

**Effective Market Timing:
Recent successes in five key dimensions using one-week market forecasts produced
by machine learning**

White Paper - September 24, 2011
updated for 5 year results March 24, 2012

Kevin B. Pratt, Chief Scientist ZZAlpha LTD.
www.ZZAlpha.com www.zzETF.com

Abstract:

We demonstrate that a machine learning technique predicts relative future price in four key dimensions and an economic core of the US equities market. The price forecasts enable effective market timing selections among: a) equities vs. bonds, b) growth vs. value vs. bonds, c) large cap vs. small cap vs. bonds, d) among twelve economic sectors (including bonds), and e) economic core materials and energy sectors (and bonds). Market timing using these one-week forecasts support annualized returns over 12% for study period Jan. 2007 through Dec 2011 using unleveraged long positions in large, well-known ETFs. The returns exceed benchmarks in the study period. The market timing also reduces risk relative to benchmarks. Using large Monte Carlo simulations, we confirm that statistical confidence in the results from the market timing recommendations exceeds three sigma (over 99.7%).

Introduction

Pundits (and experts) have popularized general advice about investing in the stock market - get in or get out, buy value or buy growth stocks, buy large cap or small cap, or pick stocks in the best economic sector. The advice implicitly assumes market timing, as opposed to "buy-and-hold," will reliably produce excess profits. However, detractors assert that market timing is ineffectual and risky. Which is it?

Is there convincing scientific evidence that one can - in trading well known ETFs - use market timing to obtain excess profits when applying correct recommendations in any or all of these four key dimensions - "in or out," "value or growth," "large or small cap," "best sector," or an economic core group?

We show strong evidence that the answer is "yes" to all, and that **risk is reduced** by market timing.

The table below provides an overview of results for market timing using ZZAlpha[®] recommendations based on one-week market forecasts (5 year study period January 2007 through December 2011).

Dimension	ETFs used in choice	Annualized return (Jan 2007-Jun 2011) using ZZAlpha[®] recommendations for market timing	Benchmark and annualized return	Second benchmark and annualized return	Statistical confidence that annualized return is not luck
In or Out	IWV, AGG	12.6 %	-0.7 % Russell 3000 IWV	5.8% bonds AGG	over 99.99 % ($\sigma > 4$)
Growth or Value	VUG, VTV, AGG	15.9%	0.8 % Vanguard Growth VUG	-0.5 % Vanguard Value VTV	over 99.9999 % ($\sigma > 6$)
Large cap or Small cap	DIA, IWM, AGG	16.2 %	2.0 % Dow Jones Industrials DIA	0.8 % Russell 2000 IWM	over 99.99 % ($\sigma > 4$)
Best Sector	12 ETFs- see below	13.2 %	-0.1 % S&P 500 SPY	2.0 % Dow Jones Industrials DIA	over 99.7 % ($\sigma > 3$)
Economic Core	XLB, XLE, AGG	20.2 %	2.3% Basic Materials Sector XLB	6.9 % Energy Sector XLE	over 99.99 % ($\sigma > 4$)

Our approach involves asking the ZZAlpha[®] machine learning technique to recommend single daily choices of readily tradable ETFs, each representing an investment preference within each of the four dimensions (sometimes called "investment styles"), and the economic core.

The market timing trading is simple and mechanistic. Each day the ETF is bought at the opening price using the ZZAlpha[®] daily recommendation, held for the duration of the one-week forecast (five trading days) and then sold at the opening price that final day. No leverage is used. Because some recommendations are unchanged five trading days later, actual trading frequency is less than daily. The table below shows historic five year trading frequency.

Historic trading frequency	
In or Out	3 in 10 days
Growth or Value	4.3 in 10 days
Large cap or Small cap	4.3 in 10 days
Best Sector	6.7 in 10 days
Economic Core	4.3 in 10 days

Trading costs are not deducted from the returns shown in this white paper.¹

¹ An estimate of commissions that would be paid to an online discount brokerage for trades can be obtained from the above chart. Assuming \$10 to buy, and \$10 to sell, annual commissions for In or Out would be \$1515, for Growth or Value, Large cap or Small cap, and Economic Core would be \$2175, and for Best Sector would be \$3380. Consistent use of a limit order would control slippage.

To be clear: not every recommendation is profitable - the stock market is subject to many unexpected influences during the one-week forecasts. However, market timing using ZZAlpha® recommendations beats benchmarks cumulatively over the study period. As discussed below, risk is also reduced.

Each ZZAlpha® ETF recommendation is selected solely by the ZZAlpha® machine learning technique. We use no subjective information or human analysis - only raw fundamental and end-of-day information. The machine learning technique evaluates the interconnections and changes in the market on a daily basis and places those in the context of historic market dynamics, using over *half a billion* pieces of data. Each night the machine learning technique evaluates the near future of US exchange traded stocks and ETFs so it can make recommendations for the next morning.

Beginning in the second half of 2011, each recommendation is time-stamped and notarized by a certified, independent third-party trusted timestamp authority to confirm for audit that every recommendation is created prior to market open on the day of recommendation.

The following sections provide an overview of consistency of results and *Risk Profiles* for market timing in each of the four dimensions and the economic core group, ZZAlpha® performance evaluation methodology, and statistical confidence from large Monte Carlo trials. The results are scientific, documented and replicable.

Consistency of ZZAlpha® recommendation returns (Jan. 2007- Dec. 2011)

The market timing returns from the ZZAlpha® ETF recommendations consistently exceed two market benchmarks (S&P 500 index and Russell 3000 index)². We show in green those years when the recommendations exceeded *both* benchmarks by 200 basis points.³

Returns by year %	In or Out	Growth or Value	Large or Small	Best Sector	Economic Core	Benchmark SP 500 Idx (SPY)	Benchmark Russell 3000 Idx (IWB)	AGG
2007	10.0	10.3	13.6	13.4	20.1	7.4	3.3	5.7
2008	-5.3	-0.3	-2.1	-25.7	5.2	-39.3	-37.7	7.8
2009	44.4	37.9	27.6	46.4	32.0	31.6	24.8	3.8
2010	14.4	20.2	19.9	32.3	27.4	13.4	14.9	5.6
2011	4.6	14.3	23.8	13.2	18.2	2.9	0.6	7.2
Annualized Return (5 yrs)	12.6	15.9	16.2	13.2	20.2	0.1	-0.7	5.8
Max Drawdown%	19.2	16.5	20.3	41.6	24.8	50.0	50.8	8.5
Statistical confidence	99.99	99.99	99.99	99.7	99.99			

² We use SPY and IWB as the benchmarks because their adjusted price data reflect dividend reinvestment (thereby giving higher returns) where the raw indices do not.

³ In the earlier 4 ½ year version of this white paper, the IWB values were incorrect in this table.

Risk profiles of ZZAlpha® recommendation returns (Jan. 2007- Dec. 2011)

The risk profiles also consistently exceed benchmarks. We show in green those statistics where the portfolio risk or reward was an improvement over the Benchmark SP500 Index (SPY).

	In-Out	Growth-Value	Large-Small	Best Sector	Econ Core	SPY	AGG
Max yr over yr drawdown (%)	19.2	16.5	20.3	41.6	24.8	50.0	8.5
Win/loss ratio	1.6	1.7	1.6	1.5	1.6	1.3	1.6
Large win/large loss ratio	1.4	1.7	1.2	1.0	1.5	0.9	0.7
Median of wins (%)	1.006	1.006	1.008	1.011	1.007	1.016	1.004
Median of losses (%)	0.994	0.993	0.991	0.987	0.994	0.981	0.997
Best win event (%)	13.4	14.7	16.2	32.7	18.4	13.4	5.0
Worst loss event (%)	-24.3	-12.2	-26.0	-17.4	-19.8	-23.1	-8.3
Annualized return %	12.6	15.9	16.2	13.2	20.1	0.1	5.8

Risk Statistics table notes: Maximum year-over-year drawdown is dominated by the 2008 crash. The win / loss ratio is the number of week-long holds ("events") that were profitable vs. those that were losses. The large win / large loss ratio refers to events that were more extreme than 4% gain or loss. Median of wins indicates the middle value of profitable events - half of the profitable holds were more profitable, half were less profitable.

In certain portfolios, we had missing data days for which we did not have data for an ETF during the study period (About 20 days in each portfolio due to missing days for AGG, with about 160 days in one component of Growth or Value, and about 2 ½ yrs in certain sectors of Best Sector (visible as "flat" segments in the graphs below)). Missing days can affect performance, risk and confidence statistics. Our scientific methodology prohibits us from "fixing" missing days with hindsight.

No single number describes risk. The depth and duration of drawdowns are important risk factors and can best be seen in the performance graphs below.

Overview of ZZAlpha® performance evaluation methodology

When evaluating performance and risk, ZZAlpha uses a consistent methodology named "equal-weighted five basket, balancing roll forward" methodology.⁴ The methodology is simple:

- a) Start by dividing capital equally into five baskets, one for each day of the week.
- b) Each day, buy a dollar amount of the recommended ETF at the opening price and put it in that day's basket. After five days, sell the ETF in the basket at the opening price and buy a dollar amount of the newly recommended ETF at the opening price to refill the basket. Rebalance purchase dollar amounts

⁴ Evaluation methodology is simple bookkeeping used to calculate results. It is entirely distinct from the advanced ZZAlpha® machine learning technique which makes the recommendations to be used in trading.

each day to keep the baskets close to equal weighted through the week. Once purchased, an ETF is held until sale at the end of five days regardless of market events. Holdings across ex-dividend dates are price adjusted to reflect collection of dividends.

Because the machine learning technique makes recommendations that are "custom" for a specific day of recommendation, we never "backtest." *Every* performance number shown in this paper is solely the result of *forward* testing on the "blind, out of sample" one-week forecast period immediately following the day of the recommendations.

The evaluation methodology assumes no use of leverage, options or derivatives (although we recognize that professional investors may use those techniques to accentuate returns).

In another paper, we describe how we now have about 1600 days of independent tests on hundreds of different portfolios to validate the effectiveness of the machine learning technique. These tests have consumed over 100,000 hours of computer time. Statistics from these large tests provide greater assurance and reliability than statistics typically obtained for the relatively infrequent, long-hold recommendations of human analysts, many of whom cover only a single market segment.

Statistical confidence of ZZAlpha[®] recommendation returns (Jan. 2007- Dec. 2011)

Proponents of the efficient market hypothesis suggest that beating a benchmark is often, if not always, "just luck." Sound scientific methodology requires more than simply comparing returns to benchmarks to calculate excess returns. To determine whether a result is "just luck," one has to first determine what "just luck" would produce. Scientific method uses Monte Carlo trials to accomplish this.

We ran 1000 Monte Carlo trials on each market dimension over the 5 year period Jan. 2007-Dec. 2011. In each trial, for each day, rather than using the ZZAlpha[®] ETF recommendation, we randomly chose ("threw darts at") one of the ETFs used in the dimension selections.

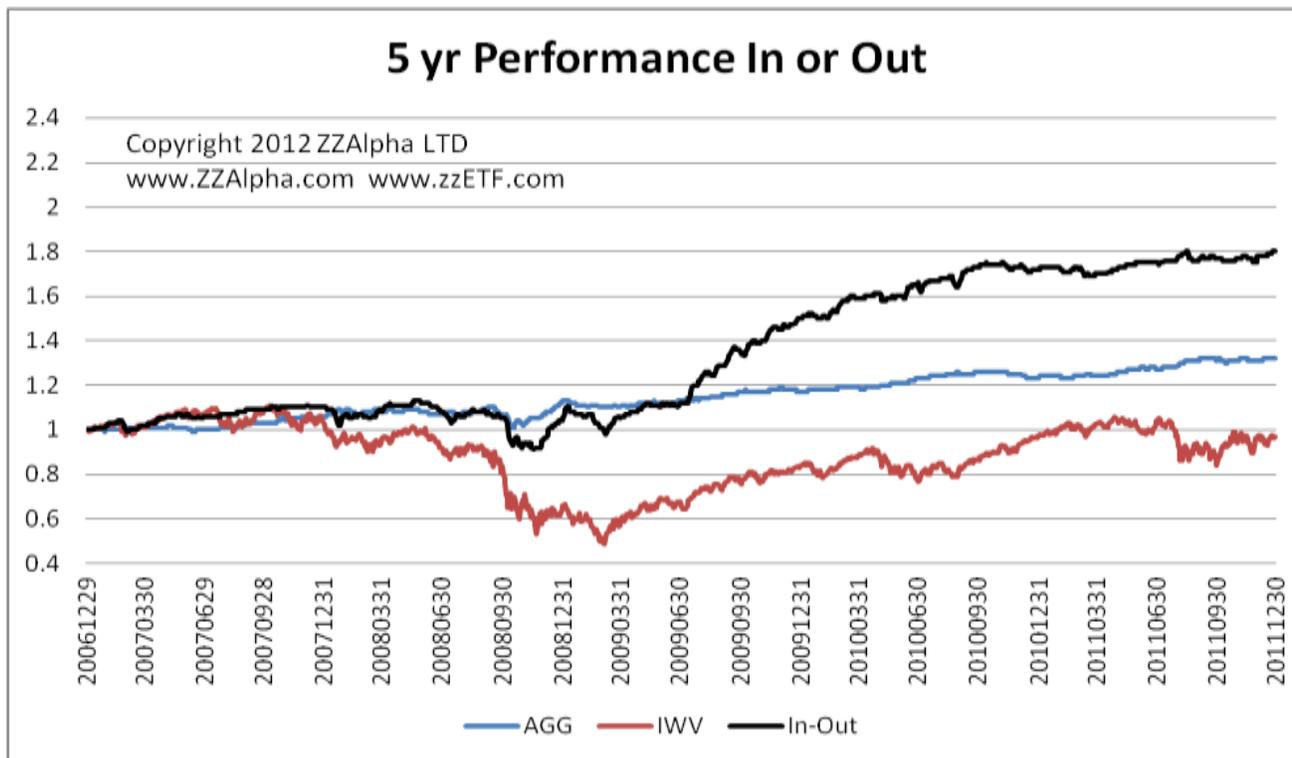
As expected, the returns from each Monte Carlo trial for a dimension differed. We use the variation to calculate a standard deviation. We can then quantify the extent to which the ZZAlpha[®] ETF recommendation return exceeded what would be expected from "just luck." The quantification is called the sigma, "z-score," or number of standard deviations.

Standard statistical theory assigns confidence that the null hypothesis (that the result is "just luck") can be discarded based on the sigma. A sigma of 3 indicates 99.7% confidence that a result is above a random occurrence result. Higher sigma implies even greater statistical confidence.

Results from market timing using the ETFs recommended by the ZZAlpha[®] machine learning technique have sigma over 3, 4 or 6 as shown in the profiles below.

Performance and Risk Profile - "In or Out"

For "In or Out" the choice was between the iShares Russell 3000 Index ETF (NYSE ticker IUV) and the iShares Barclays Aggregate Bond ETF (NYSE ticker AGG). As the performance graph below shows, the 13% annualized return and maximum 20% drawdown beat the strategies of staying fully invested in the market (IUV) or of staying out entirely in defensive bonds.



The black line in the graph indicates the cumulative value of the ZZAlpha[®] recommendations for switching between the full market Russell 3000 ETF (IUV) and a defensive out-of-market bond ETF (AGG).⁵

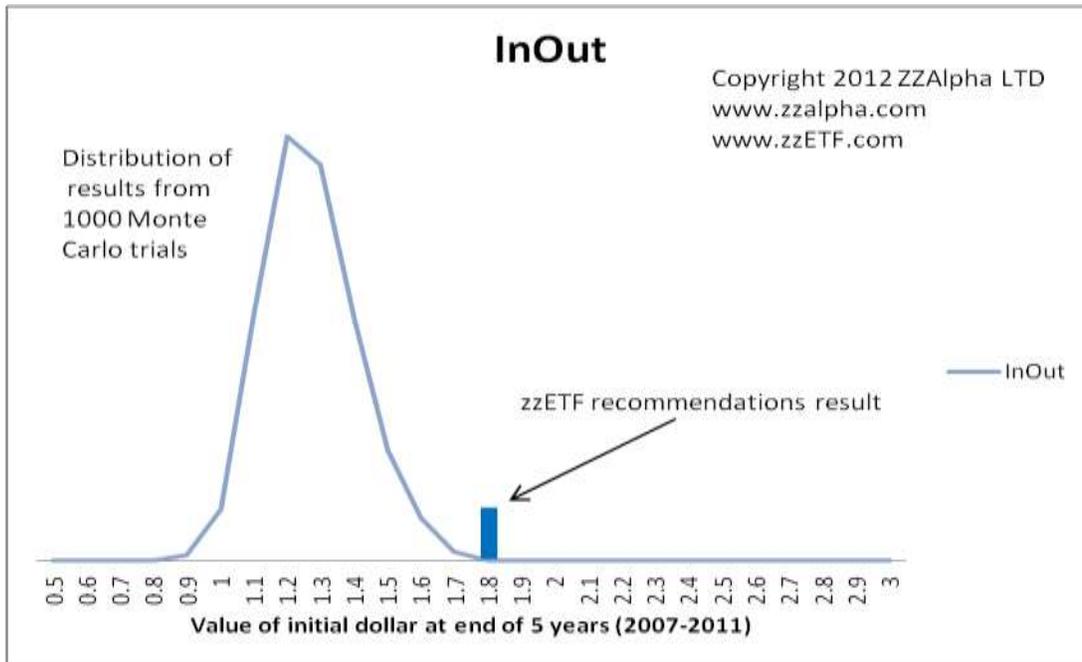
We have also evaluated "In or Out" recommendations for use in a hedge portfolio using a weighting of 2:1 long to short choice. The annualized return for the hedge is 9.0% with a smaller maximum drawdown of 7.0%.

For confirmation of the above "In or Out" result, we also considered a similar market timing choice between the SPDR Dow Jones Industrials ETF (NYSE ticker DIA) and the iShares Barclays Aggregate Bond ETF (NYSE ticker AGG). As the performance graph below shows, the 11.2% annualized return and maximum 24% drawdown beat the strategies of staying fully invested in the Dow or of staying out entirely in defensive bonds.

⁵ The flat segments in the ETF graphs below reflect days when volume was below 80,000 shares or our data provider did not provide data for the ETF.

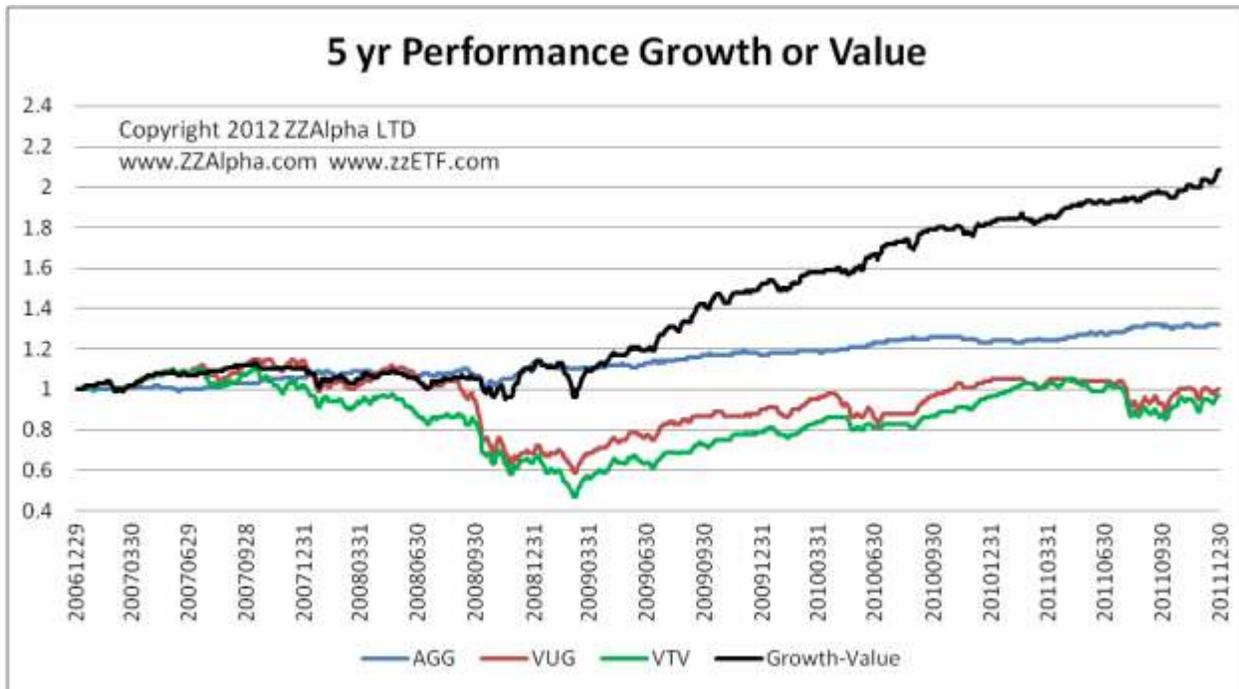


Statistical confidence that the annualized return of 12.6% is not luck exceeds 99.99%. The graph of the distribution of Monte Carlo trials below compares what luck ("throwing darts") would produce against the result of timing using the ZZAlpha® recommendations.



Performance and Risk Profile - "Growth or Value"

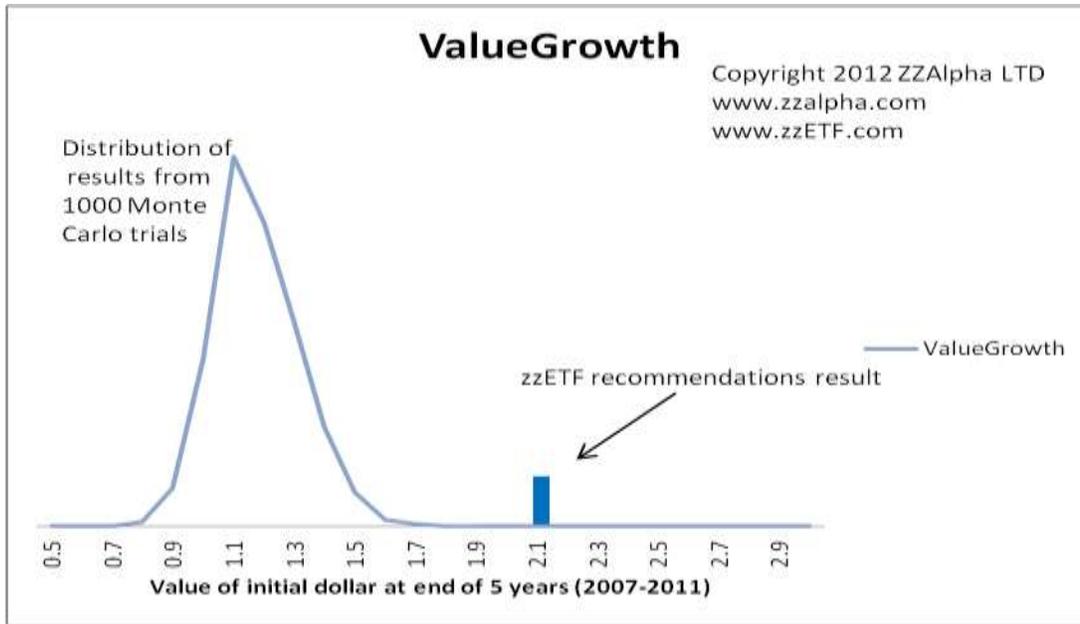
For "Growth or Value" the choice was among the Vanguard Growth ETF (NYSE ticker VUG), the Vanguard Value ETF (NYSE ticker VTV), and the iShares Barclays Aggregate Bond ETF (NYSE ticker AGG). As the performance graph below shows, the 15.9% annualized return and maximum 17% drawdown beat the strategies of staying fully invested in value style stocks or of staying fully invested in growth style stocks.



The black line in the graph indicates the cumulative value of the ZZAlpha® recommendations for switching among value style, growth style and a defensive out-of-market bond holding.

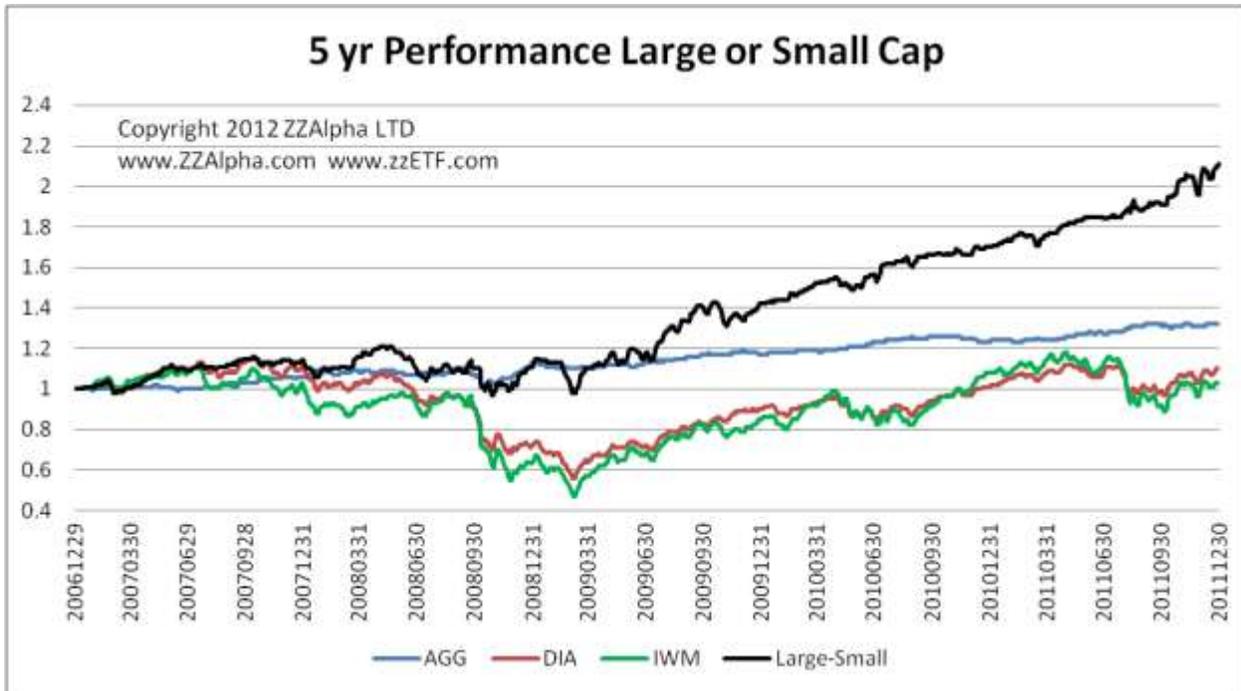
We have also evaluated "Growth or Value" recommendations for use in a hedge portfolio using a weighting of 2:1 long to short. The annualized return for the hedge is 12.3% with a drawdown of 7%.

Statistical confidence that the annualized return of 15.9% is not luck exceeds 99.99%. The graph of the distribution of Monte Carlo trials below compares what luck ("throwing darts") would produce against the result of timing using the ZZAlpha® recommendations.



Performance and Risk Profile - "Large Cap or Small Cap"

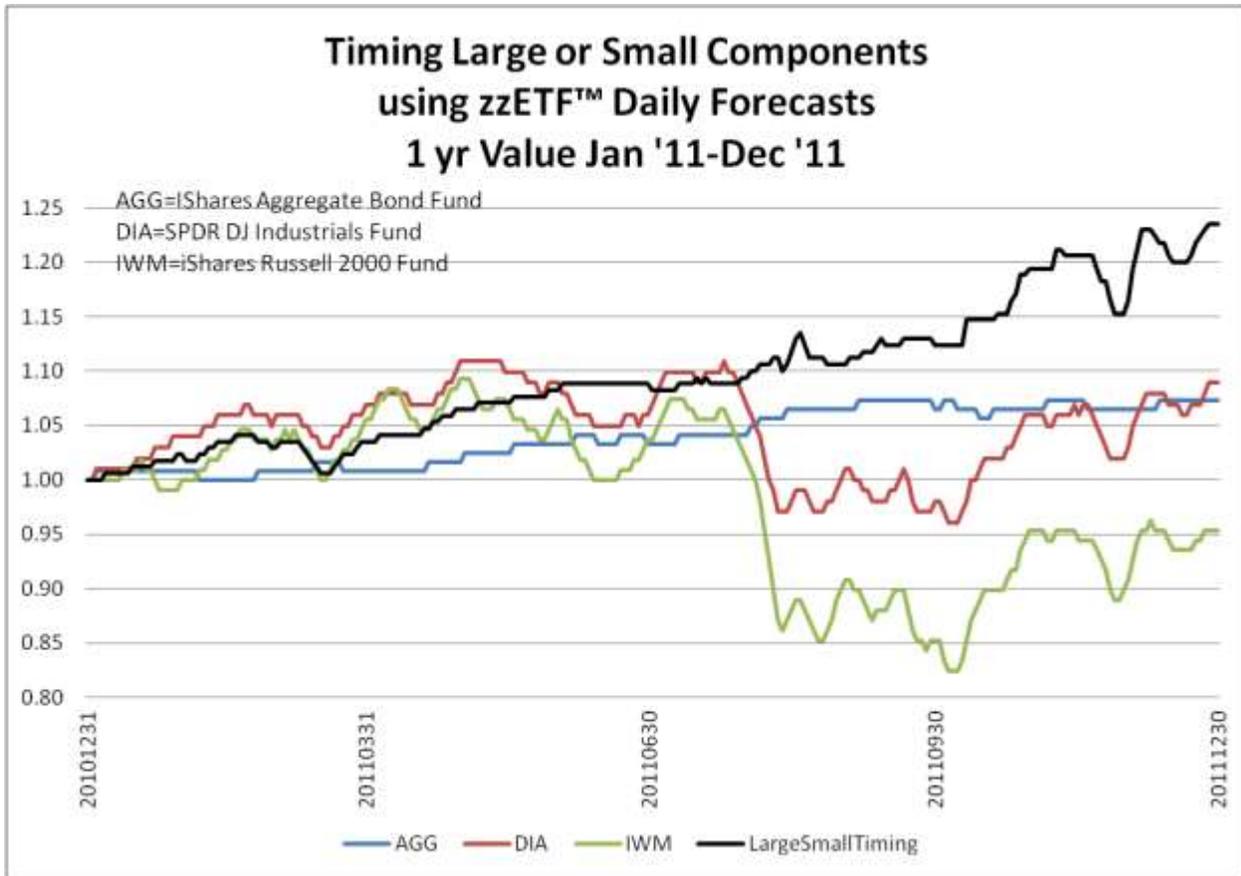
For "Large or Small" the choice was among the SPDR Dow Jones Industrial Average ETF (NYSE ticker DIA), the iShares Russell 2000 ETF (NYSE ticker IWM), and the iShares Barclays Aggregate Bond ETF (NYSE ticker AGG). As the performance graph below shows, the 14.4% annualized return and maximum 21% drawdown beat the strategies of staying fully invested in the large cap stocks or of staying fully invested in small cap stocks.



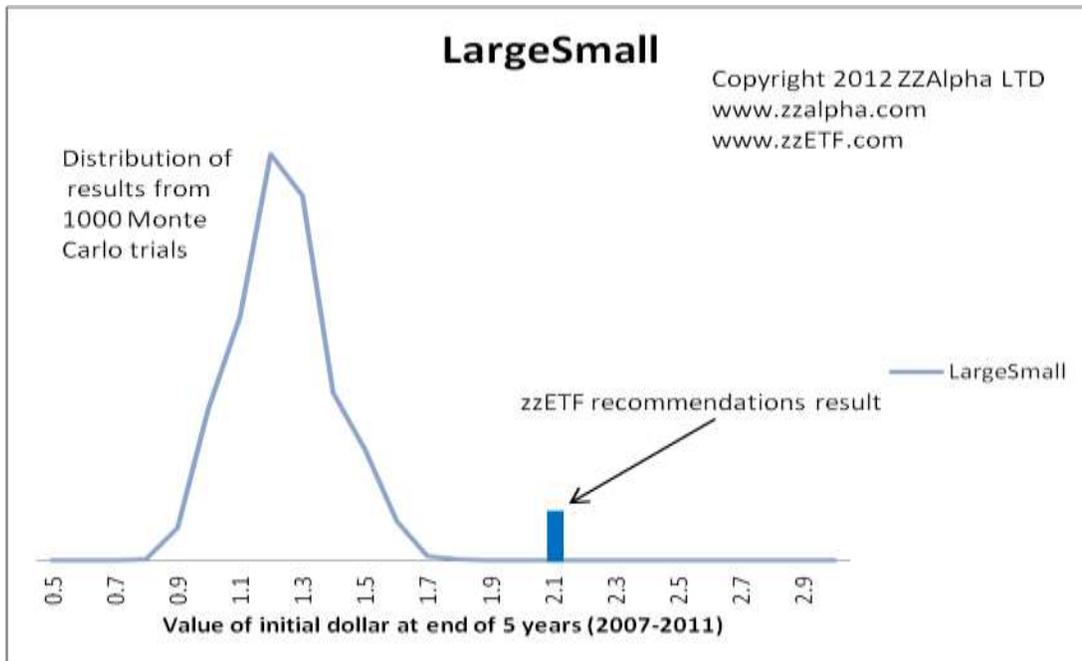
The black line in the graph indicates the cumulative value of the ZZAlpha® recommendations for switching among large cap, small cap and a defensive out-of-market bond holding.

We have also evaluated "Large or Small" recommendations for use in a hedge portfolio using a weighting of 2:1 long to short. The annualized return for the hedge is 9.7% with a drawdown of 16%.

To observe more closely the effect of switching using ZZAlpha® recommendations, we focus on a single year (2011) in the graph below (this is an extract from the graph just above for "Large or Small Cap" with the all starting values for January 1, 2011 reset to 1.0). The graph shows how switching sometimes reduces risk by switching to bonds (AGG) during market drawdown episodes. Not every recommended switch had a good outcome; however the cumulative effect over the year was beneficial.



Statistical confidence that the annualized return of 14.4% is not luck exceeds 99.99%. The graph of the distribution of Monte Carlo trials below compares what luck ("throwing darts") would produce against the result of timing using the ZZAlpha® recommendations.



Performance and Risk Profile - "Best Sector Rotation"

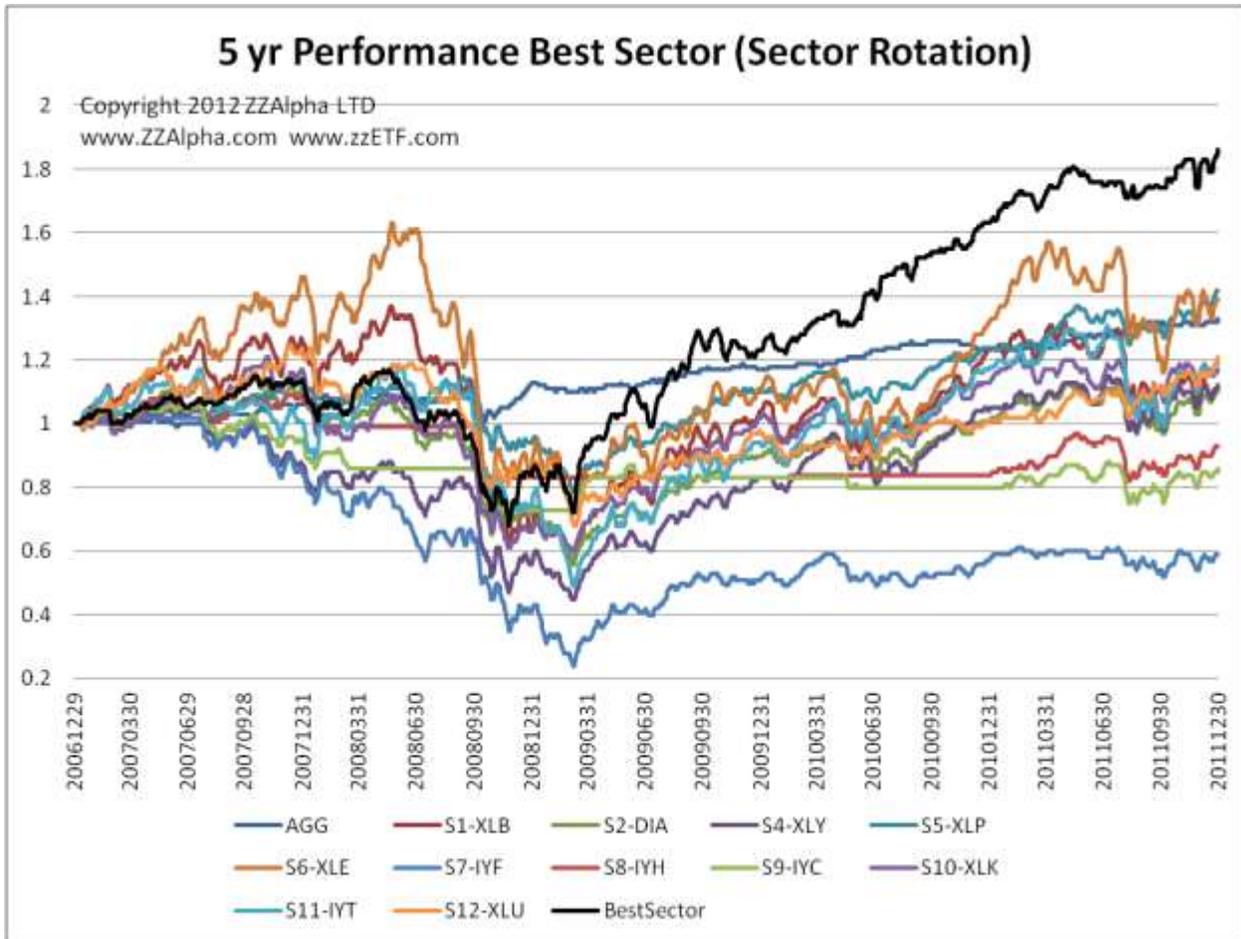
For "Best Sector" the choice was among:⁶

1. Sector 1 - Basic Materials SPDR Materials (NYSE ticker XLB)
2. Sector 2 - Capital Goods SPDR Dow Jones Industrial Average ETF (NYSE ticker DIA)
3. Sector 4 - Consumer Cyclical SPDR Consumer Discretionary (NYSE ticker XLY)
4. Sector 5 - Consumer Non-Cyclical SPDR Consumer Staples Select (NYSE ticker XLP)
5. Sector 6 - Energy SPDR Energy Select (NYSE ticker XLE)
6. Sector 7 - Financial iShares US Financial Sector (NYSE ticker IYF)
7. Sector 8 - Health Care iShares US Healthcare (NYSE ticker IYH)
8. Sector 9 - Services iShares US Consumer Services (NYSE ticker IYC)
9. Sector 10 - Technology SPDR Technology (NYSE ticker XLK)
10. Sector 11 - Transportation- iShares Dow Jones Transportation (NYSE ticker IYT)
11. Sector 12 - Utilities SPDR Utilities Select ETF (NYSE ticker XLU)
12. Bonds - iShares Barclays Aggregate Bond ETF (NYSE ticker AGG).

As the performance graph below shows, the 13.1% annualized return and maximum 42% drawdown beat the strategies of staying fully invested in an S&P 500 stocks index (SPY).

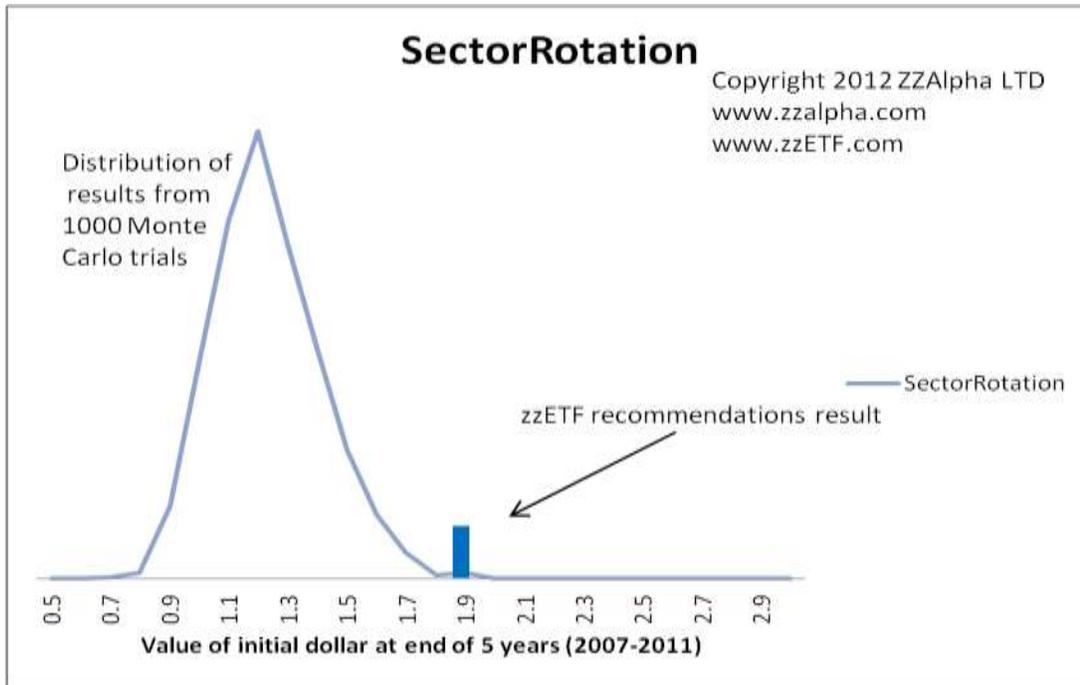
We have also evaluated "Best Sector" recommendations for use in a hedge portfolio using a weighting of 2:1 long to short. The annualized return for the hedge is 9.7% with a drawdown of 16%.

⁶ Conglomerates sector is omitted because the sector contains few instances.



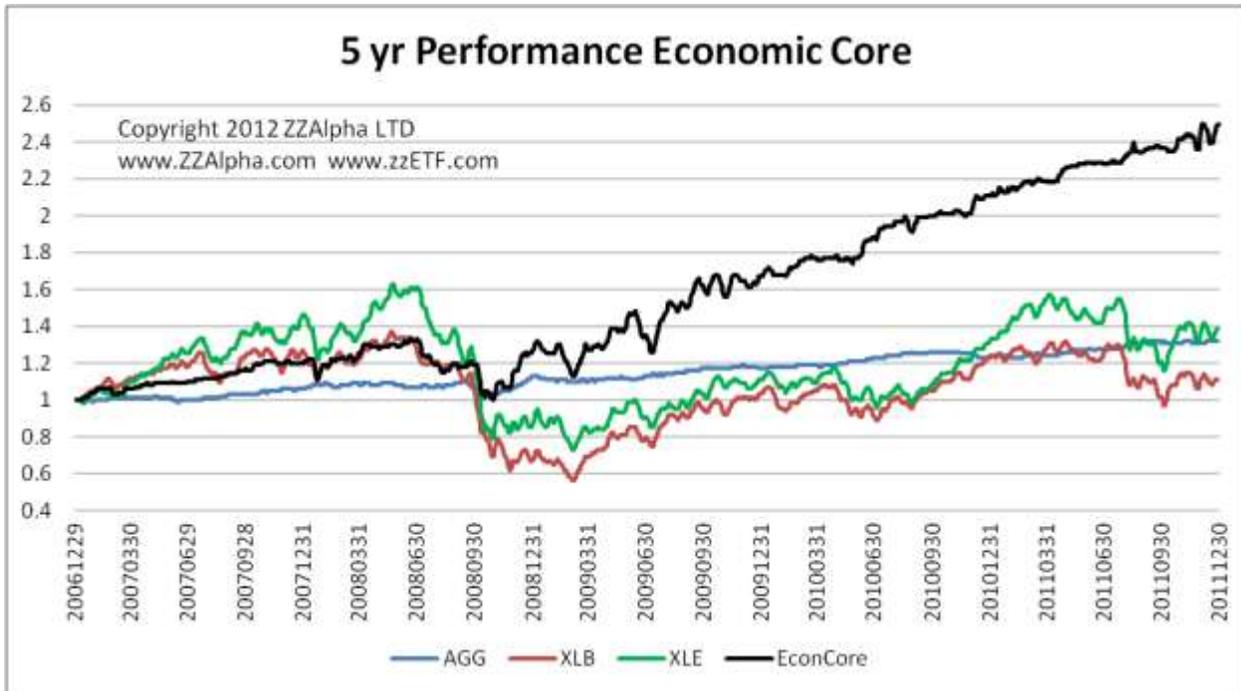
The black line in the graph indicates the cumulative value of the ZZAlpha® recommendations for switching among sectors. During the early part of the study period a few sectors consistently beat "Best Sector Rotation" and during the 2008 crash bond investments would have been more successful.

Statistical confidence that the annualized return of 13.1% is not luck exceeds 99.7%. The graph of the distribution of Monte Carlo trials below compares what luck ("throwing darts") would produce against the result of timing using the ZZAlpha® recommendations.



Performance and Risk Profile - "Economic Core"

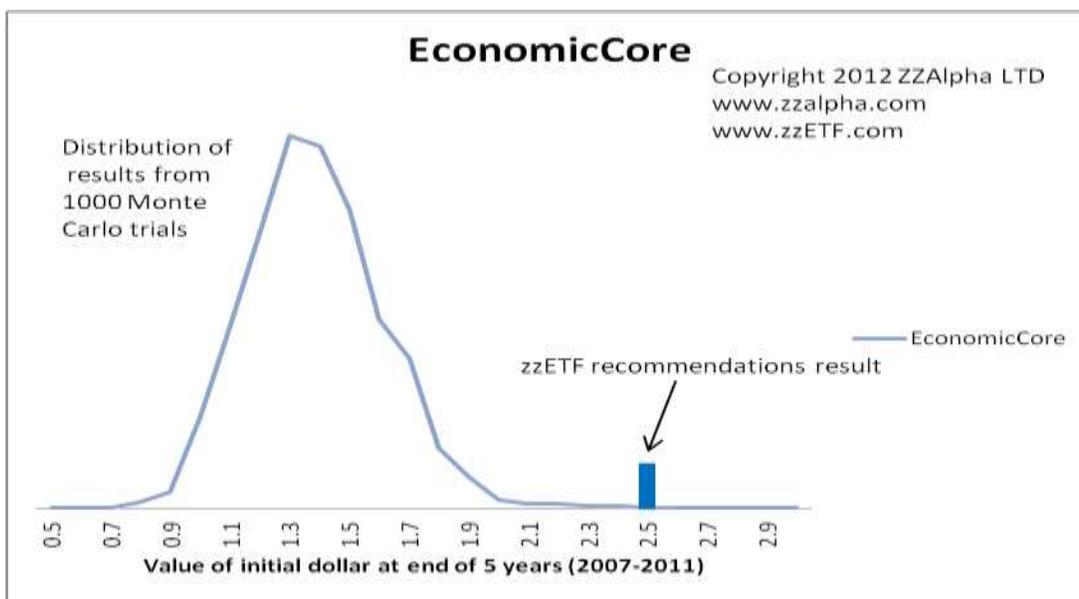
For "Economic Core" the choice was among the SPDR Materials Select (NYSE ticker XLB), the SPDR Energy Select (NYSE ticker XLE), and the iShares Barclays Aggregate Bond ETF (NYSE ticker AGG). As the performance graph below shows, the 20.3% annualized return and maximum 25% drawdown beat the strategies of staying fully invested in the Materials SPDR or of staying fully invested in the Energy SPDR.



The black line in the graph indicates the cumulative value of the ZZAlpha® recommendations for switching among materials, energy and a defensive out-of-market bond holding. The Economic Core recommendations underperformed XLB and XLE until the 2008 crash.

We have also evaluated "Economic Core" recommendations for use in a hedge portfolio using a weighting of 2:1 long to short. The annualized return for the hedge is 14.7% with a drawdown of 11%.

Statistical confidence that the annualized return of 20.3% is not luck exceeds 99.99%. The graph of the distribution of Monte Carlo trials below compares what luck ("throwing darts") would produce against the result of timing using the ZZAlpha® recommendations.



Conclusion

The evidence described here indicates that market timing can be effective to increase profits in four key dimensions of stock investing and an economic core group. The predicate to market timing is accurate daily recommendations. The ZZAlpha[®] machine learning technique consistently provides those recommendations for ETFs.⁷

The evidence described here also counters the efficient market hypothesis (EMH) that one cannot forecast the market to obtain excess profits and the assertion that market timing is ineffectual and more risky than buy-and-hold.

About ZZAlpha LTD. - We do not buy or sell stocks to investors. We are unaffiliated and receive no compensation from anyone based on which stock we recommend. We do not provide individualized investment advice. We handle no client funds.

Our sole business is delivering our daily recommendations of stocks and ETFs to professional and knowledgeable investors. All recommendations are created by our objective machine learning technique.

REMINDER

PAST PERFORMANCE does NOT indicate the probability of similar performance in future market conditions. Investment in equities involves SUBSTANTIAL RISK and has the potential for partial or complete LOSS of funds invested.

FAQ from the www.zzalpha.com site:

What is "*machine learning*?" Machine learning (also called *artificial intelligence*) is a set of computational techniques to make faster, more accurate estimates about how best to respond to new events, given what has happened (generally) in the past. The earliest of these techniques in the 1950's were rule-based expert systems ("RBES") of the sort still used in typical stock-screen systems today. RBES have been largely discarded in the machine learning community because they have been found to be "brittle" - failing to handle unexpected situations well. Today's better techniques range widely among: automata systems, Bayesian beliefs, boosting, control and operations theory, clustering methods, constraint relaxation, consensus, convex optimization, distance based associations, decision trees, ensembles, fuzzy logic, genetic algorithms, grammars, graph algorithms, neural nets, optimal search, object-pattern matching, forward-backward planning, robotic response-intention, support vector machines, structured meta-knowledge, vector quantization, and traditional methods derived from principal/independent components, signal processing filters, and statistics of multi-variate random variables. Machine learning is foundational for Google, Facebook, cell-phone communications, voice recognition, commercial auto-pilots and much of the world's advanced medical research, defense and intelligence activities.

⁷ We discuss historically higher return recommendations of individual stocks in a variety of liquidity, index, capitalization, and sector market segments in "ZZAlpha Portfolios: Their Performance, Risk and Usability - White Paper - June 21, 2011."