WHAT TACTICAL STRATEGIES OFFER DIVIDEND INVESTORS

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July 10, 2021
Updated July 10, 2021

I. INTRODUCTION AND SUMMARY

This report illustrates the workings of tactical allocation and its benefits. The emphasis is on strategies with volatilities comparable to that of the balanced portfolio. It was developed to support the author's July 11, 2021 presentation to AAII's Portland Income Special Interest Group. The author would appreciate being advised of errors and omissions.

A retiree typically seeks an adequate cash flow ("spend") with a low risk of running out of money before death. Ideally, this is accomplished without large declines in value during market corrections and without too much effort.

Tactical strategies use transparent rules to change the portfolio composition in response to current economic and market conditions. Some tactical strategies can increase return enough to grow a substantial legacy, but this usually means greater fluctuations in value, complexity and more effort.

There are several strategies for achieving adequate spend, modest fluctuations in value, low risk of running out of money and ease of use.

- **An Immediate Life Annuity**. Annuity design mirrors the stated goals. In addition, the payout ratio can be larger than is prudent for a self-managed portfolio since the insurance company assumes the risk of running out of money. The periodic income is guaranteed and can increase with inflation. The residual risk, and a low risk at that, is that the insurance company might prove unable to provide the contractual payments.

  The downsides are that an immediate life annuity leaves little for the heirs and that some investors welcome the challenge of making their own investment decisions.

- **A Dividend Strategy** invests in stable companies with growing and well financed dividends. In retirement, dividends are spent, principal is not.

  A dividend strategy typically suffers significant fluctuations is value and a self-managed dividend strategy can be time intensive.

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- **A Substantial Permanent Allocation to Fixed income** within a broadly diversified buy and hold portfolio.
- **Tactical Strategies Which Control Volatility.** Volatility refers to the fluctuations in portfolio value which are caused by the fluctuations in portfolio return. Volatility is measured as the standard deviation of the daily or monthly returns.

  My preference is for a volatility which lies between the 4.2% per month volatility of large cap US stocks and the 2.6% per month volatility of a "balanced" portfolio.

  Tactical strategies which control volatility raise the equity allocation when markets are benign (and volatility is low) and raise the bond allocation when markets are in turmoil (and volatility is high.)
- **Tactical Strategies Which Control Drawdown**

  Drawdown refers to the decline in value during market corrections and bear markets. Maximum drawdown is measured as the maximum decline, measured peak to trough, from the highest prior portfolio value.

  My preference is for the maximum drawdown to be substantially less than the fifty percent declines which large cap US stocks have suffered since 1950.

	Maximum Drawdown Date	**Max DD nominal**	**Max DD adjusted for inflation**
1974 Bear Market	Sept. 1974	43%	52%
Dot-com Bust	Sept. 2002	45%	47%
Credit Crisis	Feb. 2009	51%	54%

  Tactical strategies control drawdown by moving the portfolio from stocks to bonds and back to stocks in response to a "market timing" indicator[2].

  Tactical methods which control volatility often reduce the maximum drawdown and market timers often reduce volatility. It is seldom necessary to employ both volatility control and market timing.
- **Tactical Momentum Strategies.** Momentum is the return of a security over a look-back interval or intervals. There are many momentum algorithms. My preference is for the FundX momentum algorithm and for a combination of the FundX and DEMA20 algorithms, which I call the "ensemble" algorithm. Descriptions are available in the Bibliography.

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[2] There are many market timers. See the Bibliography.

Momentum is measured at the end of each month for each security under consideration and the portfolio is invested for the following month in the security or securities with the highest momentum.

The collection of securities under consideration is known as a "universe." When bonds are included in the universe, a good momentum strategy will transition to bonds in times of market stress. When bonds are not included in the universe, momentum optimizes the allocations among the equity components and a volatility control or market timing algorithm is necessary to control drawdowns.

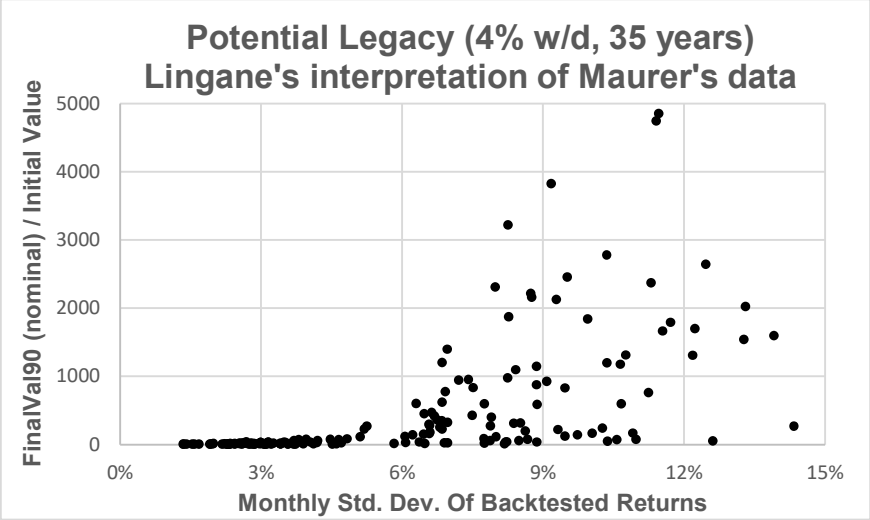
Portfolio longevity measures the degree to which a portfolio has, historically, been able to sustain a specified spending rate for a specified time interval. Portfolio longevity is one minus the risk of running out of money.

Portfolio longevity should receive more attention from investors. Volatility and drawdown are unsettling whereas an inadequate portfolio longevity can affect one's standard of living.

Portfolio longevity improves with lower spending rates, higher returns, lower volatilities and the shorter the interval over which longevity is measured.

Strategy changes to increase return or to reduce volatility may not have the anticipated impact on longevity. For example, strategy changes to control volatility will often decrease both volatility and return. While decreases in volatility tend to increase longevity, decreases in return tend to decrease longevity. Whether the net effect is a longer or shorter portfolio longevity depends on the circumstances.

Maurer maintains a database of tactical strategies[3]. Lower volatility strategies are associated with modest legacies and higher volatility strategies with higher legacies. Tactical investors need to decide whether to pursue low volatility or high legacy strategies.



Source: Volatility vs Legacry.xlsx. Examples are limited to strategies with legacy potentials of less than 5000x.

[3] Search for "SV computerized investing SIG OneDrive location."

This article focuses on easy to implement strategies to achieve an adequate spend with only modest fluctuations in value and only a low risk of running out of money. A good strategy will have

Backtest History	The longer the better. The minimum history is from 2000, about 21 years.
Volatility	Less than 4.2% per month, which is the historical volatility of large cap US stocks
Drawdown	Less than 30%, which is the historical drawdown of a "balanced" portfolio of 60% equities and 40% bonds.
Portfolio Longevity	Greater than 90%, assuming a 6% spend over 35 years.
Ease of Use	Understandable without advanced mathematics. Implemented using pencil and paper - though a spreadsheet is less tedious – or with inexpensive software such as Portfolio Visualizer.

I will show that

- Investment strategies should be evaluated using Volatility, Drawdown, Longevity, Relative Strength and possibly Legacy.

  Return and traditional statistics such as Sharpe ratio tend to be attractive if these criteria are achieved.
- AAII's dividend investing strategy exhibits relatively high volatility and drawdown as compared to dividend-focused mutual funds and ETFs.
- StormGuard® Armor is an effective market timer for dividend strategies.
- The combination of the SIMPLE RM and 27Fidos (FundX) strategies is synergistic. Volatility is moderated, drawdown is low, longevity and legacy are good, traditional statistics of Sharpe and UPI are outstanding and the relative strength profile is attractive.
- The relative performance of the Life Strategy benchmark illustrates the enormous reduction in legacy associated with strategies which control volatility and drawdown by including a constant allocation to fixed income.
- Tactical strategies using long bonds should be viewed with caution.
- Tactical strategies are best owned inside a tax-advantaged account.
- Dividend investors need to consider that performance in the post 2003 interval may be anomalous and that tax changes may degrade future performance.

This article is structured into the following sections:

II. PORTFOLIO LONGEVITY

No one knows the future. The best that can be done is to make plausible estimates about how future investments might evolve, to design investment strategies which might adapt to future possibilities and to hope that the truth lies among the range of possibilities[4].

One makes estimates of future investment performance by guessing future returns. Plausibility is established by limiting the choices to historical returns or to forecasts of future returns.

Many simulations, each using a different return sequence, produce a distribution of possible future outcomes. The distribution of possible future outcome is addressed probabilistically. For example, Value90 is the final value which is exceeded in 90% of the outcomes.

This guessing technique is known as a "Monte Carlo" analysis.

The widely quoted 4% safe withdrawal rate is the result of a Monte Carlo analysis. Bengen[5] guessed future returns by assuming that they would be the same as the historical return sequences of portfolios of large cap US stocks and intermediate term US government bonds.

There are about eight hundred unique 30-year return sequences in the historical record. About 95% of these can sustain a 4% spending rate for at least thirty years. The "sustainable withdrawal rate," which Bengen defined is the maximum spend with no more than 5% failures, is therefore 4% for a 30-year time horizon.

Saying this another way, portfolio longevity is 95% for a 4% withdrawal rate and a 30-year time horizon.

I will use a 6% spend and a 35-year time horizon in this article. The higher spend is intended to stress the investment strategies. The 35-year time horizon is approximately the maximum remaining lifespan of a couple aged sixty-five.

Bengen's approach works well with a hundred years of history, but it is inadequate when populating future years with only twenty years of history.

My approach when dealing with short histories is to populate the return sequences for the Monte Carlo analysis by drawing at random, with replacement, from a Normal distribution.

The parameters of the Normal distribution are the arithmetic mean and the standard deviation of the historical inflation-adjusted monthly returns specific to the strategy.

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[4] https://retirementplans.vanguard.com/VGApp/pe/pubeducation/calculators/RetirementNestEggCalc.jsf

[5] *Conserving Client Portfolios During Retirement*, William P. Bengen, FPA Press, 2006.

Empirical return distributions for three binary portfolios of large cap US stocks with fixed allocations to intermediate term government bonds are shown in Figure 1. The empirical return distributions are compared to Normal and Lognormal distributions with monthly parameters as described above.

The Normal and Lognormal distributions are nearly identical because the standard deviations are small.

The historical return distributions do not match the fitted distributions. That is, the historical returns are not Normally distributed. However, the distributions are apparently normal enough to provide useful estimates of sustainable withdrawal rates.

As can be seen in Figure 1, Normal distributions overestimate the frequency of negative returns. This explains the slightly smaller sustainable withdrawal rates on sampling from the Normal distribution as compared to rates determined by the Bengen technique.

Random sampling destroys any serial correlation among the returns.

DIYer Note. Returns are serially correlated if positive returns tend to be followed by positive returns and negative returns tend to be followed by negative returns. The degree of serial correlation is estimated using a spreadsheet and its built-in correlation functionality.

In EXCEL, the command is CORREL(A1:A99, A2:A100). The historical monthly returns are stored in column A, rows 1 through 100, in time sequence.

Since the A1:A99 sequence is offset by one month from the A2:A100 sequence, this formula calculates the serial correlation with a lag of one month.

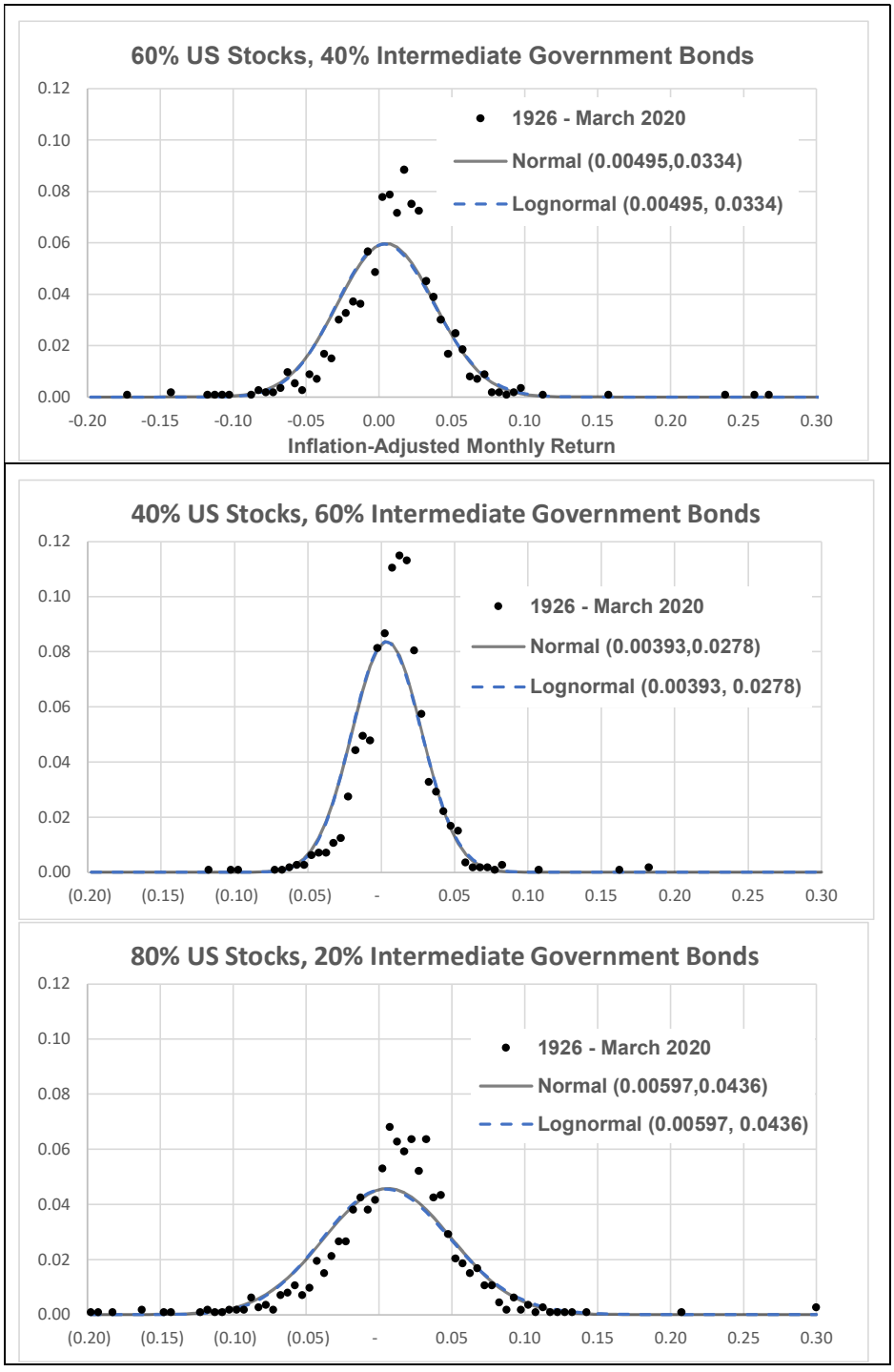
CORREL(A1:A95, A6:A100) calculates the serial correlation with a lag of five months.

The interpretation of serial correlation is addressed in Appendix B. It is unclear whether there is significant serial correlation for the returns used in this report. Unfortunately. the techniques for resolving any serial correlation that may exist change the estimates of portfolio longevity.

My bottom line is that longevity estimates are uncertain and are best used to distinguish strategies with high longevity from strategies with low longevity.

Figure 1. Historical Inflation-Adjusted Monthly Return Distributions Compared to Normal and Lognormal Distributions. The monthly mean return, and the standard deviation of the monthly returns are shown on each chart.

Source: HistoricalReturns.xlsx



Estimating portfolio longevity using Monte Carlo is easy since the analysis can be performed using Portfolio Visualizer, an inexpensive suite of online software ±" ±tools.

The Portfolio Visualizer settings for Monte Carlo analysis are

Tools: Portfolio Analysis – Monte Carlo Simulation

Initial Amount: 41,000,000

Withdrawal Amount: %5,000

Inflation Adjusted: No. (Since returns are inflation-adjusted, inflation consideration is unnecessary.)

Withdrawal Frequency: Monthly (12 x 5000 = 6% annually)

Simulation Period: 35 years

Simulation Model: Parameterized Returns

Normal Distribution: annualized parameters, adjusted for inflation

Default values are used for the other parameters.

Portfolio Visualizer requires annual values for the mean and standard deviation, which are converted internally to monthly values. This means that the historical means and standard deviations must be annualized using the same formulas that Portfolio Visualizer uses to de-annualize these parameters.

If m is the average monthly return,

$$\text{Average annual return} = (1 + m)^{12} - 1$$

If mSD is the monthly standard deviation, the standard deviation of the annual returns[6] is the square root of

$$\{ mSD^2 + (1 + m)^2 \}^{12} - (1 + m)^{24}.$$

Portfolio Visualizer conducts ten thousand simulations for each analysis. Each set of ten thousand distributions is slightly different. This means that the computed longevity and Value90 are slightly different each time that one clicks on the RUN SIMULATION button. The table entries include the symbol "±" when the variation affects the least significant figure in the longevity value.

DIYer Note. The tables in this article include the annualized mean return for each strategy and the annualized standard deviation of the returns. This is done to allow interested readers to confirm the portfolio longevity estimates using Portfolio Visualizer.

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[6] "What's Wrong with Multiplying by the Square Root of Twelve" by Paul D. Kaplan, Morningstar Canada, January 2013.

III. MITIGATION STRATEGIES EXPLAINED

This Part discusses strategies which mitigate volatility and drawdown. The strategies are applied to a portfolio of large cap US stocks and intermediate term government bonds for simplicity; higher performing strategies are discussed in Part V.

The traditional approach to mitigating volatility and drawdown involves allocating a substantial portion of the portfolio to fixed income securities. Unfortunately, the traditional approach tends to decrease portfolio longevity.

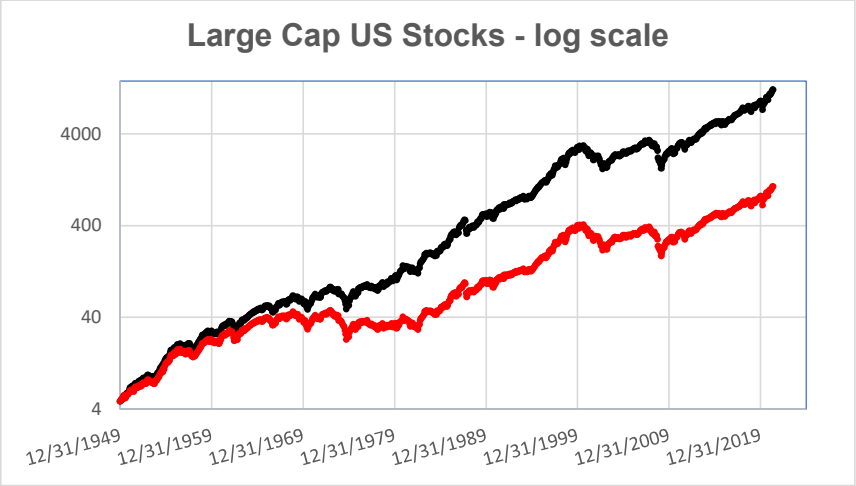
As will be seen, tactical techniques can be more effective.

Inflation Matters. Figure 2 shows the equity curve for large cap US stocks with and without adjustment for inflation.

An equity curve is simply the value of the portfolio over time. The value scale is usually displayed logarithmically because this shows detail which is hidden when the value scale is linear.

The most obvious effect of inflation-adjustment is to reduce future portfolio values. More subtle is the effect during bear markets; the inflation-adjusted portfolio values declined during the decade of the 1970s, while the nominal values increased. A similar effect is observed during the decade of the 2000s.

Figure 2. Nominal and Inflation-Adjusted Equity Curves for Large Cap US stocks, 1950 – 2021. Source: LrgCapUS Strategies from 1950.xlsx



DIYer Note. If R is the monthly return and CPI-U is the monthly inflation,

$$\text{R-adjusted} = (1 + R) / (1 + \text{CPI-U}) - 1$$

CPI-U (all cities, all items, not seasonally adjusted) is published monthly by the US Bureau of Labor Statistics.

Inflation-adjusted historical returns offer for the following advantages.

- It is simpler than the alternative of forecasting the value of future inflation, the distribution of future inflation values and correlation of future inflation with future equity and bond returns.
- It eliminates the need to apply inflation adjustments to spending and portfolio values. If future returns are inflation-adjusted, future values are automatically adjusted.
- It eliminates the need to apply inflation adjustments to income tax brackets.
- The distribution of inflation-adjusted returns is more normal-like, courtesy of the Central Limit theorem.

The 60:40 Portfolio Maintains a Permanent Allocation to Fixed Income. The portfolio being illustrated contains 60% large cap US stocks and 40% intermediate term government bonds, rebalanced monthly.

The following table compares the performance of the 60:40 portfolio to that of the large cap US stocks without bonds[7]. My focus is on maximum drawdown, volatility and portfolio longevity.

1951 – May 2021	Large Cap US	60:40 Large Cap US and IGBond
Max DD, nominal	51.0%	30.4%
Volatility, per month	4.2%	2.6%
Longevity	75±%	60±%
Value90 (real)	0[8]	0
6% spend, 35 yrs.		
Inflation-adjusted Mean	0.0876	0.0612
Inflation-adjusted Std. Dev.	0.1580	0.0965
Longevity	96±%	96±%
Value90 (real)	0.2 x	0.1 x
4% spend, 35 yrs.		
CAGR, nominal	11.35%	9.33%

Source: LrgCapUS Strategies from 1950.xlsx.

[7] The historical data start in 1950. Comparisons start in 1951 for consistency with tactical strategies which often require a year's worth of history for initialization.

[8] A disadvantage of the Value90 statistic is that the value is zero unless portfolio longevity exceeds 90%.

DIYer Note. If constructing the portfolio today, I would use the exchange traded funds VOO to represent the performance of large cap US stocks and IEI to represent the performance of intermediate term government bonds. Securities with longer histories must be used for backtesting. See Appendix A.

A 40% permanent allocation to bonds significantly reduces the drawdown and volatility (good). But it also reduces portfolio longevity (bad).

If spend is reduced to 4% of the initial portfolio value, portfolio longevities are similar. Since longevities were different at a 6% spend, we see the relative longevities of two portfolios can depend on the spending rate.

Value90 is from Monte Carlo simulations using Portfolio Visualizer. It is the value, adjusted for inflation, exceeded in 90% of the simulations. (That is, it is the tenth percentile of the final value distribution.)

Value90 is an estimate of the potential legacy associated with the strategy. It is expressed as a multiple of the initial value.

Tactical Strategies to Control Drawdown. Drawdown refers to the decline in value portfolio during market corrections and bear markets. It is measured as the maximum decline from the highest prior value.

Tactical strategies seek to control drawdown by moving the portfolio from stocks to bonds and back to stocks in response to a "market timing" indicator.

Since the 1970s. FundX Investment Management has used an algorithm called "SCORE" to rank securities by their momentum potential. The FundX SCORE includes the sum of a security's 1-, 3-, 6- and 12-month total returns.

DIYer Note. There are dozens of market timing algorithms and I have tested many dozens of combinations. For timer descriptions, see the Bibliography.

Total return includes the effect of dividends. Since some market timers and some momentum algorithms use total returns while others omit dividends, it is important to be explicit about whether dividends are being included.

John Nicholas was the first to use the sum of the 1-, 3-, 6- and 12-month total returns as a market timer. I have named this the Nicholas timer in his memory.

The historical performance of the Nicholas timer is shown in Table 1.

- It provides a substantial improvement in maximum drawdown as compared to large cap stocks alone and a better maximum drawdown than the balanced portfolio.
- It reduces volatility from that of large cap US stocks alone, but the improvement is less than with the balanced portfolio.

- It provides a substantial improvement in portfolio longevity, whereas the balanced portfolio causes longevity to decline.

Table 1. Volatility, Drawdown and Longevity of Binary Portfolios of Large Cap US Stocks and Intermediate Government Bonds. The Nicholas, VOL105d and SPVOL algorithms are computed using the risk indices shown.

Source: LrgCapUS Strategies from 1950.xlsx.

1951 - May 2021	LrgCapUS	60 LrgCapUS 40 IGBond	LrgCapUS Nicholas Mkt Timing	LrgCapUS VOL105d 0.5%/day	LrgCapUS SPVOL 0.5%/day	FundX Momentum
Risk Index	n/a	n/a	VFINX	SPX	SPX	n/a
MaxDD, nominal	0.510	0.304	0.232	0.238	0.222	0.232
Volatility, per mo.	0.042	0.026	0.034	0.026	0.026	0.032
Longevity						
6% spend, 35 yrs.	75±%	60±%	90±%	62±%	66±%	84±%
Inflation-adjusted mean	0.0876	0.0612	0.0948	0.0627	0.0644	0.0838
Inflation-adjusted SD	0.1580	0.0965	0.1281	0.0967	0.0950	0.1182
Average Equity Allocation	100%	60%	79%	66%	65%	69%
CARG, nominal	0.1135	0.933	0.1250	0.0949	0.0968	0.1143

The success of the FundX algorithm has spawned additional timers based on different weightings of the 1, 3, 6 and 12-month returns[9]. Some provide better results than the Nicholas timer. The risk index for FundX-type algorithms is usually the S&P 500 Composite index *with dividends* (VFINX or SPY).

FundX-type indicators can be evaluated from 1927. The indicator is bullish if the indicator value is zero or positive.

It is often said that "timing does not work." Kirkpatrick and Dahlquist[10] discuss the academic view of market timing.

There are at least three reasons for this misperception.

[9] Ren Curry, "Weights for 1.3.6.12 Momenta", AAII Silicon Valley CIMI Group, May 2, 2019.

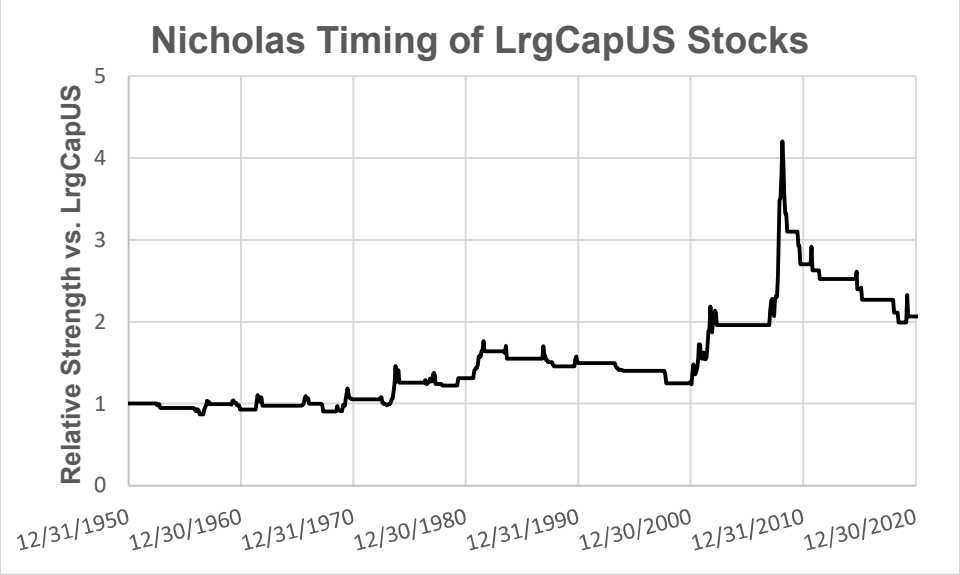
[10] Charles D. Kirkpatrick II and Julie R. Dahlquist, *Technical Analysis*, Pearson Education Inc., 2nd Edition, 2011, Chapter 4.

First, not all timers are equally effective. Siegel concluded that market timing often provides a lower return than buy and hold[11]. Faber, using a similar algorithm, reached the opposite conclusion[12]. Siegel's disappointing results have a simple explanation: he made his timing decisions daily rather than monthly and he based his timing indicator on an inferior risk index.

Second, comparisons based on less than a full market cycle tend to be misleading because market timing generally outperforms market indices during bear markets and underperforms during bull markets. See Figure 3A.

Investors who began using the Nicholas timer in 2010 would have substantially underperformed large cap US stocks over the subsequent ten years while an investor who began investing in 2005 would have benefited substantially over the following decade.

Figure 3A. Relative Strength of Nicholas Timing versus Large Cap US Stocks. Relative strength is the ratio of the value of the portfolio managed by a particular strategy, Nicholas in this instance, divided by the value of the portfolio managed by the reference strategy, the unmanaged portfolio of large cap US stocks in this instance. Nicholas timing is outperforming when the relative strength is rising and underperforming when the relative strength is declining.

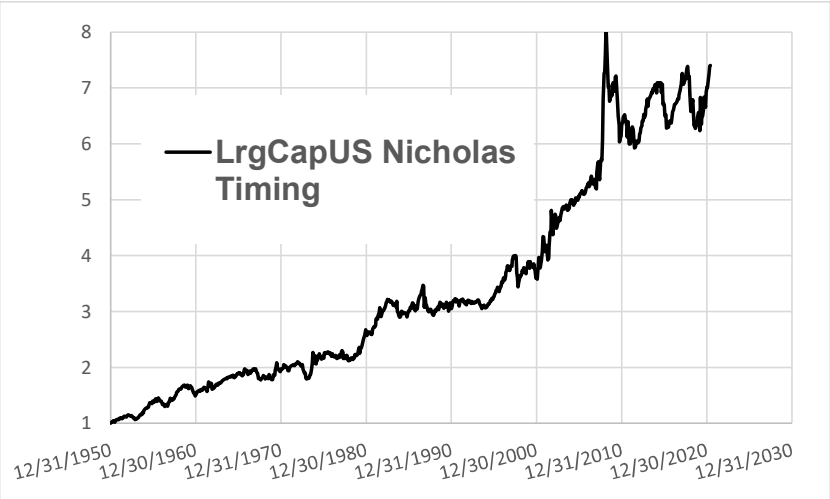


Source: LrgCapUS Strategies from 1950.xlsx.

[11] Charles Rotblut, "Smart Investing: Seeking Reward While Reducing Risk," Presentation to the San Francisco Chapter of AAII, Berkeley, CA, July 19, 2014. See Jeremy J. Siegel, *Stocks for the Long Run*, McGraw-Hill, 5th Edition, 2013, Table 20-1 and the *AAII Journal*, August 2014.

[12] 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. This article is available at MebaneFaber.com.

Figure 3B. Relative Strength of Nicholas Timing versus the 60:40 Portfolio.



Investors should compare market timing against a benchmark which is reflective of their portfolio. As shown in Figure 3B, which uses the 60:40 portfolio as the reference, the 60:40 investor who chose Nicolas timing at almost any point during the past seventy years would have been pleased by the performance of the Nicholas timer.

Third, it is challenging to follow market timing dictates. Deciding to exit the market is easy; deciding to re-establish a position when all is doom and gloom is psychologically more difficult.

Combinations of timers usually provide better results than a single timer. The StormGuard® Armor timer is a combination of several timers[13]. It provides the most successful signal in the post-1989 interval of any other that I have tested.

Scott Juds has revised Armor several times since its introduction a few years ago. In other words, Armor has been carefully tuned and there is no information about how the timer would perform "out of sample." It would be confidence building to test Armor with history from before 1989 but this is impossible because the exact formulation of Armor is unknown.

Another composite is the 5AbsMom + DR*VOL + IUC timer. It can be evaluated from 1967. The signal is the average of the signals of three market timers.

1. 5AbsMom. The price return of the S&P 500 Composite index (that is, without dividends) is compared to the total return of 1-month Treasury bills over the trailing five months.

[13] Sumgrowth.com.

The signal is to invest in stocks when the 5-month return of stocks is equal to or larger than the 5-month return of Tbills and to invest in bonds when the return of stocks is less than the return of Tbills.

The 5AbsMom signal was developed by Maurer. It can be evaluated from 1926.

2. DR*VOL. The product of the daily price return of the S&P Composite index times the daily volume is computed, smoothed and normalized.

DIYer Note. Daily values of the S&P 500 Composite index are available at Yahoo.com under the ticker symbol ^GSPC and from other sources as SPX. Volume data for the S&P Composite are available at Yahoo.com; S&P denies that they are the source of the volume data.

The signal is to invest in stocks when the timer is positive and to invest in bonds when the timer is negative.

This timer was developed by Lingane, Maurer and Nicholas; it can be evaluated from 1951.

3. IUC. This signal is based on the number of initial unemployment claims. Initial unemployment claims are published every Thursday by the US Department of Labor. The DOL also maintains the historical initial unemployment claims data.

   The signal is to invest in stocks when the smoothed value is above a threshold and to invest in bonds when the smoothed value is less than a second threshold. This timer was developed by Zmyslowski; it can be evaluated from June 1967.

Tactical Strategies to Control Volatility. The volatility of a portfolio can be controlled at a specified value by adding a lower volatility security like Treasury bills (Tbills) or intermediate term bonds. Allocations are updated at each month's end to maintain the standard deviation of the combination of the volatile portfolio plus the lower volatility security at the target value.

There are two ways in which volatility control can be achieved. The simpler approach is to make no changes to the allocations within the volatile portfolio. In effect, the volatile portfolio is simply diluted. The **return** of the combined portfolio is

$$Return_{combination} = W_{portfolio} * Return_{portfolio} + (1 - W_{portfolio}) * Return_{diluent}$$

where $W_{portfolio}$ is the allocation to the volatile portfolio and 1 - $W_{portfolio}$ is the allocation to the diluent.

When the volatility of the diluent is low and/or the covariance (correlation) between the returns of the diluent and the volatile portfolio is small, the **standard deviation** of the combination can be approximated as

$$SD_{combination} = W_{portfolio} * SD_{portfolio}$$

When the standard deviation of the returns of the diluent security is not zero, or when one wants to also optimize allocations within the volatile portfolio, one determines the allocations which maximize the return of the combined portfolio at the specified standard deviation.

It may be possible to achieve the specified volatility solely by adjusting the allocations within the volatile portfolio.

Optimization relies on the fact that there is only one combination of the securities which produces the maximum return at a specified volatility. The locus of the maximum returns as a function of volatility is known as the "efficient frontier."

This more general approach is described in Appendix C. It requires estimates of returns, standard deviations and correlations to maximize the return at the specified volatility.

The volatility control algorithms illustrated here use the simpler technique.

SPVOL - Standard & Poors' Dynamic Rebalancing Risk Control Indicator determines the allocation to the volatile portfolio as a ratio, the specified target volatility divided by the current volatility of a risk index.

Allocation to volatile portfolio = target volatility / volatility of risk index

Allocation to diluent = 1 – target volatility / volatility of risk index

The method for calculating the volatility of the risk index is what distinguishes SPVOL from other dilution algorithms. See the Bibliography for details.

The risk index used here is the S&P500 Composite *without dividends*. Other risk indices are possible, including the volatile portfolio itself. Other risk indices provide better results with certain portfolios.

VOLxxd also determines the allocation to the volatile portfolio as a target volatility divided by the current volatility of a risk index. As implemented here, the risk index is the S&P500 composite index without dividends and the volatility is the standard deviation of the risk index over 105 trading days.

The lookback interval is a parameter. It is usually set to 63 or 105 days.

Portfolio Visualizer also determines the allocation to the volatile portfolio as a target volatility divided by the current volatility of a risk index. In this case, the risk index is the portfolio being diluted.

The recommended Portfolio Visualizer settings for controlling the volatility of large cap US stocks by dilution with a short-term bond fund are

Market Timing Models from the Tools menu

Timing Model: Target Volatility

Month-to-Month time period

Cash Flows: None

Accept the default target volatility, 9% annually. Test other values.

Out-of-Market: Select. Enter VFISX or SHY

Choose "5 month" Volatility Period. (PV uses daily returns over this interval.)

Portfolio Assets. 100% allocation to VOO.

When the target volatility exceeds the portfolio volatility, leverage would be necessary to achieve the target volatility. I do not use leverage in my implementations of the SPVOL, VOL63d and Portfolio Visualizer methods.

The Efficient Frontier method cannot be tested before about 1988 because there are no daily returns for Tbills or bonds before that date. The SPVOL and VOLxxd methods can be tested from mid-1950.

The historical performance of the SPVOL and VOL105d techniques were shown in Table 1.

- The measured volatility with volatility control in operation is the same as that of the 60:40 portfolio, which is reassuring since the target volatility of 0.5% per day is the daily volatility of the 60:40 portfolio.
- The maximum drawdown is better than the drawdown of the 60:40 portfolio.
- Disappointingly, longevity is inferior to that of large cap US stocks alone and inferior to Nicholas timing.

Controlling volatility at about the volatility of the 60:40 portfolio does not provide a dramatic increase in performance, but it does provide a better drawdown than that of the unmanaged 60:40 portfolio.

Tactical methods that control volatility often reduce the maximum drawdown, and market timers often reduce volatility. It is seldom necessary to employ both volatility control and market timing.

Momentum is measured as the return of a security over a look-back interval or intervals. As implemented here, momentum is measured at the end of each month for each security under consideration and the portfolio is invested for the following month in the securities with the highest momentum.

There are many momentum algorithms; see the Bibliography.

The most effective momentum algorithm tends to vary from one universe to another. I frequently employ the FundX algorithm or the ensemble algorithm.

The ensemble algorithm determines the security rankings as the average of the ranking by the FundX and DEMA20 algorithms. After determining the TopN + 1 securities, the most volatile security is eliminated to produce a final topN.

The FundX, DEMA20 and ensemble algorithms can be evaluated from 1951.

The momentum strategy in Table1 allocates 100% to Large Cap US stocks or 100% to intermediate government bonds, whichever has the higher FundX momentum. The backtest indicates that

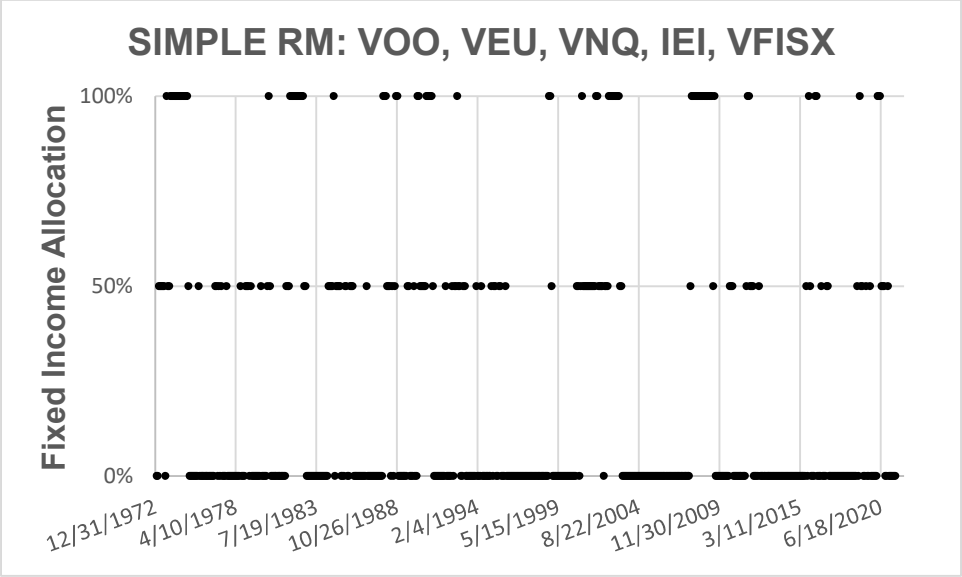
- Volatility is less than that of large cap US stocks, higher than that of the 60:40 and volatility-controlled portfolios and about that of Nicholas timing.
- The maximum drawdown is much less than that of large cap US stocks alone, an improvement over the 60:40 portfolio and about that of volatility control.
- Longevity is better than that of large cap US stocks, the 60:40 portfolio and volatility-controlled portfolios but inferior to that of Nicholas timing.

The collection of securities under consideration is known as a "universe." When there are no bonds in the universe, momentum optimizes the allocations among the equity components and a market timer is used to control drawdown.

When bonds are included in the universe, a market timer is not necessary because the momentum algorithm moves the portfolio to bonds in times of market stress.

The effect of momentum on the fixed income allocation over time is illustrated in Figure 4. This strategy holds two securities, and the investment universe includes a short and an intermediate bond fund. The algorithm moves the portfolio to bonds when the market is in turmoil. The portfolio was entirely invested in fixed income during the 1974, 2003 and 2008 bear markets.

Figure 4. Fixed Income Allocation over Time for the SIMPLE RM Strategy. The SIMPLE RM strategy is described in Part V.



Long Bonds. Market timing, volatility control and momentum strategies have been implemented with a variety of bond funds as the out-of-market asset. Returns tend to improve on substituting an intermediate bond for a short bond or a long bond for an intermediate bond. Bond yields are currently at historical lows and the future capital returns of long bonds are more likely to be losses than gains. The implication is that one should not consider strategies tested using long bonds and one should not implement strategies using long bonds.

IV. DIVIDEND INVESTING

This Part investigates dividend investing in terms of volatility, drawdown, portfolio longevity, legacy potential and ease of use. The goal is to identify an equity curve which is representative of the historical performance of the typical self-directed dividend investor.

Van Knapp summarizes his dividend investing philosophy as follows[14].

- It is realistic for a self-directed investor to implement … .

  As should tactical investing!

- It provides sufficient and reliable cash flow from dividends.

  Tactical investing provides a sufficient and reliable cash flow. But is it wise to specify the source of the cash flow?

- The cash flow grows steadily, at a rate that beats inflation … .

  Cash flow is inflation-adjusted!

- The operation provides peace of mind and psychological relief from market volatility.

  Tactical investing seeks to provide actual relief from market volatility!

Harrington, a financial advisor, reinforces Van Knapp's last point.

"The current income provided by investing in dividend stocks simply provides me a level of emotional comfort. Knowing that income will flow into my portfolios **through thick and thin** brings me comfort, conviction and confidence[15]."

The dividend yield (trailing twelve-month dividends divided by the year-end NAV) determines the initial spend for the newly retired dividend investor. It is analogous to the sustainable withdrawal rate of the tactical investor.

I have not unearthed a definitive statement about what dividend yields have been or can be realistically expected. I am basing my assumptions on the dividend yields assembled in Table 2. Dividend yields tend to vary over time and the yields shown represent a variety of different time intervals.

Some of the strategies shown involve significant expenses. I added these expenses to the dividend yields on the assumption that expenses would be low with a self-managed portfolio or an inexpensive ETF.

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[14] Dave Van Knapp, *DGI Lesson 12. Run Your Investing Like a Business*.

[15] Jenny Harrington, *AAII Journal*, April 2021. Emphasis added.

Table 2. Historical Dividend Yields. The source of the yield is shown when it was not calculated by the author.

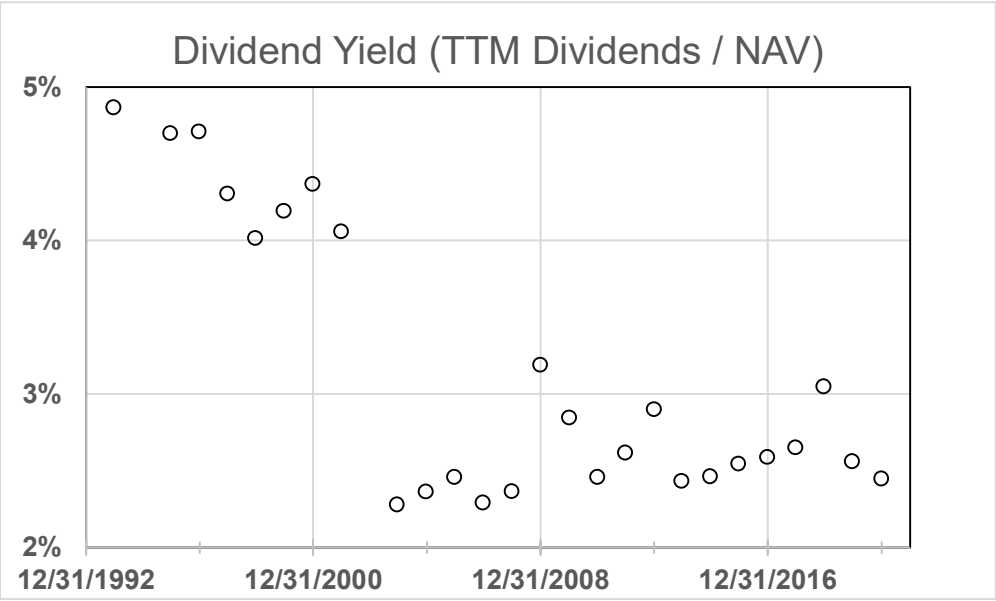
	TTM Cash Flow	Cash Flow Growth Rate
VDIGX, 2003-2020, gross of 0.3% expenses	2.6 – 3.5%	8%
PRDGX, 2003-2020, gross of 0.6% expenses	1.6 – 2.7%	
DGRO, 2015-2020, net of 0.08% expenses. SeekingAlpha.com	2.0 – 2.5%	
DVY, 2004-2020, gross of 0.4% expenses	3.4 – 4.2%	4%
NOBL 2014 – 2020, gross of 0.35% expenses. SeekingAlpha.com	2.0 – 2.8%	
PEY 2010-2020, gross of 0.52% expenses. SeelingAlpha.com	3.6 – 4.8%	
SCHD 2012 – 2020, net of 0.06% expenses. SeekingAlpha.com	2.9 – 3.5%	11%
VIG 2007 – 2020, net of 0.06% expenses. SeekingAlpha.com	1.6 – 2.8%	7%
VYM 2007 – 2020, net of 0.06% expenses. SeekingAlpha.com	2.8 – 3.4%	6%
Van Knapp Public Portfolio 2009-2020. No expenses. 1 April 1 2021 blog	3.3 – 4.2%	11%
Top 10 Dividend Aristocrats, 1 July 2021. Sure Dividend.	3.3%	
Nick Ward, Dividend Growth Investing, Portland SIG, May 2, 2021	6% is possible[16]	

The Vanguard Dividend Income Fund (VDIGX) changed its investment objective on December 6, 2002. Prior to this date, the fund was called the Vanguard Utilities Income Fund, reflecting its former policy of investing in income-producing stocks of utilities companies. Performance prior to 2003 reflects the former objective.

[16] Paraphrasing Mr. Ward, it is possible to put together a portfolio with a 6% initial dividend yield, the dividend amount growing as fast as inflation and the income lasting forever. The portfolio would likely include companies with 3-4% yield and high potential for price appreciation and companies with 7-8% yield and lower potential for price appreciation.

The strategy change coincided with the decrease in dividend yield shown in Figure 5.

Figure 5. Historical Dividend Yields of VDIGX.



*** Confirm this chart with the dividend history provided by Vanguard ***

The S&P Dividend Aristocrats Index has data from 1990. Since I do not have the data to determine historical dividend yields, I substituted the yield of NOBL, an exchange traded fund which tracks this index.

Based on Table 2, the initial spend, which equals the dividend yield at retirement, varies between about three and four percent. The variation means that the initial spend depends on the date of retirement. Once retired, spending increases faster than inflation and no longer depends on the dividend yield.

There was a sharp and widespread surge in dividend distributions following the 2003 tax cut[17]. What might happen to dividend yields if taxes were to increase?

Dividend strategies and large cap US stocks have exhibited similar volatilities and drawdowns; see Table 3. The comparison is over a common time interval.

[17] Pinar Cebi Wilber citing Matray and Boissel, *The Wall Street Journal*, June 17, 2011

Table 3. Historical Volatility and Drawdown of Dividend Strategies. Dividends are being reinvested.

March 2007 – February 2021	Monthly Volatility	Maximum Drawdown
60 SPY, 40 VFISX	2.6	30
SPY (US Large Cap)	4.5	51
Dividend Strategies Avg	4.4	50
DLN	4.3	53
DVY (“Contender”)	4.6	57
NOBL (S&P Dividend Aristocrats Index before 2014)	4.2	44
PEY	5.6	67
PRDGX	4.1	45
VDIGX	3.8	38
VIG (“Challenger”)	3.9	41
VYM (“Challenger”)	4.3	52

It is tough to beat an inexpensive mutual or exchange-traded fund in terms of easy application. A strategy which tracks published trade recommendations, such as the AAII Dividend portfolio, would also be easy to implement.

Table 4 compares the performance of several funds to AAII’s Dividend strategy. The AAII strategy exhibited a relatively high volatility and drawdown.

DIYer Note. The equity curve for the AAII Dividend strategy was supplied by AAII’s Derek Hageman, for which I am grateful. The reconstruction of the equity curve as described in Appendix D was unsuccessful.

The values shown in Table 4 for drawdowns and volatilities may be optimistic on a forward going basis since they are for a short interval that does not include a bear market.

If an investor wished to implement a dividend strategy using a fund, consideration should be given to

- Schwab U.S. Dividend Equity fund (SCHD)
- Vanguard Dividend Income Fund (VDIGX).

These funds exhibit good combinations of dividend yield, volatility, drawdown and portfolio longevity and good relative strength compared to the Dividend Aristocrats index; see Part VI.

WisdomTree U.S. Large Cap Dividend Fund (DLN), Vanguard High Dividend Yield Index Fund ETF Shares (VYM) and Vanguard Dividend Appreciation Index Fund ETF Shares (VIG) show poorer relative strength.

Direct investment in the companies comprising the Dividend Aristocrats index would be attractive since this would reduce expenses and increase dividends as compared to investing in ProShares S&P 500 Dividend Aristocrats ETF (NOBL).

Table 4. Comparison of Dividend Strategies. PRDGX has been omitted because of its low dividend yield net of expenses. The dividend yield of Dividend Aristocrats has been set equal to that of NOBL gross of expenses (contrary to the table heading). The table is ordered by decreasing monthly volatility. Source: VFINXandSIMPLE.xlsx..

2012 – May 2021	Dividend Yield net of expenses, %	Monthly Volatility	MaxDD	Longevity 6% spend 35 years	Monte Carlo Parameters
AAII Dividend Investing	2.6 - 3.6	4.4%	0.31	94%	0.1231 0.1707
PEY SeekingAlpha.com	3.1 - 4.3	4.1%	0.31	95%	0.1209 0.1595
DVY “Contender” SeekingAlpha.com	3.0 - 3.7	3.9%	0.30	94%	0.1116 0.1497
Large Cap US VFINX		3.8%	20%	99.6%	0.1468 0.1485
DLN SeekingAlpha.com	2.3 - 3.0	3.8%	0.23	97%	0.1160 0.1390
SCHD SeekingAlpha.com	2.5 - 3.2	3.8%	0.22	99%	0.1393 0.1476
Dividend Aristocrats Index	2.0 – 2.8	3.6%	0.23	99%	0.1346 0.1418
VYM “Challenger” SeekingAlpha.com	2.8 - 3.4	3.6%	0.24	96%	0.1140 0.1388
VIG “Challenger” SeekingAlpha.com	1.6 - 2.4	3.4%	0.17	99%	0.1246 0.1317
VDIGX	2.4 – 3.1	3.3%	0.18	99%	0.1260 0.1282

I am adopting the Dividend Aristocrats index as representative of the historical performance of the self-directed dividend investor. The index has history from 1990, a decent yield (if expenses are low) and a good combination of volatility, drawdown and portfolio longevity.

Table 5 compares dividend and tactical strategies. Tactical strategies have the potential for a significantly higher initial spend but spending grows faster with dividend strategies[18].

Volatility and drawdown are significantly lower with tactical strategies.

While tactical strategies with portfolio longevities above 90% have a low risk of running out of money, dividend strategies are marginally safer because there is no invasion of principal.

Some tactical strategies have the potential for large legacies. Dividend strategies do not have the potential for large legacies.

Table 5. Comparing Dividend and Tactical Strategies

	Dividend	**Tactical**
Initial Spend	3 - 4% dividend yield	~ 6%
Escalation of Spending	Faster than Inflation	Inflation
Volatility	Similar to SPY	< SPY
Drawdown	Similar to SPY	<< SPY
Portfolio Longevity (Safety)	Naturally High	> 90%
Legacy – having enough to fund personal and charitable aspirations	Modest	Potential for large legacies

[18] Spending capacity should be high initially and decline relative to inflation as a retiree ages and discretionary spending declines. An escalation of spending at a rate higher than inflation is not really advantageous.

V. TACTICAL STRATEGIES TO REDUCE VOLATILITY AND DRAWDOWN

The examples in Part III demonstrate that tactical strategies have been superior to the traditional 60:40 portfolio over a long and varied historical interval.

As mentioned in the introduction, tactical strategies tend to reduce volatilities or to increase legacies. I do not know of a tactical strategy with a low volatility and a huge legacy potential.

The focus of this Part is on strategies which achieve an adequate spend with only modest fluctuations in value and a low risk of running out of money.

Backtest History	The longer the better. The minimum history is from 2000, about 21 years.
Volatility	Less than 4.2% per month, which is the historical volatility of large cap US stocks.
Drawdown	Less than 30%, which is the historical drawdown of a "balanced" portfolio containing 60% equities and 40% bonds.
Portfolio Longevity	Greater than 90%, assuming a 6% spend over 35 years.
Ease of Use	Understandable without advanced mathematics. Implemented using pencil and paper - though a spreadsheet is less tedious – or using inexpensive software such as Portfolio Visualizer.
Long Bonds	Does not depend on capital appreciation within the bond portfolio.

This Part begins by illustrating the importance of long histories. This is followed by

- Variations on the SIMPLE Strategy.
- SIMPLE RM and 27Fidos Strategies.
- Why it is Important to Backtest More Than One Algorithm.
- QQQ Strategies.
- Combination Strategies.

The tables also show the performance of two reference portfolios, the 60:40 balanced portfolio and the Dividend Aristocrats index without expenses.

The Importance of Long Histories

Table 6 summarizes performance statistics for two dividend strategies over the short post-2012 interval and over the longer lives of the funds.

Both funds exhibit attractive drawdowns and portfolio longevities over the short interval and higher drawdowns and lower longevities over the longer intervals. Legacy potential (Value90) is significantly less over the longer intervals.

Presumably, performance over the longer intervals is more representative of what the future may hold.

Table 6. Short Backtests Tend to Understate Risk. There are no expenses associated with the Dividend Aristocrats index strategy.

	VDIGX	VDIGX	Dividend Aristocrats	Dividend Aristocrats
Backtest Interval	2012– 4/2021	2003 - 4/2021	2012 - 4/2021	2/1990 - 4/2021
Monthly Volatility	3.4%	3.5%	3.6%	4.0%
Maximum Drawdown	18%	42%	23%	44%
Portfolio Longevity Value90 (real) 6% spend, 35 years	>99% 7x	92% 0.3x	>99% 9x	91% 0.2x
Inflation-adjusted Mean Inflation-adjusted Std. Dev.	0.1294 0.1299	0.0994 0.1331	0.1384 0.1424	0.1067 0.1516

Variations on the SIMPLE Strategy

These strategies are attractive because they offer diversification among the three largest equity asset classes: US stocks, developed foreign markets and investable real estate.

The SIMPLE strategy use momentum to identify the sectors with the highest trends and a market timer to control volatility and drawdown. The SIMPLE RM strategy adds a short and an intermediate term bond fund to the universe; a market timer is not employed.

The strategies are easily implemented using Portfolio Visualizer. Trading volumes in representative ETFs are huge, reducing spreads and improving liquidity.

There is monthly history for the asset classes from 1972, which means that SIMPLE strategies can be backtested from 1973. (About a year's worth of history is "wasted" by the initialization of the momentum algorithms.)

Results are summarized in Table 7.

A risk is that SIMPLE strategies exclude the smaller equity classes which could be tomorrow's leaders. The universe could be expanded to include additional asset classes, but I have not done this.

Portfolio Visualizer implementations use FundX momentum.

SIMPLE. A market timer is required.	**SIMPLE RM**
Timing Model: Relative Strength	Timing Model: Relative Strength
Time period: Month-to-Month	Time period: Month-to-Month
Tickers: VOO, VEU and VNQ	Tickers: VOO, VEU, VNQ, IEI and VFISX
Performance periods: Multiple Periods	Performance periods: Multiple Periods
Assets to Hold: 2	Assets to Hold: 2
Time Period #1: 1 months, 25% weight	Time Period #1: 1 months, 25% weight
Time Period #2: 3 months, 25% weight	Time Period #2: 3 months, 25% weight
Time Period #3: 6 months, 25% weight	Time Period #3: 6 months, 25% weight
Time Period #4: 12 months, 25% weight	Time Period #4: 12 months, 25% weight

A comparison, in Table 7, of the SIMPLE strategy with composite timing to the SIMPLE RM strategy indicates that SIMPLE RM has had a marginally lower volatility, lower drawdown, lower CAGR and marginally lower longevity.

This interval is too long to test Armor timing.

I prefer SIMPLE RM to SIMPLE because the allocation changes are more abrupt when market timing.

A comparison, in table 7, of SIMPLE RM with allocation to the top ranked fund ("Top1") or to the two highest ranked funds ("Top2") indicates that Top2 allocation produces a lower volatility, lower CAGR and marginally lower longevity. Overweighting the second ranked fund decreases longevity significantly.

The SIMPLE RM strategy with long bonds (VUSTX) has better longevity and legacy potential (Value90), better Sharpe an UPI. Unfortunately, the outperformance with long bonds is unlike to continue given current yields.

The VOO + VEU strategy is the SIMPLE strategy without real estate. This is Antonacci's Dual Momentum universe with different algorithms.

A comparison of the VOO + VEU strategy to the SIMPLE strategy, both with composite timing, indicates that the SIMPLE strategy has a lower volatility but a marginally lower longevity.

I count that as a win for SIMPLE because of its more representative universe.

Table 7. The SIMPLE strategies use FundX momentum to choose among VOO, VEU, VNQ, IEI, VFISX (short Treasury bonds) and VUSTX (long Treasury bonds). Histories were extended backwards as described in Appendix A. The composite timing algorithm was described in Part III. Source: VFINX and SIMPLE.xlsx

1973 – 5/2021	60% VOO 40% IEI	VOO & VEU Comp Timing Top1	SIMPLE Comp Timing Top2	SIMPLE RM VFISX & IEI Top1	SIMPLE RM VFISX & IEI Top2	SIMPLE RM VFISX & IEI Top2	SIMPLE RM VFISX & IEI Top2	SIMPLE RM VUSTX & IEI Top2
Weighting of ranked securities			Equal		67% 1st 33% 2nd	33% 1st 67% 2nd	Equal	Equal
Volatility (mSD)	2.8%	3.4%	3.1%	3.8%	3.2%	3.0%	3.0%	3.1%
MaxDD	0.30	0.25	0.24	0.18	0.18	0.21	0.19	0.19
Longevity	53±%	95±%	93±%	93%	94%	89%	92%	96%
Value90 (real)		1.5x	0.6x	0.6x	0.8x		0.4x	1.3x
6% w/d, 35 years								
Annual mean return	0.0583	0.1079	0.0962	0.1100	0.0989	0.0879	0.0934	0.1022
Annual SD of returns	0.1024	0.1324	0.1180	0.1475	0.1215	0.1139	0.1151	0.1186
Average Allocation								
Total Equity	0.60	0.740	0.740	0.821			0.758	0.717
US				0.241			0.278	0.257
Foreign				0.244			0.216	0.209
RE				0.337			0.263	0.252
CAGR	0.094	0.1428	0.1322	0.1430	0.1345	0.1239	0.1295	0.1383
Sharpe	0.54	0.82	0.82	0.76	0.82	0.76	0.81	0.87
UPI	0.73	1.54	1.30	1.49	1.66	1.38	1.57	1.72

SIMPLE RM and 27Fidos Strategies

This section compares the SIMPLE RM, the 27Fidos strategies and the *pro forma* dividend strategy using market timing.

The 27Fidos strategy uses the ensemble momentum algorithm (described in Part III) to choose the from among the 27 Fidelity Select sector mutual funds, usually the top three, with the highest trends. The FundX algorithm is less successful with this universe. A market timer is used to control volatility and drawdown.

The backtest interval is limited by the history of the Dividend Aristocrats index.

Results are summarized in Table 8.

The *pro forma* dividend strategy is more volatile and has a higher drawdown than the 60:40 portfolio but better longevity and legacy potential (Value90).

Timing the *pro forma* dividend strategy with StormGuard® Armor improves the volatility, drawdown, portfolio longevity and legacy potential of the dividend strategy.

The downsides to timing a dividend strategy are the interruption of dividend payments and the realization of short-term capital gains.

The SIMPLE RM strategy achieves the same reduction in volatility as the timed dividend strategy, a better drawdown and a good longevity, though not as good as the dividend strategy with Armor timing.

The 27Fidos backtests show that the momentum algorithm affects performance. The ensemble algorithm is significantly better than FundX with this universe . They also show that allocating to the Top3 of the highest trending Fidelity Select sector funds better than Top2.

Timing the 27Fidos with Armor as compared to the composite timer improves legacies but volatility, drawdown and longevity are little effected.

27Fidos is more volatile than the other strategies in Table 8 which might be unattractive to some investors.

The 27Fidos is best implemented in a Fidelity brokerage account, which might also be unattractive to some investors. The 30-day minimum hold on the Fidelity Select funds is occasionally bothersome but Fidelity's enforcement is not draconian.

The ensemble algorithm is not implemented in Portfolio Visualizer, which means a tactical investor must evaluate the algorithm for themselves. There is an example of how the DEMA algorithm is evaluated in the Bibliography.

Armor is highly fit. There is a risk that it will perform less well in the future.

Table 8. The *Pro Forma* Dividend Strategy is the Dividend Aristocrat index through 2013 and NOBL thereafter.
Sources: VFINX and SIMPLE.xlsx and SmlOutput.cvs

Feb 1990 – June 2021	60% VOO 40% IEI	*Pro Forma* Dividend Strategy	*Pro Forma* Dividend Strategy with Armor Timing	SIMPLE RM VFISX & IEI 1:1 Top2	27 Fidelity Select Top 3	27 Fidelity Select Top 3	27 Fidelity Select Top 3	27 Fidelity Select Top 3	27 Fidelity Select Top 2
Momentum Algorithm	None	None	None	FundX	FundX	FundX	Ensemble	Ensemble	Ensemble
Market Timing	None	None	Armor	None	Composite	Armor	Composite	Armor	Armor
Out of Market Asset	IEI	None	VFISX	IEI & VFISX	VFISX	VFISX	VFISX	VFISX	VFISX
Volatility (mSD)	2.5%	4.0%	2.9%	2.9%	4.9%	4.9%	4.4%	4.4%	4.7%
MaxDD	0.30	0.44	0.22	0.15	0.31	0.31	0.16	0.14	0.18
Longevity Value90 (real) 6% w/d, 35 years	71±%	90%	>99% 6 x	97% 2 x	99% 12x	99.9% 60x	99.9% 30x	>99.9% 140x	>99.9% 140x
Annual mean return	0.0665	0.1056	0.1206	0.1010	0.1649	0.2064	0.1775	0.2210	0.2254
Annual SD of returns	0.0931	0.1514	0.1120	0.1091	0.1984	0.2050	0.1772	0.1843	0.1969
Average Allocation Total Equity US Foreign RE	0.60	1.00	0.72	0.78 0.29 0.20 0.29	Not updated to June		Not updated to June		Not updated to June
CAGR	0.0884	0.1220	0.1422	0.1222	0.1765	0.2188	0.1928	0.2371	0.2397
Sharpe	0.74	0.73	1.14	0.97	0.89	1.10	1.08	1.32	1.26
UPI	0.86	1.06	2.86	2.11	1.66	2.35	2.92	5.49	4.47
Source	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	SmlOutpu Case 20	SmlOutput Case 10	SmlOutput Case 1	SmlOutput Case 18	SmlOutput Case 19

Why You Should Backtest More Than One Algorithm

SectorSurfer uses the double exponential moving average algorithm (DEMA) to identify the top ranked fund in the investment universe. SectorSurfer periodically updates the trend constant associated with the DEMA algorithm, a potential advantage. When the DEMA algorithm easily identifies the top ranked fund, the variation in the trend constant over time is small.

Backtesting the SIMPLE strategy using the SectorSurfer portfolio optimization software shows large variations in the trend constant over time; see Table 9. This indicates that the DEMA algorithm is having difficulties with the SIMPLE universe. Volatilities, drawdowns and longevities are poor.

An investor might conclude that SectorSurfer uses a lousy algorithm. The truth is that SectorSurfer does well with many universes but not with the SIMPLE universe. The FundX allocation algorithm produces better results in this instance.

The FundX algorithm does not always produce better results. It was inferior when applied to the 27Fidos universe in the prior section for example.

My experience is that no momentum algorithm produces good results with all investment universes, which is why it is important to test a broad variety of universes and algorithms.

Table 9 also illustrates the superiority of the Armor market timer over the composite timer in the context of the SIMPLE strategy.

Table 9. SectorSurfer and the SIMPLE Strategy, 2000-May 2021. Statistics were calculated from SectorSurfer's equity curves and may differ from the values reported by SectorSurfer. There are data for VFINX, VGTSX and VSIGX from 1996. Sources: VFINX and SIMPLE.xlsx and SectorSurfer & SIMPLE.csv.

	VFINX VGTSX VGSIX	VFINX VGTSX VGSIX	VFINX VGTSX VGSIX	VFINX VGTSX VGSIX	LrgCapUS Foreign USREIT	LrgCapUS Foreign USREIT	LrgCapUS Foreign USREIT	LrgCapUS Foreign USREIT
Bonds	None	VFITX VFISX	Not confirmed	VFITX VFISX		IGBond VFISX		IGBond VFISX
Market Timing	None	None	SG Armor	SG Armor	SG Armor (IGBond)	SG Armor (IGBond)	Composite (IGBond)	None
Momentum	αDEMA α = 65±16	αDEMA α = 92±9	αDEMA α = 77±27	αDEMA α = 79±25	FundX	FundX	FundX	FundX
TopN	1	1	1	1	2	2	2	2
mSD, per month	5.6%	4.6%	3.6%	3.3%	2.8%	2.6%	2.9%	2.8%
maxDD	0.73	0.47	0.15	0.12	0.09	0.09	0.17	0.13
Portfolio Longevity Value90 6% Spend, 35 years	57±%	64±%	99% 11x	98% 4x	>99.9% 22x	99.8% 7x	97% 2x	95±% 1x
Inflation-adjusted mean Inflation-adjusted SD	0.0845 0.2104	0.0804 0.1725	0.1424 0.1444	0.1173 0.1278	0.1467 0.1126	0.1184 0.1005	0.1027 0.1127	0.0960 0.1075
CAGR	0.088	0.090	0.159	0.135	0.167	0.139	0.121	0.115
Sharpe	0.46	0.53	1.12	1.04	1.48	1.34	1.04	1.01
Allocation for June	US	US	US	US	REIT US	REIT US	REIT US	REIT US

QQQ Strategies

The exchange traded fund QQQ tracks the NASDAQ-100®, a large-cap growth index which includes domestic and international non-financial companies. The NASDAQ-100 is more volatile than the S&P 500 Composite index. There are index data from September 1985 and QQQ history from March 1999.

Table 10. QQQ Dilution Strategy. Volatility control employs NDX as the risk index; SPX was inferior as the risk index. Table has been sorted by decreasing mSD. *Not proofed*

2000 - 2020	Volatility Control Market Timer	CAGR	mSD	Sharpe	UPI	maxDD	Annualized Mean	Annualized SD	Longevity 6% w/d, 35 yr
LrgCapUS	None	0.0695	0.044	0.42	0.31	0.51	0.0584	0.1599	42%
QQQ & IGBond	5AbsMom+DR*VOL +IUC	0.1096	0.039	0.73	1.00	0.27	0.0967	0.1476	86%
LrgCapUS & IGBond	5AbsMom+DR*VOL +IUC	0.1041	0.028	0.91	1.86	0.16	0.0854	0.1069	89%
LrgCapUS & IGBond	Armor	0.1423	0.027	1.32	4.60	0.09	0.1223	0.1056	>99%
QQQ & IGBond	0.006NDX63d	0.0835	0.024	0.82	1.78	0.11	0.0650	0.0899	70%
QQQ & IGBond	0.006NDX105d	0.0829	0.023	0.85	1.91	0.12	0.0641	0.0860	70%
QQQ & IGBond	0.006SPVolNDX	0.0859	0.023	0.89	2.03	0.10	0.0670	0.0857	75%
QQQ & IGBond	0.005NDX63d	0.0779	0.020	0.90	2.51	0.07	0.0584	0.0747	62%
QQQ & IGBond	0.005NDX105d	0.0770	0.019	0.92	2.57	0.09	0.0573	0.0718	59%
QQQ & IGBond	0.005SPVolNDX	0.0802	0.019	0.98	3.01	0.07	0.0604	0.0714	67%
60% LrgCapUS 40% IGBond	None	0.0640	0.026	0.56	0.55	0.33	0.0450	0.0953	30%

Source: Results were generated using MomSim Daily Timing 02032021.cs. See also VFINX and SIMPLE.xlsx

The QQQ dilution strategies are superior to the 60:40 portfolio of US large cap stocks and bonds because the QQQ dilution strategies provide lower volatility, lower drawdowns and better, but less than 90%, longevity.

The QQQ dilution strategies are inferior to QQQ plus market timing. The only QQQ strategy which provides 90% longevity is timing with StormGuard Armor.

SIMPLE RM, 9SPDRs and Combination Strategies

State Street Global Advisors introduced nine SDPR exchange-traded funds in 1998, each tracking a different sector of the US market. The FundX momentum algorithm works well with this universe, meaning that the strategy is easily implemented.

Portfolio Visualizer implementation.

Timing Model: Relative Strength
Time period: Month-to-Month
Tickers: XLB, XLE, XLF, XLI, XLK, XLP, XLU, XLV and XLY
Performance periods: Multiple Periods
Assets to Hold: 2
Time Period #1: 1 months, 25% weight
Time Period #2: 3 months, 25% weight
Time Period #3: 6 months, 25% weight
Time Period #4: 12 months, 25% weight

The 9SPDRs strategy is less volatile than the 27Fidos strategy; see Table 11. The explanation is probably that the SPDR market sectors are broader than those targeted by the Fidelity Select funds.

Another benefit to the 9SPDRs strategy is that it uses ETFs which avoids the need for a Fidelity brokerage account.

9SDPRs has a lower longevity potential than the 27Fidos strategy, which might lead some investors to consider 9SPDRs an inferior strategy.

Let us combine the SIMPLE RM and 9SPDRs strategies and the SIMPLE RM and 12Fidos strategies, managing half of the portfolio with one strategy and half of the portfolio with the other strategy.

Implementing a composite strategy is most convenient when the strategies operate in separate brokerage accounts, but this is not essential.

The combination strategy provides better statistics in most categories.

2000 – June 2021	SIMPLE RM	9SPDRs	Composite
Volatility (mSD)	2.8%	2.9%	2.6%
MaxDD	0.13	0.11	0.10
Longevity Value90 (real)	96% 1x	96% 1x	98% 2x
CAGR	0.1165	0.1185	0.1175
Sharpe	1.03	1.03	1.13
UPI	2.13	2.95	2.98

The SIMPLE RM combination with 9SPDRs leave something to be desired in terms of relative strength; see Part VI.

The combination of SIMPLE RM and the 27Fidos (ensemble) strategy are more volatile but provide better relative strength profiles.

While better results are obtained combining with the 27Fidos (ensemble) strategy, the combination with the 27Fidos (FundX) strategy is a good alternative if implementation is an issue.

The ultimate combination strategy would be one which identifies the best strategy for the coming month, much as momentum algorithms seek to identify the best securities for the coming month. SectorSurfer's "strategy of strategies" attempts to rotate among the best strategies on a monthly basis.

Maurer is experimenting with the use of momentum algorithms to rotate among the strategies.

Table 11. Equally Weighted Combination Strategies. The Life Strategy benchmark is described in Part VI.

2000 – June 2021	*Pro Forma* Dividend Strategy	*Pro Forma* Dividend Strategy Armor Timing	SIMPLE RM VFISX & IEI 1:1 Top2	27 Fidos (Ensemble) Top 3	27 Fidos (FundX) Top 3	9SPDRs Top 2	SIMPLE RM + 9SPDRs Combination	SIMPLE RM + 12Fidos (Ensemble) Combination	SIMPLE RM + 12Fidos (FundX) Combination
Momentum Algorithm	None	None	FundX	Ensemble	FundX	FundX			
Market Timing	None	Armor	None	Armor	Armor	Armor			
Out of Market Asset	None	**VFISX**	IEI & VFISX	VFISX	VFISX	VFISX			
Volatility (mSD)	4.0%	2.7%	2.8%	3.9%	4.5%	2.9%	2.6%	2.9%	3.1%
MaxDD	0.44	0.22	0.13	0.13	0.31	0.11	0.10	0.10	0.13
Longevity Value90 (real) 6% w/d, 35 years	81%	99.6% 6x	96% 1.3x	99.9% 29x	99.5% 17x	96±% 1.4x	98% 2x	99.9% 11x	99.7% 9x
Annual mean return	0.0927	0.1174	0.0972	0.1691	0.1652	0.0993	0.0973	0.1326	0.1308
Annual SD of returns	0.1516	0.1050	0.1076	0.1553	0.1790	0.1094	0.0976	0.1149	0.1221
Average Allocation Total Equity US Foreign RE	1.00	0.71	0.76 0.25 0.21 0.30						
CAGR	0.1086	0.13.75	0.1165	0.1852	0.1781	0.1185	0.1175	0.1511	0.1511
Sharpe	0.70	1.27	1.03	1.23	1.04	1.03	1.13	1.31	1.21
UPI	0.88	2.95	2.13	4.61	1.82	2.95	2.98	4.05	3.09
Source	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xls	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx

VI. RELATIVE STRENGTH

The statistics discussed so far describe the average of the performance over time.

Relative strength characterizes relative performance at each instance of time in comparison to the performance of a benchmark. Most importantly, relative strength provides a measure of the current performance.

Relative strength is the ratio of the value of a security or of a portfolio to the value of a reference portfolio. If the two portfolios are changing in value at about the same rate, the relative strength will be flat with only modest undulations. If the portfolio of interest is outperforming the reference, the relative strength will be rising, and if the portfolio of interest is underperforming, the relative strength will be falling. If the relative performance of the two portfolios is constant over time, the relative strength will be steadily increasing or decreasing.

The initial relative strength value is normalized to unity by dividing by the ratio of the initial portfolio values. Relative strength is often plotted on a logarithmic scale so that a given vertical change equates to the same percentage change.

Relative strength can tease out information which is hidden by other statistics.

Consider the performance of the Fidelity Diversified International Fund (FDIVX). The historical performance was seven percentage points per year higher than that of Vanguard Total International Stock Fund (VGTSX) over the nine years ending June 2005. So many investors wanted to invest in the Fidelity fund that the fund was forced to close.

A more complete picture emerges by examining relative strength over time.

As shown in Figure 6, the Fidelity Diversified International Fund strongly outperformed the Vanguard Total International Stock Fund through about the end of 2002. The relative strength then began a slow decline.

In mid-2005, when assets were pouring into the Fidelity fund, there was no *current evidence* for superior relative performance.

Figure 6. Relative Strength of Fidelity Diversified International fund versus Vanguard Total International Stock Index fund, 7/1996 - 2012. The value of FDIVX is shown in red and the value of VGTSX is shown in green. The third curve is the relative strength of FDIVX versus VGTSX.

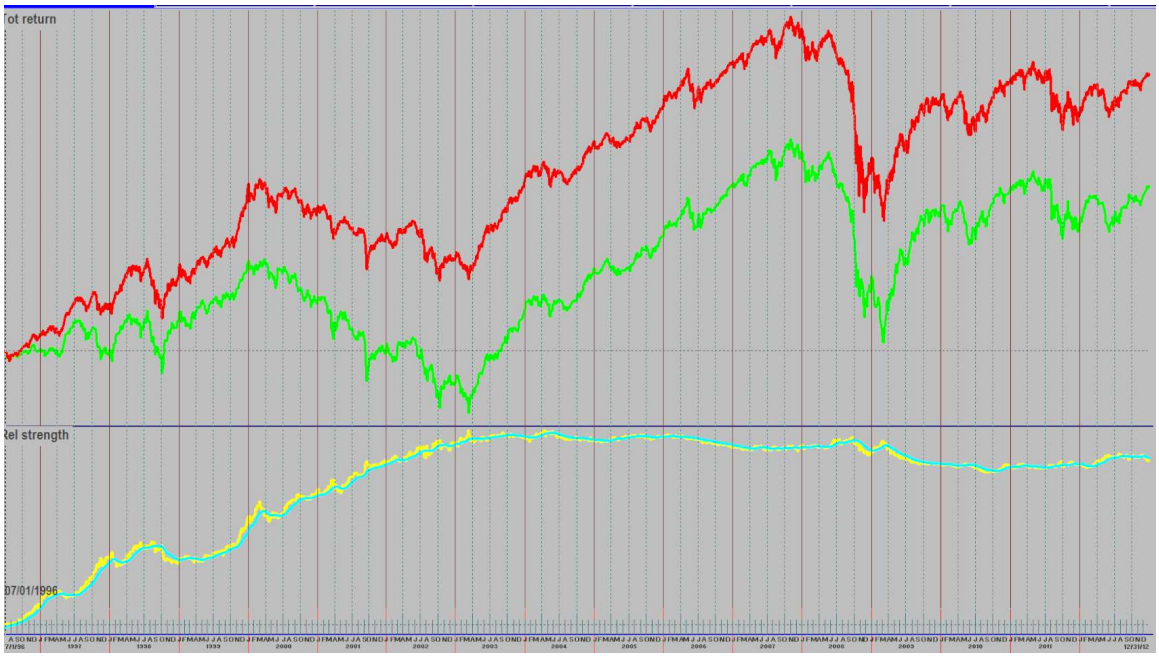
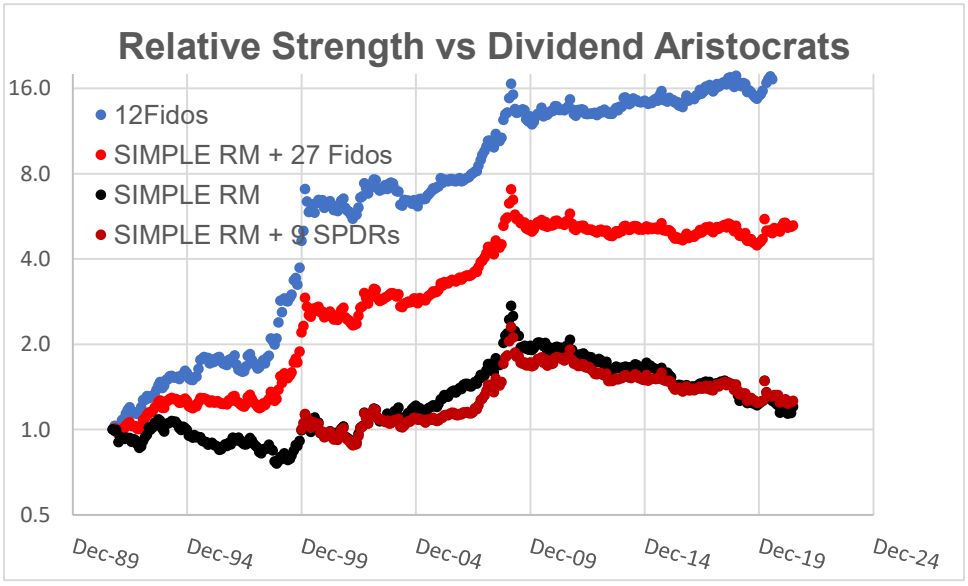


Figure 7 shows the relative performance of several tactical dividend strategies versus the Dividend Aristocrats index. Note the logarithmic vertical scale.

Figure 7. Relative Strength of Tactical Strategies, 2000 – June 2021. The blue line is the 27Fidos strategy with the Ensemble momentum algorithm, the red line is the combination of the 27Fidos and Simple RM strategies, the black line is the SIMPLE RM strategy and the maroon line combines the SIMPLE RM and 9SPDSRs strategies.

Source: VFINX and SIMPLE.xlsx.



SIMPLE RM underperformed the index during the nineties, outperformed through the 2008 bear market and has underperformed since.

This is not an attractive relative strength profile because there are extended periods of underperformance.

The 27Fidos (ensemble) strategy is more attractive since there are no periods of underperformance. The 27Fidos strategy outperformed though the mid-1990s, was flat for a few years and outperformed towards the end of the decade. The strategy was flat through the dot-com bust, outperformed in the years before the 2008 bear market and has outperformed since.

The challenges with the 27Fidos (ensemble) strategy are its volatility and complexity.

Volatility is addressed by combining the 27Fidos and SIMPLE RM strategies. The combined strategy, the red line, has lower volatility and eliminates the relative decline suffered by the SIMPLE RM strategy during the nineties and most of the relative decline after the 2008 bear market.

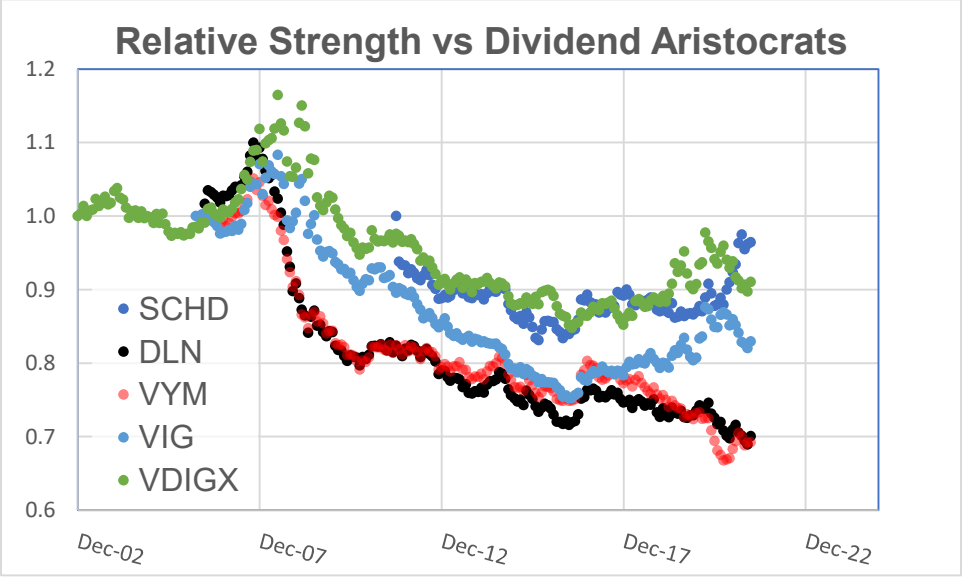
Complexity is addressed by shifting from the 27Fidos (ensemble) strategy to the more volatile 27Fidos (FundX) strategy.

Combining the SIMPLE RM strategy with the 9SPDS, the maroon line, improves the profile of the 9SPDS strategy (not shown) but does nothing to address the decline of the SIMPLE RM strategy over the past decade.

Turning to the dividend funds, Figure 8 – note the linear scale - shows that the SCHD and VDIGX have the closest performance relative to that of the Dividend Aristocrats index. Bear in mind that there are only ten years of data for SCHD.

Figure 8. Relative Strength of Dividend Focused Funds.

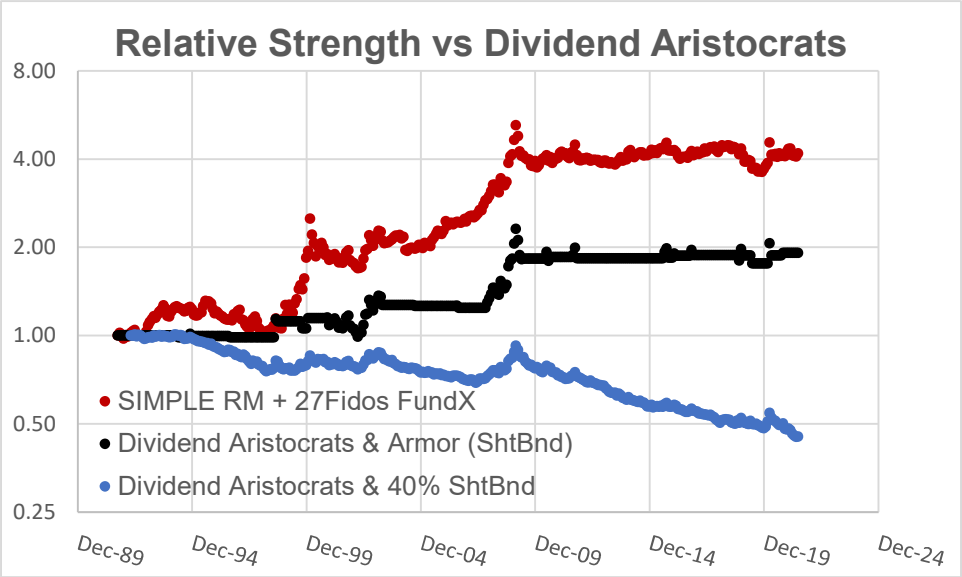
Source: VFINX and SIMPLE.xlsx.



The final comparison is the Dividend Aristocrats index with and without Armor timing; see Figure 9. Market timing boosted performance during the don-com and 2008 bear markets. The movements reflect losses due to poor timing recommendations.

Figure 9. Relative Strength of Dividend Aristocrats with Armor Timing.

Source: VFINX and SIMPLE.xlsx.



Bear in mind that the moves to fixed income will frequently interrupt the dividend payments.

The figure shows the relative strength of the SIMPLE RM + 27Fidos (FundX) Combination Strategy. The final value of the combination strategy is four times that of the index and twice that of the timed index. This illustrates the legacy potential of the combination strategy.

The relative performance of the benchmark illustrates the enormous performance toll exacted by strategies which control volatility and drawdown by including a constant allocation to fixed income. The two tactical strategies shown in Figure 9 have achieved similar volatility control and better drawdown control without hits to portfolio longevity and legacy.

Life Strategy Benchmark

The Vanguard LifeStrategy® funds are composed of US and foreign stocks, US and foreign bonds[19].

- The total equity allocation is 20, 40, 60 or 80%.
- The equity elements contain 60% total US stock market and 40% total international stock market.
- The bond elements contain 70% US bonds and 30% foreign bonds. The allocation to foreign bonds is difficult to replicate due to the lack of a long-lived mutual fund.

The life strategy benchmark contains 36% VTSMX. 24% Foreign and 40% IGBond, rebalanced monthly. It can be evaluated from May 1992.

The life strategy benchmark has significantly underperformed a portfolio containing 60% US stocks and 40% US bonds since 2000.

2000 - June 2021	60% VOO 40% IEI	36% VTI 24% VXUS 40% IEI
Momentum Algorithm	None	None
Market Timing	None	None
Out of Market Asset	n/a	n/a
Volatility (mSD)	2.5%	2.6%
MaxDD	0.30	0.32
Longevity 6% w/d, 35 years Annual mean return Annual SD of returns	27% 0.0435 0.0907	17% 0.0386 0.0935
Average Allocation Total Equity US Foreign RE	 0.60 0.60	 0.60 0.36 0.24
CAGR	0.0630	0.0577
Sharpe	0.58	0.51
UPI	0.57	0.50
Source	VFINX and SIMPLE.xlsx	VFINX and SIMPLE.xlsx

[19] https://investor.vanguard.com/mutual-funds/lifestrategy/#/

VII. CONCLUSIONS

- Volatility, drawdown, longevity, relative strength and possibly legacy potential are all that are needed to identify an effective strategy.

  The values of CAGR, Sharpe ratio, and Ulcer Performance Index are usually satisfactory when volatility, drawdown and longevity are attractive.

- It is essential to backtest tactical strategies and investment universes over extended histories and to test variations of the allocation and timing algorithms.

- Dividend and tactical strategies follow different philosophies.

  The dividend investor is reluctant to spend principal, whereas the tactical investor spends principal if this does not threaten portfolio longevity.

  The dividend investor adopts a stoical attitude towards volatility whereas the tactical investor seeks to control volatility and drawdown.

  Initial spend and legacy potential can be significantly larger with tactical strategies.

- AAII's dividend investing strategy exhibits relatively high volatility and drawdown as compared to dividend-oriented funds like SCHD and VDIGX.

- The SIMPLE RM and 9SPDRs strategies are easily implemented using Portfolio Visualizer.

  They have exhibited safe and large spends during extended backtesting.

  They have exhibited lower volatilities and drawdowns than dividend strategies.

  SIMPLE RM has sometimes underperformed during bull markets while 9SPDRs is US focused and Armor timing has not been tested out of sample.

  The relative strength profile of SIMPLE RM is not attractive.

- The combination of SIMPLE RM and 9SPDRs reduces strategy specific risks while providing a lower volatility and drawdown than either strategy.

  The relative strength profile of the combination is not attractive.

- The 27 Fidos strategies have a larger legacy potential than the SIMPLE RM and 9SPDRs strategies but may be too volatile for some investors.

  The ensemble version of the 27Fidos strategy is also more challenging to implement.

- The combination of the SIMPLE RM and 27Fidos strategies is synergistic. Volatility is moderated, drawdown is reduced, longevity and legacy are good, traditional statistics of Sharpe and UPI are outstanding and the relative strength profile is attractive. The combination using the FundX version of the 27Fidos strategy is easy to implement.

- The relative performance of the 60:40 portfolio illustrates the enormous reduction in legacy associated with strategies which control volatility and drawdown by including a constant allocation to fixed income.
- Tactical strategies which rely on long bonds should be viewed with caution.
- Tactical strategies are best owned inside a tax-advantaged account.
- Dividend investors need to consider that performance in the post 2003 interval could be anomalous and that tax changes could degrade future after-tax performance.

BIBLIOGRAPHY. The following articles are available at www.lingane.com/qi.

- **SectorSurfer Forward Walk Progressive Tuning, 2015**. This article illustrates the double exponential moving average (DEMA) trend calculation and how SectorSurfer can be evaluated in terms of both tuning and return.
- **The SIMPLE Investment Strategy, 2017**. This article addresses downside risk mitigation and argues that tactical changes to the bond allocation (otherwise known as market timing) is cost effective compared to the usual approach of including a static bond allocation.

  We trace the evolution of the SIMPLE strategy from its origin as Antonacci's Dual Momentum strategy, describe backtested performance since 1974 and illustrate the effect of the SIMPLE strategy on savings accumulation and portfolio longevity.
- **Definition of Timing and Allocation Algorithms, 2019**.
- **Curated Data, 2020**. This EXCEL file illustrates common investment calculations and documents the curated equity curves for large, mid and small-cap US stocks, foreign stocks, US real estate, CASH and Treasury bills.

  The spreadsheet also illustrates the calculation of the SPVOL timer and the calculation of the AbsMom5_1 + DR*VOL + IUC composite timer.

Appendix A. Data for Backtesting

Simulations require data. Practitioners are forced into compromises when backtesting more than a few years. Echoing allocatesmartly.com, a long backtest with inferior data is more confidence building than a short backtest with superior data.

Strategies which employ monthly data and strategies based on SPX are more readily backtested.

Histories for backtesting were constructed as outlined below, together with the funds that would be used to for implement a strategy.

Backtesting	Implementation
LrgCapUS. There are SBBI monthly returns for large cap US stocks from 1926 and daily returns for VFINX from 1980. The curated data transition in 1998.	VOO
Foreign. There are monthly returns for the MSCI-EAFE foreign developed market index from 1970. These transition to daily returns for FSIIX in 1998 and to daily returns for FSPSX in 2013.	VEU or VXUS
USREIT. There are monthly returns for the USNAREIT index from 1972. These transition to daily returns for VGSIX in 1998.	VNQ
IGBond. There are SBBI monthly returns for 5-year Treasury government bonds from 1926. These transition to daily returns for a 50:50 blend of VFITX and VFISX in 1998 and to daily returns for IEI in 2008.	IEI
ShtBnd. FRED reports daily constant maturity 2-year Treasury yields from June 1976. These transition to daily returns for VFISX in October 1991. The relative strength in the overlap region suggests that the return of VFISX is higher than that of 2-year bonds. SHY underperforms VFISX by 0.3% annually.	VFISX or SHY
LngBnd. FRED reports daily constant maturity 20-year Treasury yields from 1962. These transition to daily returns for VUSTX in October 1988. The relative strength in the overlap region suggests that the return of VUSTX is substantially higher than that of 20-year bonds.	VUSTX
Risk Free Rate/Tbills. SBBI monthly returns for 1-month Treasury bills from 1925. These transition to daily returns inferred from ^IRX, the 13-week T-bill yield, in 1998 and to DGS1MO, the constant maturity 1-month Treasury yield curve, in August 2001.	Money Market Account
NASDAQ. Daily returns of NDX, the NASDAQ100 index without dividends, from October 1985 and of QQQ from April 1999. The relative strength of the index versus QQQ suggests that dividends net expenses represent about zero annually through 2005 and about 1% annually thereafter.	QQQ

SmlCap. There are SBBI returns for small cap US stocks from 1926; these transition to daily returns for DFSCX in 1998. SmlCap is not entirely satisfactory because it only approximates the French “Lo 30” small cap index (since 1926) and the Russell 2000 index (since 1986.)	IWM

APPENDIX B. LONGEVITY ESTIMATES FROM SHORT HISTORIES

One approach is to populate the future by drawing monthly returns from a Normal distribution with the same mean and standard deviation as the historical returns. Historical returns are not accurately represented by a Normal distribution. The Normal distribution tends to provide more negative returns than is observed experimentally with the result than longevity tends to be underestimated.

A second approach is to populate the future by drawing returns from the historical population. My analysis shows that this approach also tends to underestimate longevity, for unknown reasons.

A third approach is to draw short historical return sequences. This preserves some of the correlation among the historical returns[20]. This approach tends to underestimate longevity and the effect of sequence length or "block size" is not understood.

All Monte Carlo approaches are untethered from the current situation. Interest rates are currently low and yet many simulations will start at a time when interest rates are high without modelling the transition.

Any approach which uses historical return sequences suffers from under sampling of the initial and final returns in the historical sequence. To achieve uniform sampling, the returns are often 'wrapped around" such that the first value of the original sequence follows the last value of the original sequence. I find this problematic; a return sequence drawn from the post 1926 history might start with 2010 and would be followed by the great depression!

Different approaches to estimating future returns provide different estimates of Longevity, especially with short (21-year) histories. Consequently, the longevity values are uncertain and are best used to distinguish the strategies with higher or lower longevity.

Longevity of the 100% Large Cap US stocks and of the 60:40 Portfolio, 1950 - May 2021. There are 857 simulations using unique 420-month historical sequences (including wrapped around sequences) and 5000 simulations for the other approaches.

The inflation-adjusted parameters for the Normal distribution of the Large Cap US stock portfolio are 0.0901 annualized mean and 0.1578 annualized standard deviation.

Large Cap US Stocks	Longevity 6% spend, 35 years	Sustainable Withdrawal Rate 5% failure, 35 years
Historical Sequences (Bengen)	70% success	4.10% of initial value

[20] Don Maurer, Silicon Valley CI SIG, April 1, 2021, at about 1 hour and 55 minutes.

Normal Distribution		
Normal Distribution, Portfolio Visualizer	78%	4.2%
Random, N = 1	79%	4.18%
Random, N = 3	78%	4.10%
Random, N = 6	77%	4.00%
Random, N = 420	71%	4.14%

The inflation-adjusted parameters for the Normal distribution of the 60:40 portfolio are 0.0624 annualized mean and 0.0962 annualized standard deviation.

60:40 Portfolio	Longevity 6% spend, 35 years	Sustainable Withdrawal Rate 5% failure, 35 years
Historical Sequences (Bengen)	65% success	4.12%
Normal Distribution		
Random, N = 1	64%	4.30%
Random, N = 3	64%	4.26%
Random, N = 6	63%	4.15%
Random, N = 420	65%	4.14%

Longevity of the 100% Large Cap US stocks, 2000 - May 2021. There are 257 simulations using unique 420-month historical sequences (including wrapped around sequences) and 5000 simulations for the other approaches.

The inflation-adjusted parameters for the Normal distribution of the Large Cap US stock portfolio are 0.0594 annualized mean and 0.1600 annualized standard deviation.

Large Cap US Stocks	Longevity 6% spend, 35 years	Sustainable Withdrawal Rate 5% failure, 35 years
Historical Sequences (Bengen)	33% success	3.66% of initial value
Normal Distribution		
Normal Distribution, Portfolio Visualizer	43%	2.6%
Random, N = 1	43%	2.54%
Random, N = 3	45%	2.67%
Random, N = 6	46%	2.54%

Random, N = 420	33%	3.66%

N= 420 guarantees three or four bear markets in each simulation

Appendix C. Efficient Frontier Method for Volatility Control.

Describing the Efficient Frontier in EXCEL. The example is specific to month-end 12/31/2019. The "risky portfolio" contains three securities: SPY, QQQ and IEF; 1-month treasury bills ("Tbills") is the "risk-free" asset.

1. Calculate returns for each security and the variance-covariance matrix for all securities at the end of each month.

   The daily return of a security is taken to be the average of its daily returns over the prior 63 days, including the month-end date. Do not annualize the returns.

SPY	QQQ	IEF	Tbills
0.1573%	0.2073%	-0.0311%	0.0060%

   The variance-covariance matrix is determined from the daily returns over the prior 105 days, including the month-end date, using EXCEL's VAR.S and COVARIANCE.S functions.

   The entries below have been annualized by multiplying by the 252 trading days in a typical year. Annualization is not necessary and does not affect the results.

	SPY	QQQ	IEF	1-mo Tbills
SPY	1.722E-2	2.017E-2	-4.700E-3	2.34E-6
QQQ		2.533E-2	-5.548E-3	1.91E-6
IEF			5.103E-3	1.24E-6
Tbills				6.29E-8

2. The efficient frontier is the locus of returns where the portfolio allocations have been chosen to maximize the portfolio return for a given standard deviation.

   The frontier stretches along the standard deviation axis from the standard deviation of the portfolio with minimum variance to the standard deviation of the portfolio with maximum return.

   The minimum variance portfolio can be identified using EXCEL's SOLVER function to determine the weights which minimize the variance of the combined portfolio, subject to the constraints that each weight is zero or positive and that the sum of the weights equals one.

   The maximum return portfolio can be identified using EXCEL's SOLVER function to determine the weights of the securities which maximize the return of the combined portfolio subject to the constraints that each weight is zero or positive and that the sum of the weights equals one.

   The intermediate points can be identified using EXCEL's SOLVER function to determine the weights which maximize the return of the combined portfolio subject to the constraints that each weight is zero or positive, that the sum of the weights equals one AND that the variance (or standard deviation) is a fixed value between the standard deviation of the minimum variance and maximum return portfolios.

3. The variance is determined using EXCEL's matrix formulas. Matrix multiplication requires that the number of rows in the first matrix equals the number of columns in the second. That is,

X X X	times X X X is valid but X X X times	X X X	Is not.
X X X		X X X	
X X X		X X X	

X X	times X X is valid but X X times	X X	Is not.
X X		X X	

The variance covariance matrix in this example has three rows and three columns.

If the weights are in a row, the variance of the risky portfolio is

MMULT(weights, MMULT(Var-Covar Matrix, TRANSPOSE(weights)))

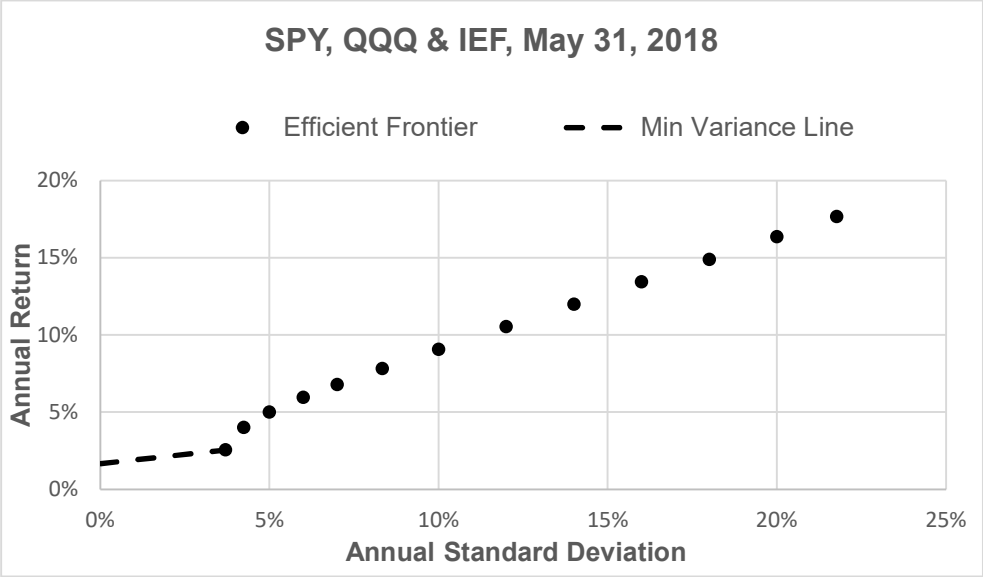
If the weights are in a column, the variance of the risky portfolio is

MMULT(TRANSPOSE(weights), MMULT(Var-Covar Matrix, weights))

4. The daily return of the risky portfolio is $\Sigma W_i R_i$ where W_i and R_i are the weights of the securities and the average daily returns.

   The annual return of the risky portfolio is (1 + daily return) ^ 252 -1.

The efficient frontier for the SPY, QQQ, IEF portfolio as of a specific date is reproduced below. Redo for four components



Determining Allocations for a Blended Portfolio of Specified Standard Deviation.

The variance of a portfolio formed by blending two portfolios is determined from the variances and covariance of the two portfolios as follows.

$$VAR_{blend} = W_1\text{^}2*VAR_1 + (1-W_1)\text{^}2*VAR_2 + 2*W_1*(1-W_1)*COVAR_{12}$$

This formula can be simplified when the second portfolio is Tbills because the variance of Tbills is small and the covariance with the risky portfolio is also small.

$$SD_{blend} = SQRT(VAR_{blend}) = Weight_{risky\ asset} * SD_{risky\ asset}$$

When blending the risky portfolio with bonds, it is generally necessary to solve the quadratic formula because the variance of bonds and the covariance with bonds are not small. Alternatively, the variance of the blended portfolio can be determined using matrix formulas. The variance covariance matrix is a 4x4 matrix in this example.

The return of a blended portfolio comprising Tbills and this risky asset (portfolio) varies linearly between the return of Tbills and the return of the risky portfolio. This is the dashed black line in the prior figure.

$$Return_{blend} = Weight_{risky\ asset} * (R_{risky\ asset} - R_{tbills}) + R_{tbills}$$

If the desired standard deviation of the blended portfolio is 0.2% daily (about 0.2% * sqrt(252) = 3.2% annually), the weight of the risky asset (portfolio) to achieve the desired standard deviation is 0.002 divided by the daily standard deviation of the risky asset. The balance of the blended portfolio would be Tbills.

Assume that the optimized weights in the risky portfolio are {0.3, 0.3, 0.4} and that the weight of the risky portfolio to achieve the standard deviation goal is 40%. The weights in the blended portfolio, risky portfolio plus Tbills, are {0.12, 0.12, 0.16, 0.60}.

When the standard deviation goal exceeds the standard deviation of the risky portfolio, these formulas lead to the shorting of Tbills and more than 100% allocations to the risky securities. There is no shorting of Tbills in the simulations described here. That is the desired standard deviation was treated as a cap.

Determining the Maximum Sharpe Portfolio.

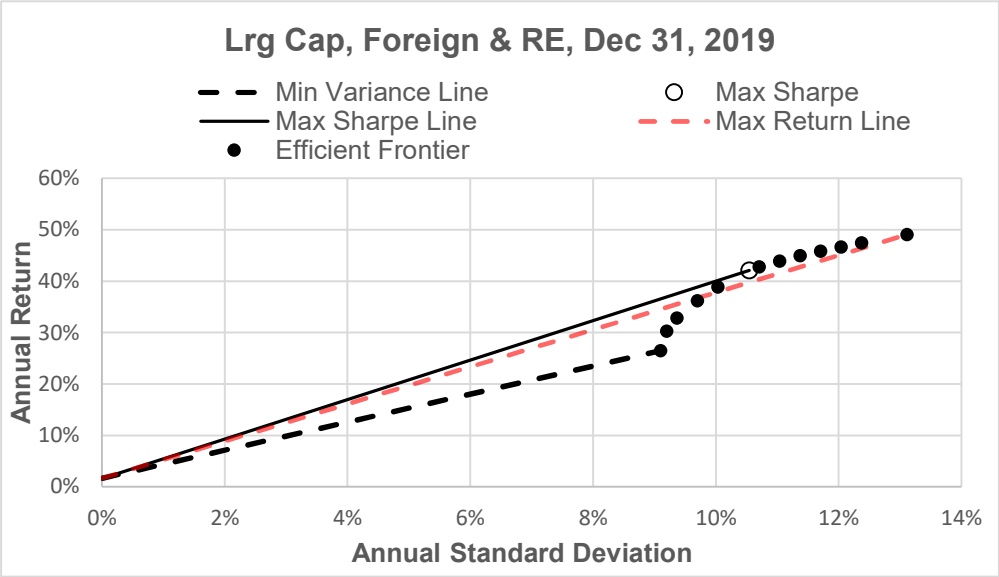
Use EXCEL's solver function to determine the weights which maximize the Sharpe Ratio of the risky portfolio subject to the constraints that the weights cannot be negative and that the sum of the weights equals one.

Sharpe adjusted each return by subtracting the return of the risk-free asset, Tbills in this context. He defined his ratio as the average of the adjusted returns divided by the standard deviation of the adjusted returns.

For simplicity, we define the Sharpe ratio in this application as the average of the daily returns of the risky portfolio minus the average of the daily returns of Tbills all divided by the standard deviation of the daily returns of the risky portfolio.

The standard deviation of the risky portfolio is the square root of the variance of the risky portfolio, whose calculation was illustrated previously. The weights which maximize the Sharpe Ratio do not depend on whether the variance is expressed daily or annually.

The following chart illustrates the Efficient Frontier with the location of the Sharpe Ratio indicated by the open circle.



Appendix D. Constructing the Equity Curve for AAII's Dividend Investing Portfolio.

1. Assemble the transaction data into a single EXCEL file showing date, transactions (BUY, SELL Dividend Received), Number of Shares and Cost/Proceeds net of commissions.
2. Calculate the Cash Balance over time as the Starting Cash Balance ($11.28) plus the sum of subsequent inflows and outflows.
3. Adjust for stock splits since the free historical prices at Yahoo.com are split adjusted. For compatibility, the number of shares in each transaction before the split was increased.

   For example, the portfolio bought 32 shares of V. F. Corporation (VFC) on 1/3/2012 at a net cost of $4,166. This security split 4:1 on 12/20/2013 and 1.062:1 o 5/23/2019. The number of shares purchased was increased to 136.936 (32*4*1.062) at a net cost of $4,166.

   Other splits included

   AAPL, 7:1 on 6/9/14 and 4:1 on 8/31/2020

   AFL, 1::1 on 3/16/2018 and 2:1 on 3/19/2018

   BAX, 1.841:1 on 7/1/2015

   CPK, 3:2 on 9/9/2014

   IP, 1.014:1 on 7/2/2014

   OXY, 1.042:1 on 12/1/2014 and 1:0.9983 on 2/25/2016

   PPL, 0.9314:1 on 6/2/2015

   VFC, 4:1 on 12/23/2013 and 1.062:1 on 5/23/2019
4. Determine portfolio allocations over time. Anomalies were traced to the following errors and omissions in the transaction file.

   VVC. -137 shares purchased 2/8/2012 was corrected to +137 shares purchased.

   Exchange of WBA for WAG 12/31/2014. Changed to 110 shares of WBA bought and 110 shares of WAG sold.

   Spin-off of BXLT from Baxter 7/1/2015. Added purchase of 89 shares of BXTL at zero cost.

   Spin-off of CRC from XXXXX 3/29/2016. Added purchase of 8 shares of CRC at zero cost.

   10/15/2015. Cash Dividend from OXY was recorded as a BUY.

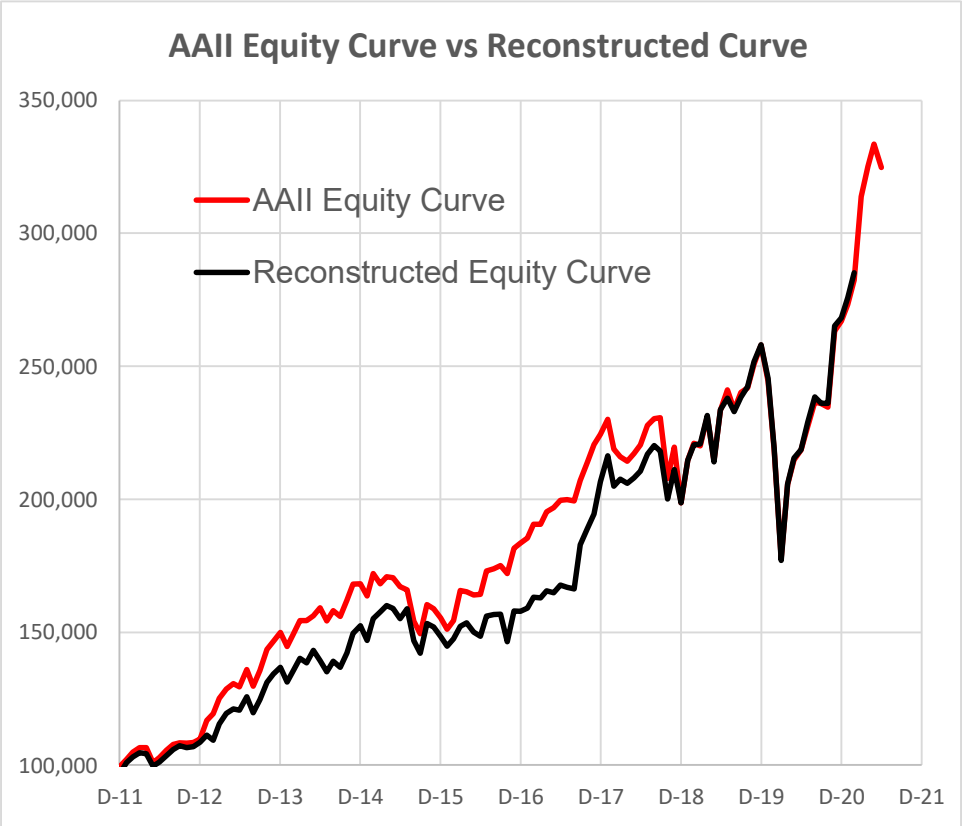
   At the beginning of 2018, there was an accounting change. Whereas debits and credits had been positive numbers, proceeds from sales are now

reported as positive numbers and the costs of purchases are reported as negative numbers.

5. Determine the portfolio value over time as the number of shares times closing price. When historical prices were not available, the security was valued at the purchase price until sale.

   This approach neglects commissions and cash balances. Cash balances were generally a few hundred dollars and rarely exceeded a few thousand dollars on a portfolio valued at more than a hundred thousand dollars.

   The reconstituted equity curve is compared AAII's equity curve. The reconstitution has failed to reproduce performance in the 2012 - 2017 timeframe despite my best efforts.



Source: AAII Dividend Investing Transactions_modified.xlsx.

The statistics in Table 4 in the body of this report were derived from the AAII equity curve.

Appendix E. Income Taxation.

Tactical investments tend to turnover at least annually, meaning that most of the appreciation is taxed as ordinary income. Dividend investing, in contrast, tends to recognize only dividends received as income and qualified dividends are taxed at preferential rates under current law. Appreciation is deferred

Returns for the SIMPLE RM and Fidelity Select strategies are on the order of 10 to 20% annually. This means that a million-dollar tactical portfolio owned in a taxable account would typically realize one to two hundred thousand dollars in ordinary income annually. With the passage of time, the value of a tactical strategy could appreciate ten-fold in real terms, even after annual withdrawals, meaning that the future ordinary income could be millions of dollars annually.

Incremental income of this magnitude is currently taxed at marginal rates approaching fifty percent[21]. It does not matter much whether you are married or single or whether you live in California or Oregon.

The dividend investor with a million-dollar taxable account might receive $40,000 in annual dividends and appreciation is likely to be less. Income tax might be 25% of a smaller taxable income.

If the tactical or dividend investment were held in a Roth IRA, income tax would be zero under current law.

To understand whether it is wise to own a tactical or dividend strategy in a Roth IRA, one must consider the strategy being displaced. If the strategy being displaced generates 5% in ordinary income annually, it does not make tax sense to displace this with a strategy generating 4% in preferentially taxed dividend income. But it would make sense to displace a 5% strategy with a tactical strategy generating 10 - 20% in ordinary income.

If the dividend and tactical investments are held in a traditional IRA or tax-advantaged pension plan, the amount of tax depends on spend and age. Age is involved because required minimum distribution typically start at about 4% at age 72 and increase from there.

To compare owning an investment strategy within a traditional IRA to ownership within a Roth IRA or taxable account, one must adjust initial account balances to the same purchasing power. If the traditional IRA involves an unrealized tax liability of, say, one third, the initial nominal value of the IRA account should be $1.5 million if the taxable and Roth accounts are $1 million.

Longevity forecasts need to distribute the same percentage of the nominal account balances independent of the tax environment in which the strategy is

[21] The 37% federal bracket for 2021 starts at incomes of $524,000 for single taxpayers and 628,000 for those filing jointly. Add the 3.8% net investment income tax and at least 10% state tax.

imbedded. It is not appropriate to compare a 4% withdrawal from a Roth account to a 4% withdrawal from a traditional IRA plus enough extra to pay the tax on the amount distributed.

A retiree with a $1.5 million IRA would be required to withdraw about $60,000 at age 72. This rises to about $84,000 at age 85 if the account value is unchanged.

IRA distributions are ordinary income. Required distributions of these magnitudes would be taxed at a marginal rate of about 31%.

Table E-1. Federal and State Annual Tax Liability. No change in account values.

	Nominal Account Value	Dividend Investing	Tactical Investing
Roth IRA	$1 MM	Zero	Zero
Traditional IRA Ages 72 and 85	$1.5 MM	$19,000 - $26,000	$19,000 - $26,000
Taxable Account 4% dividend yield	$1 MM	$10,000	$50,000 - $100,000

This analysis neglects

- Appreciation/depreciation, which would affect taxable income
- Taxation of the unrealized appreciation within the taxable account at death. Will this tax be forgiven (stepped-up in basis) as under current law or will the unrealized appreciation be taxed in the year of death and at what rates?
- The unrealized tax imbedded in the traditional IRA account at death. Under current law, the IRA must be distributed to a nonspouse beneficiaries within ten years, which could result in substantial tax liabilities for the beneficiaries.

  Or should tax liability be neglected because the heir is a charity?
- The taxable account created when minimum required distributions exceed spending. This account is unlikely to be invested in a tactical strategy because income taxation would be prohibitive. Investing this account in a lower performing strategy reduces the combined performance of the tactical account in IRA, but the reduction has not been quantified.
- Changes to federal and state tax policy, specifically a change making Roth IRAs subject to the minimum required distribution rules.

In summary, both tactical and dividend strategies tend to pay the least tax in Roth IRA accounts. Dividend strategies should do better in a taxable account rather than in a traditional IRA if the current step-up in basis at death is retained. A tactical strategy in a traditional IRA should do about as well as a

dividend strategy with the caveat that tactical strategies which are expected to greatly appreciate could produce large future tax bills of the heirs.

Future Taxation. There are proposals to double the income tax rate on qualified dividends and capital gains for higher income taxpayers. There are also proposals to eliminate the step-up in basis at death. This section considers some of the implications if these proposals were to become law.

If the proposals become law, the tax burden on a dividend strategy held in a taxable account will double for higher income taxpayers and companies may reduce dividends. These changes will reduce the after-tax income of a dividend strategy which will require spending less or spending principal. These changes could make a tactical strategy or an immediate life annuity more attractive.

Investors may want to consider the following actions, depending on their view of future tax changes and where their investments are currently located.

	Taxes Unchanged	Taxes Increased
Investments are primarily in taxable accounts	No changes seem warranted. Consider tactical strategy in IRA if IRA is available	Step-up is a concern. Tax on QD and LTCG is a concern at incomes >$400K. To reduce appreciated assets, consider gifting to heirs or to a donor advised fund and gradual sales. Do not implement a tactical strategy in a taxable account.
Investments are primarily in traditional IRAs	Consider a tactical strategy to supplement the dividend strategy, perhaps making room by shifting bonds from the IRA to a taxable account.	The impact of tax changes seems limited Consider shifting part of a dividend strategy to a tactical strategy, perhaps shifting bonds from the IRA to a taxable account.

APPENDIX F. TICKER SYMBOLS OF FIDELITY SELECT FUNDS

FBIOX
FBMPX
FDCPX
FDFAX
FDLSX
FIDSX
FRESX
FSAIX
FSAVX
FSCHX
FSCSX
FSDAX
FSDPX
FSELX
FSENX
FSESX
FSHCX
FSLBX
FSPCX
FSPHX
FSPTX
FSRBX
FSRFX
FSRPX
FSTCX
FSUTX
FSVLX

APPENDIX G. FURTHER WORK

- Maurer plans to reconstruct the equity curve for the Dividend Aristocrats index from Norgate data. Reconstructing the equity curve would be useful because it would generate, among other things, the history of dividend yields for this index. Having the historical dividend yields would provide a better sense of what has been possible with dividend investing.

  Alternatively, I may be able to acquire this history from ProShares.

- There are numerous newsletters which address dividend investing. The track records could be evaluated much as I evaluated the AAII Dividend strategy.

- Sure Dividend inaugurated a new service on July 1. There are two points of interest. First, the current dividend yield of their Ton10 picks is 3.3% which tends to confirm that a 4% yield is a stretch for the dividend investor.

  Second, there is almost no overlap between their Top10 picks and the Top10 stocks that are chosen by momentum algorithms from the 44 "A" stocks in the Sure Dividend database.

  Of course, momentum algorithms are guessing about the immediate future whereas Sure Dividend is forecasting performance over the next five years.

Sure Dividend "A" Group	Sure Dividend Top10	FundX Momentum Top10	DEMA20 Momentum Top10	DEMA50 Momentum Top10	12-month Momentum Top10	Ensemble Momentum Top10
7/1/2021	7/1/2021	6/30/2021	6/30/2021	6/30/2021	6/30/2021	6/30/2021
ABBV	ABBV					
ABT						
ADM	ADM			ADM		
AFL						
AOS		AOS				
ATO	ATO					
BDX	BDX					
BEN		BEN	BEN	BEN	BEN	BEN
BFB						
CAH	CAH					
CB						
CINF		CINF	CINF	CINF	CINF	CINF
CL						

CTAS			CTAS			
DOV						DOV
ECL						
EMR	EMR				EMR	
EXPD		EXPD	EXPD	EXPD	EXPD	EXPD
GD						
GPC				GPC		
GWW						
HRL						
ITW						
JNJ	JNJ					
KMB	KMB					
LEG						
LOW	LOW					
MDT						
MKC						
MMM						
NUE		NUE	NUE	NUE	NUE	
PG						
PNR		PNR		PNR	PNR	PNR
PPG		PPG		PPG	PPG	PPG
ROP			ROP			
SHW						
SPGI			SPGI			SPGI
SWK	SWK					
SYY	SYY					
TGT		TGT	TGT	TGT	TGT	TGT
TROW		TROW	TROW	TROW	TROW	TROW
WBA	WBA					
WMT						
WST		WST	WST		WST	WST

- Understanding Armor

