Momentum Strategies to Increase Return and Reduce Risk.

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This is a working document. It likely contains errors and misinterpretations.

Comments welcomed to peter@lingane.com

Introduction

This report compares the historical performance of the Dual Momentum, FundX and SectorSurfer® momentum strategies. These strategies seek to invest in the stocks or stock funds which are growing in value most rapidly. For a lighthearted introduction to momentum investing, I suggest "Why Newton was wrong[1]." For more information, I suggest Antonacci's book[2] and other references[3].

Let me begin with an analogy. Imagine that you are designing a self driving automobile and that you want the car to perform safely on streets with a maximum speed of 45 mph and on freeways with a maximum speed of 65 mph. One approach would be to set the maximum speed at 45 mph in both environments. The disadvantage of this approach is that it takes longer to get where you are going when the automobile is operating on the freeway. A second approach would be to use an algorithm to determine whether the car is on a street or on a freeway and to set the maximum speed accordingly.

The first approach is akin to including sufficient bonds in the portfolio so that the portfolio safely navigates market downturns. The disadvantage of this approach is that it takes longer to amass wealth because the bond allocation reduces returns in bull markets. The second approach is uses an algorithm to determine whether the portfolio should be bond-heavy because the market is in turmoil or whether it is smooth driving and bonds are not needed.

The second approach is called "market timing." The "timing" algorithm decides whether it is better to own stocks or bonds in the current market environment.

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[1] *The Economist,* January 8, 2011, www.economist.com/node/17848665.

[2] Gary Antonacci, *Dual Momentum Investing*, McGraw Hill, 2015.

"Annotated Bibliography of Selected Momentum Research Papers," www.aqrindex.com.

[3] "Fact, Fiction and Momentum Investing" by Clifford S. Asness, Andrea Frazzini, Ronem Israel and Tobias J. Moskowitz, papers.ssrn.com/sol3/papers.cfm?abstract_id=2435323.

"Relative Strength and Portfolio Management" by John Lewis, Dorsey Wright & Associates, 2012. Available at papers.ssrn.com/sol3/papers.cfm?abstract_id=1998935.

Momentum strategies also involve an allocation decision. Which stocks or stock funds are likely to outperform?

Dual Momentum addresses the timing and allocation decisions by comparing returns over the trailing 12-months[4].

- Absolute Momentum decides between stocks and bonds based on whether the 12-month total return[5] of the S&P 500 Composite exceeds the 12-month total return of T-bills.
- Relative Momentum decides between US and foreign stock funds based on relative 12-month total returns.

The *NoLoad FundX Newsletter* has been published since 1976[6]. The newsletter ranks funds for inclusion in the portfolio based on the several factors including the average of the fund's 1-, 3-, 6- and 12-month returns. The NoLoad FundX strategy does not include an explicit timing decision between stocks and bonds.

The FundX *timing* algorithm used here applies the 1-, 3-, 6- and 12-month algorithm to the S&P 500 Composite[7]. To avoid confusion, this timing algorithm will be called the "1-3-6-12 algorithm." When the average return of the S&P Composite is positive, the recommendation is to own stocks. When the average return is negative, the recommendation is to own bonds.

SectorSurfer® offers three timing algorithms. The original algorithm, StormGuard® standard, is the double exponential moving average (DEMA) of the daily returns of the S&P 500 Composite *without dividends* plus a shift.

SectorSurfer® allocates to the fund with the highest trend. The SectorSurfer® allocation algorithm measures the trend of a fund as the double exponential moving average of the daily returns of that fund.

The value of a DEMA depends on a parameter which Scott Juds, the creator of SectorSurfer®, calls the "trend constant." StormGuard® standard uses a trend constant of 50 days[8]. The trend constants used in the DEMA calculations are determined through an optimization process.

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[4] Antonacci, *op. cit*., describes his Dual Momentum strategy on p. 98. Antonacci describes two variations of his strategy but he does not use the variations in the preparation of his charts and tables.

[5] Unless otherwise stated, all returns and prices assume the reinvestment of dividends.

[6] FundX Investment Group, www.fundx.com.

[7] Table C-3 in Appendix C illustrates the performance of this indicator with various risk indices.

[8] The factor used in the SectorSurfer® DEMA calculations is the reciprocal of the trend constant. The more usual definition is that the DEMA factor equals 2/(1+trend constant).

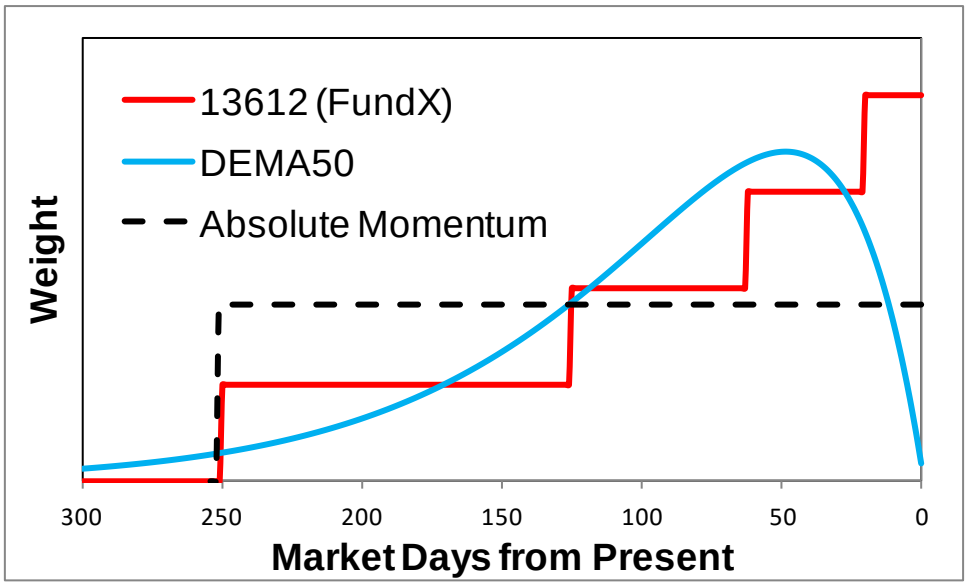
The original definition of StormGuard® standard was 22 * DEMA50 + 0.006. The 22 factor adjusts the daily DEMA to a monthly DEMA assuming 22 market days per month.

The definition has been revised to 21 * DEMA50 plus 0.0055.

DEMA algorithms are discussed in Appendix A.

The Absolute Momentum, 1-3-6-12 and StormGuard® timing algorithms are all based on the price changes of the S&P 500 Composite but the algorithms emphasize different time regions[9].

Chart 1. Timing Algorithms Emphasize Different Portions of the Data History.
Source: theory.xlsx.



Comment. "Source: theory.xls" and similar references in the charts and tables cite internal documents. References to external sources appear in footnotes.

Absolute Momentum does not distinguish among price changes over the past twelve months. Absolute Momentum algorithm puts the same emphasis on price changes last month and eleven months ago. This is illustrated by the dashed line in the chart. Absolute Momentum places more emphasis than the other algorithms on price changes more than six months ago and less emphasis on price changes during the most recent six months.

SectorSurfer® does not report the value of the shift to sufficient precision to allow a determination of whether the code was actually changed to reflect the new definition.

For equivalence between the original and revised definitions, the revised shift should be 21*0.0060/22 = 0.00573 rather than 0.00550. The difference is not considered material.

The value of the shift is portfolio dependent, ranging from a low of about 0.003 to a high of about 0.008. The value of the shift for the SIMPLE portfolio is 0.006. In this report, we define StormGuard® standard as 22 * DEMA50 plus 0.006 for all portfolios.

[9] For a more general approach reaching a similar conclusion with respect to simple moving averages, exponential moving averages and simple moving average crossovers, see "Market Timing with Moving Averages: Anatomy and Performance of Trading Rules," Valeriy Zakamulin, SSRN-id2585056. Revised May 29, 2016.

The FundX timing algorithm places more emphasis on recent price changes than do the other algorithms. The FundX timing algorithm is expected to be more responsive to recent market performance than the other algorithms.

StormGuard® standard places the least emphasis on what happened over the past month and the greatest emphasis on what happened from one to six months ago. Price changes more than 300 days ago have a measurable effect on the value of the StormGuard® timing algorithm.

Price Data

The price data used in this report are from the following sources[10].

Bonds	Spliced VBMFX: Intermediate Term Government Bonds (SBBI) before September 1988 and the mutual fund VBMFX thereafter. The VBMFX benchmark is the Barclays US Aggregate Bond Index.
T-bills	Spliced BIL: 13-week T-bills (^IRX) to June 2007 and BIL thereafter. BIL is an exchange traded fund which uses the Barclays 1-3 Month U.S. Treasury Bill Index as its benchmark.
Large Cap US Stocks	Spliced VFINX: S&P Composite (SBBI) before September 1988 and the mutual fund VFINX thereafter. VFINX uses the S&P Composite with dividends as its benchmark.
Foreign Stocks	Spliced HAINX: MSCI-EAFE (net of foreign tax) before September 1988 and the mutual fund HAINX thereafter. HAINX is an actively managed fund. The mutual fund VGTSX is more representative of foreign stocks

[10] SBBI refers to Ibbotson's "Stocks, Bonds, Bills and Inflation Yearbook" published by Morningstar, Inc.

SBBI attributes the large company stock total returns from 1977 - August 1997 to the American National Bank and Trust Company of Chicago and to Standard and Poor's thereafter.

Daily data for the S&P 500 Composite without dividends are from Yahoo.com (^GSPX) and FastTrack.net (SP-CP).
Monthly data for the MSCI-EAFE index are from msci.com. This index excludes the US, Canada and emerging markets.

Monthly data for the FTSE NAREIT All REITs Index are from reit.com. This is a market capitalization-weighted index that includes all tax-qualified real estate investment trusts (REITs) that are listed on the New York Stock Exchange, the American Stock Exchange or the NASDAQ National Market List.

^IRX is the bank discount rate of 91-day Treasury bills. The market day return of a T-bill maturing in n days is $[1 + \{ R_{bd} * n / 36{,}000 / (1- R_{bd} * n / 36{,}000)\}] ^ (365 / (252 * n) – 1$. See Bodie, Kane and Marcus, 4th Edition, pp. 27-29. The market day return was approximated as (1+^IRX/100)^(1/252).

Daily ^IRX data are from Yahoo.com.

Daily data for stocks, mutual funds, ETFs and indices after August 1988 are from FastTrack.net.

Monthly data for the equal weighted Wilshire 5000 index are from wilshire.com.

Monthly returns for the AAII Shadow Stock portfolio were supplied by Wayne Thorpe in January 2017.

	because it uses the FTSE World exUS Index as its benchmark. Unfortunately, VGTSX has no data history before May 1996.
Real Estate	Spliced FRESX: FTSE NAREIT US Real Estate "ALL REITS" Index before September 1988 and the mutual fund FRESX thereafter. FRESX is an actively managed fund which uses the MSCI US REIT Index as its benchmark.

Determining the Timing and Allocation Signals

The signals for the Absolute Momentum and 1-3-6-12 momentum algorithms can be easily calculated using dividend adjusted prices from a free source like Yahoo.com.

If you are seriously into momentum strategies, it is worth the effort to code the calculations in a spreadsheet and it is worth considering the purchase of a data license. There are often problems in the automated transmission of fund dividends. Investors FastTrack, my data provider, corrected more than fifteen hundred dividends in the first week of January 2017. Free sources may correct fewer errors

The data used here were downloaded from Yahoo.com on January 15, 2017. I mention the date because the dividend adjusted prices could be different if downloaded today because the adjusted prices change every time a dividend is posted.

The changes are of no import because returns are determined from price ratios and price ratios do not change if the dividend adjustments are made properly.

The Absolute Momentum timing signal at the end of August, 2015 compares the 12-month return of US stocks to the 12-month return of T-bills. The investor's first decision is to decide which funds to use as surrogates for "US stocks" and for "T-bills." I'm using the Vanguard Index 500 fund (VFINX) as the surrogate for US stocks and BIL, an exchange traded fund which tracks the Barclays 1-3 Month U.S. Treasury Bill Index, as the surrogate for T-bills.

You may prefer a broader stock fund or a different T-bill index.

The 12-month return is the ratio of the dividend adjusted price today divided by the dividend adjusted price 12 months ago, minus 1.

	VFINX	VTSMX	BIL
August 29, 2014	176.45	48.25	45.73
August 31, 2015	177.07	48.33	45.68
12-month Return	0.004	0.002	-0.001

Because the 12-month return for US stocks is larger than the return for T-bills, the Absolute Momentum signal is to own stocks during September 2015.

It does not matter in this instance whether US stocks are represented by VFINX or by VTSMX, which is a broader index representing the total US market.

The 1-3-6-12 timing signal requires five dividend adjusted prices. The signal is to own stocks if the average of the 1-, 3-, 6- and 12-month returns is positive.

We do not need to calculate the average of the returns. It is sufficient to calculate the sum of the 1-, 3-, 6- and 12-month price ratios minus 4.

	VFINX	VTSMX
August 29, 2014	176.45	48.25
February 27, 2015	187.12	51.08
May 29, 2015	188.26	51.47
July 31, 2015	188.46	51.41
August 31, 2015	177.07	48.33
Sum of Price Ratios - 4	-0.170	-0.173

The sum of the price ratios minus, and hence the average of the returns, is negative. The 1-3-6-12 signal is to hold bonds during September 2015.

The choice of US stock surrogate, VFINX or VTSMX, makes no difference in this instance.

While the calculation of the StormGuard® standard timing signal is not difficult[11], the calculation does require three or four hundred daily returns and a spreadsheet.

Fortunately, there is no need to calculate this signal. Juds provides the signal for free, every day, at www.sumgrowth.com/InfoPages/Market-Sentiment.aspx.

The value of the StormGuard® standard signal at the end of August 2015 is positive. The recommendation is to own stocks during the following month.

The Relative Momentum allocation algorithm compares the trailing 12-month returns of US and foreign stocks using the Harbor International fund (HAINX) to represent the performance of foreign stocks. You may prefer to use another mutual fund or ETF as your surrogate for foreign stocks. Two possibilities, VGTSX and VEU, are shown in the following table.

	VFINX	HAINX	VGTSX	VEU
August 29, 2014	176.45	65.82	16.18	48.48
August 31, 2015	177.07	59.87	14.27	42.77
12-month Return	0.004	-0.090	-0.118	-0.118

[11] The DEMA calculation is illustrated at www.lingane.com/sectorsurfer/discussion.pdf.

Since the 12-month return for US stocks is larger than the 12-month return for foreign stocks, the Relative Momentum allocation algorithm recommends holding US stocks during September 2015.

The other foreign stock surrogates lead to the same allocation decision in this instance.

The FundX allocation algorithm[12] compares the average of the 1-, 3-, 6- and 12-month returns of US stocks to the average of the 1-, 3-, 6- and 12-month returns of foreign stocks. We have already calculated the average for US stocks.. All we need do now is repeat the calculation for foreign stocks.

	VFINX	HAINX	VGTSX	VEU
August 29, 2014		65.82	16.18	48.48
February 27, 2015		64.66	15.56	46.81
May 29, 2015		67.25	15.94	47.84
July 31, 2015		65.09	15.39	46.36
August 31, 2015		59.87	14.27	42.77
Sum of Price Ratios - 4	-0.170	-0.354	-0.378	-0.388

Since the sum of the ratios minus 4 for US stocks is less negative than the average for foreign stocks, the average for US stocks will be less negative than the average for foreign stocks. The FundX allocation algorithm recommends holding US stocks during September 2015.

The other foreign stock surrogates lead to the same allocation decision in this instance.

SectorSurfer® measures the trend of each fund as the double exponential moving average of that fund's daily returns plus a "hysteresis" for the lead fund. Hysteresis is meant to reduce whipsaws and is usually without effect in my experience[13]. Hysteresis is neglected here.

Calculating the trends means a spreadsheet with hundreds of daily prices for each fund in the portfolio.

[12] Jay Matsuda of the FundX Investment Group e-mailed me on September 26, 2016 that the FundX score is the average of the average monthly returns over 1-, 3-, 6- and 12-months. If a fund were appreciating at a uniform 1% a month, the average of the average monthly returns would be

(1% + 1% + 1% + 1%) / 4 = 1% per month plus any bonus points.

If there were 4 bonus points because the fund was among the top 15 funds in each of the four intervals, the FundX score would be 1 + 4 = 5.

As implemented here, the FundX indicator would be the average of 1.01^12 + 1.01^6 + 1.01^3 + 1.01 – 4 which equals 0.229/4 or 0.057. There are no bonus points.

[13] Hysteresis is further discussed at www.lingane.com/sectorsurfer/discussion.pdf, p. 15.

The bigger challenge is that SectorSurfer® determines the trend constant for the DEMA calculation through an optimization process. Investors may find the optimization process difficult to replicate.

The easiest way to acquire the DEMA trends for portfolios with twelve or fewer fund is to purchase a SectorSurfer® license.

Alternatively, an investor could develop software or the portfolio could be managed using Relative Momentum and Absolute Momentum alone.

Neglecting the SectorSurfer® allocation algorithm makes little difference for the SIMPLE portfolio of US and foreign stocks. However, DEMA allocation algorithms are beneficial for more complex portfolios.

Timing and allocation signals tend to change slowly over time. This means that it is usually possible to make allocation decisions during the last weekend of the month with trades executed on the month-end date.

Performance of the Timing Algorithms

I prefer to test algorithms over the longest possible timeframe. Data limit the testing of the StormGuard® standard timing algorithm to the post 1951 interval. The Absolute Momentum and FundX timing algorithms can be tested over even longer intervals.

Let's refresh our memories about simulating the performance of a timed portfolio.

We begin with the equity curves of stocks (spliced VFINX) and of an intermediate term, investment grade bond fund (spliced VBMFX). An equity curve is the value of a portfolio over time.

Our first goal is to calculate the equity curve of a blended portfolio containing 60% stocks and 40% bonds, rebalanced monthly. By convention, the beginning value of the equity curve equals one.

The value of the blended equity curve at the end of the first month is one times a factor. The factor is one plus the blended return over the first month. More generally, the value of the blended portfolio at the end of month i is the value of the blended portfolio at the end of the prior month times one plus the return of the blended portfolio over month i.

$$BlendedValue_i = BlendedValue_{i-1} * (1 + BlendedReturn_i)$$

The return of a portfolio containing two components, stocks and bonds in this instance, is the weighted sum of 1 plus the individual returns. If the portfolio contains 60% stocks and 40% bonds,

$$1 + BlendedReturn = 60\% (1 + Return_{stocks}) + 40\% (1 + Return_{bonds}).$$

The factor one plus the return over the month can be calculated as the value at the end of the month divided by the value at the end of the prior month. Thus our formula could be equally well written as

$$1 + BlendedReturn = 60\% Ratio_{stocks} + 40\% Ratio_{bonds}$$

where Ratio represents the ratios of the month-end values of stocks and bonds.

The equity curves for timed portfolios use the same formula. The difference is that the weights of stocks and bonds are not constant but are redetermined each month from the timing algorithm.

If the timing algorithm recommends owning 100% stocks in the following month, one plus the return of the blended portfolio over the following month would be $100\% Ratio_{stocks}$.

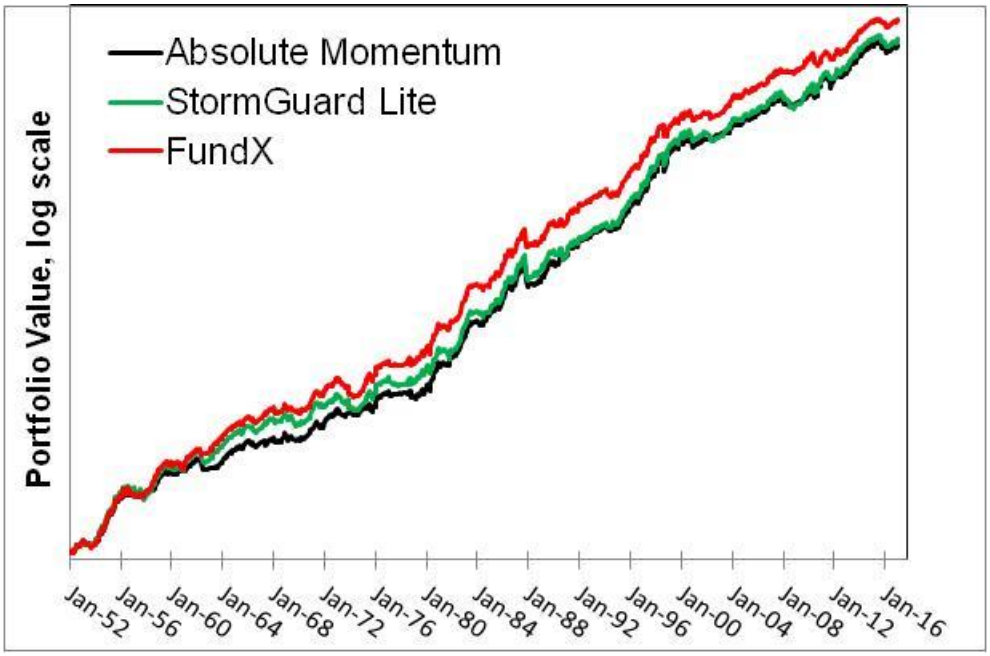
If the timing algorithm recommends owning 100% bonds in the following month, one plus the return of the blended portfolio over the following month would be $100\% Ratio_{bonds}$.

If the timing algorithm recommends owning two thirds stocks and one third bonds in the following month, one plus the return of the blended portfolio over the following month would be $67\% Ratio_{stocks} + 33\% Ratio_{bonds}$.

Chart 2 displays the values of three timed portfolios over time.

Each portfolio was managed by a different timing algorithm. The timing algorithms determine whether the portfolios should be invested in stocks (spliced VFINX) or bonds (spliced VBMFX). Commissions, other transaction costs and taxes were not considered.

Chart 2. Equity Curves for Timed Portfolios of US Stocks and Bonds from 1952.



Source: Monthly Allocations January2017.xlsb; workbook: Summary

There is variation in the performance of the timing algorithms. Compare, for example, the separation of the green and black curves over time.

The green and black curves separate between 1952 and the mid 1960s. The implication is that the portfolio managed by the black timer (Absolute Momentum) is underperforming relative to the portfolio managed by the green timer (StormGuard® Standard).

The two curves have drawn together by the year 2000, meaning that the black timer subsequently outperformed the green timer.

These variations are obscured by the long term statistics in Table 1. Each of these timers modestly improved the annualized return as compared to the return of the unmanaged portfolio. Each timer significantly reduced the maximum drawdown and improved the Sharpe ratio.

Table 1. Allocating between Bonds and the S&P 500 Composite, 1952 – 2016[14].

	CAGR	Sharpe	MaxDD
Absolute Momentum	11.48	65	30
StormGuard Standard	11.61	63	30
1-3-6-12	12.08	68	23
1:1:1 Composite	11.77	67	27
Unmanaged	10.70	48	51

Plots of relative strength can tease out the performance variations which are obscured by long term statistics. Relative strength in this context is the value of a portfolio managed by one investment strategy divided by to the value of the same portfolio managed by another strategy.

Chart 3 illustrates the relative strength of two intermediate bond funds. The red line is the equity curve for PIMCO Total Return fund (PTTRX) and the green line is the equity curve for Vanguard Total Bond Market (VBMFX). The PIMCO fund has the long term advantage.

The cyan colored curve is the relative strength, the value of PTTRX divided by the value of VBMFX. The relative strength curve demonstrates that the long term advantage of the PIMCO fund is the result of steady, year in year out performance improvement and not the result of exceptional results in a few years. An investor with a long time horizon would almost always have achieved more with PTTRX rather than VBMFX.

[14] "CAGR" is the compounded annual growth rate or annualized return. It is computed as the nth root of the ratio of the current value to the value n years ago, minus 1. The units are percent per year.

"Sharpe ratio" measures the annualized return per unit of return variation. It is computed as the square root of 12 times the average Adjusted Monthly Return divided by the standard deviation of the Adjusted Monthly Returns. Adjusted Monthly Return is the portfolio return less the return of Treasury Bills.

"Drawdown" is the percentage decline in portfolio value from a high (measured at month's end) to a trough (again measured at month's end.) "Maximum drawdown" is the largest decline over the interval.

Chart 3. Relative Strength Illustrating Steady Outperformance. PTTRX (red line) versus VBMFX (green line). The cyan colored curve is the relative strength.

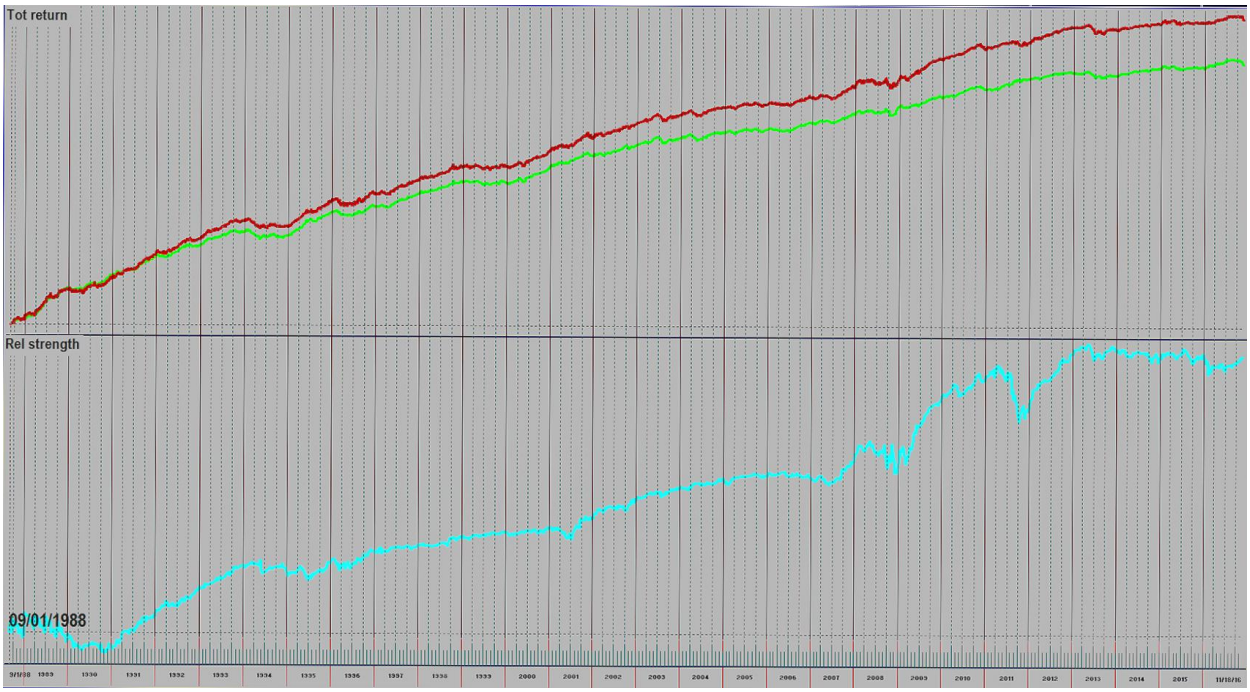


Chart 4 displays the relative strength of the 1-3-6-12 algorithm compared to StormGuard® standard. Relative strength in this instance is the value of the portfolio managed by the 1-3-6-12 algorithm divided by the value of the portfolio managed by the StormGuard® standard algorithm.

The initial value of relative strength is one because the ratios are normalized by the initial values of the managed portfolios. The 1-3-6-12 algorithm is outperforming when the relative strength is rising.

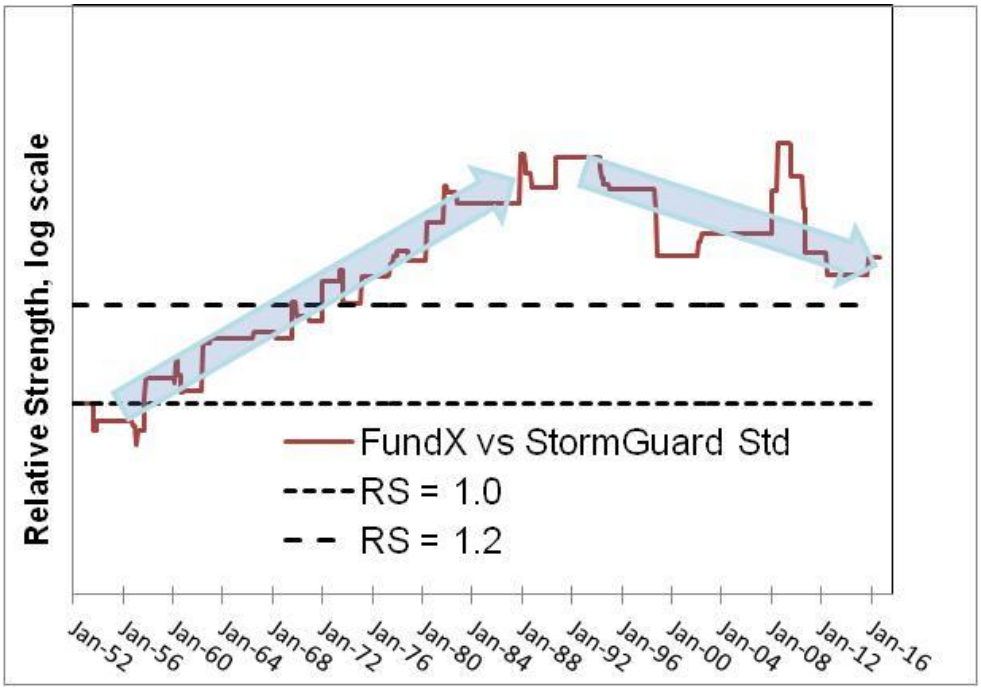
The blue arrows in Chart 4 are meant to suggest that, broadly speaking, the portfolio managed by the 1-3-6-12 algorithm gained relative to the portfolio managed by StormGuard® standard from 1952 until about 1992, a period of forty years. StormGuard® standard outperformed 1-3-6-12 after 1992.

The vertical movements are large. The horizontal dashed lines represent relative strengths of 1.0 and 1.2 which means that the vertical difference between the dashed lines represents a 20% change in relative values and twice the vertical difference represents a 40% change.

In 1992, the portfolio managed by the 1-3-6-12 algorithm was 158% of the value of the portfolio managed by StormGuard® standard. As of the end of 2016, the value of the portfolio managed by 1-3-6-12 had declined to 131% of the value of the StormGuard® portfolio.

The 1-3-6-12 algorithm was the better timer for the first forty years and StormGuard® standard has been the better timer for the most recent twenty-five years.

Chart 4. Relative Strength of FundX versus StormGuard® Standard.



Reference: Monthly Allocations January 2017.xlsb. Workbook "Summary"

Chart 5 displays the relative strength of a portfolio managed by StormGuard® standard as compared to a portfolio managed by Absolute Momentum. StormGuard® standard is outperforming when the relative strength is rising.

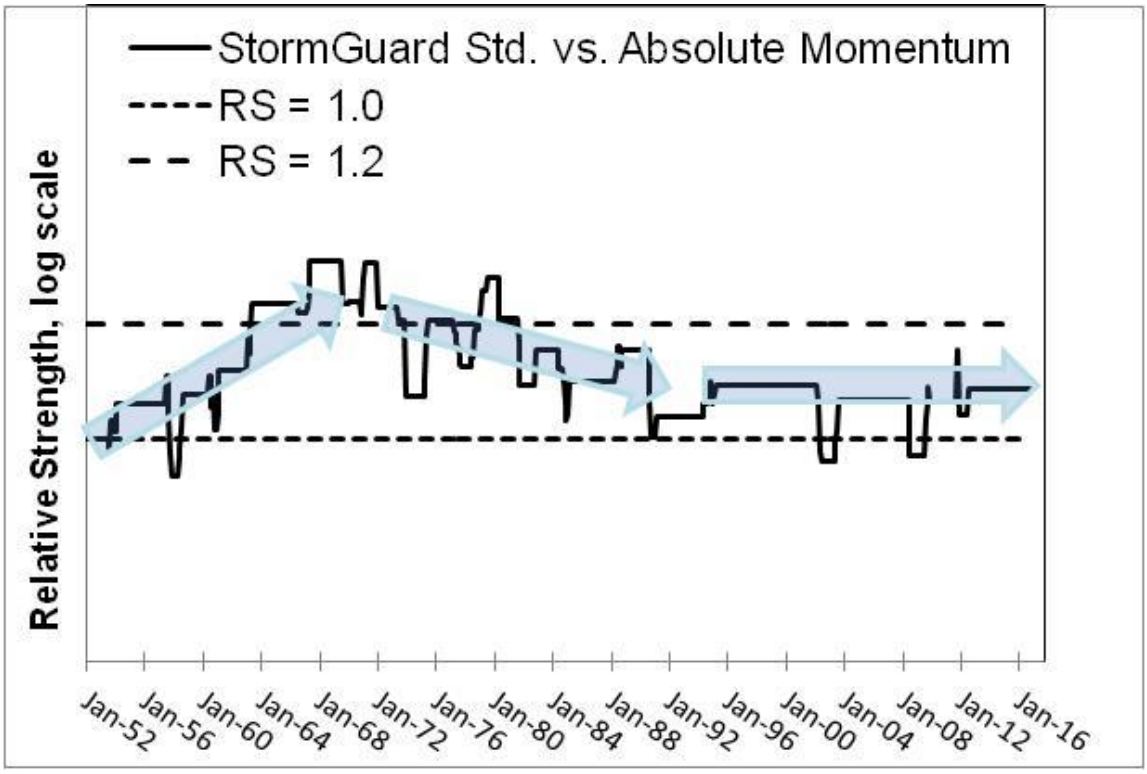
The value of the StormGuard® standard portfolio increases faster than the value of the Absolute Momentum portfolio for about twenty years. The performance then reverses for twenty years. There has been no evident trend with one algorithm being better than the other for the past twenty years.

These charts illustrate that no timer was in the ascendancy over the entire interval. An investor who relied on a one or another timer would have suffered decades of underperformance.

A composite timer reduces the risk of managing with an algorithm which is poorly suited to the current market conditions.

Choosing the timers for a composite is somewhat like constructing a portfolio in that the timers should compensate for each other's deficiencies. The 1-3-6-12 and StormGuard® timers, for example, have complimentary performance profiles over time and make a reasonable combination.

Chart 5. Relative Strength of StormGuard® versus Absolute Momentum.



Source: Monthly Allocations January 2017.xlsb, workgroup Summary

The ultimate goal is for the timer to consistently exceed the benchmark. Consistently exceeding the benchmark is more important than a high long term return which includes extended periods of underperformance.

The purpose of a benchmark is to provide a sense of how an investment strategy would have performed relative to another strategy. Ideally, the benchmark should reflect your investment strategy.

A benchmark of US stocks and bonds is the most complex portfolio that can be formulated from 1952. The following table lists the frequency with which the return of the timed portfolio exceeds the return of the benchmark.

Table 2 introduces an additional timer, the Delta Market Strength Indicator (MSI). We will see in a later section that the combination of the 1-3-6-12 and MSI timers is superior to the 1:1:1 Composite which is the combination of the 1-3-6-12, StormGuard® standard and Absolute Momentum timers.

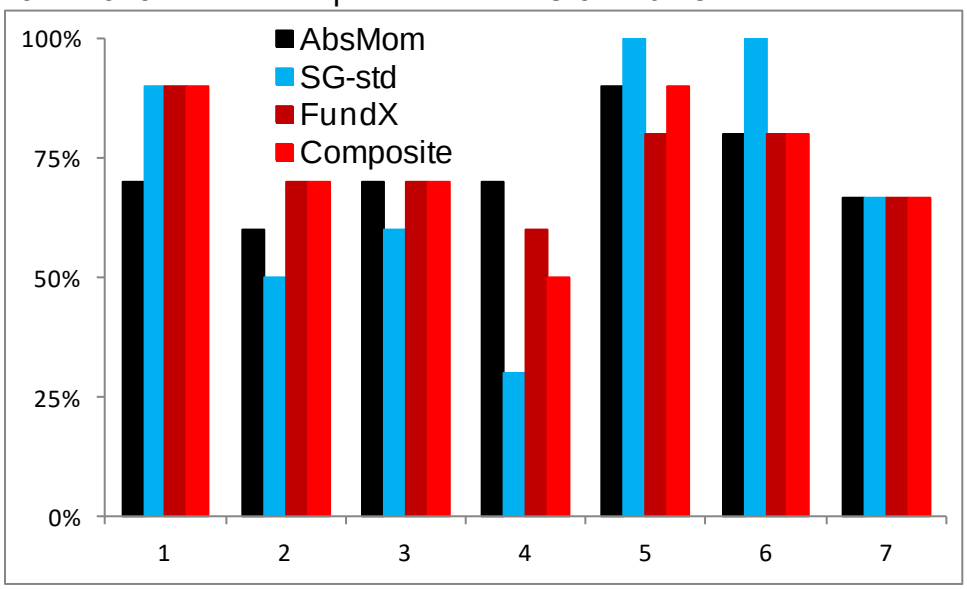
Table 2. Frequency With Which the Return of a Timed US Large Cap Portfolio Exceeds the Return of a Benchmark of 60% Stocks and 40% Bonds, 1952-2016.

	Absolute Momentum	StormGuard® Standard	1-3-6-12 Timing	1:1:1 Composite	1-3-6-12 & MSI[15]
1-year	65%	69%	66%	66%	72%
3-years	73%	73%	73%	73%	78%
5-years	70%	79%	86%	79%	89%

Source: Monthly Allocations January 2017.xlsb, workbook Frequency

The following chart illustrates how the frequency of outperformance, averaged over decade long intervals, changes over time.

Chart 6. Frequency With Which the 3-year Return of the Timed US Large Cap Stock Portfolio Matches or Exceeds the 3-year Return of the 60:40 Benchmark. The bars are averages over 1954-63, 1964-73, 1974-83, 1984-93, 1994-2003, 2004-2013 and 2014-2016. "FundX" represents the 1-3-6-12 timer.



Source: Monthly Allocations January 2017.xlsb. Workbook "Frequency"

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[15] Delta's Market Strength Indicator measures the price of about 3,500 stocks in an unidentified universe relative to the individual 75-day simple moving averages (www.deltawealthaccelerator.com). The indicator is bullish when 53% or more of the stocks are trading above their moving averages and bearish when the indicator is 47% or below. "Investor discretion is advised" when the value of the indicator lies between these limits. Historical values are available from June 2013.

The indicator can be computed daily. Weekly values are available at *Barron's* online and through a free subscription to the Delta Wealth Adviser weekly newsletter at deltawealthadviser.com.

Lingane, Maurer and Zmyslowski extended the indicator's beginning date to the end of January 1999 by measuring the daily fraction of stocks in the Russell 3000 universe with prices above their respective 75-day simple moving averages. The indicator value is the exponential moving average of the daily fractions (alpha is 0.1). Indicator values above 50% are bullish. There are two differences between Delta's month-end signals and the extended methodology over the 37 months from June 2013 through June 2016.

Source: Data&Timers 1952-2016.xlsb.

The performance differences among the algorithms are especially stark in the fourth interval (1984-1993).

The average frequencies over the past three years – interval 7 – are 67% which is below the 73-75% average for the prior sixty years.

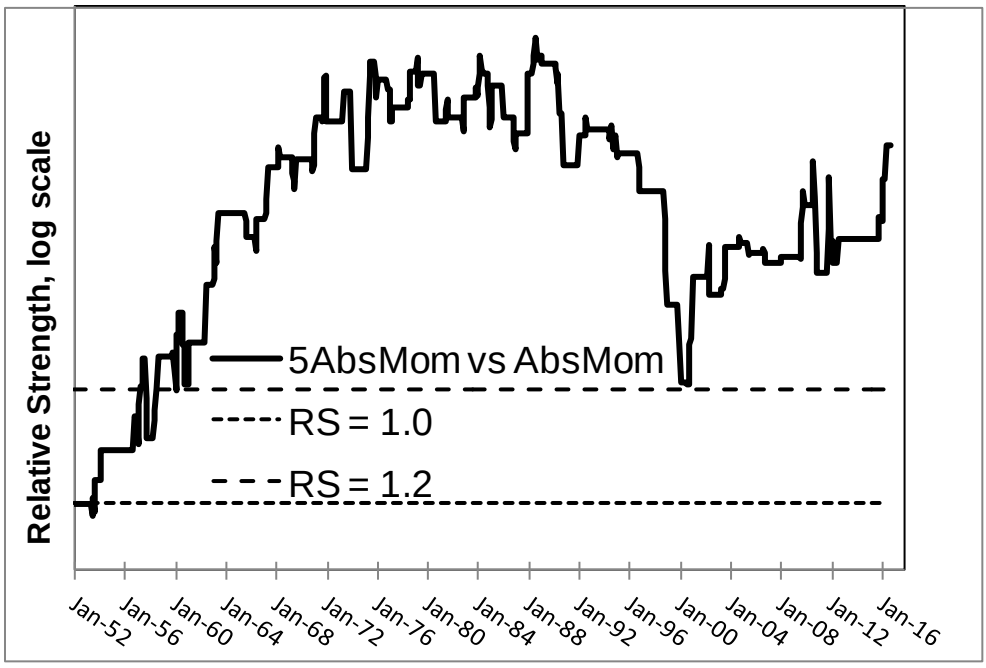
It is possible to enhance performance in the fourth decade using more complex timers and by decreasing the trend constant associated with StormGuard® standard. Many investors would find more complex timers difficult to use.

Long term statistics for these and other timing algorithms are in Table 3.

The Faber and Siegel timing algorithms are discussed in the next section. Additional combinations of timing algorithms are discussed in a later section.

Chart 7 examines the relative strength of a portfolio of large cap US stocks managed by Antonacci's 12-month Absolute Momentum and by Maurer's faster responding 5-month Absolute Momentum[16].

Chart 7. **Relative Strength of Large Cap US Stocks Managed Using 5AbsMom and AbsMom.** 5AbsMom is outperforming when the relative strength is rising.



Source: Monthly Allocations January 2017.xlsb, workbook Summary.

The plot of relative strength shows four distinct phases:

1. 5-month Absolute Momentum outperformed from 1952 to the mid 1970s;
2. 5-month and 12-month Absolute Momentum provided comparable results from the mid 1970s through the mid 1980s;

[16] Don Maurer, "An Approach to Testing Price Based Timers," Silicon Valley CIMI Group, March 3, 2016.

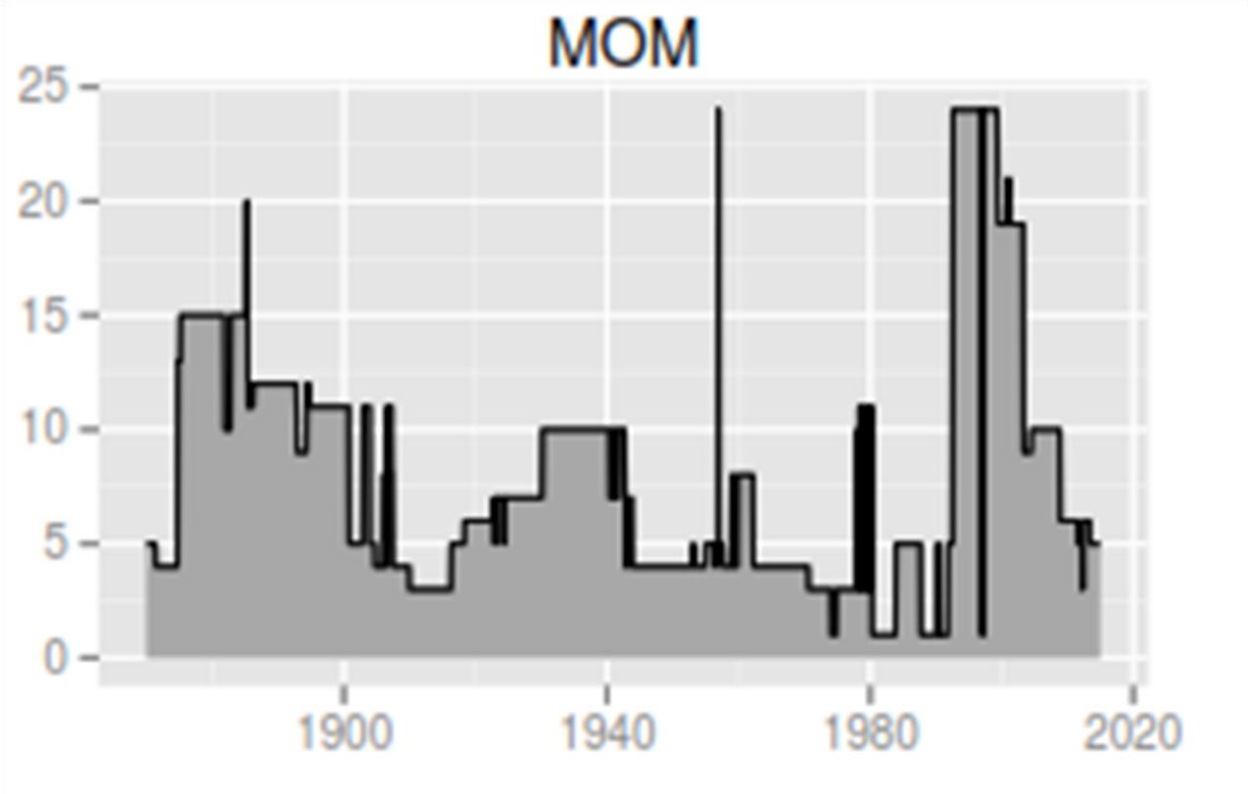
3. 12-month Absolute Momentum outperformed from the mid 1980s to about 2000; and,
4. 5-month Absolute Momentum has outperformed since about 2000.

Neither 5-month nor 12-month Absolute Momentum has been superior in all market conditions. The investor would have been better off using the 5-month Absolute Momentum in the 1952 – 1990 and post 2000 intervals and 12-month Absolute Momentum in the 1991 – 2000 interval.

Antonacci decided on a twelve month "formation period" based on the Sharpe ratios measured over the 1974 – 2012 interval. Chart 7 confirms that a 12 month lookback provides the larger return, and likely the higher Sharpe ratio, over this interval.

Zakamulin[17] shows that it is possible to identify the best lookback interval for Absolute Momentum by examining performance over rolling ten year intervals. Chart 8 shows considerable month-to-month variation but the general pattern is that a 4-month lookback was best from 1952-1995, 24 months from 1996-2003, 10 months 2004-2009 and 6 months 2010 – 2014.

Chart 8. Optimized Lookback Interval for Absolute Momentum, years. Zakamulin.



[17] Valeriy Zakamulin, "A Comprehensive Look at the Empirical Performance of Moving Average Trading Strategies," SSRN-id2677212, revision December 11, 2015.

The times in Chart 8 at which there is a change from one optimum lookback interval to another are offset by about five years as compared to Chart 7. This is a reasonable lag given that the measurement interval is ten years.

Zakamulin reports that the optimization interval could be reduced to as little as five years. A 5-year optimization interval should reduce the lag.

Zakamulin also measured the optimum lookback interval for the SMA and Golden Cross algorithms. The optimum lookback intervals for these algorithms also show considerable variation over time.

His conclusions are worth quoting at some length.

We discovered strong evidence that the stock market dynamics are changing over time. Specifically, our findings revealed that over the second half of our sample the stock market was less volatile, the stock prices grew with a rate that was more than double as much as that over the first half, and the ratio of the average Bull market length to the average Bear market length was almost double as much as that over the first half. We found evidence that over the total sample the moving average strategies outperformed the market. However, over the second half of our total sample, even though both halves were chosen to have exactly the same number of Bull and Bear market phases, we did not find statistically significant evidence of outperformance. Contrary to the common belief, our results indicated that there is no single optimal lookback period in each trading rule, as well as we found no support for the common belief that over-weighting the recent prices allows one to improve the performance of a market timing rule. Whereas we found some indications that over very long-term horizons the market timing strategy tends to outperform the market, over more realistic short- to medium-term horizons the market timing strategy is more likely to underperform the market than to outperform.

Thereby our findings cast doubts that market timing strategies can consistently beat the market. Therefore our findings are in sharp contrast with the findings reported in the majority of previous studies where the authors document that "market timing works". However, it is important to emphasize that our findings do not indicate that previous studies were implemented with some errors. In fact, we can easily reconcile our findings with prior studies. Already Zakamulin (2014) pointed to the following features of the market timing strategies: the outperformance delivered by market timing strategies is highly uneven over time; most of the outperformance is generated mainly over relatively few particular historical episodes; and, as the immediate consequence from these two features, the outcome of both in- and out-of-sample tests of profitability depends crucially on the choice of the historical sample period. If one chooses the sample period to be, for instance, either 1900-2010, 1970-2010, or 1990-2010, and simulates, for example, the [10-month SMA] strategy, then one comes to conclusion that market timing works. Yet strictly speaking, such a result tells us that a market timing strategy outperformed the market in some particular historical period in the past. The question of paramount importance is whether such a result represents a typical performance of the [10-month SMA] strategy, and whether the performance in this specific historical period can be used as a reliable estimate of the expected future performance.

Based on the findings revealed by our study, we can argue that the most relevant sample period for an empirical study on the profitability of trading rules is the whole post World War II period, as we found that prior to this period the stock market dynamics were significantly different. By starting the sample period from 1970, one excludes from the study a long period of 25 years where market timing strategies underperformed the market. Finally, by choosing a period that starts not long before the Dot-Com bubble crush and ends not long after the Global Financial Crisis, one captures the most successful period for market timing strategies where all of them delivered extraordinary good outperformance[18].

Concluding this paper, we would like to mention that the results of our empirical study, as the results of every empirical study, are, in principle, data-set specific and data-frequency specific. The data-frequency issue seems to be the least of these two concerns. In particular, Clare et al. (2013) find that there are no advantages in trading daily rather than monthly. That is, the performance of market timing rules virtually does not depend on the choice of the data frequency. In contrast, Zakamulin (2014) documents that the advantages of market timing rules depend on the choice of the underlying passive index. Specifically, the advantages of market timing are more apparent when the passive index is the S&P 500 and are less obvious when the passive index is the Dow Jones Industrial Average[19].

Table 3. Timing Large Cap US Stocks. When the month-end signal is bullish, the portfolio contains spliced VFINX during the following month. When the month-end signal is bearish, the portfolio contains spliced VBMFX during the following month.

1952 – 2016	**CAGR**	**Sharpe**	**MaxDD**	**Wins[20]**
US Large Caps, unmanaged	10.7	48	51	73
60:40 Benchmark	9.2	54	33	reference
Absolute Momentum	11.6	65	30	73
StormGuard® Standard	11.7	63	30	73
1-3-6-12 (FundX)	12.1	68	23	73
SPVOL (15%, 100%)[21]	10.9	55	37	76

[18] John Nicolas was fond of referring to this interval as the “golden age of momentum.”

[19] This observation is consistent with our own observations in Appendix C.

[20] “Wins” is the frequency, in percent, with which the 3-year return of the timed portfolio exceeds the 3-year return of the 60:40 benchmark.

[21] Limiting Risk Exposure with S&P Risk Control Indices, February 2012; S&P Indices: Index Mathematics Methodology, January 2012; and S&P Risk Control Indices: Parameters, 5 January 2012. These reports are available at spindices.com.

Russell Investments, Butler *et al*. and Zmyslowski have described similar methods. See Russell Volatility Control Index Series. Construction and Methodology," February 2012.

"Adaptive Asset Allocation: A Primer" by Adam Butler, Michael Phil brick, Rodrigo Gorilla and David Verdi, September 2013. papers.ssrn.com/sol3/papers.cfm?abstract_id=2328254.

DR*VOL[22]	11.9	67	23	71
10mSMA (Faber)	11.9	67	23	73
200dSMA, no tolerances	12.4	74	23	76
Golden Cross[23]	11.6	67	30	63
5 mo Absolute Momentum[24]	12.5	75	23	71
StormGuard® Std & SPVOL	11.3	61	27	76
StormGuard® Std & DR*VOL	11.8	66	26	73
AbsMom, SG std & 13612	11.8	67	27	73
5 AbsMom, SG std & 13612	12.1	71	25	73
SG std & 1-3-6-12	11.9	67	26	73
Absolute Momentum, 13612	11.9	68	26	75
Absolute Momentum. SG std	11.6	66	30	75
5AbsMom, SG std	12.1	71	26	75
5AbsMom, 1-3-6-12	12.4	73	23	76
1-3-6-12 and MSI	13.0	77	23	78

Source: Monthly Allocations January 2017.xlsb.

I will call the equally weighted composite of Absolute Momentum, FundX and StormGuard® standard timers the "Composite timer" or 1:1:1 Composite timer." The composite timer is generally used in the balance of this report because this composite is an improvement over the individual timers and it is easy to implement. To paraphrase an old proverb, don't disparage an improved timing algorithm simply because it is not a perfect timing algorithm.

Performance since the 2008 bear market suggests that it is desirable to modify this composite. See the section entitled **Recent Performance** later in this report.

Allan J. Zmyslowski, Vol1%SingleEquity.xlsm, AAII Silicon Valley CIMI Group, April 29, 2013.

[22] DEMA50 of the product of the daily return of ^GSPC times its daily volume, normalized by the DEMA50 of the daily volume. (The constant in the DEMA50 calculation equals 0.02 which is not the conventional definition.) The signal is bullish if the indicator is positive.

Gregory Morris describes algorithms of this type in his *The Complete Guide to Market Breadth Indicators: How to Analyze and Evaluate Market Direction and Strength*. The specific form of this algorithm was suggested by John Nicholas and Don Maurer in April 2016.

[23] Golden Cross signals occur when the 50-day SMA of the daily price of the risk index crosses the 200-day SMA of the daily price of the risk index. The signal is bearish if 50SMA is declining at the crossover and bullish if 50SMA is rising at the crossover.

[24] Don Maurer, "An Approach to Testing Price Based Timers," Silicon Valley CIMI Group, March 3, 2016. This timer compares the 5- month total return of US stocks to the 5-month total return of T-bills.

The Faber and Siegel Timing Algorithms

Mebane Faber[25] and Jeremy Siegel[26] have tested timing algorithms. Faber makes decisions based on a 10-month simple moving average (10mSMA) while Siegel makes decisions based on a 200-day simple moving average (200dSMA). Faber found "equity-like returns with bond-like volatility and drawdown" while Siegel concluded that timing reduces volatility but underperforms buy and hold.

Why do two timing systems produce such different results even though they average over similar time frames? The first reason is that is that Siegel makes timing decisions daily whereas Faber, and we, make decisions monthly.

The second reason is that the two timing systems calculate moving averages of different market indices. Faber measures the moving average of the S&P 500 Composite while Siegel measures the moving average of the thirty stocks in the Dow Jones Industrial Average.

The market index from which a timing algorithm is calculated is the "risk index," a term that I borrowed from the S&P lexicon. The risk index matters. The effects of the risk index are explored in Appendix C.

***** Proofed to this point *****

[25] Mebane Faber, Presentation to the San Francisco Chapter of AAII, Berkeley, CA, September 9, 2009; Mebane Faber, "A Quantitative Approach to Tactical Asset Allocation," *Journal of Wealth Management* (2006) as updated 2013. The latter article is available at MebaneFaber.com.

[26] Jeremy J. Siegel, *Stocks for the Long Run*, McGraw-Hill, 5th Edition, 2013, Chapter 20 and Table 20-1.

Level3 Portfolios

The "Level3" investor seeks out smaller stocks using fundamental and momentum analysis. The Level3 investor prefers equal weighting to capitalization weighting, prefers concentrated to diversified portfolios and holds no defensive securities before retirement[27].

Dr. Cloonan provides several examples of Level3 portfolios: equally weighted US stock indices, real estate, the higher performing AAII screens, the higher performing O'Shaughnessy portfolios[28] and the AAII Shadow Stock portfolio.

Statistics for Level3-type portfolios with history from 1990 or thereabout have been assembled in Table 4.

Table 4. Level3-type Portfolios. Returns for the Wilshire and Russell indices and for the French Small Cap Value Portfolio are overstated by about 0.4% a year because expenses have been neglected.

1990 – 2016	CAGR	Sharpe	MaxDD
Equal Weight Wilshire 5000	14.9	64	59
40% bonds	11.8	74	39
Absolute Momentum timing	14.2	76	29
StormGuard® standard timing	15.0	77	29
1-3-6-12 timing	15.5	81	29
1-3-6-12 and MSI timing	21.4	122	29
AbsMom, SG std, 1-3-6-12 timing	15.0	80	29
AbsMom, MSI and 1-3-6-12 timing	19.2	112	29
Wilshire 5000 Small Cap Value	11.9	59	55
40% bonds	9.9	69	35
Absolute Momentum timing	12.5	76	26
StormGuard® standard timing	12.4	73	30
1-3-6-12 timing	12.0	74	26
1-3-6-12 and MSI timing	16.4	111	26
AbsMom, SG std, 1-3-6-12 timing	12.4	77	26
Composite timing	15.3	104	26
Russell MidCap Value (RUM-J)	11.6	61	57
40% bonds	9.6	72	37
Absolute Momentum timing	12.6	85	21
StormGuard® standard timing	13.0	84	27
1-3-6-12 timing	12.4	84	23
1-3-6-12 and MSI timing	15.7	118	21
AbsMom, SG std, 1-3-6-12 timing	12.7	87	21
AbsMom, MSI and 1-3-6-12 timing	14.8	112	21

[27] *Investing at Level3*, James B. Cloonan, AAII, 2016.

[28] *What Works on Wall Street*, James P. O'Shaughnessy, McGraw-Hill, 2012.

Real Estate (FRESX)	11.1	50	71
40% bonds	9.5	59	48
Absolute Momentum timing	11.8	70	29
StormGuard® standard timing	12.9	73	37
1-3-6-12 timing	11.5	67	28
1-3-6-12 and MSI timing	14.0	87	23
AbsMom, SG std, 1-3-6-12 timing	12.1	73	32
AbsMom, MSI and 1-3-6-12 timing	13.4	86	22
Prudent Speculator[29]			
40% bonds			
Absolute Momentum timing			
StormGuard® standard timing			
1-3-6-12 timing			
1-3-6-12 and MSI timing			
AbsMom, SG std, 1-3-6-12 timing			
AbsMom, MSI and 1-3-6-12 timing			
Perfect timing			
AAII Shadow Stocks, 1993 - 2016[30]	16.0	76	63
40% bonds	12.2	86	42
Absolute Momentum timing	16.1	91	28
StormGuard® standard timing	16.8	93	28
1-3-6-12 timing	16.5	96	22
1-3-6-12 and MSI timing	23.0	144	16
AbsMom, SG std, 1-3-6-12 timing	16.5	96	26
AbsMom, MSI and 1-3-6-12 timing	20.7	129	16
Perfect timing	35.5	288	4
French Small Cap Value Portfolio	13.6	63	60
40% bonds	10.9	73	39
1-3-6-12 timing	14.1	80	27
1-3-6-12 and MSI timing	19.5	123	26
AbsMom, SG std, 1-3-6-12 timing	14.1	81	26
Benchmarks			
S&P 500® Composite	9.3	49	51
S&P 500® Dividend Aristocrats®	11.4	68	44

[29] Xxx kindly provided the monthly returns for the TPS portfolio from 1977.

[30] Wayne Thorp kindly provided the monthly returns. As Mr. Thorp explains "Actually, the Shadow Stock Portfolio started out as a "Beginner's Portfolio" by Dr. Cloonan that followed the basic tenets of the current Shadow Stock methodology. At the beginning of 2004, he made some additional changes to the portfolio management methodology and it became the Shadow Stock portfolio we are more familiar with today. The performance we report consists of the Beginner's Portfolio until the start of 2004." Source: Data Timers 1952-2016.xlsb, workbook AAII.

Wellington Fund™, 35% bonds	9.4	70	33
BNY Mellon[31], 40% bonds	8.2	62	33
Wellesley Income Fund, 65% bonds	8.6	90	19

The annualized returns are higher than the returns of the benchmarks and Level3-type portfolios are also more volatile. Volatility is evidenced by the modest Sharpe ratios and the large drawdowns.

No mutual fund or ETF tracks the Wilshire indices. IShares Russell Mid Cap Value ETF (ticker IWS) tracks the Russell MidCap Value index. The expense ratio of IWS is 0.25% and there are data from mid 2001.

The largest risk *when accumulating assets* is the risk of not having saved enough by retirement according to Dr. Cloonan. He is less concerned about volatility because the conventional approach to reducing the volatility – adding bonds as illustrated in Table 4 – tends to reduce the return. Anything that reduces the return increases the risk of not having enough at retirement.

Dr. Cloonan is correct that investors may have to accept higher volatility if they cannot save more, work longer or reduce spending in retirement.

That being said, an investor may retreat from equity investments if he loses half of his life savings in his first bear market. Such a retreat would increase the risk of not having enough at retirement.

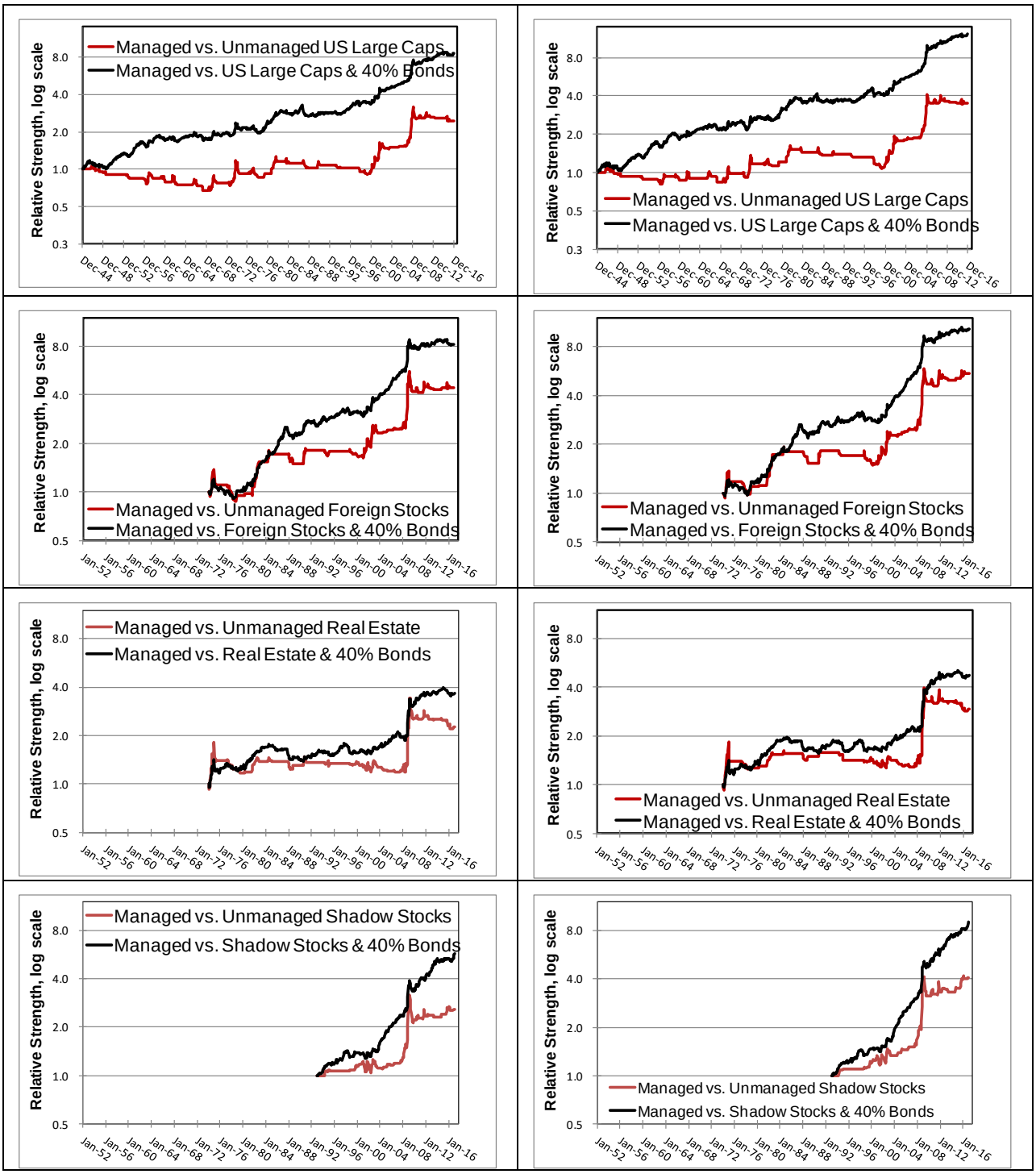
More investors might be attracted to high return investing if the portfolios were less volatile. As shown in Table 4, a variety of market timers and combinations of timers reduce the volatility and drawdown of Level3-type portfolios without reducing the return.

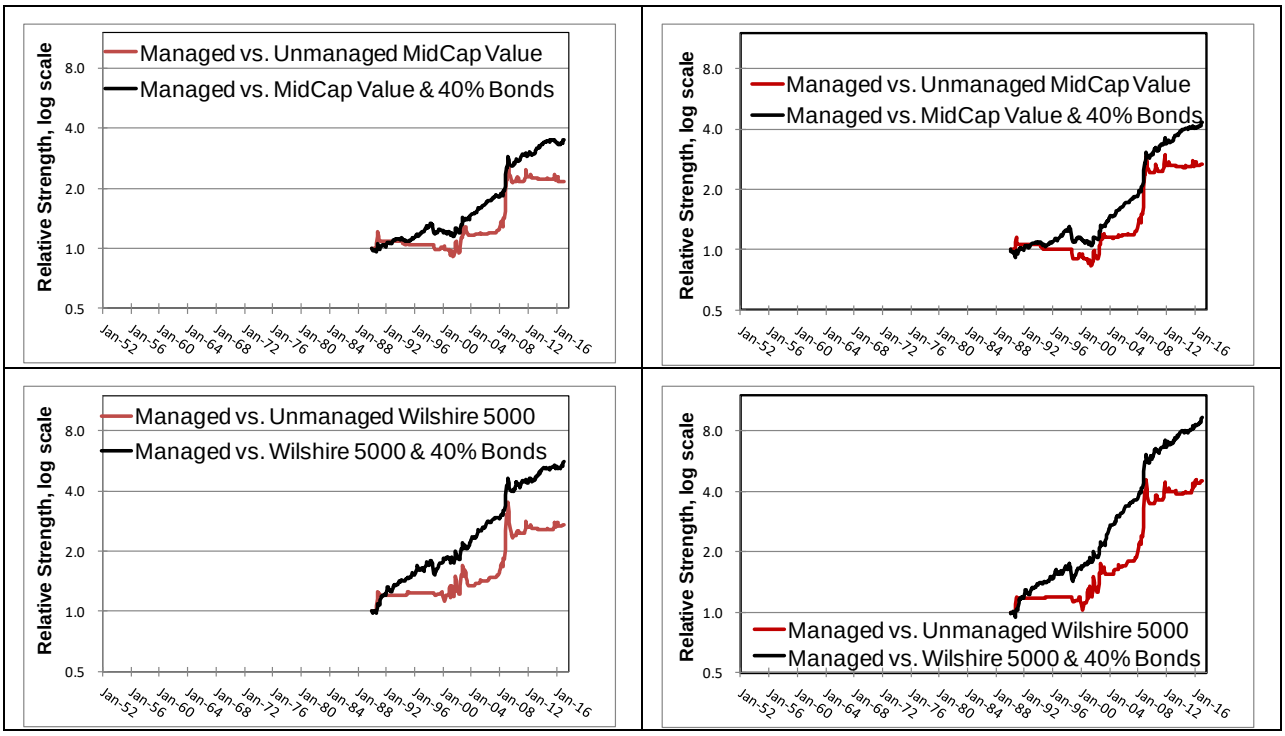
Relative strengths of managed (timed) Level3-type portfolios and of managed (timed) portfolios of US and foreign stocks are shown in Chart 9. The column on the left uses the Absolute Momentum, StormGuard® standard and 1-3-6-12 algorithms; the column on the right uses the 1-3-6-12 and MSI algorithms.

Chart 9. Relative Strengths with respect to the unmanaged portfolio and with respect to the unmanaged portfolio blended with 40% intermediate bonds (VBMFX).

Managed using equal weights of Absolute Momentum, 1-3-6-12 and MSI timers	Managed using equal weights of 1-3-6-12 and MSI timers

[31] BNY Mellon compares hundreds of corporate and public pension, foundation, endowment, Taft-Hartley and health care plans (their US Master Trust Universe) to a portfolio of 50% US stocks (Russell 3000, represented here by spliced VFINX), 10% foreign stocks (MSCI World exUS, represented here by spliced HAINX) and 40% bonds (US Aggregate Bond Index, represented here by spliced VBMFX).





Source: Monthly Allocations January2017.xlsb. Workbook: RS Charts

Let's start with US stocks in the top row of Chart 9. The red curves are the ratios (relative strength) of the value of the managed (timed) US stock portfolio to the value of the unmanaged S&P Composite with dividends.

The general pattern for US large cap stocks after 1945 is that timing provides a performance boast in major bear markets and tends to provide a performance drag in between major bear markets. Timing is like insurance; you are glad to have it when disaster strikes but you hate the premiums when you are disaster free.

Leverage is a solution adopted by some momentum strategies to offset the performance drag during bull markets. Leverage has been expensive in the past but it less so today using inverse funds. We do not use leverage in the examples in this report.

Using the combination of three timers, relative strength declined by twenty-five or thirty percent between 1945 and the early 1970s and by about eighteen percent between 1985 and 2000. Relative strength using two timers declined about fifteen percent and twenty-five percent during these intervals.

Relative strength using either timing combination rose slightly during the bull market between the dot-com cash and 2008. Relative strength using the combination of three timers declined slightly after 2009 while the relative strength using the combination of two timers was flat.

Timing has reduced the drawdown of US stock portfolios. Any increase in the return depends on the interval over which the return is measured. The following table assumes management (timing) by the 1-3-6-12 and MSI timers.

	Managed CAGR	Unmanaged CAGR	Change in CAGR
1945 - 1973	10.5	8.0	-2.5
1974 - 2016	14.3	10.8	3.5
1945 - 2016	11.7	10.7	1.0

Few invest exclusively in stocks; a portfolio of 60% stocks and 40% intermediate bonds is more realistic. The black curves illustrate the relative strength of the timed portfolio of US stocks with respect to a portfolio of 60% US stocks and 40% bonds. The black curves generally rise over time, meaning that both timed portfolios generally outperform the 60:40 portfolio.

The relative strength of the managed portfolio of foreign stocks (Chart 9, second row) would probably have exhibited a similar declines during the 1950s and 1960s if foreign stock data had existed during these intervals.

Either combination of timers reduces losses among foreign stocks during the bear markets and do not represent large drags on performance between bear markets. The two timer combination provides the larger long term return and higher Sharpe ratio.

The relative strength of the managed portfolio of US real estate (Chart 9, third row) differs from the performance of US and foreign stocks in that timing only produces a benefit during the 2008 bear market. At other times, the relative strengths of the timed portfolios slowly decline, meaning that timing is providing a drag on performance. The two timer combination again provides the larger long term return and higher Sharpe ratio.

The performance of the Shadow Stock portfolio (Chart 9, fourth row) is similar to real estate in that timing does not provide a boast during the dot-com bust. However, unlike real estate, neither combination of timing algorithms provides a drag on the Shadow Stock portfolio during bull markets.

Timing boasts the returns of the Equal Weight Wilshire 5000 index (Chart 9, fifth row) and of the Russell Mid Cap Value index (last row) during the dot-com and 2008 bear markets. Neither timer underperformed the untimed portfolio during other markets. The two timer combination provides the larger long term returns and higher Sharpe ratios.

Relative strength of the Prudent Speculator portfolio, when available.

The timer on the right, the combination of the 1-3-6-12 and MSI algorithms, is preferred because it better manages the portfolio of US large cap stocks before about 1972.

The SIMPLE Portfolio

Antonacci's Dual Momentum strategy has three elements. The first two elements are his timing and allocation algorithms. The third element is his portfolio: US stocks (represented here by spliced VFINX) or foreign stocks (spliced HAINX) depending on the recommendation of the allocation algorithm or bonds (spliced VBMFX) when recommended by the timing algorithm.

It is possible to backtest Antonacci's "SIMPLE" portfolio strategy from 1974. What Antonacci found is that the SIMPLE portfolio strategy adds hundreds of basis points to the annualized return and provides huge improvements in the Sharpe ratio and maximum drawdown.

Table 5. Momentum Management of the SIMPLE Portfolio. Trade on the month-end signal date. The BNY Mellon benchmark is 50% spliced VFINX, 10% spliced HAINX and 40% spliced VBMFX rebalanced monthly. Composite allocation is equal parts Relative Momentum, DEMA6 and FundX.

1974-2016 (43 years)	CAGR	Sharpe	MaxDD
BNY Mellon Benchmark			
No timing	10.0	56	33
Composite timing	11.1	80	14
Relative Momentum Allocation			
Absolute Momentum timing	16.8	92	21
StormGuard® standard timing	16.1	83	24
FundX timing	16.7	90	20
Composite timing	16.6	91	17
Monthly DEMA4 Allocation			
Absolute Momentum timing	16.5	90	21
StormGuard® standard timing	16.2	82	24
FundX timing	16.1	86	19
Composite timing	16.3	89	19
Monthly DEMA6 Allocation			
Absolute Momentum timing	16.8	91	26
StormGuard® standard timing	16.7	85	24
FundX timing	16.8	90	21
Composite timing	16.8	91	18
FundX Allocation			
Absolute Momentum timing	16.2	90	18
StormGuard® standard timing	15.5	79	24
FundX timing	16.0	86	18
Composite timing	16.0	88	18
Composite Allocation and Timing	16.5	92	16
Composite Allocation w/o DEMA6	16.3	90	17

Source: Monthly Allocations January 2017.xlsb

Table 5 illustrates that the Sharpe ratio and drawdown of the BNY Mellon benchmark can be improved can be improved by composite timing. The increase in return is about 110 basis points a year over the 1974 – 2016 interval.

As shown previously, timing improvements are interval dependent.

Table 5 confirms Antonacci's observations about the increase in return and improvements in the Sharpe ratio and maximum drawdown.

The managed portfolio is thirty percent more volatile than the timed benchmark[32]. It has a slightly larger drawdown than the benchmark.

Table 5 also includes results for allocation using the FundX allocation algorithm and approximations to the SectorSurfer® allocation algorithm.

It was not possible to apply the SectorSurfer® allocation algorithm directly since the SectorSurfer® trend calculation requires daily returns and daily returns do not exist for US and foreign stocks over so long an interval.

The trends of US and foreign stocks were therefore determined from the double exponential moving averages of the monthly returns of spliced VFINX and of spliced HAINX using a trend constant of four or six months. See Appendix A.

These approximations are identified in the table as "Monthly DEMA4 Allocation" and "Monthly DEMA6 Allocation." "Composite allocation" as used in this report is based on equal weighting of the FundX, Relative Momentum and DEMA6 allocation algorithms.

The new idea in Table 5 is that the performance of the SIMPLE portfolio is not strongly affected by the timing and allocation algorithms employed.

The genius of the SIMPLE portfolio is that it provides excellent results with several timing and allocation algorithms.

On the dust jacket for his book, Antonacci claims "an innovative strategy for higher returns and lower risk." It would be more accurate to say that he has identified an innovative *portfolio* which provides higher returns and lower risk with several momentum algorithms. His portfolio of US and foreign stocks is Simply Great!

I had mentioned earlier that investors who find it challenging to determine the values of the DEMA trends could omit DEMA allocation without much effect on the performance of the SIMPLE portfolio. The Table 5 entry "Composite Allocation without DEMA6" demonstrates the truth of this assertion.

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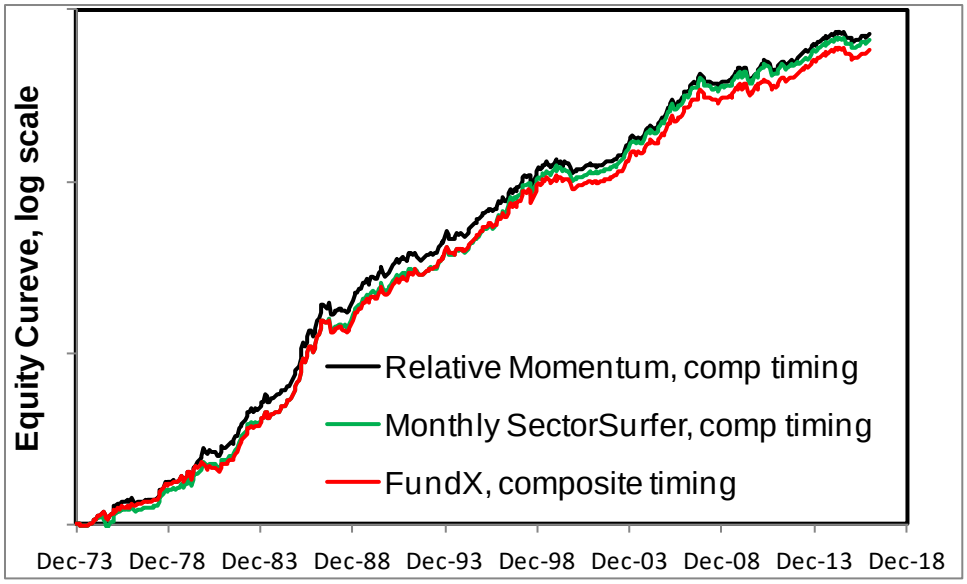
[32] Since the Sharpe ratio is return divided by volatility, the increase in volatility can be assessed as the increase in the Sharpe ratio divided by the increase in return. Comparing the statistics for the timed benchmark and the SIMPLE portfolio with composite timing and allocation, the calculated increase in volatility is 16.5/11.1 divided by 92/80 = 1.29 or about thirty percent.

The equity curves for the SIMPLE portfolio benefit from both timing and tactical allocation. They are shown in Chart 8. The performance of the allocation algorithms is different. For example, the green equity curve is the lowest of the three early on but ends up near the top forty years later.

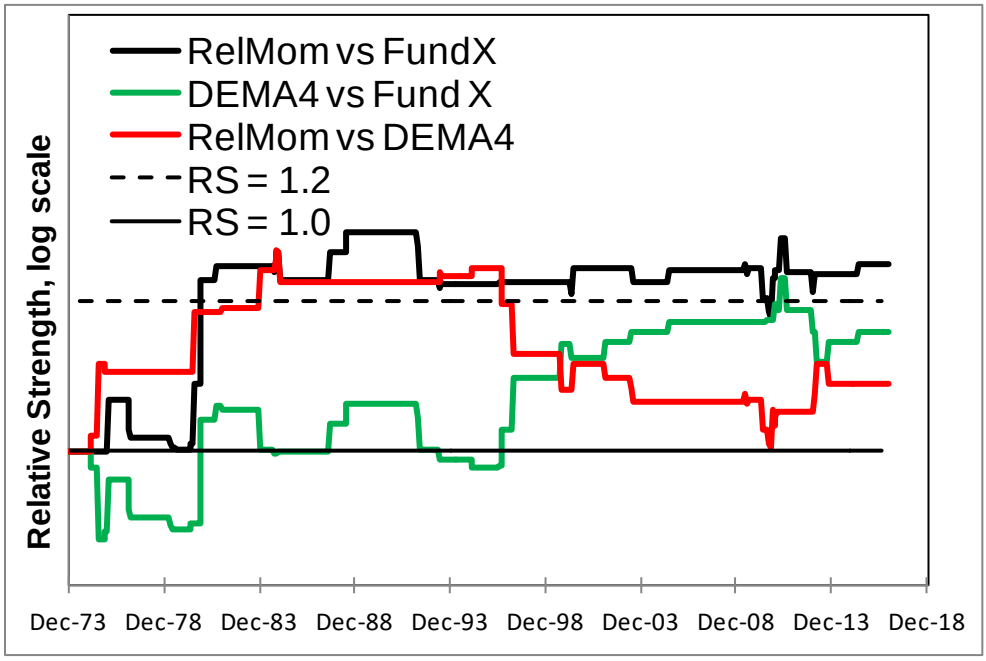
Chart 8. Equity Curves for the SIMPLE Portfolio. Composite timing.



Source: Monthly Allocations January 2017.xlsb, workgroup US&For Frequency

The relative strengths of the managed portfolios with respect to each other are shown in Chart 9. There is variation in the relative performance over time.

Chart 9. Effect of Different Allocation Algorithms on the Relative Strength of Managed SIMPLE Portfolios. Composite timing.



Source: Monthly Allocations January 2017.xlsb, workbook Summary

The variation in performance warrants the use of composite allocation for the SIMPLE portfolio.

What is Composite Allocation?

Each algorithm recommends an allocation over the following month. If using three algorithms, composite allocation means investing one third of the portfolio using the recommendation of each algorithm.

The average of 1 + the return over the following month for each of the recommended allocations equals 1 + the composite return.

Example. The portion of the portfolio managed by algorithm A doubles in value; the portion managed by algorithm B goes to zero and the portion managed by algorithm C is unchanged. The average of 1 + $Return_A$, 1 + $Return_B$ and 1 + $Return_C$ equals one plus the composite return.

((1 + 100%) + (1 - 100%) +(1 + 0%)) / 3 = 1 = 1 + composite return.

The composite return is zero. The value of the composite portfolio is unchanged.

Imagine that $100 is allocated to each algorithm at the beginning of the month. The total portfolio is valued at $300 at the beginning of the month. The value at the end of the month is $200 + $0 + $100 = $300. The portfolio does not change in value over the month.

NoLoad FundX

FundX Investment Group reports the annual performance of managed portfolios[33]. The portfolios differ in the volatility of the fund universes from which the portfolios are constructed. FundX Investment Group recommends the Class 3 portfolio for long term core holdings.

As shown in Table 6, the Class 3 portfolio has been less volatile than Classes 1 and 2 portfolios over the past 27 years. The Class 3 portfolio has also provided the lowest annualized return and the largest annual loss.

Sharpe ratios, as used in this report, are calculated from monthly data. I do not have monthly data for the FundX portfolios.

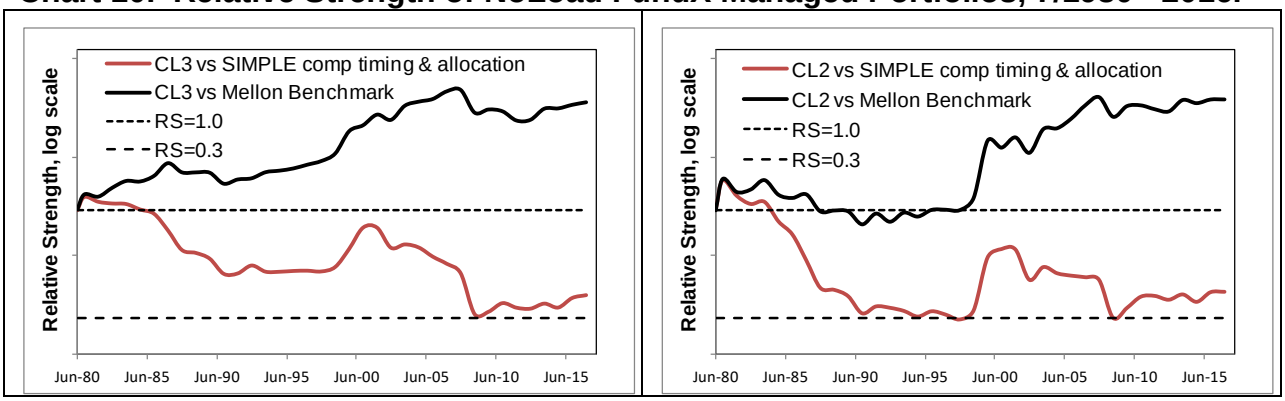
Table 6. Statistics for NoLoad FundX Portfolios. The SIMPLE portfolio employs composite timing and composite allocation.

1990-2016 (27 years)	CAGR	StdDev	Maximum Annual Loss
Class 1	12.9%	37%	37%
Class 2	13.3%	28%	38%
Class 3	11.3%	18%	40%
BNY Mellon Benchmark	8.2%	11%	23%
SIMPLE portfolio	13.1%	14%	16%

The SIMPLE portfolio with composite timing and allocation achieved a comparable return with a lower standard deviation and lower annual loss.

The black curves in Chart 10 illustrate the relative strength of NoLoad FundX Class 2 and Class 3 portfolios with respect to the BNY Mellon benchmark. The NoLoad FundX managed portfolios have provided three-fold gains relative to the benchmark.

Chart 10. Relative Strength of NoLoad FundX Managed Portfolios, 7/1980 - 2016.



[33] See www.fundx.com/performance.aspx.

Chart 10 also illustrates the relative strength of NoLoad FundX portfolios relative to the SIMPLE portfolio.

The SIMPLE portfolio outperformed the NoLoad FundX portfolios in most years. The 2016 year-end values of both NoLoad FundX portfolios equaled about 40% of the value of the SIMPLE portfolio.

Whereas the NoLoad FundX performance is determined from actual investment recommendations, the SIMPLE performance is the result of backtesting.

Momentum Funds

There are two types of momentum strategies. The first type of momentum strategy selects the better performing stocks from a universe of similar stocks. The NoLoad FundX Newsletter, which chooses five funds from several hundred, is an example of the first type of strategy. The second type of strategy might be called a "rector rotation" strategy. This strategy chooses one or a few funds from among dissimilar choices. The SIMPLE strategy is an example of the second type of strategy.

Antonacci mentioned two momentum funds in his presentations to the AAII Silicon Valley Chapter on February 11, 2017. Both are of the first type.

- The PowerShares DWA Momentum Portfolio is an ETF which invests in the common stocks of the approximately one hundred companies in the Dorsey Wright® Technical Leaders Index. The hundred stocks are winnowed from the top thousand stocks by market capitalization in the NASDAQ US Benchmark Index using proprietary relative strength techniques. The index returns are market capitalization weighted price returns with dividends reinvested proportionately in the index rather than in the securities which generated the dividends[34].

  There are two Dorsey Wright® Technical Leaders indices, a price index and a total return index. According to the prospectus, this ETF benchmarks itself against the price index, ticker DWTL, prior to 2014 and on DWTLTR thereafter. Backtested history prior to 2007 was requested from Mike 800-983-0903 on 3/16/17.

  The ticker is PDP, the expense ratio is 0.65% and there are price data from 2007.

- AQR Large Cap Momentum Style Fund is a mutual fund which invests in stocks of large and mid-cap U.S. companies. AQR ranks the stocks by their total return over the prior 12 months excluding the last month, selects those that rank in the top third (about five hundred stocks) and weights the stocks by market capitalization. Index returns include the effects of dividends, rights issues, share buy-backs and issuances, and spin-offs[35].

  We use the Class I fund (ticker AMOMX) in this analysis since it has data from 2009. The minimum initial purchase is $5 million but Class N (ticker AMONX) can be purchased in a Fidelity IRA for a $2,500 initial investment.

Neither PDP nor AMOMX uses timing. As shown in Table 7, the PowerShares fund provides a similar return since its inception as compared to the SIMPLE

[34] DORSEY WRIGHT TECHNICAL LEADERS INDEX FAMILY METHODOLOGY January 2017.

[35] AQR Momentum Indices — U.S. Equities Methodology Description. Undated.

portfolio without timing. Timing improved the return of the SIMPLE portfolio and presumably would have improved the return of the PowerShares fund.

Table 7. Annualized Returns of the SIMPLE Portfolio and Momentum Funds.

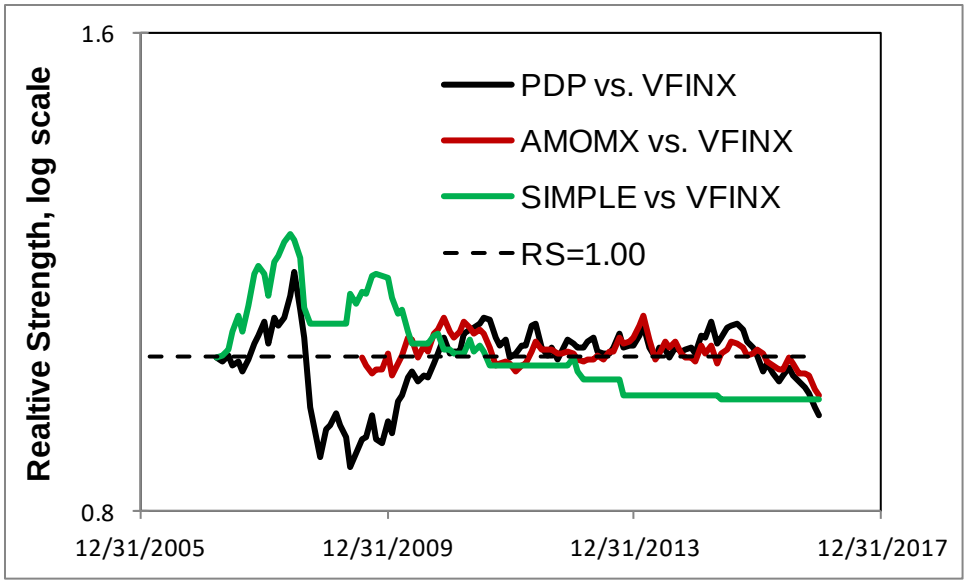
	PowerShares DWA Momentum Portfolio	AQR Large Cap Momentum Style
Momentum Fund, no timing	6.0	13.1
SIMPLE, RelMom and FundX allocation, no timing	6.3	11.5
SIMPLE, RelMom and FundX allocation, 1-3-6-12 and MSI timing	13.6	12.0
Interval	30 Mar 2007-31 Dec 2016	31 Jul 2009-31 Dec 2016

The AQR portfolio provided a higher return than the SIMPLE portfolio since its inception without and with timing. Timing provides only a limited benefit to the performance of the SIMPLE portfolio over this interval which is understandable since the interval is essentially a continuous bull market.

As shown in Chart 11, the relative strength of the SIMPLE portfolio rises entering the 2008 bear market and then steadily declines.

The relative strength of PDP also rises before the 2008 bear market but declines during the bear market. It then rebounds more rapidly than US large cap stocks on exiting the bear market.

Chart 11. Relative Strength of Momentum Strategies With Respect to the Unmanaged US Large Cap Stocks (VFINX). No timing. Allocation for the SIMPLE portfolio is equal weights of the Relative Momentum and FundX algorithms.



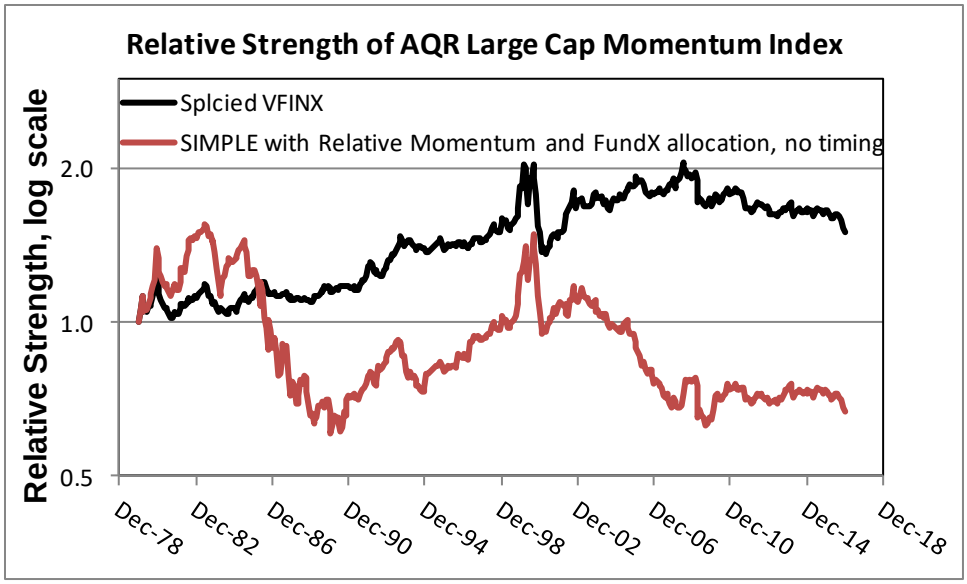
Source: Compare momentum funds.xlsx

The relative strength of AMOMX has been approximately flat since its inception a few months after the end of the bear market.

No conclusions can be drawn about the long term relative performance of the SIMPLE, PDP and AMOMX strategies because of the short history. Chart xx compares the relative strength of the AQR Large Cap Momentum Index over a longer time horizon.

Over the longer term, the AQR Momentum Index underperformed the SIMPLE portfolio during the 1980 and between the dot-com bust and the 2008 bear market and out performs during the 1990s. The relative performance since the 2008 bear market has been flat. A combination of the AQR Momentum Index and the SIMPLE portfolio might provide more uniform performance than either.

Chart 12. Relative Strength of AQR Momentum Index with respect to US stocks and to the SIMPLE portfolio Without Timing. Allocation within the SIMPLE portfolio is based on equal weights of the Relative Momentum and FundX algorithms.



Add chart illustrating relative strength of DWTL.

It would be imprudent to invest in PDP or AMOMX without providing a separate timing capability.

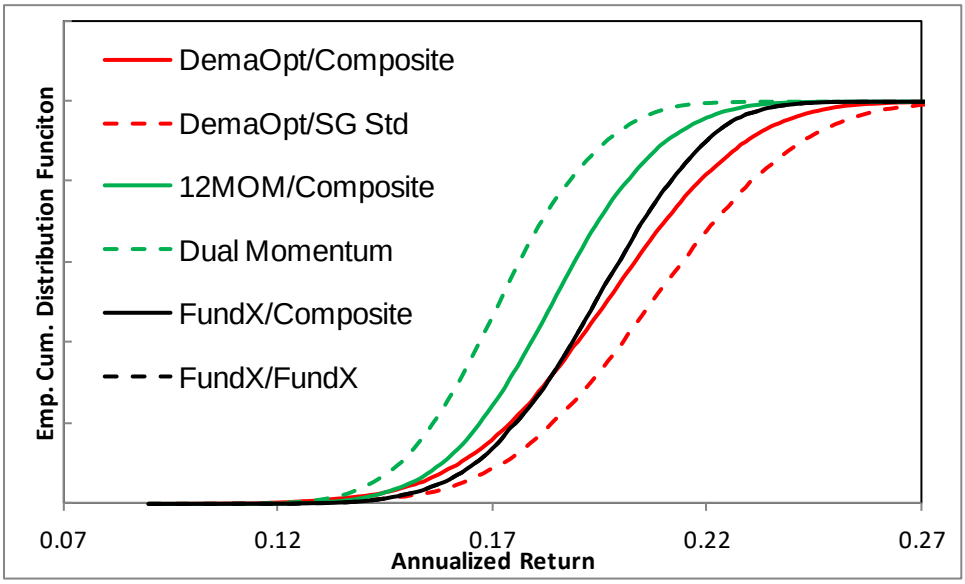
Does Performance Persist?

In 2013, John Nicholas synthesized thousands of portfolios by choosing twelve funds at random from a 32 fund universe[36]. His goal was to create a large number of portfolios which were unaffected by selection bias so that differences in the performance of momentum algorithms would be statistically significant.

Twelve fund portfolios were chosen because that is the maximum number of funds allowed by SectorSurfer®. The 32 fund universe included just about every focused US fund with data from 1988. See Appendix B.

Don Maurer determined performance statistics for thousands of John's portfolios using several algorithms. Don also introduced a "no skill" algorithm in which the monthly allocations of the 12-fund portfolios are determined randomly[37].

Chart 13. Empirical Cumulative Distribution Curves for Ten Thousand 12 of 32 Portfolios Using Different Timing and Allocation Algorithms, 1990-2016. The further that a curve is to the right, the higher its average returns. DemaOpt is analogous to the SectorSurfer® forward walk progressive tuning methodology[38].



Source: ECDS_January 2017.xlsb

[36] John B. Nicholas, "Random Portfolio Selection with Various Timing and Weighting Algorithms," and "Random Portfolio Selection with FundX Momentum and Timing," AAII Silicon Valley CIMI Group, October 1, 2013 and November 4, 2013.

[37] Don Maurer "Use of Random No-Skill Portfolios for Strategy Testing," AAII Silicon Valley CIMI Group, February 4, 2014.

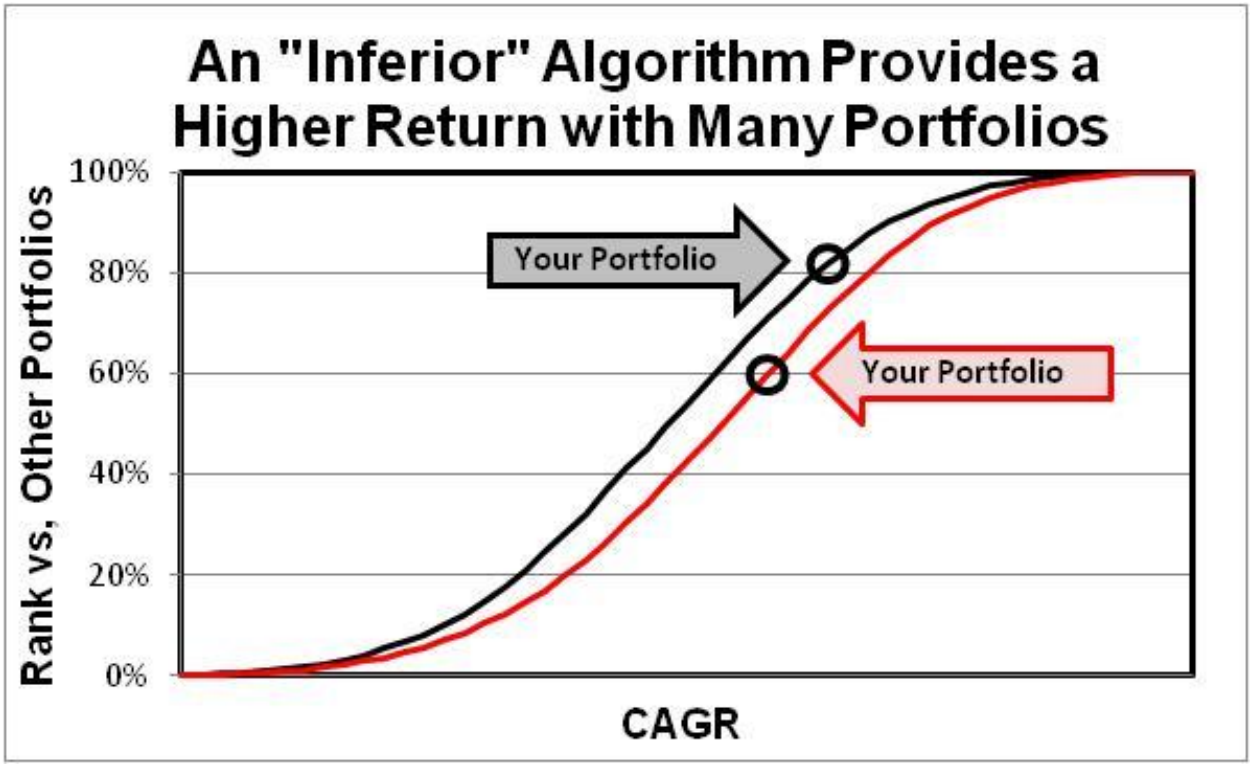
[38] The trend is calculated from daily data and the trend constant is optimized annually based on the returns over the trailing twelve months.

Nicholas and Maurer, and more recently Juds[39], have used this approach to conclude that certain momentum algorithms are better than others. Chart 13 illustrates the sorts of results produced by the Nicholas Maurer approach.

We need to be careful before concluding from Chart 13 that one algorithm is better than another. A software provider, with thousands of customers, wants the algorithm which provides better performance for the largest fraction of customer portfolios. The DemaOpt/StormGuard® standard combination may be better than the other algorithms from this perspective.

From the vantage of the individual investor however, differences in the average performance of large numbers of portfolios are not important because many portfolios perform better with an "inferior" algorithm. This is illustrated notionally in Chart 14.

Chart 14. Empirical Cumulative Distribution Functions of Two Algorithms. The algorithm which created the distribution plotted in black provides lower returns, on average, than the algorithm which created the distribution plotted in red. However, the black curve provides a higher return for particular portfolios.



The fraction of the random portfolios which excel with a particular algorithm is shown in Table 8. Antonacci has not discussed the performance of the Dual Momentum algorithms with anything more complex than the SIMPLE portfolio.

[39] Scott Juds, "Investment Performance Improvement Utilizing Automated Polymorphic Momentum." This report is available at the NAAIM website www.naaim.org/programs/find-a-whitepaper.

Some algorithms provided more top returns than the others but no algorithm provided the top return for all portfolios. The decision for the individual investor is not "Which is the best algorithm?" but rather "Which is the best portfolio for the algorithm used by my software provider?"

Table 8. Frequency of Best Returns, 1990-2016. The annualized return of a portfolio using one algorithm was compared to the returns of the same portfolio using other algorithms. If two returns agreed to within 0.2%, the returns were considered a "tie." The statistics are based on ten thousand portfolios. The percentages in the table do not sum to 100% due to ties.

Timing Algorithm / Allocation Algorithm	Composite Timing	Absolute Momentum	FundX Timing	StormGuard Standard
Relative Momentum	16	6		
FundX	42		17	
DemaOpt	51			82

Source: ECDFs_January 2017.xlsb

The compositions of the superior portfolios for the algorithm used by a particular software provider are usually identified by backtesting. Identifying a portfolio by backtesting implicitly assumes that the superior performance persists into the future.

Backtesting is a high risk way to try to identify the 12-fund portfolios which will provide superior performance in the future. This was shown by identifying a large number of portfolios with superior returns over fourteen years and testing the subsequent performance of these portfolios.

Superior returns over a fourteen year backtesting interval do not guarantee superior returns over the next dozen years. Rather, subsequent returns are about equally distributed from superior to poor and there is a fifty percent chance that the future return of a superior portfolio will be below average.

The subsequent return distributions are shown in Table 9. The returns of the superior portfolios ranked in the top 20% of the returns of all ten thousand portfolios.

The NoSkill algorithm processed the same ten thousand 12-fund portfolios. The difference is that the monthly allocation was random and not determined by the trends of the funds. The NoSkill algorithm provides the same number of subsequent returns in each quintile. This is to be expected since the subsequent returns are randomly related to the prior returns.

Table 9. Subsequent Return Distribution, 2004-2016, of the 12 of 32-Fund Portfolios with the Highest Returns During the Backtest Interval 1990-2003.
Allocation is to the fund with the highest trend and trades are on the day after the month-end signal date. Totals may not equal 100% due to rounding.

	Bottom Half	Top 20%	2nd Quintile	3rd Quintile	4th Quintile	Bottom 20%
NoSkill (random), Composite timing	50	20	19	19	21	20
Relative Momentum, Composite timing	43	23	23	21	19	14
Dual Momentum	44	24	22	21	18	15
FundX, Composite timing	43	23	23	21	19	14
FundX, FundX timing	44	24	22	21	18	15
Dema20 Composite timing	56	14	19	23	27	17
Dema20, StormGuard® Std	58	14	18	22	26	20
DemaOpt, Composite timing	56	17	17	22	23	21
DEMAopt, StormGuard Std.	57	16	17	20	24	22

Source: Persistence January 2017.xlsb

The subsequent returns for the Dual Momentum, FundX and DEMA algorithms are about equally distributed in each quintile. The conclusion is that the subsequent returns of superior 12-fund portfolios are not likely to persist.

The simulations identified the funds which contributed the most to the return in the two intervals. The most important funds in the backtest interval are different from the most important funds in the subsequent interval.

Backtesting identifies the funds that were important in the past but it cannot identify the funds that will be important in the future. Backtesting risks the omission of funds that will be important in the future.

"Selection bias" occurs when funds are excluded from the future portfolio solely because they were not important in the backtesting. Selection bias is more likely when there is a limit on the number of candidate funds and/or when the candidate funds have limited histories.

The solution to selection bias is straightforward. Do not limit the fund choices which are available to the simulator. As a practical matter, this means allowing the simulator to choose from a large number of plausible funds.

The SIMPLE portfolio includes a broadly diversified portfolio of US and foreign stocks but there is one omission.

The total value of global equity markets is on the order of $50T USD, split about equally between the US and ex-US. The total value of professionally managed global real estate is about $7T USD in 2015 while investable real estate is on the order of $80T USD[40].

Although real estate is comparable in size to global equity markets, real estate - in the form of REITs primarily - represents only a fraction of global equity indices.

The SIMPLE portfolio risks selection bias because it under weights real estate. The SIMPLE portfolio would be expanded to include real estate.

A portfolio of focused US sectors should include all reasonable possibilities, on the order of at least 30 funds.

A focused global portfolio should include many more than 30 funds.

Portfolios with more than a hundred choices do not present computational difficulties.

Possible US and global focused portfolios are described in Appendix B.

[40] Dow Jones Indices, 2016 and Value Walk, January 2016; MSCI, June 2016 and Value Walk, January 2016.

Be Realistic in Your Expectations

My impression after listening to Scott Juds for the first time was that the engineering principles on which SectorSurfer® is built distinguish can the trends in financial markets from the associated financial noise with the same accuracy as the telephone companies can distinguish the sound of the human voice from the associated electronic noise. This was a misconception.

Algorithms are better at identifying whether the equity market is going up or down over the coming month than random guesswork but the algorithms are a long way from perfect.

If an accurate timing prediction is defined as the US equity market rising faster than the bond market after predicting a rising equity market, or falling more than the bond market after predicting a declining US equity market, then the accuracy of the timing algorithms is on the order of 71 – 74%.

If we exclude months with small changes, the accuracy is on the order of 80%.

The return of US stocks exceeded the return of bonds in 58% of these months. The NoSkill timing algorithm picks a random number each month between 1 and 100. If the random number is 58 or less, the algorithm allocates to stocks. If the random number is more than 58, the allocation is to bonds.

Comparing actual monthly performance to 10,000 realizations of the NoSkill algorithm shows that the accuracy of the NoSkill algorithm is about 51%.

The deviation from the theoretical 50% accuracy may be due to the fact that there are only 324 actual monthly observations.

Table 9. Accuracy, 1990-2016. Timing accuracies are the same for all portfolios which make independent timing and allocation decisions. Allocation accuracies are for the SIMPLE portfolio (VFINX, HAINX and VBMFX) and were measured without timing.

NoSkill Timing	Absolute Momentum	FundX Timing	StormGuard® Standard
51 ± 2.7	70.6	70.9	74.3
Random Allocation	**Relative Momentum**	**FundX Allocation**	**DEMA70 Allocation[41]**
50	52.9	52.6	53.9

Source: Accuracy of SIMPLE Predictions.xlsb

If an accurate allocation prediction is defined as the US market rising faster than foreign markets in the month after predicting a rising US market, or foreign markets rising faster than the US market in the month after predicting rising foreign markets, the accuracy of the allocation algorithms is 53 – 54%.

[41] Trends are calculated as DEMA of the daily returns with a trend constant of 70 days. This daily algorithm corresponds to the monthly DEMA4 used previously. See Appendix A.

Guessing the allocation would provide an accuracy of 50% averaged over many months.

With the SIMPLE portfolio plus real estate, the accuracy of the allocation algorithms is 40 – 43%.

With a portfolio of 32 US sector funds, the allocation accuracy is on the order of 10%.

There will be many months in which the algorithms provide the wrong signals. For example, the timing signals at the end of September 2015 were to go to cash. The market rose sharply during October 2015.

Traders rate their performance in terms of win/loss ratios and the magnitudes of the wins and of the losses. Since a trader usually loses more often than he or she wins, a successful trader must manage losses to be small.

The magnitudes of wins and losses cannot be controlled with momentum investing if decisions are made at fixed intervals. The average win for the SIMPLE portfolio was about 3% per month and the average loss was of a similar magnitude. About two thirds of the months produced wins and only one third produced losses[42].

[42] SIMPLE portfolio. The following combinations were tested 1990 - 2016: DEMA70 and StormGuard® standard; Relative Momentum and Dual Momentum; and FundX allocation and FundX timing. There was not a large variation among the combinations. Months in which the timing algorithm allocated to bonds were excluded. Source: Accuracy of SIMPLE Predictions.xlsb, worksheet Wins&Losses..

Multi-Fund Portfolios

This section discusses the effects of adding real estate to the SIMPLE portfolio, the performance of portfolios containing US sector funds or focused US funds and the benefits of allocating to more than one fund[43].

Table 10. Momentum Management of the SIMPLE Portfolio plus Real Estate. Trade on the month-end signal date. The BNY-Mellon benchmark contains 50% spliced VFINX, 10% spliced HAINX and 40% spliced VBMFX. There was allocation to the top trending fund or equal allocation to the top two trending funds.

1974 – 2016	CAGR	Sharpe	Max DD
BNY Mellon Benchmark	10.0	56	33
Relative Momentum Allocation			
Absolute Momentum timing	16.3	87	22
Composite timing	16.2	87	16
Composite timing, top 2	15.9	94	21
Monthly DEMA4 Allocation			
StormGuard® standard timing	17.5	89	24
Composite timing	17.9	97	17
Composite timing, top 2	15.8	94	21
FundX Allocation			
FundX timing	16.4	85	17
Composite timing	16.2	85	17
Composite timing, top 2	15.4	92	21
Composite allocation and timing			
US and foreign stocks	16.3	90	18
US, foreign and real estate stocks	16.8	92	16
US, foreign and real estate, top2	15.7	94	21

Source: Monthly Allocations January 2017.xlsb

Table 10 summarizes the statistics for the SIMPLE portfolio plus real estate (in the form of spliced FRESX). Real estate provides modest improvements to the return, Sharpe ratio and maximum drawdown. The primary benefit is that including real estate reduces the risk of selection bias.

With three equity funds, it is possible to allocate to the top trending fund or to the top two trending funds. When allocating to the top two funds, the portfolio would contain VFINX and FRESX or HAINX or FRESX or VFINX and HAINX when the market is quiescent.

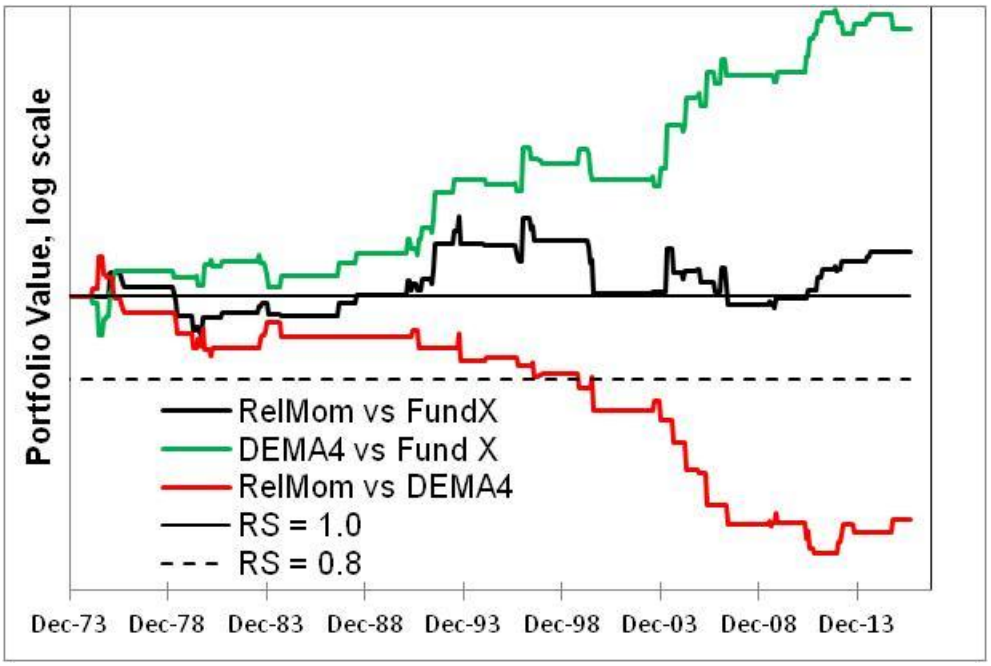
The portfolio would contain VBMFX when the market is in turmoil.

[43] John Nicholas has tested allocation to more than one fund in the context of the FundX algorithm. See JBN_AAII_Nov_Meeting.pdf, AAII Silicon Valley CIMI, 131104 Meeting.

Allocating to the top two funds reduces the return for all algorithms and increases the Sharpe ratio for two of the algorithms. The reduction in the volatility is greater than the reduction in the return.

The relative strengths of the algorithms are displayed in Chart 13. The DEMA4 SectorSurfer® approximation has outperformed Relative Momentum and FundX since about 1990. Allocation based on the recommendations of all three timers is again seen to be lower risk than relying on one algorithm alone.

Chart 13. Relative Strength of the SIMPLE Portfolios plus Real Estate with respect to Each Other.



Source: Monthly Allocations January 2017.xlsb

The effects of including real estate and of allocating to the top two funds are similar since 1990. Compare Table 11. Including real estate and allocating to the top two funds would not have made much practical difference to the historical performance of the SIMPLE portfolio.

Table 11. Allocating to the Top Two Trending Funds, 1990-2016. Trade on the signal date. The equity allocation is the average recommendation of the Relative Momentum, FundX and Dema4 algorithms; composite timing.

1990 - 2016	CAGR	Sharpe	Max DD
BNY Mellon Benchmark	8.2	62	33
SIMPLE portfolio	13.1	86	18
SIMPLE portfolio plus Real Estate	13.7	90	16
With Real Estate and Top 2 Allocation	13.4	96	15

Source: Monthly Allocations January 2017.xlsb

There are two systems for classifying US companies. The first is the Global Industry Classification Standard system. The GICS system is preferred by MSCI and Standard & Poor's. The second system is the Industry Classification Benchmark system. The ICB system is preferred by Dow Jones and FTSE. Both systems divide US companies into primary categories or sectors; real estate was separated from the rest of the financial category in 2016.

The SPDR sector funds were developed by State Street Global Advisors based on the GICS classification system. There were nine sectors prior to the separation of real estate into a separate sector in 2016. There are price data for these nine funds from December 1998. Since about a year's worth of data are required to initialize the algorithms, simulations are possible from the end of December 1999.

Table 12 summarizes statistics for a portfolio of nine US SPDR funds. While one might think that funds representing US sectors would perform well with momentum algorithms, the truth is that this portfolio does not impress.

Table 12. Simulation of Nine Sector Funds, 2000 - 2016. These results are "deterministic;" that is, they did not involve random portfolios or random allocations. Timing is based on a composite of the Absolute Momentum, 13612 (FundX) and MSI timers and trades are on the day after the month-end signal date. The nine funds are described in Appendix B.

	CAGR	Sharpe	MaxDD
SIMPLE (US and foreign stocks)			
FundX allocation	0.1321	117	14
Relative Momentum allocation	0.1350	119	12
DemaOpt allocation	0.1389	121	14
Dema20 allocation	0.1323	117	14
Nine US Sectors			
FundX allocation	0.1082	73	21
Relative Momentum allocation	0.1008	63	21
DemaOpt allocation	0.1047	71	23
Dema20 allocation	0.1021	72	19

Source: Nine Sectors.xlsx.

Much better results are obtained with a portfolio of US funds with narrowly focused investment objectives. Table 13 summarizes some of the results.

Table 13. Simulation of 28 Funds. These results are "deterministic;" that is, they did not involve random portfolios or random allocations. Composite timing; trades are on the day after the signal date. The 28 fund universe is described in Appendix B.

The first columns correspond to equal allocation to N funds. The second columns correspond to allocations weighted inversely by 60-day standard deviations.

1990 – 2016	CAGR		Sharpe		MaxDD		Rank
BNY-Mellon Benchmark	8.2		59		35		
FundX allocation							
Top Fund	19.5		78		39		33%
Top 2	18.4		82		33		
Top 4	19.4	18.8	96	96	22	21	
Top 5	18.7		96		21		
Top 6	18.8	18.4	99	101	20	20	
Relative Momentum allocation							
Top Fund	16.1		66		29		71%
Top 2	17.9		80		28		
Top 4	18.1	17.8	87	87	26	24	
Top 5	17.9		90		26		
Top 6	18.1	17.8	94	97	23	20	
Dema20 allocation							
Top Fund	22.8		89		34		8%
Top 2	21.7		96		29		
Top 4	20.0	19.6	104	106	21	20	
Top 5	19.6		106		19		
Top 6	19.3	19.2	108	112	18	17	
DemaOpt allocation, top fund	21.9		88		34		10%
FundX and Dema20 allocation							
Top Fund							
Top 2							
Top 4	19.7	19.3	102	103	20	20	
Top 5	19.2		103		19		
Top 6	19.1	18.8	106	109	18	18	
Relative Momentum, FundX and Dema20 allocation							
Top Fund	19.5		82		28		
Top 2	19.5		90		25		
Top 4	19.2	18.8	98	99	21	20	
Top 5	18.8		99		19		
Top 6	18.8	18.5	103	106	18	18	

Source: 28 Deterministic January 2017.xlsb; 28 & 32 Deterministic January 2017.xlsb; 12of32 Jan 2017.xlsb; 12of32 DemaOpt January 2017.xls

Momentum strategies provide larger returns with multi-fund portfolios. However, the returns are more volatile and exhibit larger drawdowns. In addition, a spreadsheet is needed to calculate the allocation signals.

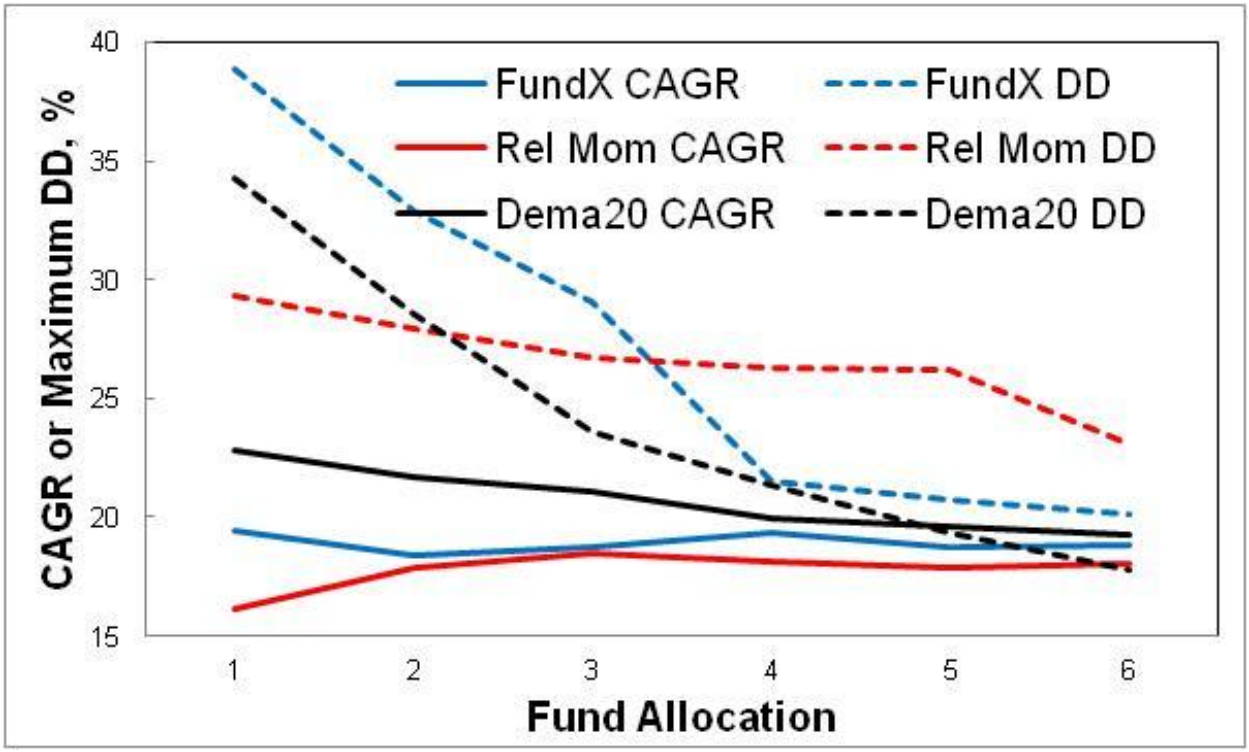
For a portfolio of 28 funds, composite allocation improves the statistics of the Relative Momentum and FundX allocation algorithms but degrades the return and Sharpe ratio of the DEMAopt algorithm. Another way of saying the same thing is to note that the performance statistics for DemaOpt exceed those for the Relative Momentum and FundX allocation algorithms.

"Rank" indicates the ability of the algorithm to identify the top performing funds from among the many possibilities. The DemaOpt and Dema20 algorithms do very well, achieving a return which is larger than the vast majority of the ten thousand 12 of 32-fund portfolios.

The FundX and Relative Momentum algorithms are less effective at identifying the top trending funds.

The drawdowns shown in Table 12 are probably not acceptable to the risk adverse investor. However, drawdowns can be reduced by allocating to more than the top fund. This is illustrated in Table 12 and Chart 14.

Chart 14. Drawdown is Reduced by Allocating to Several Funds, 1990-2016.
Twenty-eight fund universe, composite timing. Trade on the day after the signal date.



It is beneficial to allocate to several stocks when using these algorithms to manage a portfolio containing the stocks in the NASDAQ 100 index.

It is tempting to conclude that DemaOpt and Dema20 are superior to the other allocation algorithms for the 28 fund universe. However, multi-fund portfolios can only be backtested from 1990. Chart 9 shows that the DEMA algorithm excels (for the SIMPLE portfolio) from the mid 1990s through the mid 2000s but that the DEMA algorithm is unexceptional before and after this interval.

The multi-fund portfolios discussed here are constructed of funds with a narrow investment focus. This was because my goal had been to employ index-like funds that follow the same investment strategy indefinitely.

My goal was influenced by the fact that I was using SectorSurfer® as my primary simulator and SectorSurfer® limits my investment universe to twelve funds.

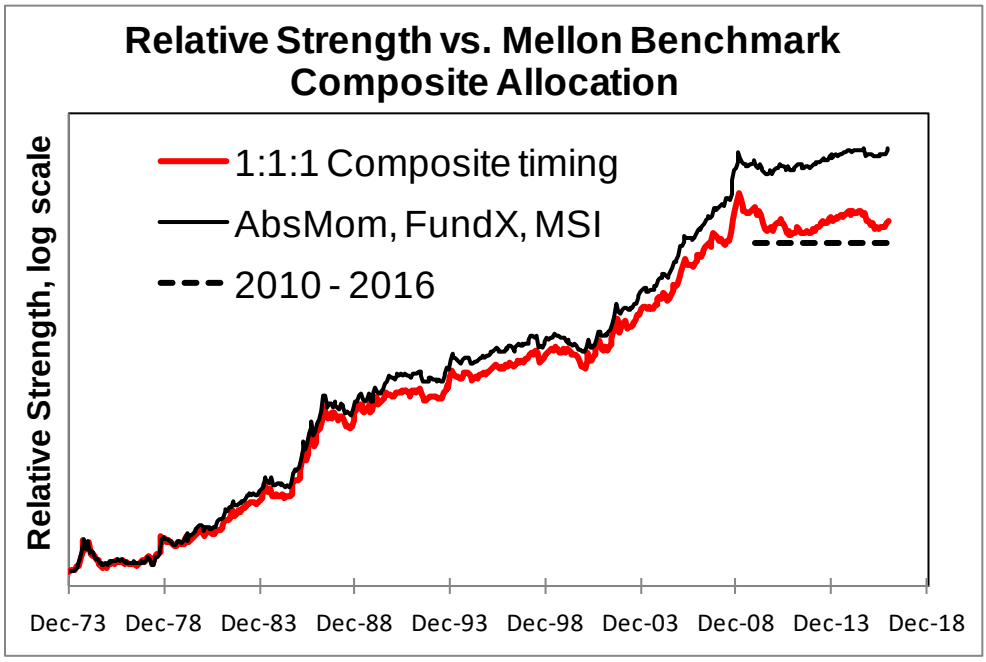
Having shown that the simulator performs well with many funds and that it can distinguish between important and unimportant funds, the investment universe could be expanded to include funds with multiple and amorphous objectives.

Recent Performance

As shown by the red curve in Chart 15, the performance of SIMPLE portfolio has been disappointing since the 2008 bear market[44]. After many years of strong growth relative to the benchmark, the rate of growth no longer exceeds that of the benchmark. Over the seven years from 2010 through 2016, the SIMPLE portfolio using composite allocation and composite timing has returned only 6.7% annually while the Mellon Benchmark has returned 8.2%.

It was discovered in August 2017 that the MSI timing signals were offset by one month. The signal as of the end of January was acted upon as of the end of December. This error likely enhanced the performance of the MSI timer.

Chart 15. Relative Strength of the SIMPLE Portfolio. The red curve reflects timing using an equally weighted composite of Absolute Momentum, StormGuard standard and FundX. The black curve represents timing using Absolute Momentum, FundX and the Delta MSI. Trade on the signal date. There are MSI signals from January1999.



Source: Monthly Allocations January 2017.xlsb.

The explanation for the disappointing performance is rooted in the performance of the timing algorithms.

The generally poor performance of the timers is demonstrated by Table 14. The annualized returns for the timed SIMPLE portfolio plus real estate are generally less than the untimed return independent of the allocation algorithm.

Table 14. Annualized Returns for a Managed Portfolio of US and Foreign Stocks plus Real Estate, 2014-2016. Allocation to a single fund. Dxxx = Demaxxx, SS =

[44] I am indebted to Bill Paseman for highlighting this issue at the February 2017 CIMI meeting.

SectorSurfer® and RelMom = Relative Momentum. Source: Uses C# simulator, Effect of Timing Algorithm.xls.

Allocation Algorithm Timing Algorithm	D20	D70	D103	DOpt	SS[45]	RelMom
BNY Mellon Benchmark	5.25	5.25	5.25	5.25	5.25	5.25
Untimed	12.06	3.89	5.65	11.10	6.12	7.85
Absolute Momentum	6.79	(1.45)	0.69	2.62		2.62
10MOM	7.63	0.06	2.23			
StormGuard Std	6.79	(1.45)	0.69	5.88	1.17	
FundX	6.03	(0.37)	1.79			
10monthSMA	6.03	(0.37)	1.79			
200daySMA	7.72	1.22	3.42			
SPVOL	10.32	2.92	4.81	9.37		6.12
Golden Cross	6.42	0.00	2.17			
EMA Golden Cross	8.12	(0.23)	1.93			
DR*VOL	8.12	1.60	3.80			
200EMA	6.03	(0.37)	1.79			
GOOD	10.55	2.49	4.23	9.60		6.23
WLIg+	8.30	3.94	5.71			
NASDAQ HiLo	5.43	0.93	3.12			
StormGuard Armor	7.92	4.85	6.83	7.00	3.63	7.22
Unemployment Claims	12.06	3.89	5.65	11.10		7.85
5AbsMom	12.40	5.62	7.91	11.43	7.65	8.00
AbsMom, SGstd & FundX	6.54	(1.09)	1.06	5.63		2.38

Comment. SectorSurfer® performs poorly with this portfolio. The SectorSurfer® FWPT optimization routine chooses values for the trend constant for this portfolio which are too large. Juds would likely attribute the poor performance to the inclusion of real estate which, in his opinion, does not share "common mode noise" with US and foreign stocks.

DemaOpt, my implementation of FWPT optimization, does well with this portfolio in this interval. (DEMA20 does better but the better performance of the DEMA20 algorithm would not have been known in advance.)

See Appendix A for the relative performance of SectorSurfer® over the longer 1990 – 2016 interval.

[45] Ver. 5.3.201, VFINX, HAINX and FRESX, cash = VBMFX, FWPT with BOD 1/2/1998. Performance with the 5AbsMom timer was determined by applying the timer to the untimed SectorSurfer® equity curve.

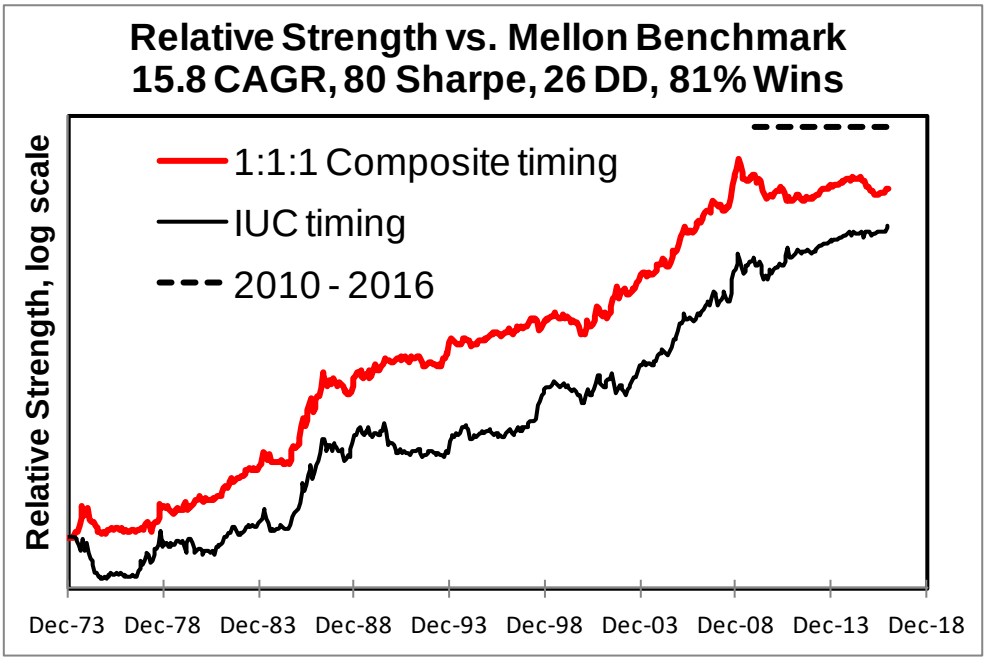
As was shown in Chart 6, the frequency with which the 3-year return of a timed portfolio matches or exceeds the return of the benchmark changes over time. The current performance (interval 7, 2014-2016) is inferior to that of all of the preceding decades except 1984-1993.

Since the performance of the composite timer has been variable, the performance of the composite timer may improve in the future. "In the future" could be a decade away and during this time the patient investor would be earning no much more than the benchmark or perhaps even less than the benchmark.

Another approach is to change the algorithms that are being used to time the portfolio. To this end, Table 15 illustrates the performance of each timer over the 2010-2016 interval.

StormGuard® armor was not considered because it is not known how this timer is calculated and because of anomalous behavior with 28 fund portfolios.

Chart 16. Relative Strength of the SIMPLE Portfolio using IUC Timing. The red curve reflects timing using an equally weighted composite of Absolute Momentum, StormGuard standard and FundX. The black curve represents timing using IUC.



The Delta MSI and the initial unemployment claims are the better individual timers in the 2010 - 2016 interval. The initial unemployment claims timer was discounted since it did poorly in the mid 1970s and late 1980s. See Chart 16.

Table 15. Recent Performance Statistics for the SIMPLE Portfolio, 2010 - 2016.
Allocation is based on equal weighting of the relative momentum, FundX and DEMA6 allocation algorithms

2010-2016	Time In Equities	CAGR	Sharpe	MaxDD
US Large Caps (VFINX)	100%	12.7	100	29
BNY Mellon benchmark	60%	8.2	107	12
Allocation between US and foreign stocks using Relative Momentum, FundX, DEMA6				
Composite timing	93%	6.7	61	16
Delta MSI (MSI)	70%	16.0	166	6
Initial Unemployment Claims (IUC)	93%	11.8	96	16
StormGuard® Armor	88%	11.5	98	12
5-month Absolute Momentum	81%	9.0	87	16
SPVOL, 100% leverage, 15% target	92%	8.9	78	20
200dSMA	83%	8.2	79	14
DEMA50 DR*VOL / DEMA50 VOL	79%	8.7	84	14
StormGuard® Standard	93%	7.7	66	16
NASDAQ HiLo	70%	7.0	75	12
Absolute Momentum	95%	7.1	58	22
“Get Out of Dodge”	91%	6.8	56	22
Golden Cross (50, 200)	82%	6.6	62	16
Weekly Leading Index Growth Plus	70%	5.5	53	23
10mSMA	87%	5.2	51	19
FundX	89%	5.2	50	20
Equally weighted 200dSMA, DR*VOL and IUC	85%	9.6	93	12
Equally weighted AbsMom, FundX and MSI	85%	9.5	94	12
Equally weighted Absolute Momentum, DR*VOL and MSI	81%	10.7	108	12
Equally weighted 200dSMA, DR*VOL and MSI	77%	11.0	116	10
Equally weighted DR*VOL, MSI	74%	12.4	135	7
Equally weighted 200dSMA, MSI	77%	12.2	131	7

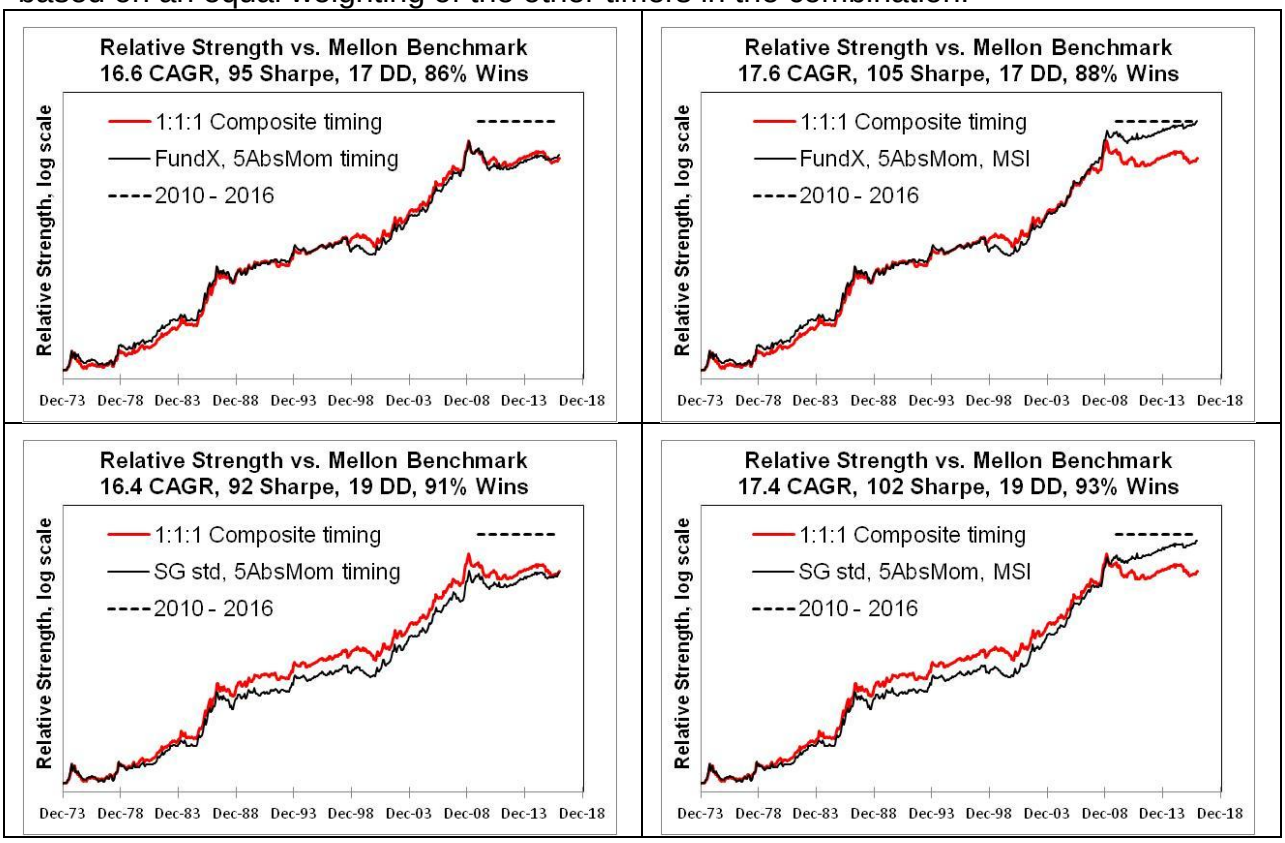
Equally weighted 1-3-6-12 and MSI	80%	10.6	105	15

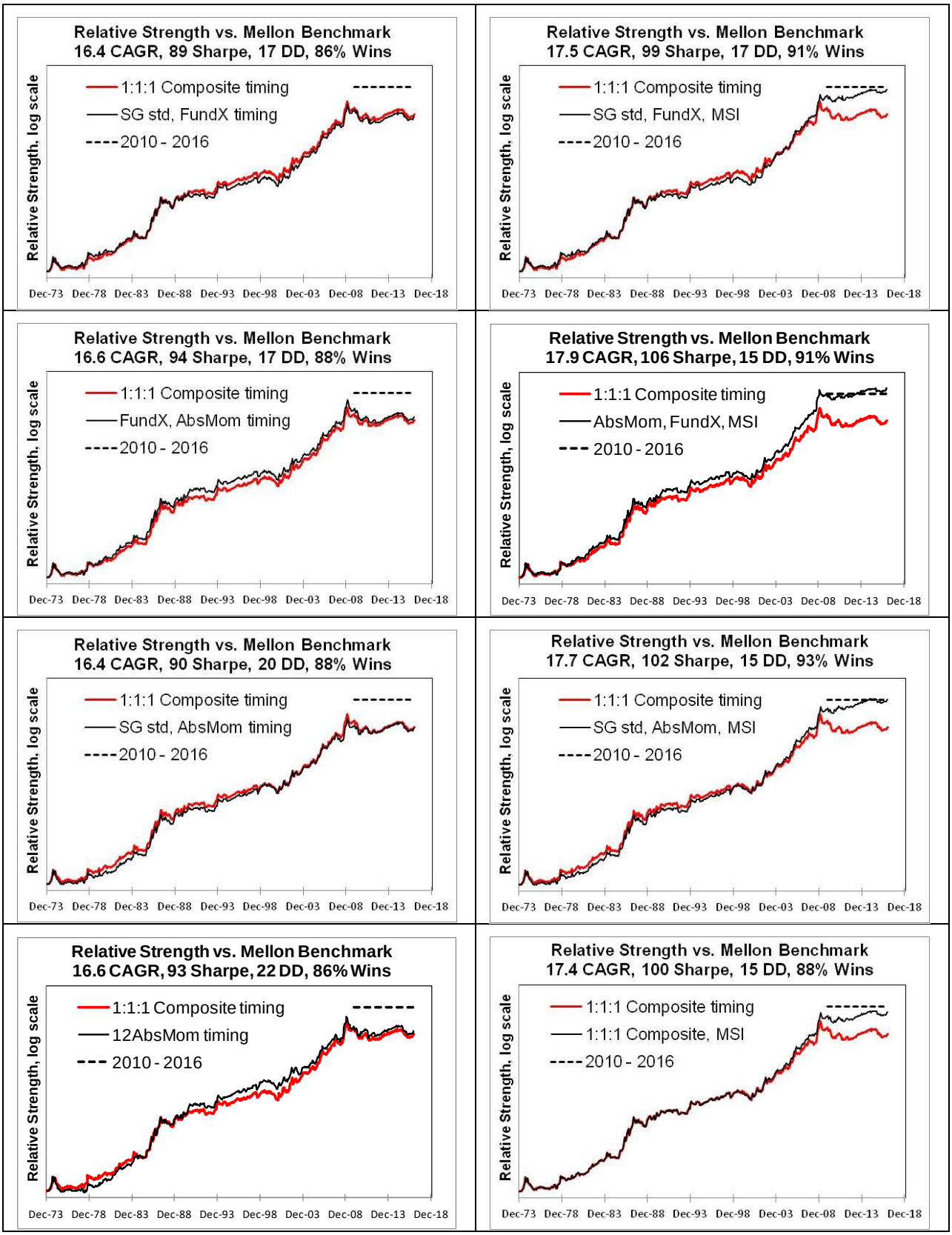
Source: Monthly Allocations January 2017.xlsb

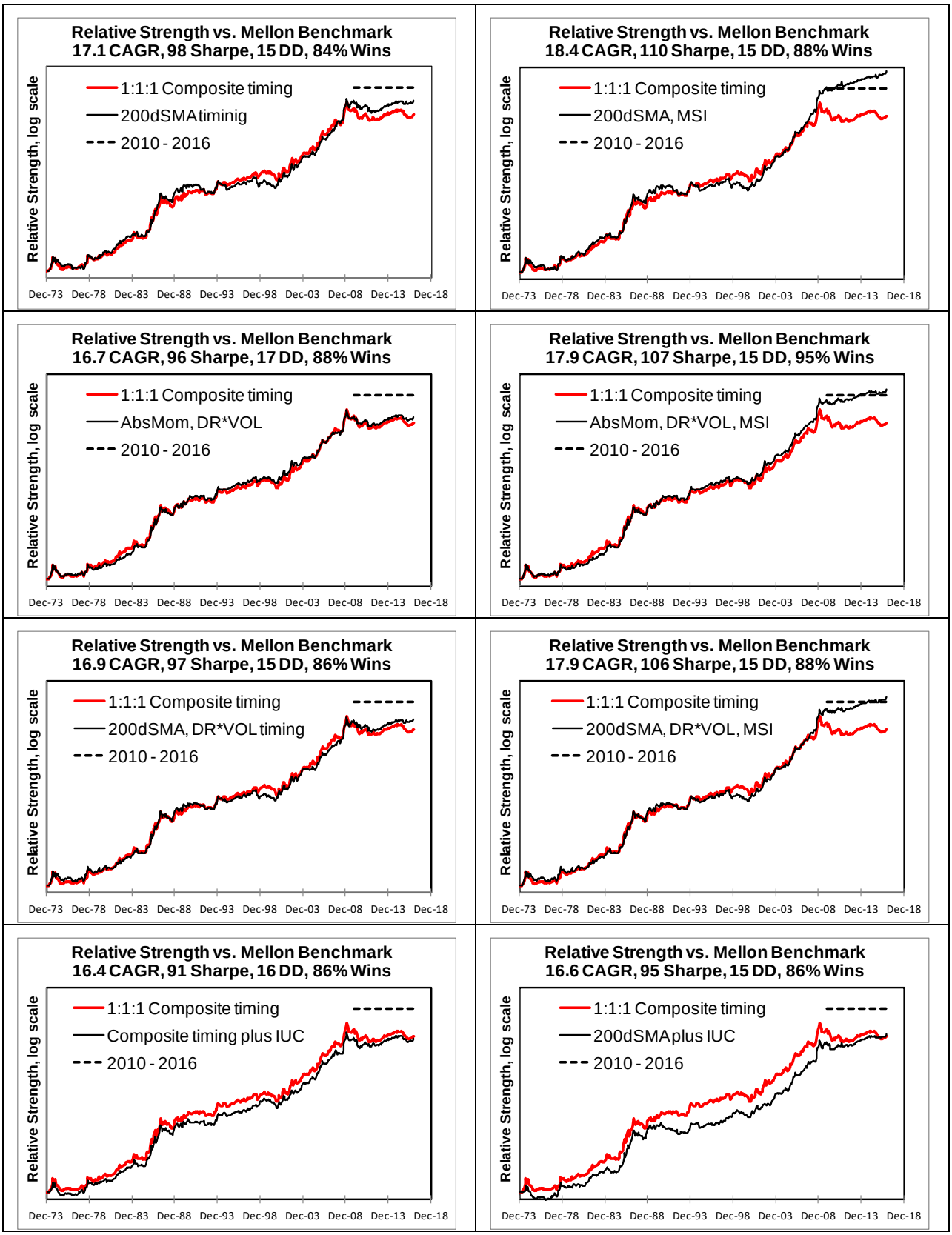
Relative strength plots have been assembled in Chart 17. In evaluating these plots, I sought to maintain the pre 2010 performance as evidenced by the black curve falling near the red curve.

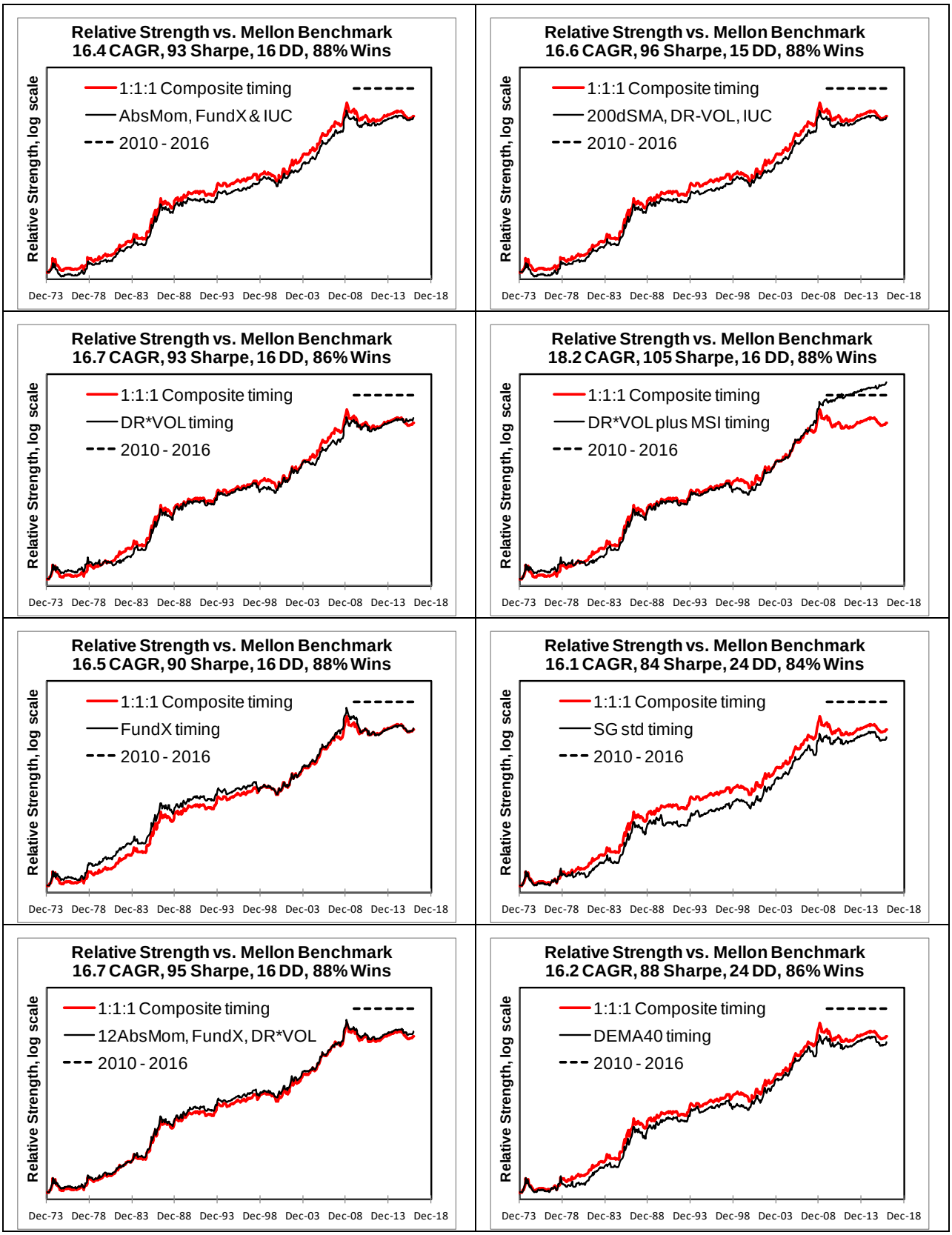
Chart 17. Relative Strength of the SIMPLE portfolio for Combinations of Timing Algorithms, 1974 - 2016. Allocation is based on equal weights of the relative momentum, FundX and DEMA6 allocation algorithms. The statistics for composite timing over this interval are 16.5 CAGR, 92 Sharpe, 16 MaxDD and 88% Wins versus the 60:40 benchmark.

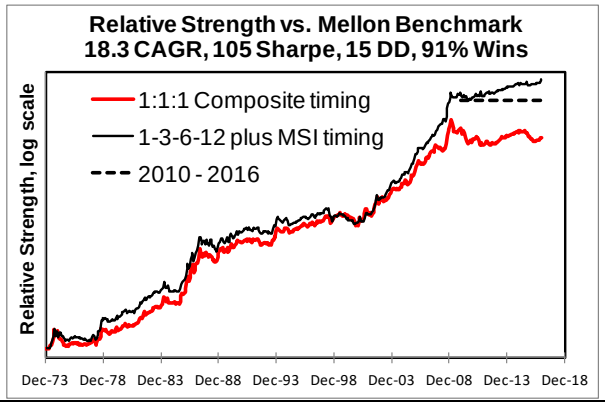
Before MSI timing signals become available in 1999, the composite timing signal is based on an equal weighting of the other timers in the combination.











Three equal weight timer combinations would retain historical performance and improve recent performance. The combinations are

1. The Absolute Momentum and FundX timing algorithms plus MSI. This combination is easiest to implement but is relatively weak post 2009.
2. Absolute Momentum and DR*VOL timing algorithms plus MSI. This combination provides the highest "win" frequency.
3. DR*VOL timing algorithm plus MSI. This combination provides the best post 2009 return but is relatively weak in "win" frequency.

The MSI timing algorithm alone is another option.

	CAGR 1974-2016	CAGR 1974-2016	MaxDD 1974-2016	Wins 1974-2016	CAGR 2010-2016
AbsMom, FundX, MSI	17.9	106	15	91%	9.5
AbsMom, DR*VOL, MSI	17.9	107	15	95%	10.7
DR*VOL, MSI	18.2	105	16	88%	12.4
MSI					16.2

The risk of changing to a new timer is that the new timer may stop performing as hoped. Investors will have to decide whether this risk is acceptable or whether they prefer to stay with a composite which is not outperforming the benchmark but may improve.

There are three takeaways.

First, relative strength is an important tool for evaluating algorithm performance.

Second, it is unlikely that any algorithm is superior under all market conditions. We need to develop an algorithm which can adjust the composite timer to current market conditions.

Third, consideration should be given to one of the three composite timers discussed above. Aggressive investors might choose the MSI timer alone.

Portfolio Visualizer Has Implemented Dual Momentum

Portfolio Visualization[46] has implemented the "How to Use It" version of Dual Momentum that Antonacci describes in Figure 8.4 of his book. Antonacci used the "2-step" method, described on his p. 98, when constructing his figures and tables.

The "How to Use It" method underperforms as can be seen in the following table. Trades are on the month-end signal dates.

12/29/1989 – 12/31/2016	CAGR	Sharpe	MaxDD
SIMPLE portfolio: VFINX, HAINX and VBMFX			
Portfolio Visualizer	11.7	71	25
2-Step	13.1	84	21
28 Fidelity Select Funds, top 1			
Portfolio Visualizer	14.6	56	41
2-Step	14.9	59	38
28 Fidelity Select Funds, top 6			
Portfolio Visualizer	16.2	77	35
2-Step	17.3	90	23

Source: PoerfolioVisualizer.xlsx

The explanation for the lower performance of Portfolio Visualizer with the SIMPLE portfolio is that the How to Use It method allocates to foreign stocks in months when the 2-step method allocates to bonds.

I am told that Portfolio Visualizer has been updated to use the 2-step Dual Momentum algorithm. I have not tested the update.

[46] Portfoliovisualizer.com, a free service.

Other Considerations

You may have noticed that trades occurred on the signal date in some of the simulations and on the day after the single date in others. It is only possible to trade on the month-end signal date in simulations before 1990 as the data are only available at monthly intervals. Trading on the day after the signal date is likely to be more realistic for many investors.

You probably did not notice that I used different simulators with the monthly and daily data.

What are the effects of trading on the signal date as opposed to the day after the signal date and what are the differences in the results of the two simulators? Table 16 investigates.

Changing the trade date produces small differences in the returns and other statistics. The direction of the changes is not the same for all algorithms.

Table 16. Effects of Simulator and Trade Date, SIMPLE Portfolio. Stocks are represented by spliced VFINX and by spliced HAINX and bonds are represented by spliced VBMFX. DEMA4 measures the trend based on monthly data and a 4 month trend constant. DEMA70 measures the trend based on daily data and a 70 day trend constant.

1990 – June 2016	CAGR	Sharpe	Max DD
FundX & composite timing			
EXCEL, trade same day	12.95	84.5	17.6
C#, trade same day	12.95	82.6	17.6
C#, trade next day	12.87	83.5	18.7
Relative Momentum & composite timing			
EXCEL, same day	12.79	82.4	17.3
C#, same day	12.79	82.4	17.3
C#, next day	12.94	83.7	18.1
DEMA & composite timing			
EXCEL, DEMA4, same day	13.31	85.7	19.0
C#, DEMA70, same day	13.48	87.2	16.7
C#, DEMA70, next day	13.31	86.5	17.1

Source: Monthly Allocations 1952-2016 revised 09132016.xlsb; Deterministic 09162016.xlsb, workbook "2 Funds".

There are modest differences in return, Sharpe ratio and drawdown between the simulators for the DEMA algorithm. The EXCEL simulator uses the monthly DEMA approximation with a 4 month trend constant while the C# simulator uses the daily DEMA algorithm with a trend constant of 70 days.

I have neglected the effects of simulator and trade date in this report since the differences are small in comparison to the performance gains associated with momentum management.

The performance of a managed portfolio is often reduced by an estimate of trading costs. While it is appropriate to correct for trading costs, the correction should employ an estimate of future costs. Our goal, after all, is to estimate how the algorithm might perform if historical market conditions were to reappear in the future.

There is usually no commission associated with exchanging one mutual fund for another in the same family.

Selling an exchange traded fund and buying another involves a commission of less than $20, which is only 0.02% on a hundred thousand dollar portfolio.

FolioInvesting.com allows investors 2,000 "window" trades of stocks, mutual funds and ETFs each month for a $290 annual fee. The commission is $3 per trade for market, limit, stop and stop limit orders. Vanguard charges a $2 per trade for investors with account balances of $500,000 or more.

More important are the effects of intra-day price movements and of bid-ask spreads. Intra-day price movements can be a half percent or more for or against your positions but these intra-day price movements should average out over many trades.

The bid ask spread for liquid, index-like exchange traded funds (VTI, VEU, VNQ and BND) is on the order of 0.02% per round trip. The spread is on the order of 0.1% per round trip for the NASDAQ 100 components[47]. Bid ask-spreads reduce returns by a negligible amount for the SIMPLE and 28-fund universes assuming that they are implemented with funds or ETFs and by about 1% a year for the NASDAQ 100 universe.

Trading costs appropriately include any tax liability or benefit resulting from the trade. There is no current tax liability or benefit if the trade occurs in an IRA, 401k or 403b account.

My conclusion is that trading costs do not diminish in any substantive way the potential gains from the momentum strategies discussed here.

Some mutual funds impose frequent trading fees. Holding for less than 30 calendar days costs 0.75% for some Fidelity funds. Vanguard makes it difficult to repurchase a Vanguard fund which was sold a month or two previously.

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[47] Al Zmyslowski illustrated an easy way to harvest bid-ask spreads at the December 1, 2016 Silicon Valley CIMI meeting. Using his approach, bid-ask spreads were measured at six approximately hourly intervals from 1030 EST on December 8, 2016 to 1534 EST on the same date. The average spread for liquid ETFs was 0.015% and for the NASDAQ 100 components was 0.042%.

Source: YahooQuotes.xlsm.

The average spread is about the round trip cost since one pays half of the spread at the time of purchase and another half of the spread at the time of sale.

I readily acknowledge that one day of measurements is not sufficient to fully define the spreads.

Conclusions

- Relative Strength is an important tool to understanding the relative performance of the timing and allocation algorithms.
- Each of three timing algorithms underperformed the others for decade long intervals. The recommendation is to reduce the risk of underperformance by employing a composite based on several timing algorithms.

  Future research may confirm that it is possible to switch from an underperforming timing algorithm based on actual performance/
- Performance statistics for the SIMPLE portfolio are not strongly affected by the allocation algorithm. A composite of several allocation algorithms is recommended.

  The inclusion of the DEMA algorithm is not essential for the SIMPLE portfolio but DEMA is advantageous for more complex portfolios.
- The SIMPLE portfolio provides excellent returns and attractive drawdowns.
- The SIMPLE portfolio is easily managed and should provide substantial performance gains for risk adverse investors.

1990 – 2016	**CAGR**	**Sharpe**	**MaxDD**
Unmanaged S&P 500®	9.3	49	51
SIMPLE, composite allocation, and AbsMom, SGstd and FundX timing	13.1	86	18
SIMPLE, composite allocation, and AbsMom, FundX and MSI timing	15.3	110	15
Wellington™, VWELX, 33% bonds	9.4	70	33
BNY-Mellon Benchmark, 40% bonds	8.2	62	33
Wellesley Income, VWINX, 65% bonds	8.6	90	19
S&P 500® Dividend Aristocrats®[48]	11.4	68	44
Shadow Stocks, 1993-2016 with composite timing	16.0 16.5	76 96	63 26
28 US funds, composite allocation[49], composite timing, equal weighted top6	18.8	103	18

[48] Due to Dividend Aristocrats® data limitations, CAGR is reported for the 1990-2016 interval and the Sharpe ratio and maximum drawdown are reported for the 2007-2016 interval. SP Dividend Aristorcrats.xlsx.

[49] Equal weight FundX, Relative Momentum and DEMA20 allocation algorithms.

Source: 28 Deterministic January 2017.xlsb.

- Performance of the SIMPLE portfolio since the 2008 bear market suggests a need for improvements to the composite timer. Several timers are suggested which maintain historical performance while improving post 2009 results.
- Multi-fund strategies provide more return than the SIMPLE and Shadow Stock portfolios with attractive drawdowns.
- Selection Bias is reduced by building inclusive portfolios.
- Drawdown is reduced by allocating to more than the single top fund.

Acknowledgement

It is said that progress comes from standing on the shoulders of others. Peter salutes Scott Juds, Don Maurer, the late John Nicholas and Al Zmyslowski for their considerable assistance.

Appendices

A. Determining the DEMA Trend

B. The 32 and 74-Fund Opportunity Sets

C. The Risk Index

D. Timing Algorithms

Appendix A. Determining the DEMA Trend

SectorSurfer® uses double exponential moving averages (DEMA).

The calculation of the exponential moving average of daily returns is algebraically equivalent to calculating the weighted sum of the daily returns.

$$EMA = \sum W(red) * Daily\ Return$$

The weights are given by the red line in Chart A-1.

The red weights are “exponential" because the values of the weights approximate the exponential $e^{-\alpha t}$, where t is the number of market days before the measurement date and α is a smoothing factor.

A double exponential moving average is the exponential moving average of the exponential moving average.

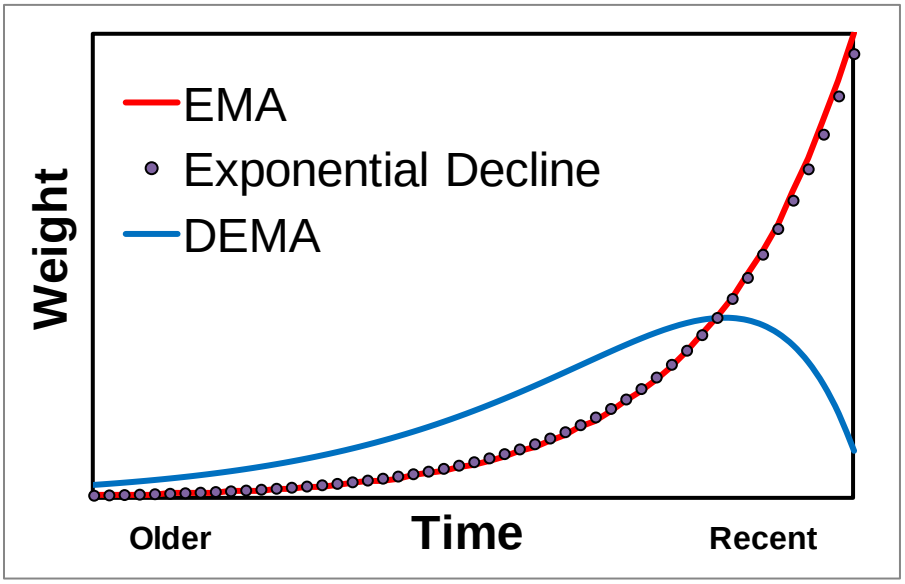
$$DEMA = \sum W(red) * \sum W(red) * Daily\ Return$$

The double exponential moving average is equivalent to the weighted sum of the daily returns with weights defined by the blue line in Chart A-1[50].

$$DEMA = \sum W(blue) * Daily\ Return$$

The blue line in Chart A-1 illustrates that the double exponential moving average places less emphasis on the current returns, the highest emphasis on the returns a few weeks or a few months ago and a decreasing emphasis on older returns.

Chart A-1. Weighting Functions, Exponential Averaging. Reference: theory.xls.

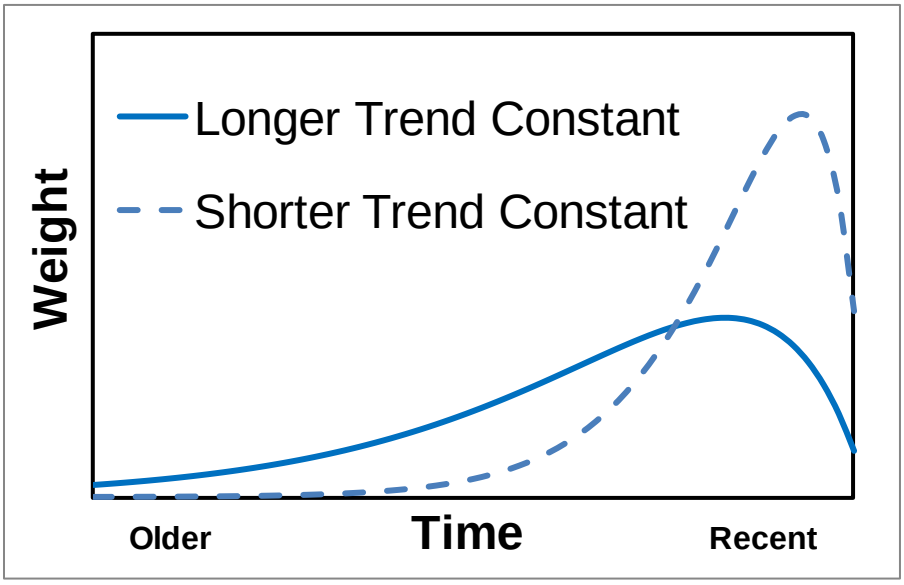


[50] This assumes that the smoothing factors are the same for both moving averages.

A parameter, which Juds calls the "trend constant," determines the time span over which the DEMA puts the most emphasis. A smaller value of the trend constant puts a greater emphasis on near term returns, as is illustrated in Chart A-2.

Juds' formulation of the DEMA algorithm differs from the usual formulations in that Juds defines the smoothing factor as the reciprocal of the trend constant.

Chart A-2. Effect of Trend Constant on DEMA Weighting. Reference: theory.xls.



Juds observed that the value of the trend constant affects the backtested investment performance. He introduced an optimization routine to periodically adjust the trend constant. Juds calls this process "forward walk progressive tuning" or FWPT.

The Monthly DEMA Approximation.

SectorSurfer® calculates double exponential moving averages from daily returns. The StormGuard® standard timing algorithm can be determined from December, 1950. Daily data for the S&P Composite without dividends are available from December, 1950 and the StormGuard® standard timing algorithm can be determined from 1952. (The delay is due to the time required for the algorithm to initialize.)

Daily mutual fund price data are not generally available before September 1988. Thus the SectorSurfer® daily DEMA allocation algorithm cannot be calculated before about 1990 for most funds.

Monthly data are available for foreign stock and REIT indices from the 1970s. A DEMA allocation algorithm based on monthly returns would allow additional years of backtesting of SectorSurfer®.

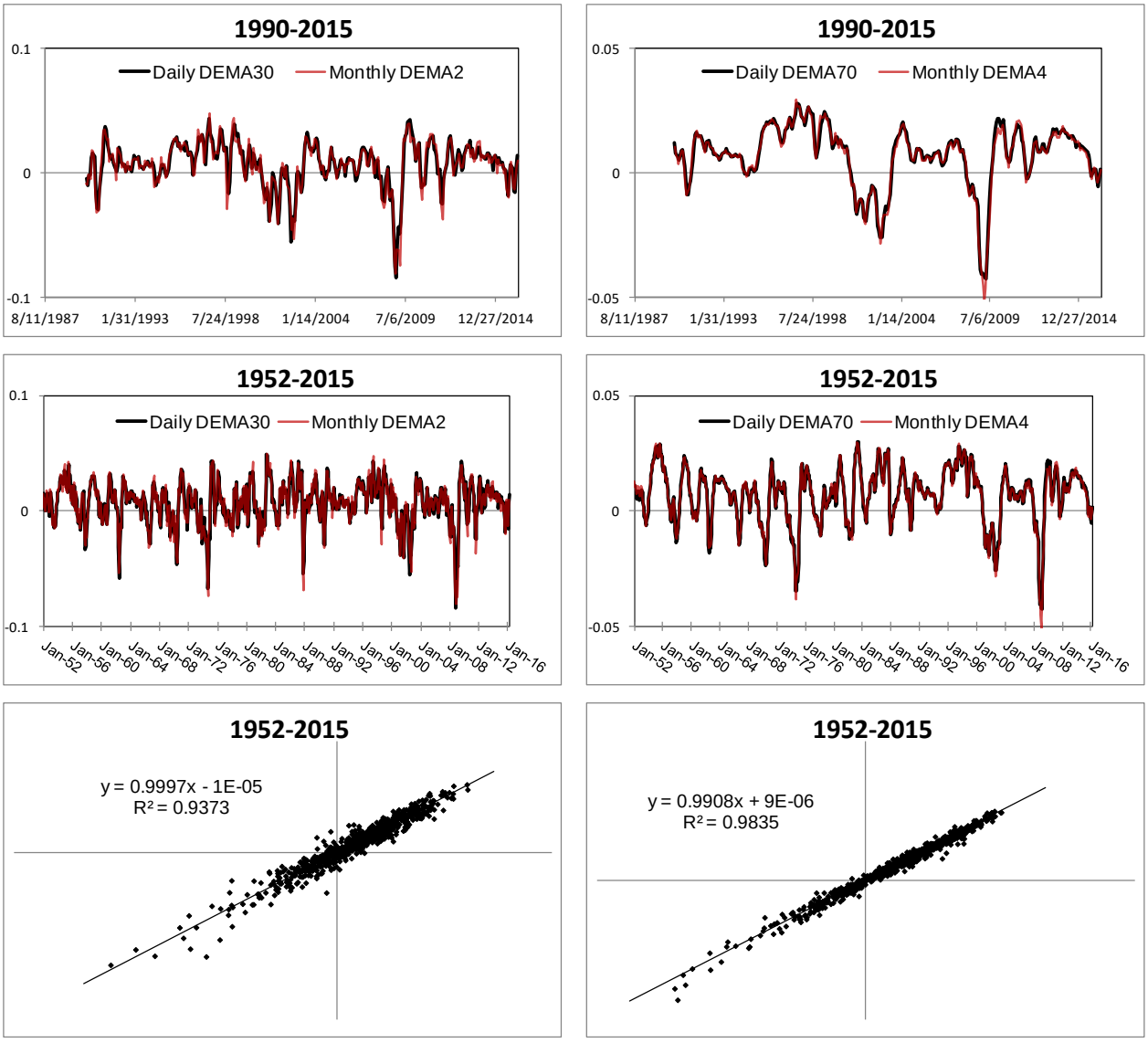
SectorSurfer® scales the daily returns in order to approximate monthly returns. Scaling is not needed when basing the allocation decision on monthly data.

Removing the scaling factor and reducing the trend constant produce DEMA trends based on monthly returns which approximate the DEMA trends from daily returns.

The monthly trend constant should be about equal to the daily trend constant reduced by a factor equal to the number of market days in a typical month. The reduction factors were chosen to maximize the value of R-squared of the difference between the two distributions. For example, a monthly constant of two months corresponds to a daily trend constant of thirty days.

Chart A-3. DEMA Based on Daily or Monthly Values. S&P Composite without dividends. The red curves nearly superimposes on the black curves.

The black points are the differences between the monthly and daily DEMAs.



Source: forecasting with monthly data.xlsb.

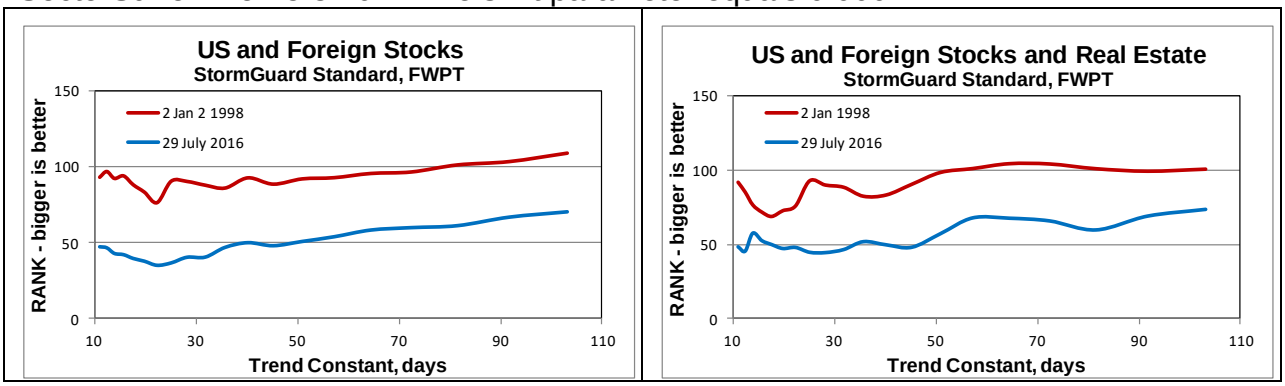
As shown in Chart A-3, DEMA trends calculated from monthly data using a trend constant of 2 months match the DEMA trends calculated from daily data using a trend constant of 30 days with an R-squared of 94%[51].

Trend constants of 4 months and 70 days provide similar DEMA trends with an R-squared of 98%. Rounding out the list, 3 months correlates with 50 days (R-squared 97%) and 5 months correlates with 90 days (R-squared 99%).

Knowing the relationship between the daily and monthly trend constants does not address the value of the trend constant needed for allocation decisions.

SectorSurfer® uses "tuning plots" to determine the value of the optimum value of the trend constant to be used in the allocation algorithm. The optimum trend constant is the value which maximizes RANK, a SectorSurfer® measure of return[52].

Chart A-4. SectorSurfer® Tuning Plots. FWPT adjusts the value of the trend constant at six month intervals to a value near the maximum in the tuning plot. US stocks are represented by VFINX, foreign stocks by HAINX and real estate by FRESX. SectorSurfer® ver. 5.3.201. The shift parameter equals 0.006.



Source: Monthly Allocations January 2017.xlsb. Workbook: SS.

Chart A-4 illustrates how RANK is affected by the value of the trend constant for the SIMPLE portfolio (left) and the SIMPLE portfolio plus real estate (right).

The tuning plots do not show pronounced maxima and are similar in 1998 and 2016. SectorSurfer sets the value of the trend constant equal to 103 days for the SIMPLE portfolio. The average value of the trend constant is 94 days for

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[51] The values of R-squared correspond to the trend constants quoted. Marginally better values of R-squared are possible if the daily trend constant is changed by a few days.

[52] SectorSurfer® ver. 5.0.85 defines RANK as the annualized return through the tuning date plus the annualized return over the 3 years ending on the tuning date divided by the sum of 0.4 + RiskofLoss.

RiskofLoss is defined as the average of the rolling 1-yr returns (losses only; gains are neglected) over the period prior to the retuning date.

RANK is defined differently at the initial tuning which is why the red curves lie above the blue curves.

RANK may be defined differently in later versions of the software.

the SIMPLE portfolio plus real estate. These values of the trend constant correspond to a monthly trend constant of about 5 months.

Table A-1 compares the statistics for SIMPLE portfolio managed using SectorSurfer® and the monthly approximation. DemaOpt and SectorSurfer® trade on the day after the signal date.

Table A-1. Statistics for US Stocks (VFINX) and Foreign Stocks (HAINX), 1990 - 2016. Month-end signals; trade next day. The table also shows the average allocation to US and foreign stocks and to bonds. SectorSurfer® ver. 5.3.201.

	US Stocks	Bonds	Foreign Stocks	CAGR	Sharpe	Max DD	Max DD Date
Buy and Hold	0.300	0.400	0.300	5.7	38	36	2/2009
DEMA(TC=4) & StormGuard Std	0.460	0.157	0.383	13.6	83	24	10/2008
DEMA(TC=5) & StormGuard Std	0.481	0.157	0.361	14.0	85	24	10/2008
DEMA(TC=6) & StormGuard Std	0.481	0.157	0.361	14.7	89	24	10/2008
DemaOpt, StormGuard Std	0.441	0.157	0.401	14.2	89	20	10/2008
SectorSurfer(FWPT) & StormGuard Std	0.495	0.154	0.351	14.9	91	23	10/2008

Source: Monthly Allocations January 2017.xlsb; Appendix3_DemaOpt.xlsb

The monthly DEMA approximation provides similar statistics and similar average allocations as compared to SectorSurfer®[53] when trading on the day after the signal date.

Table A-2 summarizes the statistics for the SIMPLE portfolio plus real estate.

[53] Performance statistics, including the maximum drawdown, were calculated by the author from month-end values drawn from the daily SectorSurfer®' equity curve.

Table A-2. Statistics for US Stocks (VFINX), Foreign Stocks (HAINX) and Real Estate (FRESX). SectorSurfer® statistics were calculated from the monthly equity curve. SectorSurfer® ver. 5.3.201.

1990 - 2016	US Stocks	Bonds	Foreign Stocks	RE	CAGR	Sharpe	Max DD
24:24:12:40 Buy & Hold	0.240	0.400	0.240	0.120	7.4	52	37
Dual Momentum, 2-Step	0.249	0.215	0.148	0.388	12.8	56	18
DEMA(TC=4), StormGuard Std	0.256	0.157	0.185	0.401	14.2	86	25
DEMA(TC=5), StormGuard Std	0.278	0.157	0.151	0.414	13.5	83	25
DEMA(TC=6), StormGuard Std	0.302	0.157	0.120	0.420	13.1	79	25
DemaOpt, StormGuard Std	0.194	0.157	0.262	0.386	15.1	89	20
SectorSurfer(FWPT), StormGuard Std, TC = 0.006	0.245	0.154	0.182	0.419	16.3	97	23

Source: Monthly Allocations January 2017.xlsb; Appendix3_DemaOpt.xlsb

SectorSurfer® performs differently from the monthly DEMA approximation with the SIMPLE portfolio plus real estate. SectorSurfer® allocates more frequently to real estate and less frequently to foreign stocks. SectorSurfer® provides an extra hundred basis points of return, higher Sharpe ratio and slightly lower maximum drawdown.

The good performance of SectorSurfer with the SIMPLE portfolio plus real estate over the 1990 – 2016 interval differs from the poor performance reported on p. 39 for the 2010 – 2016 interval.

The combination of StormGuard (shift = 0.006) and the monthly DEMA approximation are referenced in this report as the "monthly SectorSurfer strategy."

The monthly SectorSurfer strategy is a reasonable approximation for SectorSurfer® in situations, as with the SIMPLE portfolio, where RANK is not sensitive to the trend constant.

Appendix B. The 28, 32 and 74-Fund Opportunity Sets

There are two systems for classifying US companies. The first is the Global Industry Classification Standard system. The GICS system is preferred by MSCI and Standard & Poor's. The second system is the Industry Classification Benchmark system. The ICB system is preferred by Dow Jones and FTSE. Both systems divide US companies into eleven primary categories; real estate was separated from the rest of the financial category in 2016.

There are data for the GICS categories back to at least 1970.

The eleven SPDR sector funds were developed by State Street Global Advisors based on the GICS classification system. Investments are limited to the companies in the S&P 500 Composite. There are price data for nine of these funds from December 1998.

The ten iShares Dow Jones Sector ETFs employ the ICB classification system. Investments are drawn from all of the companies in the Dow Jones US Index. These sector funds therefore include the stocks of smaller firms that are excluded from the SPDR sector funds. There is also an iShares US real estate fund. There are data for the iShares funds from mid 2002.

Vanguard has ten funds based on the ten GICS categories. Vanguard also offers a real estate index fund. The Vanguard funds are available as both mutual funds and ETFs. Data are generally from 2004.

Vanguard has three actively managed sector funds with long histories.

There are many actively managed Fidelity Select funds[54]. The Fidelity funds are more focused than the GICS or ICB categories and they often provide higher and more volatile returns. The frequent manager changes suggest that past performance vis-à-vis a sector could be different from future performance vis-à-vis the same sector.

The 32 funds shown in Table F-1 were obtained by eliminating the funds without data histories from September 1988, by eliminating the funds that invest in more than one category and by eliminating money market funds.

FSAVX was unwisely omitted because I considered it too volatile. A prima face example of selection bias!

GD-PM was included so as to be able to track the price of gold bullion over a longer period than is possible using GLD, an exchange traded fund which tracks the price of gold with history from 2004. The price of GLD steadily underperforms GD-PM by about the expense ratio of GLD, 0.4% annually.

The price history of GLD bears little relationship to the price history of FSAGX or VGPMX.

[54] There were 46 Fidelity Select funds 2014. This included FRXIX, which is a different share class of FSRVX the Dow Jones Real Estate Index fund. This total also included FSPFX and FNINX which have been discontinued.

Table B-1. The 32 Fund Universe. The percentage figures indicate a fund's allocation to its sector; for example, FIDSX holds mostly financial stocks and about 5% technology stocks. Sector allocations are from Fidleity.com under the "Composition" tab and reflect allocations as of December 31, 2013 or thereabouts. Ticker symbols for the 19 funds used to construct the 10 of 19 portfolios are preceded by asterisks.

Ticker	Category[55]	Name or Description
*FBIOX	Healthcare 99%	Biotechnology
FBMPX	Discretionary 98%	Multimedia
*FDCPX	Technology 99%	Computers
*FDFAX	Staples 97%	Consumer Staples
*FDLSX	Discretionary 98%	Leisure
*FIDSX	Financial, 5% Tech	Financial Services
FRESX	Real Estate	Real Estate
*FSAGX	Precious Metals (Materials)	Gold stocks and gold bullion
*FSAIX	Industrial 93%	Air Transportation
FSCGX	Industrial, 3% Discretionary	Industrial Equipment
*FSCHX	Materials 97%	Chemicals
*FSCSX	Technology, 3% Discretionary	Software & Computer
*FSDAX	Industrial, 2% Materials	Defense & Aerospace
FSDPX	Materials, 2% Energy	Materials
*FSELX	Technology 95%	Electronics
*FSENX	Energy 96%	Energy
*FSESX	Energy 99%	Energy Services
FSHCX	Healthcare 95%	Medical Delivery
*FSLBX	Financial 97%	Brokerage & Investment Mgmt.
FSPCX	Financial 97%	Insurance
*FSPHX	Healthcare 96%	Healthcare
*FSPTX	Technology, 5% Discretionary	Technology
FSRBX	Financial, 2% Technology	Banking
FSRFX	Industrial, 2% Energy & Financial	Transportation
FSRPX	Discretionary, 4% Staples & Tech	Retailing
*FSTCX	Technology, 9% Financial	Telecommunications

[55] The IT and telecommunications categories have been combined. FSAGX and VGPMX invest in Precious Metals, a subsector of Materials. FSAGX has an allocation to gold bullion and VGMPX has a modest allocation to Industrials.

*FSUTX	Utilities, 19% Energy	Utilities
*FSVLX	Financial, 19% Technology	Consumer Finance
GD-PM	Precious Metals	Gold Price, London PM Fixing
VGENX	Energy	Energy
VGHCX	Healthcare	Healthcare
VGPMX	Precious Metals (89% Materials, 11% Industrials)	Mining and Exploration for Precious Metals

Experience with the 32 fund universe suggests that several funds could be eliminated.

- There is seldom allocation to a fund if the return is correlated to the return of a more volatile fund. For example, there is seldom allocation to the Vanguard funds because the Fidelity Select funds with similar objectives are more volatile.

  The less volatile fund could probably be eliminated without introducing selection bias but the simulator seems undeterred by the presence of less volatile funds.

- It is desirable to have all of the investment choices in the same mutual fund family because of the practical challenges in trading between fund families in accounts where margin in not an option.

What these observations mean for the 32-fund universe is that the Vanguard funds might be eliminated. The precious metal funds might be eliminated if you do not see yourself investing your entire portfolio in gold bullion.

Backtesting shows that there have been times when precious metals were important investment options.

The 28 fund universe is the 32-fund universe plus FSAVX and less the precious metal and Vanguard funds.

Less thought went into the construction of the 74 fund Global Opportunity Set. The primary purpose in creating this universe was to test how the simulator would perform with so many choices. It seemed to do just fine. Several country ETFs were omitted from the Global Opportunity set because of low trading volumes.

Table B-2. The 74 Fund Global Opportunity Set includes the funds in Table B-1plus the funds in Table B-2 and plus FSAVX.

Ticker	Name or Description	History
ECH	Chile	Nov 2007
EIDO	Indonesia	May 2010
EPHE	Philippines	Sep 2010
EPOL	Poland	May 2010
EPU	Peru	Jun 2009
ERUS	Russia	Nov 2010
EWA	Australia Index (iShr)	Mar 1996
EWC	Canada Index (iShr)	Mar 1996
EWD	Sweden Index (iShr)	Mar 1996
EWG	Germany Index (iShr)	Mar 1996
EWH	Hong Kong Index (iShr)	Mar 1996
EWI	Italy Index (iShr)	Mar 1996
EWJ	Japan Index (iShr)	Mar 1996
EWK	Belgium Index (iShr)	Mar 1996
EWL	Switzerland Index (iShr)	Mar 1996
EWM	Malaysia Index (iShr)	Mar 1996
EWN	Netherlands Index (iShr)	Mar 1996
EWO	Austria Index (iShr)	Mar 1996
EWP	Spain Index (iShr)	Mar 1996
EWQ	France Index \(iShr)	Mar 1996
EWS	Singapore Index (iShr)	Mar 1996
EWT	Taiwan (iShr)	Jun 2000
EWU	United Kingdom Index (iShr)	Mar 1996
EWW	Mexico Index (iShr)	Mar 1996
EWX	Emerging Markets Small Cap (SPDR)	May 2008
EWY	South Korea (iShr)	May 2000
EWZ	Brazil (iShr)	Jul 2000
EZA	South Africa	Feb 2003
FXI	China Large Cap (iShr)	Oct 2004

INDA	India (iShr)	Feb 2012
THD	Thailand	Mar 2008
TUR	Turkey	Mar 2008
FSAVX	Automotive	Sep 1988
FSCPX	Consumer Discretionary	Jun 1990
FSDCX	Communications Equipment	Jun 1990
VEIEX	US Extended Market	May 1994
VEURX	European Large Cap	Jun 1990
VEXMX	US Extended Market	Sep 1988
VGTSX	World ex-US	Apr 1996
VPACX	Pacific Large Cap	Jun 1990
VBMFX	Intermediate Term Bonds	Sep 1988
VUSTX	Long Term Treasury Bonds	Sep 1988

Appendix C. The Risk Index

The Siegel Timing Strategy

A 200dSMA timer compares the daily price of a "risk index" to the 200-day simple moving average (SMA) of the risk index. This appendix shows that the performance of the 200dSMA is influenced by whether signals occur daily or monthly and by the nature of the risk index.

Siegel made unfortunate choices with respect to both parameters[56].

Siegel bases his timer on the daily dividend adjusted prices of the Dow Jones Industrial Average (DJITR). In S&P's parlance, the DJITR is the "risk index."

Siegel's algorithm buys stocks when the price of DJITR is at least one percent above its 200dSMA and sells stocks when the price of DJITR is at least one percent below its 200dSMA.

Decisions are made daily. The comparison between price and 200dSMA is made at the close on the signal date and trades occur at the close on day after the signal date.

The purpose of the one percent tolerance is to reduce the risk of trading just before the market reverses direction. The round trip associated with premature trading often results in a "whipsaw" loss.

Siegel invests his cash position in Treasury Bills.

Siegel concludes

The buy-and-hold strategy from 2001 to 2012 beats the timing strategy by more than 2 percentage points per year even before transaction costs are factored in. ... Although the returns from the timing strategy often fall behind that of a buy-and-hold investor, the major gain from the timing strategy is that the timing investor is out of stocks before the bottom of every major bear market. Since the market timer is in the market less than two-thirds of the time, the standard deviation of returns is reduced by about one-quarter over the returns of a buy-and-hold investor. This means that on an annual risk-adjusted basis, the return on the 200-day moving-average strategy is still impressive, even when transaction costs are included[57].

The statistics in Table 1 confirm Siegel's observation that daily timing with the DJITR as the risk index reduces the return (bad) and reduces the standard deviation (good) over this interval as compared to the unmanaged portfolio.

Siegel was too quick to generalize from this observation. Table 1 also shows that making timing decisions at the end of the month, rather than daily, or

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[56] Jeremy J. Siegel, *Stocks for the Long Run*, McGraw-Hill, 5th Edition, 2013, Chapter 20 and Table 20-1.

[57] Jeremy J. Siegel, *op. cit.*, Chapter 20.

using the S&P 500 Composite without dividends as the risk index provides a higher return, a higher Sharpe Ratio and a lower drawdown than the unmanaged portfolio.

Table C-1. Timing the Dow Jones Industrial Average Total Return Index, 2001-2012. The first signal is on Dec. 29, 2000, annualized returns are measured as of Dec. 31, 2012, statistics are determined from the monthly equity curve, tolerances are 1% and cash is represented by FSLXX. The first two rows are from Siegel, Table 20-1.

When two entries are shown for a statistic, the first entry corresponds to trading on the signal data and the second corresponds to trading on the day after the signal date. The offset in trade date has no effect for monthly timing to within the precision shown.

	Risk Index	CAGR	Standard Deviation[58]	Sharpe Ratio[59]	Maximum Drawdown
DJITR, B&H		4.07	16.4	not reported	not reported
DJITR, daily timing	DJITR	1.33	12.3	not reported	not reported
DIA, B&H		4.06	15.0	22	47
DJITR, B&H		4.15	15.1	23	47
DIA, daily timing	DIA	2.45/2.18	9.9/10.1	11/9	42/42
DJITR, daily timing	DJITR	3.20/3.03	9.9/9.7	19/17	38/38
DJITR, daily timing	DJ-30	1.63/1.54	9.5/9.6	3/2	44/44
DJITR, daily timing	SP-CP	5.42/5.21	9.6/9.7	44/41	11/12
DIA, monthly timing	DIA	6.22	8.6	53	28
DJITR, monthly timing	DJITR	6.34	8.7	54	29
DJITR, monthly timing	DJ-30	5.11	8.3	43	24
DJITR, monthly timing	SP-CP	7.95	7.8	79	11
DJITR, monthly timing	VFINX	8.55	8.3	82	9
BNY-Mellon Benchmark	B&H	4.70	9.8	34	33

Source: DailyMarketTimer.xlsb

[58] SQRT(12) times the monthly standard deviation.

[59] SQRT(12) times the arithmetic average of the reduced monthly returns divided by the standard deviation of the reduced monthly returns. The reduced monthly return is the return in a specific month less the T-bill return for that month (Ibbotson SBBI data).

The Faber 10mSMA Indicator

Faber uses the S&P Composite with dividends reinvested as the risk index when calculating his timing indicator[60].

Faber's indicator signals a move to cash, or from cash, when the price of the S&P Composite with dividends reinvested is less than, or larger than or equal to, the 10-month simple moving average (10mSMA) of his risk index.

There is no tolerance band. Faber makes decisions and executes trades at the close on the last day of the month. He neglects transaction costs, as did Siegel, and invests his cash position in 90-day Treasury Bills.

Table C-2. Timing the Dow Jones Industrial Average Total Return Index Using Faber's 10MOM Algorithm, 2001-2012. Statistics are from the monthly equity curves, the tolerances are zero, trades are on signal date, and cash is represented by FSLXX.

	Risk Index	CAGR, %	Standard Deviation	Sharpe Ratio	Maximum Drawdown
DJITR, B&H		4.15	15.1	23	47
DJITR, monthly timing	VFINX	7.80	8.3	73	14
DJITR, monthly timing	SP-CP	8.26	8.2	79	11
DJITR, monthly timing	DJITR	5.95	8.8	50	29
BNY-Mellon Benchmark	B&H	4.70	9.8	34	33

Source: DailyMarketTimer.xlsb

Faber's 10mSMA bests the BNY-Mellon benchmark in terms of CAGR for all three risk indices and bests the benchmark in terms of drawdown for the S&P Composite, with or without dividends, as the risk index.

The final table in this appendix illustrates the effects of risk index for several algorithms. It can be seen that

- No algorithm is more effective with DJITR as the risk index.
- Differences between the S&P 500 Composite with and without dividends are small
- Using a bond fund to represent cash rather than a money market fund increases the return.

The 10-month MOM algorithm provides a lower drawdown than the Absolute Momentum algorithm over this interval.

[60] Mebane T. Faber "A Quantitative Approach to Tactical Asset Allocation." Working Paper May 2006, (the most recent revision is 2014) and *The Journal of Wealth Management*, Spring 2007.

Table C-3. Effects of Risk Index and Cash Representation, 1990 – June 2016. The algorithms are allocating between DJITR and cash using month-end signals. Tolerances are zero except where indicated. The trade date has no effect within the precision shown. SP-CP is the S&P Composite without dividends and Vanguard's Index 500 (VFINX) represents the S&P Composite with dividends.

	SP-CP and FSLXX			SP-CP and VBMFX			VFINX and VBMFX			DJITR and VBMFX		
	CAGR	Sharpe	MaxDD	CAGR	Sharpe	MaxDD	CAGR	Sharpe	MaxDD	CAGR	Sharpe	MaxDD
200dSMA (1%)	9.1	63	16	10.8	77	16	10.9	76	16	9.3	61	23
200dSMA	9.8	68	16	11.3	80	16	11.5	82	16	9.3	61	27
10mSMA	9.6	66	16	11.1	78	16	10.7	73	16	9.5	62	23
FundX	9.8	66	16	10.9	75	16	10.6	72	16	10.2	67	19
10MOM[61]	10.2	68	17	11.6	79	16	12.0	83	16	11.4	76	16
Absolute Momentum	10.9	71	17	11.7	76	21	11.7	75	20	9.6	57	31
DEMA50 (0.006)	10.9	71	17	11.7	76	21	11.7	75	20	9.6	57	31
Golden Cross[62]	9.5	64	16	10.7	74	16	11.3	77	16	9.2	58	28
SPVOL[63]	9.5	61	25	10.2	66	23	10.2	66	23	10.0	63	25

Source: DailyMarketTimer.xls

[61] The 10MOM indicator is bullish if the total return of the risk index is positive over ten months. The signal is bearish if the total return is negative.

[62] Golden Cross signals occur when the 50-day SMA of the daily price of the risk index crosses the 200-day SMA of the daily price of the risk index. The signal is bearish if 50SMA is declining at the crossover and bullish if 50SMA is rising at the crossover.

[63] Standard & Poors Dynamic Rebalancing Risk Control Indicator with a target volatility of 15% and no leverage. See Limiting Risk Exposure with S&P Risk Control Indices, February 2012; S&P Indices: Index Mathematics Methodology, January 2012; and S&P Risk Control Indices: Parameters, 5 January 2012.

Appendix D. Timing Algorithms

Trading signals are calculated from the price of the "Risk Index." Unless otherwise indicated, the risk index is the price of the S&P 500 Composite without dividends. Others calculate signals values from other risk indices.

Signals are available month-end from 1952 except as indicated.

xMOM The Return over x months. In general, the signal is bullish if the current price is higher than xMOM.

Antonacci's Absolute Momentum is bullish if 12MOM of the S&P Composite **including dividends** is higher than 12MOM of Treasury Bills.

We have used the following sources of data for T-Bills.

- The SBBI 1926-2014 dataset includes monthly returns of 1-month T-Bills. Ken French at Dartmouth College is continuing this series.
- Yahoo reports the daily equity curve of ^IRX, which is the value of the 13-week T-Bill, from 1960.
- BIL is a SPDR ETF which has tracked the Bloomberg Barclays 1-3 Month T-Bill since 2007.

xSMA or SMAx. The simple moving average of the daily price of the risk index over x days; alternatively, the simple moving average of monthly prices over x months.

The signal is bullish if the price is higher than xSMA. Siegel's 200dSMA and Faber's 10mSMA are examples of this algorithm[64].

Unless the text specifies otherwise, 200SMA as implemented here generates monthly signals calculated from the S&P Composite without dividends and uses zero tolerances.

Faber calculated his timing signals from monthly prices of the S&P Composite with dividends reinvested. Unless the text specifies otherwise, 10mSMA as implemented here generates monthly signals from the S&P Composite **with dividends** and uses zero tolerances.

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[64] Jeremy J. Siegel, *Stocks for the Long Run*, McGraw-Hill, 5th Edition, 2013, Chapter 20 and Table 20-1. Siegel concluded that timing reduces volatility but provides lower returns than buy and hold.

Mebane T. Faber "A Quantitative Approach to Tactical Asset Allocation." Working Paper 2014 and *The Journal of Wealth Management*, Spring 2007. Faber found "equity-like returns with bond-like volatility and drawdown."

We have confirmed the results of both Siegel and Faber and identified why their timing systems produce different results even though they average over similar time frames? The first reason is that is that Siegel makes timing decisions daily whereas Faber makes decisions monthly.

The second reason is that Faber measures the moving average of the S&P 500 Composite while Siegel measures the moving average of the thirty stocks in the Dow Jones Industrial Average.

The 10mSMA indicator performs slightly better when dividends are omitted.

xEMA or EMAx - Exponential moving average of the daily price of the risk index. Alpha = 2 / (1 + x). The signal is bullish if the price of the risk index is higher than xEMA.

GOOD or "Get Out of Dodge" – This indicator is attributed to Don Gimpel[65]. Enter the market when the 50-day EMA rises above the 200EMA and exit the market when the 75EMA falls below the 300EMA. Alpha = 2 / (1 + x). No tolerance.

Gimpel based his indicator on the dail values of SPY, which tracks the S&P Composite with dividends. As implemented here, the indicator is based on the daily values of the S&P 500 Composite without dividends.

This change allows GOOD to be evaluated from the 1950s but we have not tested the effect of this change.

EMA Golden Cross. EMA50 of the daily price crossing EMA200 of the daily price. The indicator is bearish if EMA50 is declining at the crossover and bullish if EMA50 is rising at the crossover. Alpha = 2/(1 + x).

Nicholas (formally FundX)– average of the returns S&P 500 Composite **with dividends** over 1-, 3-, 6- and 12-months[66]. The signal is bullish if the indicator is positive.

FundX Investment Management has used a similar algorithm since the 1970s to rank funds for momentum potential. FundX Investment Management does not use a timer.

Golden Cross - 50-day SMA of the daily price crossing the 200-day SMA of the daily price. The signal is bearish if 50SMA is declining at the crossover and bullish if 50SMA is rising at the crossover.

SPVOL - Standard & Poors' Dynamic Rebalancing Risk Control Indicator[67] allocates between stocks and cash based upon the current volatility of the S&P Composite without dividends. Target volatility is 18% annually; no leverage.

S&P has released a new timer based on synthetic puts.

StormGuard® standard – double exponential moving average of daily returns, Alpha = 1/50. The signal is bullish if 22*DEMA50 is more than the shift parameter.

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[65] Don Gimbel, Note 115: An Absolute Take-Out Signal, October 2013.

[66] John B. Nicholas, "Market Timers Yet Again," AAII Silicon Valley CIMI Group, August 10, 2015.

[67] Limiting Risk Exposure with S&P Risk Control Indices, February 2012; S&P Indices: Index Mathematics Methodology, January 2012; and S&P Risk Control Indices: Parameters, 5 January 2012.

SectorSurfer® adjusts the value of the shift parameter for each portfolio composition using an unknown algorithm. SectorSurfer® uses a shift of 0.006 in the published historical values of StormGuard® standard.

An increase in The StormGuard® "shift" parameter delays the move to cash when the market is falling and accelerates the return from cash when the market is rising.

Table D-1. Effect of "Shift" and Trend Constant When Timing US large Cap Stocks. Signals, trades, and rebalancing of the benchmark, occur at month-end.

TC/Shift	CAGR 1952-1973	Sharpe 1952-1973	MaxDD 1952-1973	CAGR 1974-2016	Sharpe 1974-2016	MaxDD 1974-2016	Trades 1952-2016
50/0.005	9.6	59	18	12.7	65	30	52
50/0.006	9.6	59	19	12.7	65	30	54
50/0.007	10.6	66	19	12.3	61	30	46
50/0.008	10.7	66	19	12.5	62	30	44
50/0.010	10.0	59	24	12.2	60	30	46
45/0.004	9.8	61	20	13.0	68	23	60
45/0.005	9.9	61	18	12.9	67	23	54
45/0.006	10.0	62	18	12.9	66	30	54
45/0.007	10.0	62	18	12.7	64	30	60
45/0.008	9.9	60	19	12.4	62	30	54
40/0.003	10.2	66	16	12.8	68	23	68
40/0.004	10.5	68	17	13.0	69	23	70
40/0.005	10.4	66	17	12.6	65	23	70
40/0.006	10.0	62	18	12.7	66	23	66
40/0.007	9.9	61	18	12.9	67	23	62
40/0.008	10.1	62	18	12.7	65	23	62
35/0.000	10.1	68	15	12.6	67	23	94
35/0.002	10.6	69	15	12.8	68	23	84
35/0.003	10.9	72	16	13.0	69	23	80
35/0.004	10.8	71	17	13.0	69	23	84
35/0.005	10.4	66	17	12.8	68	23	78
35/0.006	10.5	67	17	12.7	66	23	76
30/0.000	10.1	67	15	12.3	65	23	120

30/0.001	10.5	70	15	12.3	64	23	118
30/0.002	10.7	71	16	12.3	64	23	106

The result of increasing the value of the shift parameter is that the timer does not react to smaller market corrections. (Generally speaking, it is better to say invested during small corrections and to exit the market only during larger corrections and bear markets.)

The StormGuard® trend constant affects the speed with which the timer reacts to changing market conditions. A smaller value of the trend constant produces a more agile timer.

Table D-1 illustrates the effect of the trend constant and shift on performance in the 1952 - 1973 and 1974 - 2016 intervals. There are combinations which provide better performance in the first interval than the official parameter set (50, 0.6%) and similar or better performance in the second interval.

This information demonstrates the importance of the 1952-73 interval when optimizing a timing algorithm.

DR*VOL - DEMA50 of the product of the daily return of the S&P Composite without dividends times the daily volume, normalized by DEMA50 of the daily volume[68]. Alpha = 1/50. The signal is bullish if the indicator is positive.

WLIG+ - This is a weekly indicator developed by van Vuuren and Vrba[69] from the Weekly Leading Indicator Growth index. A positive value is bullish. The WLIg+ indicator can be calculated from 1968.

The Economic Cycle Research Institute publishes the Weekly Leading Indicator Growth index, generally on Friday mornings, based on data through the end of the prior week. Month-end signals using the WLIg+ indicator are lagged by at least one week and potentially by as much as two weeks.

Initial Unemployment Claims Timing Indicator. Presented to the CIMI group in March 2015 and again in April 2016 by Al Zmyslowski; stimulated by articles on the Doug Short blog. Buy stocks if the most recent seasonally adjusted initial unemployment claims are less than 97% of the 22 week SMA, buy bonds if the claims are more than 112% of the 22 week SMA and use the prior week's signal where the number of claims are within these limits.

Data are released each Thursday and reflect claims as of the prior week end. The week ending data as cited in the press releases is a Saturday.

Data are often revised and the revisions have been incorporated into historical simulations, which would have been impossible if using the data live.

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[68] Gregory Morris, *The Complete Guide to Market Breadth Indicators: How to Analyze and Evaluate Market Direction and Strength* describes algorithms of this type. The specific form of this algorithm was suggested by John Nicholas and Don Maurer in April 2016.

[69] *Further Improving the Use of the ECRI WLI*, Dwaine van Vuuren and Georg Vrba, January 17, 2012.

Signal dates are month-end and reflect the number of claims as or one to two weeks earlier. The historical data begin with the week ending January 7, 1967. The first month-end signal was available on June 29, 1967, based on claims as of the week ending June 24, 1967.

NHiLo - The cumulative sum of new daily highs on the NASDAQ exchange less new daily lows crossing the EMA of the cumulative sum. Alpha = 1/8. The signal is bullish if the indicator is positive.

Table D-2 shows that performance is similar over a range of EMA trend constants. Alpha = 1/8 was chosen based on the Sharpe ratio.

Table D-2. Performance of the NASDAQ HiLo Indicator, 1990 - June 2016. Allocation is between cash or a portfolio of 40% VFINX, 40% HAINX and 20% FRESX. The shaded parameters correspond to the *Patient Fisherman* blog[70].

	CAGR, %	Sharpe	MaxDD, %	Trade Frequency
40:40:20:00	9.95	52	56	Monthly
24:24:12:40	8.65	65	37	Monthly
Unsmoothed vs. 4EMA	12.05	98	10.1	3.0 per year
2SMA vs. 4EMA	11.71	95	10.1	3.1
Unsmoothed vs. 5EMA	12.14	98	10.1	2.9
2SMA vs. 5EMA	11.99	97	10.1	2.9
Unsmoothed vs. 6EMA	11.90	96	10.6	2.8
2SMA vs. 6EMA	11.96	96	10.6	2.8
Unsmoothed vs. 7EMA	11.97	97	10.6	2.8
2SMA vs. 7EMA	12.22	99	10.6	2.8
Unsmoothed vs. 8EMA	12.53	102	10.6	2.5
2SMA vs. 8EMA	12.15	97	11.1	2.7
Unsmoothed vs. 9EMA	12.17	98	10.3	2.5
2SMA vs. 9EMA	11.95	95	11.1	2.6
Unsmoothed vs. 10EMA	11.67	92	11.1	2.5
2SMA vs. 10EMA	10.98	87	11.1	2.6
Unsmoothed vs. 20EMA	11.40	94	11.5	2.2
Unsmoothed vs. 30EMA	11.34	91	14.0	1.7

[70] Al Zmyslowski drew my attention to this indicator published on the *Patient Fisherman* blog. The blog employed a 1-day moving average (that is, unsmoothed data) crossing 10EMA over the interval 2009-2011. 10EMA corresponds to alpha = 2/(10+1) or to a 5½ day time constant in the notation used here.

Unsmoothed vs. 50EMA	10.52	83	14.0	1.4

Source: DailyMarketTimer.xlsb.

DELTA MSI. This is a weekly indicator. It measures the price of about 3,500 stocks relative to their individual 75-day simple moving averages[71]. The fund universe is not identified. The indicator is bullish when 53% or more of the stocks are trading above their moving averages and bearish when the indicator is 47% or below. "Investor discretion is advised" when the value of the indicator lies between 47 and 53%

Delta Investment Management publishes its MSI indicator each Thursday in Barron's. Historical values are available from June 2013.

The timing decision was automated by allocating to stocks when the 2-period exponential moving average of Delta's weekly indicator exceeds 50%. (Alpha = 1/x.) There were differences between Delta's signal and the automated signal in two of the thirty-seven month-end signals (5%) from June 2013 through June 2016.

Portfolio 123 was used to measure the daily fraction of stocks in the Russell 3000 universe with prices above their respective moving averages[72]. Daily indicator values are the 10-day exponential moving average of the daily fractions. Alpha is 1/x.

Indicator values above 50% are considered bullish. Five percent of the month-end signals differ from Delta's signals from June 2013 through June 2016. This approach extends the index to January 1999.

Source: Static Allocation Market Timer 32 fund version Antonacci.xlsb

Empiritrage[73], Cleveland OH. This firm seems to have disappeared.

Their indicator is in equities when 10SMA of VIX is less than 30SMA of VIX AND 12mSMA of SP500 is greater than SP500; otherwise own cash or bonds.

There are VIX data from January 2, 1990 (CBOE).

Composite Timer. A composite timer is the equally weighted average of the timers making up the composite. If timer A recommends 100% allocation to equities, timer B recommends 0% allocation to equities and timer C recommends 75% allocation to equities, the recommendation of the composite of A, B and C would be the average of 1.0, 0.0 and 0.75 or 58.3% equities.

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[71] Delta mentions sizes ranging from 3300 to 3600 stocks in its blog at www.deltawealthaccelerator.com.

[72] I am indebted to Don Maurer and to Al Zmyslowski for assistance in determining the daily fractions for a variety of universes. The Portfolio123 analysis used the Prussell 3000 universe and Close(0) > SMA75. While other universes provided comparable results, the Russell universe is the better known.

[73] Cited by John Nicholas, CIMI April 29, 2013.