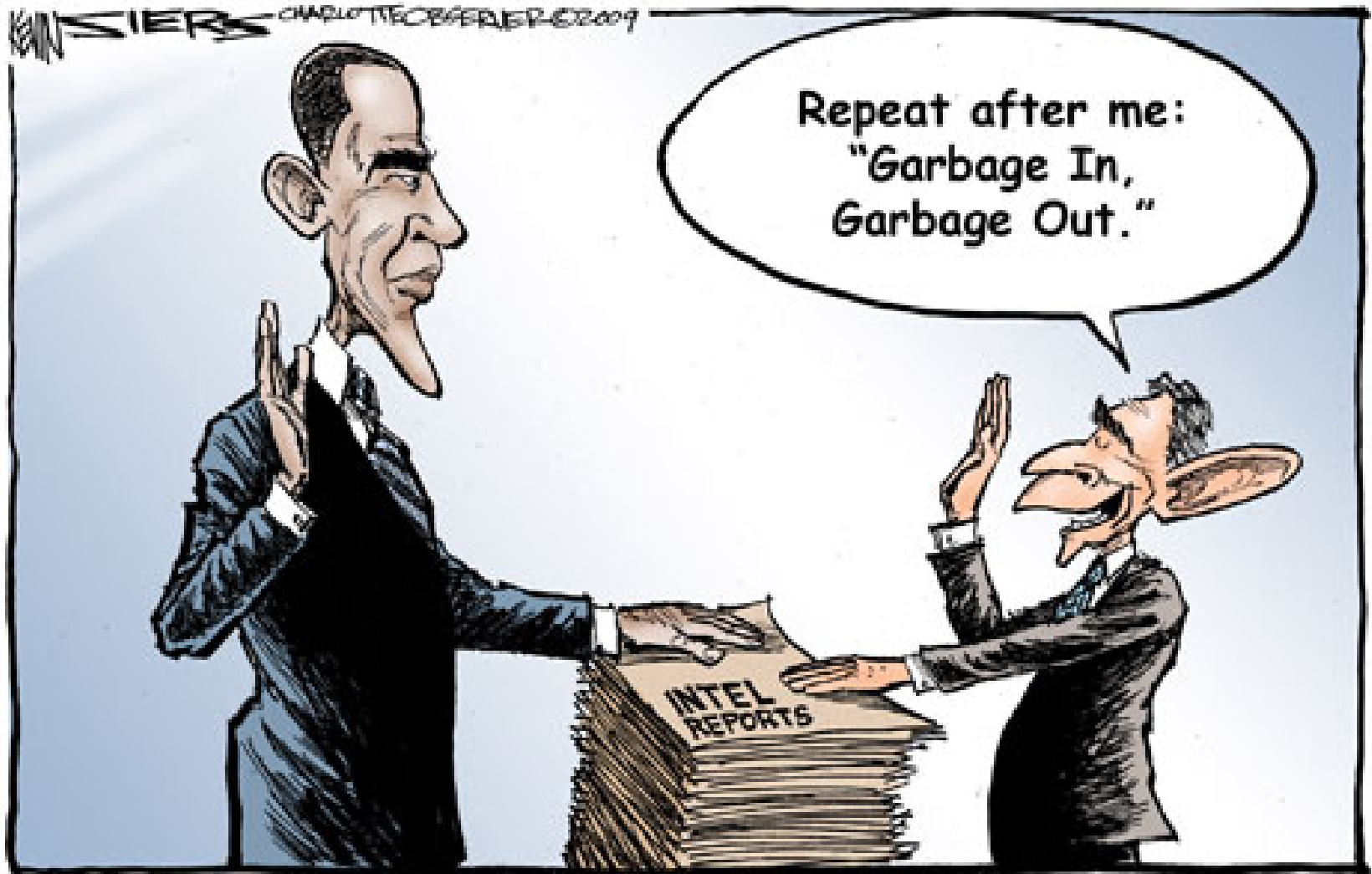
Strategy	S&P sectors $N = 11$	Industry portfolios $N = 11$	Inter'l portfolios $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
1/N	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794 (0.12)	0.0679 (0.17)	-0.0332 (0.03)	0.2186 (0.46)	0.0128 (0.02)	0.1841 (0.45)
bs	0.0811 (0.09)	0.0719 (0.19)	-0.0297 (0.03)	0.2536 (0.25)	0.0138 (0.02)	0.1791 (0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410 (0.08)	0.0581 (0.14)	0.0707 (0.08)	0.0016 (0.00)	0.0004 (0.01)	0.2355 (0.17)
min	0.0820 (0.05)	0.1554 (0.30)	0.1490 (0.21)	0.2493 (0.23)	0.2778 (0.01)	-0.0183 (0.01)
vw	0.1444 (0.09)	0.1138 (0.01)	0.1239 (0.43)	0.1138 (0.00)	0.1138 (0.01)	0.1138 (0.00)
mp	0.1863 (0.44)	0.0533 (0.04)	0.0984 (0.15)	-0.0002 (0.00)	0.1238 (0.08)	0.1230 (0.03)
mv-c	0.0892 (0.09)	0.0678 (0.03)	0.0848 (0.17)	0.1084 (0.02)	0.1977 (0.02)	0.2024 (0.27)
bs-c	0.1075 (0.14)	0.0819 (0.06)	0.0848 (0.15)	0.1514 (0.09)	0.1955 (0.03)	0.2062 (0.25)
min-c	0.0834 (0.01)	0.1425 (0.41)	0.1501 (0.16)	0.2493 (0.23)	0.1546 (0.35)	0.3580 (0.00)
g-min-c	0.1371 (0.08)	0.1451 (0.31)	0.1429 (0.19)	0.2467 (0.25)	0.1615 (0.47)	0.3028 (0.00)
mv-min	0.0683 (0.05)	0.0772 (0.21)	-0.0353 (0.01)	0.2546 (0.22)	-0.0079 (0.01)	0.1757 (0.50)
ew-min	0.1208 (0.07)	0.1576 (0.21)	0.1407 (0.18)	0.2503 (0.17)	0.2608 (0.00)	-0.0161 (0.01)

*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.

Source: DeMiguel, V., L. Garlappi, and R. Uppal, 2009, *Optimal Versus Naïve Diversification: How Inefficient is the 1/N Portfolio Strategy?* Review of Financial Studies 5, 1915-1953.

The background of the slide is a faded, grayscale image of architectural blueprints. The blueprints show various lines, dimensions, and symbols, including circles with numbers like 5 and 7, and rectangular boxes with numbers like 310, 311, 314, and 315. A calculator is visible in the upper right corner, and a ruler is placed diagonally across the lower half of the image. A horizontal blue line runs across the middle of the slide, separating the title from the content.

WHY COMPLEXITY DOESN'T ADD VALUE



➤ Summary Stats: Jan 1927 to Dec 1960

	SP500	HML	LTR
Average	1.00%	0.36%	0.26%
Std. Dev.	7.04%	4.42%	1.26%
Correlation	SP500	HML	LTR
SP500	100.00%	58.93%	5.64%
HML	58.93%	100.00%	4.03%
LTR	5.64%	4.03%	100.00%

➤ Summary Stats: Jan 1961 to Dec 2013

	SP500	HML	LTR
Average	0.91%	0.40%	0.59%
Std. Dev.	4.32%	2.83%	2.36%
Correlation	SP500	HML	LTR
SP500	100.00%	-26.41%	16.91%
HML	-26.41%	100.00%	0.44%
LTR	16.91%	0.44%	100.00%

➤ Tangency/Min.Var Weights: Jan 1927 to Dec 1960

	Tangency Weights	Min. Var. Weights
W(SP500)	17.92%	-0.55%
W(HML)	-5.81%	7.07%
W(LTR)	87.90%	93.48%

➤ Tangency/Min.Var Weights: Jan 1961 to Dec 2013

	Tangency Weights	Min. Var. Weights
W(SP500)	41.22%	18.37%
W(HML)	15.27%	38.95%
W(LTR)	43.51%	42.68%

➤ Out of Sample Performance: 1961 to 2013 (using 1927 to 1960 weight estimates)

1961-2013	Equal Weights	Tangency	Min. Var.
CAGR	7.64%	7.83%	6.81%
Worst Drawdown	-19.90%	-18.14%	-19.90%
Sharpe Ratio	0.73	0.60	0.51
Sortino Ratio	0.64	0.58	0.40

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PERFORMANCE OF COMMON TECHNIQUES

Strategy Background

➤ **Simulated Historical Performance:** 1/1/1979 to 12/31/2013


- Results are gross of management fee and transaction costs for illustrative purposes only.
- These are simulated performance results and do not reflect the returns an investor would actually achieve.
- All returns are total returns and include the reinvestment of distributions (e.g., dividends).
- Max Sharpe weights are constrained between -1 and 1
- Data is from Bloomberg and publicly available sources.

➤ Legend

1. **SP500** = SP500 Total Return Index
2. **EAFE** = MSCI EAFE Total Return Index
3. **REIT** = FTSE NAREIT All Equity REITS Total Return Index
4. **GSCI** = GSCI Index
5. **LTR** = Merrill Lynch 7-10 year Government Bond Index (prior to 6/1982, Amit Goyal Data)
6. **RISK_PARITY** = Risk parity on core 5 asset classes, 3-yr rolling windows
7. **MOM_TAA** = Momentum on core 5 asset classes, 12-month momentum,
8. **MAX_SHARPE** = Tangency portfolio weights on core 5 asset classes, 3-yr rolling windows (weights constrained [-1,1])
9. **MIN_VAR** = Minimum variance portfolio weights on core 5 asset classes, 3-yr rolling windows
10. **EW_INDEX** = Equal-weight, monthly rebalanced across core 5 asset classes
11. **EW_INDEX_MA** = Equal-weight, monthly rebalanced across core 5 asset classes, with 12-month moving average rule
12. **RANDOM** = $\frac{1}{4}$ random chance of moving to risk-free rate, monthly rebalanced across core 5 asset classes

- Hypothetical performance results have many inherent limitations, some of which, but not all, are described in the disclosures at the end of this document. 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.
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The background of the slide features a faded architectural drawing of a building floor plan. A grey calculator is positioned in the upper left, and a wooden ruler is placed diagonally across the center. The blueprints include various numerical dimensions, notes, and structural symbols.

HISTORICAL PERFORMANCE

➤ [Summary Statistics: Benchmarks](#)

Summary Statistics	SP500	EAFE	REIT	GSCI	LTR
CAGR	12.12%	9.38%	12.68%	6.62%	8.95%
Standard Deviation	15.27%	17.47%	17.50%	19.29%	8.66%
Downside Deviation (MAR=5%)	11.36%	12.39%	14.79%	13.47%	5.39%
Sharpe Ratio	0.51	0.32	0.50	0.18	0.47
Sortino Ratio (MAR=5%)	0.67	0.45	0.58	0.24	0.74
Worst Drawdown	-50.21%	-56.68%	-68.30%	-67.65%	-20.97%
Worst Month Return	-21.58%	-20.18%	-31.67%	-28.20%	-8.41%
Best Month Return	13.52%	15.58%	31.02%	22.94%	15.23%
Profitable Months	63.81%	60.00%	61.19%	56.67%	64.52%

Fixed Income

Domestic Equity

Real Estate

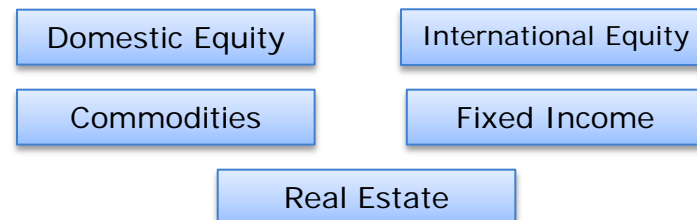
International Equity

Commodities



➤ [Summary Statistics: Asset Allocation with Core 5](#)

Summary Statistics	EW_INDEX	RANDOM
CAGR	10.78%	9.40%
Standard Deviation	10.47%	8.38%
Downside Deviation (MAR=5%)	9.20%	7.40%
Sharpe Ratio	0.57	0.52
Sortino Ratio (MAR=5%)	0.64	0.59
Worst Drawdown	-46.27%	-35.28%
Worst Month Return	-19.60%	-14.58%
Best Month Return	9.96%	9.08%
Profitable Months	68.38%	69.51%

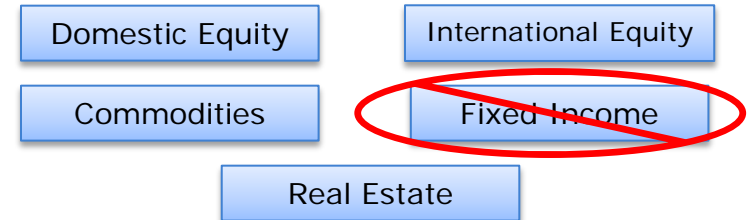


Summary Statistics	RISK_PARITY	MOM_TAA	MAX_SHARPE	MIN_VAR	EW_INDEX_MA
CAGR	10.86%	12.33%	8.89%	8.53%	11.19%
Standard Deviation	8.30%	10.67%	17.79%	7.16%	7.35%
Downside Deviation (MAR=5%)	6.87%	9.40%	14.68%	4.99%	5.87%
Sharpe Ratio	0.70	0.69	0.30	0.50	0.82
Sortino Ratio (MAR=5%)	0.83	0.77	0.35	0.69	1.01
Worst Drawdown	-30.12%	-45.01%	-47.51%	-18.05%	-11.67%
Worst Month Return	-13.13%	-19.63%	-25.82%	-8.42%	-9.84%
Best Month Return	7.84%	9.53%	19.87%	14.20%	7.37%
Profitable Months	70.24%	70.48%	59.76%	66.90%	72.14%



➤ [Summary Statistics: Asset Allocation with Core 4 \(no 10-Years\)](#)

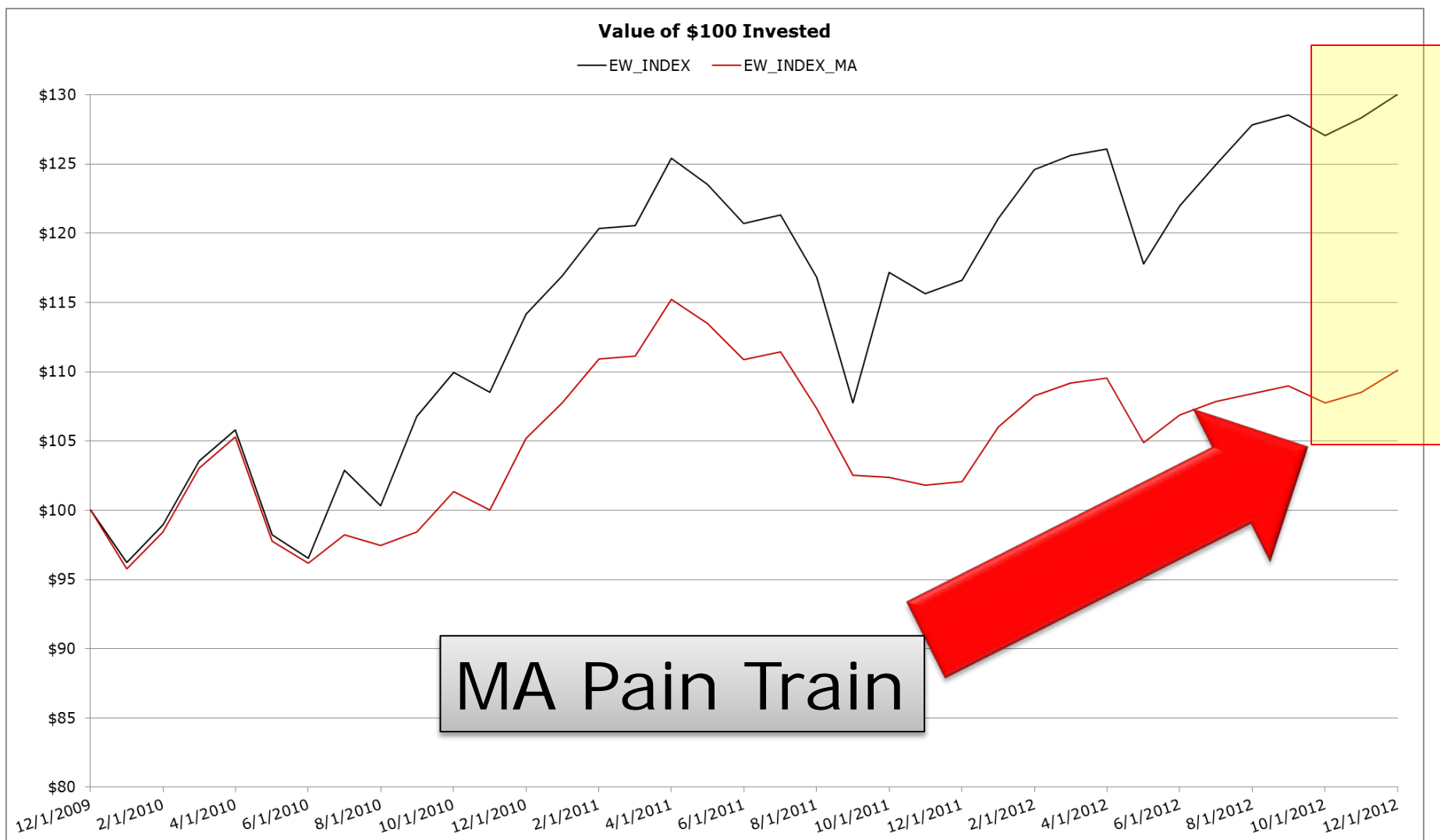
Summary Statistics	EW_INDEX	RANDOM
CAGR	10.88%	9.66%
Standard Deviation	12.76%	10.22%
Downside Deviation (MAR=5%)	11.48%	9.31%
Sharpe Ratio	0.50	0.47
Sortino Ratio (MAR=5%)	0.54	0.53
Worst Drawdown	-56.03%	-45.32%
Worst Month Return	-24.19%	-18.67%
Best Month Return	13.08%	11.42%
Profitable Months	67.40%	68.09%



Summary Statistics	RISK_PARITY	MOM_TAA	MAX_SHARPE	MIN_VAR	EW_INDEX_MA
CAGR	11.08%	11.72%	11.04%	10.41%	11.74%
Standard Deviation	12.47%	12.94%	20.01%	11.72%	8.86%
Downside Deviation (MAR=5%)	11.26%	11.71%	13.22%	9.50%	7.22%
Sharpe Ratio	0.52	0.56	0.38	0.49	0.75
Sortino Ratio (MAR=5%)	0.56	0.61	0.57	0.59	0.91
Worst Drawdown	-55.55%	-58.00%	-47.80%	-49.07%	-16.42%
Worst Month Return	-22.93%	-25.16%	-20.66%	-17.82%	-12.44%
Best Month Return	12.22%	11.80%	29.60%	11.63%	8.87%
Profitable Months	66.91%	68.38%	58.58%	64.95%	72.30%



➤ [Summary Statistics: Asset Allocation with Core 5, the most recent 4 years](#)



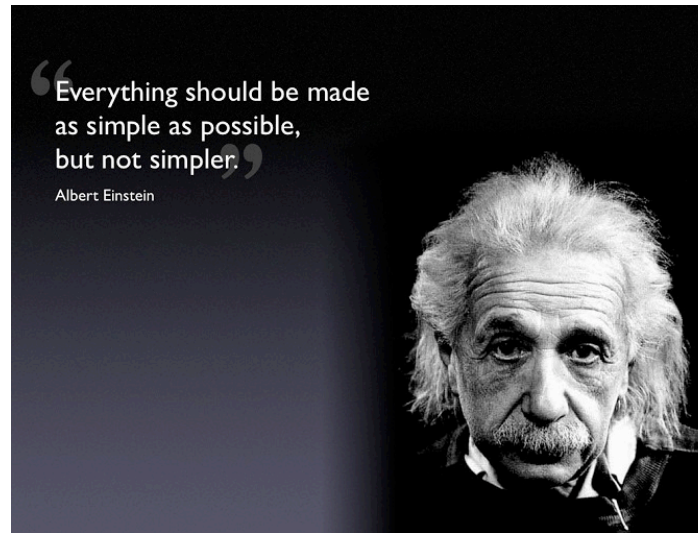
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Are you a **Story-Based Investor**?

$$\text{– Story} \rightarrow = \left[\frac{2}{\pi} \cos(n\pi) \left[\frac{4}{n^2 \pi^2} - \frac{4}{n} \right] + \frac{8}{n \pi^2} \sin(n\pi) \right] - \left[\frac{2}{\pi} \cos(0) \left[\frac{4}{n^2 \pi^2} \right] + 0 \right]$$

Or are you an **Empirical-Based Investor**?

$$\text{Evidence} \rightarrow = 1/N$$



Keep it Simple





APPENDIX



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
- **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

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.

Indexes are unmanaged, do not reflect management or trading fees, and one cannot invest directly in an index.

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.





QUESTIONS?

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