



Satisfying the Prudent Man

FINRA 2111, ERISA § 404, DOL PBGC, SEC §§ 275, UPIA, and Industry Practice

-- New Tools Change Old Rules --

By Scott M. Juds, January 2017

Abstract

Although investment risk decisions made by professionals are aggressively audited by regulators, the suitable and prudent fiduciary standards by which they are judged provide excess room for interpretation. Strikingly absent from the Financial Industry Regulatory Authority (FINRA) Rules, the Employee Retirement Income Security Act of 1974 (ERISA), the Securities and Exchange Commission (SEC) Investment Advisers Act of 1940, and the Uniform Prudent Investor Act (UPIA) is (a) any practical definition of risk or how it is quantitatively measured; (b) any guidance for determining how much diversification is required; and (c) any mention of the risk categories (conservative, moderate and aggressive) financial professionals most commonly discuss and employ. While regulators have given financial professionals wide latitude, they've provided no quantitative means for professionals to defend their investment advice as suitable and prudent. Fortunately, we can look to the traditional risk-classification model portfolios used by respected industry leaders that have long stood the test of time with regulators. Although some variation between these portfolios exists, together they form a consensus set of industry-standard definitions that enable risk category portfolios to be modeled, quantified, and used as reference standards in assessing the relative risk performance of other investment portfolios. This paper will (1) develop consensus-based portfolio definitions for each risk category, (2) establish standardized risk performance measures for each category, (3) quantitatively assess the relative risk performance of a few noteworthy portfolios, and (4) demonstrate the compelling relative risk performance advantage provided by embracing the methods of Temporal Portfolio Theory.

The Genesis of Suitable and Prudent Fiduciary Duty

The “*Prudent Man Rule*” originates from an [1830 Massachusetts court ruling](#) by US judge Samuel Putnum requiring trustees to act “how men with prudence, discretion and intelligence manage their own affairs, not in regard to speculation ... but in regard to probable income and safety of the capital invested.” The fiduciary duty of investment advisers was later more formally established through case law interpretations of the anti-fraud provisions within the [Investment Advisers Act of 1940](#). The Prudent Man Rule was originally interpreted to apply separately to each investment in a portfolio without regard to the client’s individual situation. With the advent of Modern Portfolio Theory ([MPT](#)) in 1952, it evolved into the “Prudent Investor Rule,” which requires investments to “be evaluated not in isolation but in the context of the trust portfolio as a whole ... and have risk and return objectives reasonably suited to the trust.” The Department of Labor’s Employee Retirement Income Security Act of 1974 (ERISA) [29 USC § 1104](#) “Fiduciary Duties” also incorporated the rule in paragraph (a) “Prudent Man Standard of Care,” stating that “a fiduciary shall discharge his duties ... with the care, skill, prudence, and diligence under the circumstances then prevailing that a prudent man acting in a like capacity and familiar with such matters would use ... by diversifying the investments of the plan so as to minimize the risk of large losses, unless under the circumstances it is clearly prudent not to do so.” The Prudent Investor Rule further became the centerpiece of the Uniform Prudent Investor Act of 1994 ([UPIA](#)), which has now been adopted by every state.



On a parallel path, assessing the “*suitability*” of an investment was recognized as the responsibility of broker-dealers as early as 1938 in the National Association of Securities Dealers’ (NASD) “Rules of Fair Practice.” In Article III, Section 2, it states:

In recommending to a customer the purchase, sale or exchange of any security, a member shall have reasonable grounds for believing that the recommendation is suitable for such customer upon the basis of the facts, if any, disclosed by such customer as to his other security holdings and as to his financial situation and needs.

In his [1965 Duke Journal article](#), “Professional Responsibilities of Broker-Dealers: The Suitability Doctrine,” Robert Mundheim proposed shifting the responsibility for making appropriate investment decisions from the customer to the broker-dealer because current practices had not been wholly effective in protecting the investor – including protecting him from his own greed. In 1990, following the consolidation of NASD into the Financial Industry Regulatory Authority (FINRA), the 1938 NASD suitability rules became [FINRA Rule 2310](#) “Recommendations to

Customers (Suitability),” and further required making a reasonable effort to ascertain the customer's financial status, tax status, investment objectives, and such other information used in making recommendations to the customer. In 1994 the SEC proposed rule [§275.206\(4\)-5](#) entitled “Suitability of Investment Advice” to formally up the ante, declaring it fraudulent or deceptive to provide investment advice to a client without (1) a reasonable inquiry into the client’s financial situation, experience and objectives; and (2) a reasonable determination that the investment advice was suitable for the client. Although the proposed rule was never enacted, the SEC successfully used it to permanently change the regulatory meaning of suitability. In 2011, the SEC formally approved today’s [FINRA Rule 2111](#) “Suitability” to (a) further clarify that a customer’s investment profile includes the customer's age, other investments, financial situation and needs, tax status, investment objectives, investment experience, investment time horizon, liquidity needs, risk tolerance, and any other disclosed information; and (b) codify case law regarding institutional investor exceptions and the three primary components of suitability: reasonable-basis, customer-specific, and quantitative.

Suitable vs Prudent – What’s the Difference?

On the surface, it’s difficult to distinguish between these parallel standards, which have both evolved over time to technically require evaluation of the portfolio as a whole in view of the investment’s objectives and time horizon. Logistically, however,



FINRA’s “Suitability” Rule 2111 is applied to broker-dealers while ERISA’s “Prudent Man Standard of Care” and the UPIA are applied to investment advisors and uniformly considered the higher fiduciary standard. The difference is often described as a more thorough application of professional judgement when evaluating a customer’s investment profile. For example, while a young man may have sufficient income to suitably afford an expensive sports car without jeopardizing rent, food, clothing, utilities and other expenses, it may not be prudent to buy one if it conflicts with meeting appropriate retirement savings objectives. *Prudence includes evaluating the investments of the 22-year-old in view of the needs of his 65-year-old future self.* Notably, the Pension Benefit Guaranty Corporation (PBGC) similarly demonstrated prudence in 2008 when adopting a [more aggressive investment policy](#) to meet its obligations. [PBGC Director Charles Millard stated](#): “Most important, it addresses the greatest risk of all: The risk that the Corporation could someday fail in its commitment to the 1.3 million Americans who depend on it for retirement income.”

Defining and Measuring Risk

To credibly judge the level of risk associated with an investment portfolio, the term “risk” first must be defined in a manner that can be quantifiably measured. However, a review of the rules, regulations, and standards of FINRA, ERISA, UPIA and the SEC reveals they are either silent or nebulous about risk’s definition, as illustrated by the words and phrases of the documents cataloged in Table 1 and Appendix A.

The column headers of Table 1 identify the four basic risk assessment methods found in the rules, regulations and standards documents of Appendix A. They include:

1. **Loss of Value:** This method is referenced in (a) the ERISA regulations, (b) the UPIA (3) diversification comments, and (c) the SEC’s form ADV-2 for investment advisors.
2. **Downside Deviation:** An academic favorite not referenced in any rule or regulation.
3. **Standard Deviation:** An industry favorite not referenced in any rule or regulation.
4. **Insufficient Returns:** The UPIA requires a return objective suited to the trust, which includes both purpose and term, i.e. the risk of not meeting a long-term objective.

Table 1. Definitions of Risk (see also Appendix A)			
Loss of Value	Downside Deviation	Standard Deviation	Insufficient Returns
• Webster’s Dictionary • SEC Form ADV-2 Item 8 • UPIA 3 Diversification • ERISA § 404(a) • 29 CFR § 2550.404a-1 • PBGC Press Release	• Behavioral Economics • Post-MPT • Sortino Ratio • Morningstar	• MPT (variance) • Sharpe Ratio • PBGC Press Release • NASDAQ	• UPIA 2(b) Objectives • PBGC Press Release

While neither standard deviation nor downside deviation are anywhere to be found in the rules, regulations, and standards, it’s well understood that (a) the Prudent Man and Suitability standards predate the use of standard deviation as the measure of risk in MPT and the Sharpe Ratio; and (b) the use of standard deviation predates the development of downside deviation as the measure of risk in [Behavioral Economics](#) and the Sortino Ratio. Today, academia has clearly indicated its preference for downside deviation as the measure of risk, and FINRA 2111.03(c) is satisfied with any definition, so long as it is “based on generally accepted investment theory.”

Although regulatory language uniformly indicates investment risk is about “loss of value,” it doesn’t specify how to measure it. Downside deviation is clearly a better conceptual match to “loss of value” than is standard deviation, and has rightfully gained traction in recent years.

Reducing Investment Risk

Once risk is quantified, the matters of “acceptable risk” and “sufficient diversification” must still be resolved to satisfy suitability and prudence. A review of the rules, regulations, and standards again reveals they are either silent or nebulous on these matters, as illustrated by the words and phrases of the documents cataloged in Table 2 and Appendix B.

The column headers of Table 2 identify three categories related to magnitude of risk or amount of diversification found in the documents of Appendix B. They include:

1. **No more than 20% in any one stock:** 29 U.S. Code § 1025, “Reporting of Participant’s Benefit Rights” regarding investor reports about possible risks that must be provided.
2. **No automatic rule, diversify as needed:** The UPIA-3 Diversification section indicates there can be no automatic rule because there are situations, such as owning a family business, where diversification is not an appropriate solution.
3. **Invest at risk level suitable to purpose:** The UPIA-2 Comments section says it is the duty of the trustee to invest at a risk level that is suitable to the purposes of the trust.

Table 2. How Much Risk / Diversification (see also Appendix B)

More than 20% in any one stock may not be enough diversification.	No automatic rule. Diversify unless it is better served without.	Invest at a risk level suitable to purposes of trust.
• ERISA 29 USC § 1025	• UPIA-3 Diversification • ERISA § 404(a)	• UPIA-2 Comments

The only quantitative guidance for judging how much risk or diversification is appropriate is found in 29 USC § 1025, “Reporting of Participant’s Benefit Rights,” which is really only about providing risk information to investors, not about the rules, regulations or standards for investment management. While it is good advice for stocks, it offers no guidance pertinent to ETFs and mutual funds which are already well diversified. Since there are no other rules, financial advisors have only [UPIA-3](#) to guide them, which states “there is no automatic rule.”

Absent any regulatory measure of risk, there can be no safe harbor during a fiduciary audit.

Fortunately, regulators have long-accepted the asset allocation portfolio definitions marketed by members of the financial industry, such as those illustrated in Appendix C. Together they form a consensus set of industry-standard risk category portfolio definitions that can be modeled, quantified, and used as reference standards in assessing the performance of other portfolios.

Developing Consensus Risk Category Portfolios

While regulators have set broad fiduciary standards for suitable and prudent investments, financial institutions have been free to interpret exactly how to create and offer a range of risk category portfolios, such as conservative, moderate, and aggressive. Not surprisingly, the number of risk categories and asset class allocation weights varies from one institution to another as illustrated by the portfolio charts of ten well-known financial institutions in Appendix C. However, together they can be used to form a consensus set of industry-standard risk category portfolios provided the ambiguities listed in Table 3 are resolved – as suggested therein.

Table 3. Ambiguities to Resolve for Consensus Standardized Risk Category Portfolios

Ambiguity	Ambiguity Resolution Used Herein
1. Number of Risk Categories	Industry models typically include three-to-five risk categories. As three is too granular, five risk categories will be used: aggressive, growth, moderate, conservative, and stable income.
2. Number of Asset Classes to Use	The simplest portfolios include only stocks and bonds. These are often further subdivided. REITs and gold are sometimes included. We use U.S. stocks, foreign stocks, bonds, and a money market fund.
3. The Allocation Weights to Use	Weights of the four asset classes will change in equal steps starting with allocations typical of a fixed income portfolio and moving toward allocations typical of an aggressive portfolio (Figure 1).
4. How Risk Will be Measured	Downside deviation, the favored behavioral economics definition of risk, will be used. Downside deviation will be measured on a quarterly basis – monthly is a bit short, and yearly is a bit long.
5. How Risk Will Be Standardized	“Relative Risk” is the ratio of downside deviation for a client portfolio to the downside deviation of the consensus definition for an aggressive portfolio (Figure 1) measured over the same time span.

The underlying measure of risk used herein will be the **Quarterly Downside Deviation**, which is calculated as the root mean square of negative quarterly returns, sampled daily over the portfolio’s data span. More specifically:

$$\text{Quarterly Downside Deviation} = \sqrt{\frac{\sum_{i=1+3mo}^{Total\ Days} \left[\text{Min} \left(\frac{p(i)}{p(i-3mo)} - 1, 0 \right) \right]^2}{Total\ Days - 3mo}}$$

Where:

- Total Days = the number of market days in the evaluation period.
- 3mo = one quarter of a year, typically 63 market days.
- $p(i)$ = the equity curve value on day i .

However, **Relative Risk** would provide a better perspective and will be used in the comparative performance charts that follow. It is the ratio of the Quarterly Downside Deviation (QDD) of the test portfolio to the QDD of the Consensus Aggressive Portfolio of Figure 1. Thus, *the Consensus Aggressive Portfolio is the reference standard, and by definition has a Relative Risk of 100%.*

$$\text{Relative Risk} = \frac{\text{QDD of Test Portfolio}}{\text{QDD of Consensus Aggressive Portfolio}}$$

The financial industry's risk category portfolios of Appendix C together with the ambiguity resolution methods of Table 3 were used as the basis for defining the five consensus risk category portfolios of Figure 1. Vanguard mutual funds VFINX, VTRIX, VBMFX, and VWSTX (Figure 2) were selected as proxies to represent the four asset classes (Domestic Equity, International Equity, Fixed Income, and Short-Term Funds) because of their excellent asset class matches, long data history, and broad industry respect. However, there are numerous equally suitable virtual clones of these funds available from other companies that will produce like results.

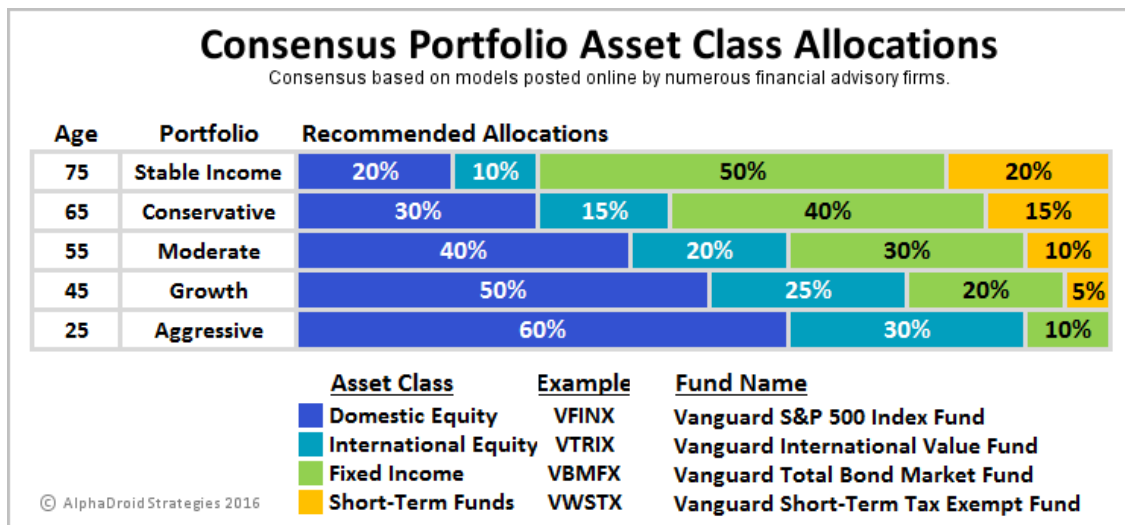


Figure 1. Consensus Portfolio asset class allocations and risk appetite categories

Regulators have indirectly approved the Consensus Portfolio definitions of Figure 1 by default through their decades-long acceptance of the financial industry's risk category portfolios of Appendix C. As such, these Consensus Portfolio definitions form a regulatory accepted set of standardized risk category portfolios that can be statistically quantified and used to set reference standards for the risk and return statistics typical of the Stable Income, Conservative, Moderate, Growth, and Aggressive portfolios typically offered within the industry.

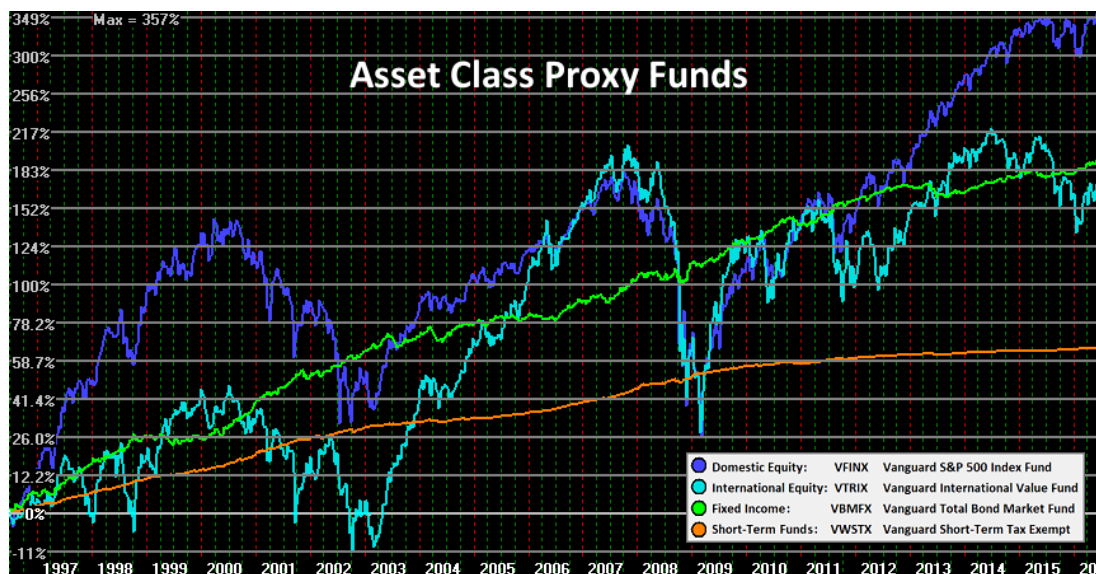


Figure 2. Vanguard mutual funds as a proxy for traditional asset class investments.

Risk Category Portfolio Performance

The 24-year risk/return performance for the five consensus risk category portfolios is plotted in Figure 3. Return is simply measured as the compound annual growth rate (CAGR). Risk is measured as the Quarterly Downside Deviation and is an absolute negative volatility measure not scaled by return in the manner employed by the Sharpe and Sortino ratios. As should be expected, portfolios **1** through **5** line up evenly distributed just beneath MPT's efficient frontier stretching between the ● domestic equity fund and the ● fixed income fund. The five portfolios lie just beneath the efficient frontier because their asset class allocations actually are slightly sub-

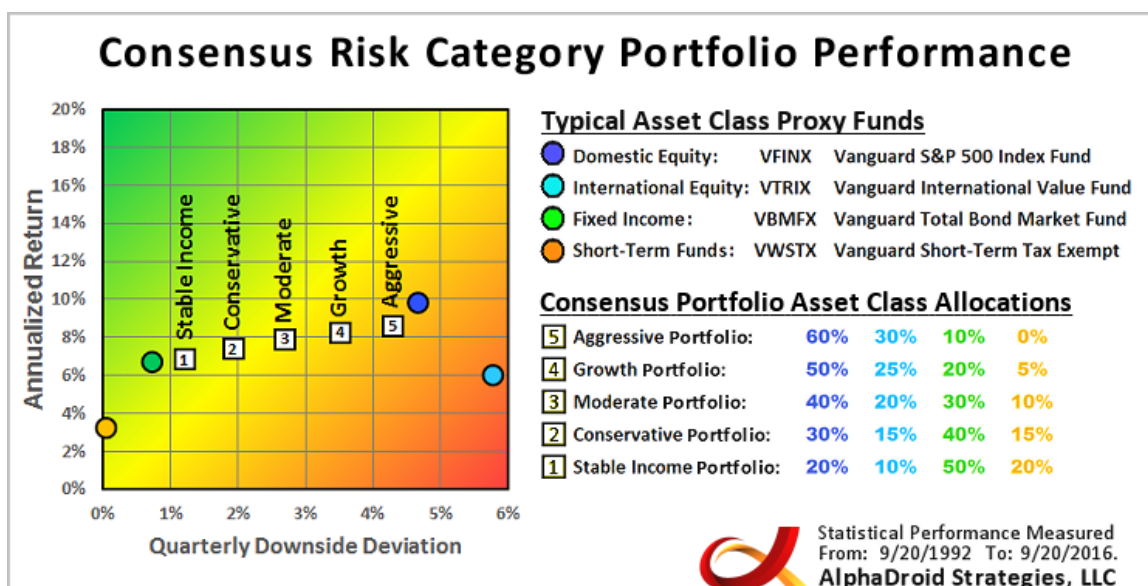


Figure 3. Consensus risk category portfolio performance.

optimal, as can be demonstrated with this [Efficient Frontier online analysis tool](#). Although their absolute values will move around somewhat depending on the time interval evaluated, their locations relative to one another will remain fairly stable because they all will include or exclude the same major market events. The horizontal axis of Figure 4 has been rescaled from Figure 3 to instead indicate Relative Risk. The Consensus Aggressive Portfolio **5** is designated as the primary reference portfolio and thus by definition has a Relative Risk value of 100%. The Relative Risk for the Stable Income, Conservative, Moderate, and Growth Consensus Portfolios is 28%, 45%, 63%, and 82%, respectively. *These five Consensus Risk Category Portfolios actually are the de facto reference standards against which all other investment portfolios can be judged.*

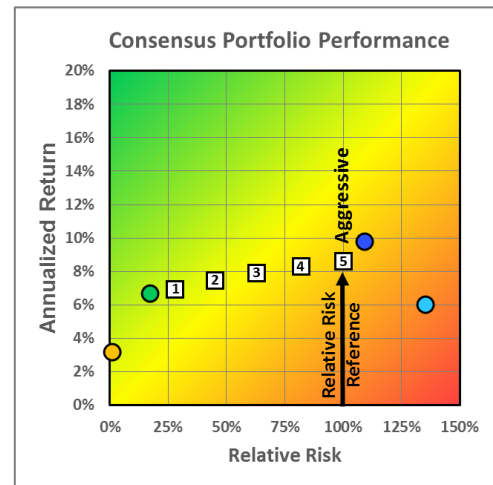


Figure 4. The Aggressive Portfolio by definition has 100% Relative Risk.

Relative Risk vs Perceived Risk

Isn't it common knowledge that it's not safe to put all of your money into one fund? But, it's not true if it's a money market fund or a target-date retirement fund with built-in asset allocation glide slope. Conversely, a portfolio holding 30 stocks, all of which are biotech startups, will not cut the mustard for diversification in a fiduciary risk audit. Notably, even though portfolios **1** through **5** have the same set of funds, their Relative Risk values are quite different. *Risk cannot be assumed or measured simply by knowing the names or the number of funds in a portfolio. Risk is known only when the portfolio's performance is plotted on the chart of Figure 4.*

Relative Risk of Funds

Investment companies have not only proposed risk category models, such as those of Appendix C, but actually offer corresponding sets of mutual funds that implement them – as exemplified by Fidelity's Asset Manager, Vanguard's LifeStrategy, BlackRock's LifeCycle, Russell's LifePoints, and Columbia's LifeGoal series of funds. Not surprisingly, the Fidelity's Asset Manager family of funds plotted in Fig. 5A aligns well with consensus risk category portfolios **1** through **5**.

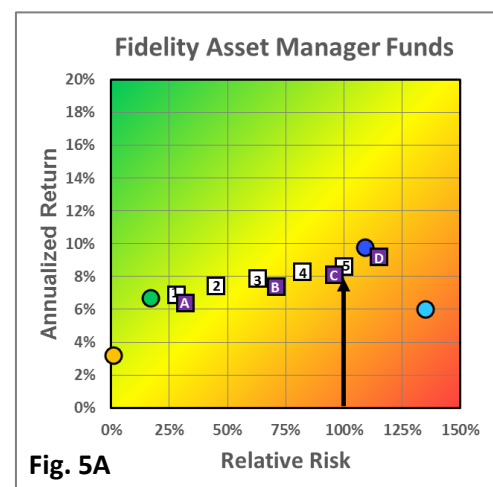
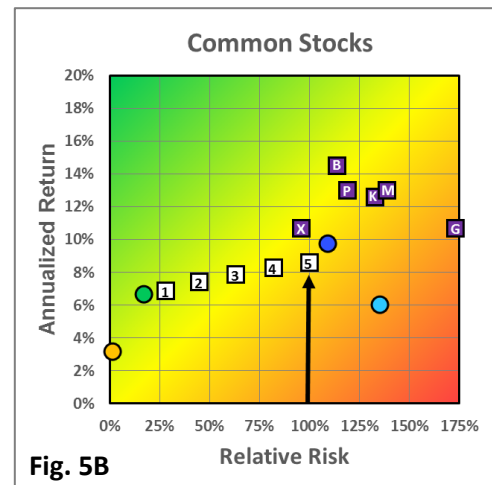


Fig. 5A

A FASIX - Fidelity Asset Mgr 20% **C** FASGX - Fidelity Asset Mgr 70%
B FASMX - Fidelity Asset Mgr 50% **D** FAMRX - Fidelity Asset Mgr 85%

Relative Risk of Stocks

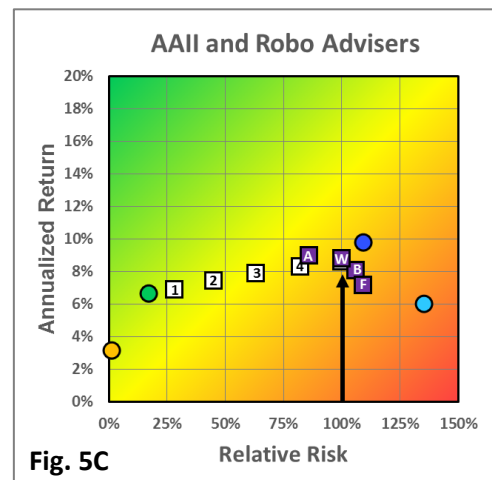
The chart of Fig. 5B illustrates the well-deserved reputation held by stocks for their higher risk and return characteristics in comparison to diversified funds. Stocks are well known for pops and drops in price associated with earnings reports, product problems, aggressive competitors, management scandal and regulatory challenges – any of which can devastate an investment account overnight. The charted stocks include five selected from the DJ-30 plus Warren Buffet’s Berkshire Hathaway (which is really more of a diversified collection of well-run companies.)



B BRK-A - Berkshire Hathaway **K** KO - CocaCola Company
G GE - General Electric **X** XOM - Exxon Mobile
P PG - Proctor & Gamble **M** MCD - McDonald's

Relative Risk of Robo Advisors

In 2008, a wave of “Robo Advisor” startups began launching with a mission to automate personal portfolio management for a fraction of the 2% wrap fee typical of professionally managed accounts. Today, virtually all large investment management firms offer their own Robo Advisor service. [MarketWatch Research](#) examined the portfolios recommended by Betterment, Wealthfront, FutureAdvisor, and the AAll for a typical 35 year old investor, which corresponds well to the Consensus Aggressive Portfolio **5** of Figure 1. Their portfolios (Appendices E and F) performed similarly to the Aggressive Portfolio’s 100% Relative Risk as plotted in Fig. 5C. It’s particularly noteworthy that all Robo Advisors offer only MPT style portfolios that



A AAll **W** Wealthfront **B** Betterment **F** FutureAdvisor

aren’t meaningfully different from the performance and function of ordinary [target-date mutual funds](#) that perform the same function with no annual fee. Automating Modern Portfolio Theory may make it faster or more cost effective, but improves neither its risk nor return performance. In spite of their automated guidance and slick cellphone apps, it’s not hard to conclude that *Robo Advisors sell ordinary MPT and are “a distinction without a difference.”*

New Tools Change Old Rules

One of MPT's more famous tenets is that one must trade risk for return. It turns out that this is only true when analysis is constrained by MPT's principles – no thinking outside of the box. Indiana Jones demonstrated how new tools change old rules when he reduced his risk of death by bringing a gun to a sword fight – a prudent man indeed! A prudent man likewise would expect to look outside the bounds of MPT's box for new tools to further improve investment performance.



Fig. 6 Indiana Jones reduces his risk by bringing a gun to a sword fight.

Fortunately, there have been numerous advances applicable to investment theory since MPT's debut in 1952. These new tools include:

1. Momentum in market data was formally [found](#), [confirmed](#), and [practiced](#).
2. [Shannon](#) shows [signal-to-noise ratio](#) determines probability of good decision.
3. Signal-to-noise ratio optimized with [Matched Filter Theory](#).
4. Signal-to-noise ratio further improved with [differential signal processing](#).
5. [Kahneman and Tversky](#) redefine risk through use of [behavioral economics](#).
6. Multiple analog information sources can be better combined using [fuzzy logic](#).
7. Holistic Risk Management: [Conquering the Seven Faces of Risk](#).

These advancements have all been made outside of MPT's box and largely relate to time domain (temporal) signal processing. Taken as a whole, we refer to the application of these tools to the science of investing as **Temporal Portfolio Theory (TPT)**. See Appendix D for a detailed summary of TPT with numerous external links to aid further study. In brief, TPT boils down to the five primary algorithmic components listed below.



1. **True Sector Rotation:** Momentum used to identify the trend leader and avoid laggards.
2. **StormGuard - Armor:** Determines safety of market using three separate market views.
3. **Bear Market Strategy:** Alternate set of candidate funds used only during bear markets.
4. **Forward-Walk Progressive Tuning:** Uses out-of-sample data to establish performance.
5. **Portfolio-of-Strategies:** A layered framework that further reduces overall portfolio risk.

Even MPT stalwarts Fama and French now confirm that momentum is pervasive in market data.

The opportunity is to embrace momentum and make dust, or ignore it and eat dust.

Temporal Portfolio Theory's™ Paradigm Shift

The departures from MPT and rudimentary sector rotation that define TPT as a paradigm shift include: (1) recognizing the [Efficient Market Hypothesis](#) is false because momentum exists in market data; (2) understanding sector rotation performance depends on the signal-to-noise ratio of the momentum signal; (3) recognizing that the character difference between bull and bear markets requires problem segmentation; and (4) discovering that simplistic market direction indicators generally perform poorly because the real problem to solve is about evaluating the market's safety.

Applying the principles of TPT to the asset class proxy funds of Figure 3 includes the following steps: (1) Enabling [StormGuard-Armor](#) as the method for determining whether to use a bull or [bear market strategy](#); (2) during a bull market, investing in the better trending of the two stock funds VFINX and VTRIX; and (3) during a bear market, investing in the better trending of fixed income funds VBMFX and VWSTX. The formal TPT Strategy chart and its underlying Bear Market Strategy chart are illustrated in Appendix F-0. The equity curve for the strategy is additionally charted in Figure 7A alongside the equity curves for the related Consensus Aggressive Portfolio and the Consensus Stable Income Portfolio, which use the same funds. While a traditional MPT portfolio holds a fixed portion of every one of its funds, a TPT strategy holds only the trend leader among them at any given time. This is called Serial Diversification and is a risk avoidance form of diversification where many funds are owned across the span of time, but only one is owned at

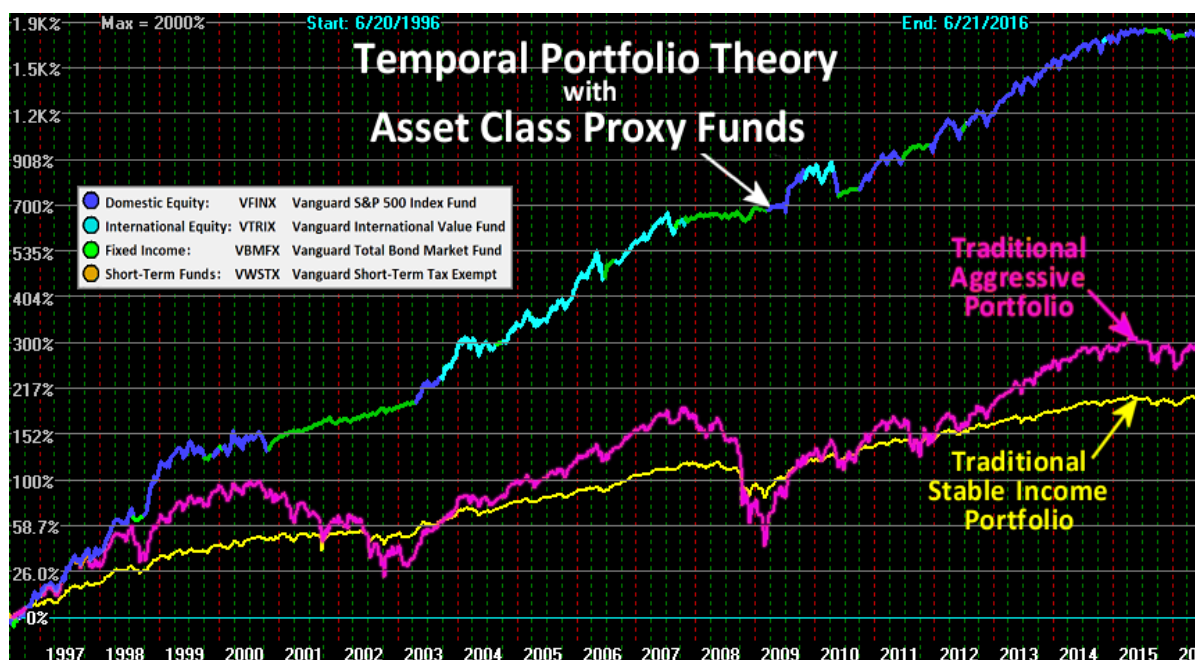


Figure 7A. Temporal Portfolio Theory vs. Traditional Consensus Portfolios.

any given time. Figure 7B clearly illustrates that **TPT produced twice the return with half the risk of a traditional moderate risk MPT portfolio**. While owning a single fund often triggers the fear of insufficient diversification, Table 4 illustrates that even the least diversified of the four Asset Class Proxy Funds holds 156 stocks. The risk of failure of any individual company is already more than sufficiently diversified away.

Appendices F1 through F4 document the performance of TPT Strategies utilizing the AAIL, Betterment, Wealthfront, and FutureAdvisor fund sets previously evaluated for Figure 5c. The performance of these funds utilizing a TPT strategy is plotted in Figure 8 and stands in stark contrast to their MPT performances of Figure 5c. **By owning only the trend leader and avoiding the trend laggards one can simultaneously improve returns and reduce risk.**

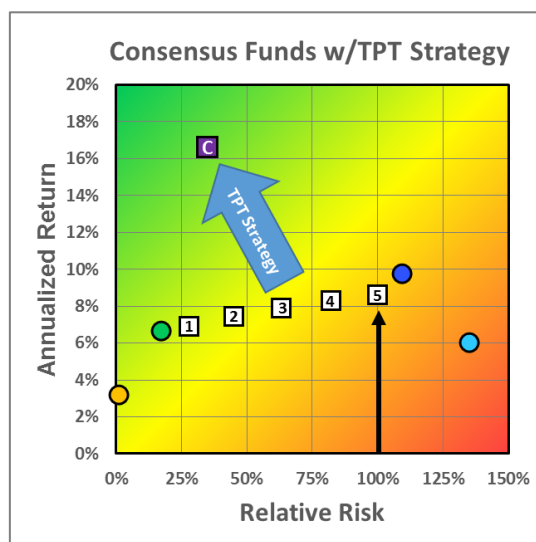


Figure 7B. TPT Strategy using Consensus Asset Class Funds has 2x Return, .5x Risk.

Table 4. Equities Held by Asset Class Proxy Funds

Fund Name	Equities
VFINX Vanguard 500 Index	510
VTRIX Vanguard International Value	156
VBMFX Total Bond Market Index	8571
VWSTX Vanguard Short-Term Tax-Exempt	1883

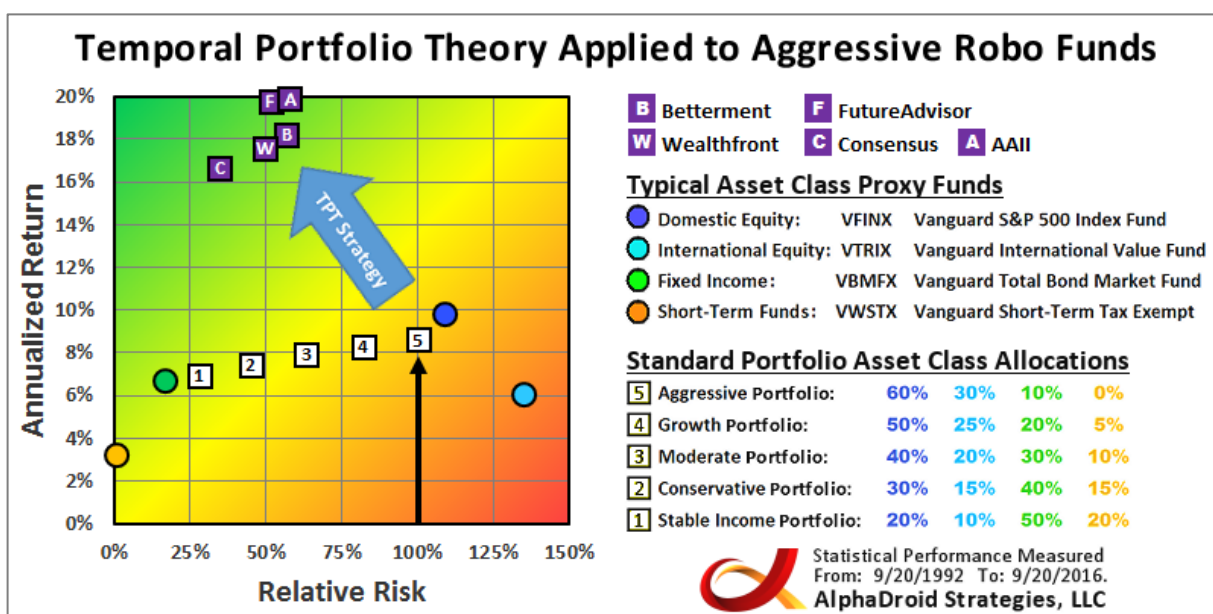


Figure 8. TPT applied to Robo Advisor funds for an aggressive portfolio.

Algorithmic Prudence

Performance counts: It's prudent to use the right tool for the job. The prudent question when measuring momentum is: Which trend is our friend? There are numerous momentum algorithms (such as RSI, SMA, EMA, and DEMA), and the time span over which momentum can be measured varies from seconds to years. Furthermore, there are significant character differences between bonds, treasuries, utilities, sectors, value funds, growth funds, and broad index funds. The short answer is that the optimum choice for algorithm and time constant depends on the character and mix of a strategy's candidate funds, and is why Automated Polymorphic Momentum was developed. The term Polymorphic means that the momentum filter is both adaptive in shape and duration to accommodate the diverse character of these asset classes and the evolving character of the market. Additional information about it can be found in Appendix D and in the peer reviewed paper "[Investment Performance Improvement Utilizing Automated Polymorphic Momentum](#)," which documents the outstanding performance advantage Automated Polymorphic Momentum over numerous other popular momentum algorithms in tests involving many hundreds of randomly selected sets of mutual funds and ETFs. Interestingly, authors of momentum investing books and research articles commonly defend their choice of algorithm and time constant based simply on choices made by prior published authors, as opposed to offering a technically defensible explanation for their choice. The 12-month SMA (simple moving average) is the most popular choice, although it is far from the optimum. It appears to be a popular choice because it works fairly well, is easy to compute, and prior authors have never been seriously challenged to defend that choice. Algorithmic prudence, however, means making this choice based on quantitative evidence, the importance of which is made obvious by the comparative analysis of eight Fidelity Asset Class Strategies below.

The set of funds listed in Table 4 is employed by each of eight Fidelity Asset Class Strategies summarized in Table 5 and more thoroughly documented in their Charts G1-G8 of Appendix G. The set of funds includes representatives from a wide range of basic market asset classes. An equally weighted portfolio of these funds would have a bond allocation weight of approximately 17%, a stock allocation weight of approximately 83%, and thus would be expected to have a Relative Risk value between that of the Consensus Growth and Consensus Aggressive portfolios – as is confirmed by the **P:** marker in the chart of Figure 9.

Fidelity Stock Selector SmallCap I	FDSCX
Fidelity LargeCap Stock Fund	FLCSX
Fidelity Growth Company Fund	FDGRX
Fidelity Value Fund	FDVLX
Fidelity MidCap Stock Fund	FMCSX
Fidelity Balanced Fund	FBALX
Fidelity Intermediate Bond Fund	FTHRX
Fidelity Telecom Utilities Fund	FIUIX
Fidelity Investment Grade Bond F	FBNDX
Fidelity Worldwide Fund	FWWFX
Fidelity New Markets Income Fun	FNMIK
Fidelity Europe Fund	FIEUX

Table 4. Asset Class Strategy Funds.

Appdx Chart	Bull Market Algorithm	Market Direction Indicator	Bear Market Algorithm	CAGR	Relative Risk	Sharpe Ratio	Max D.Down
---	S&P 500 Dividend Adjusted	---	---	10.1%	109%	0.45	55%
P:	Portfolio: Equal Weight Funds	---	---	9.8%	91%	0.54	48%
G1	1-Mo. SMA	---	---	14.0%	99%	0.67	38%
G2	3-Mo. SMA	---	---	13.2%	90%	0.59	32%
G3	12-Mo. SMA (Dual Momentum)	12-Mo. SMA of S&P	Money Market	11.9%	107%	0.52	35%
G4	125-Day EMA (like Fund-X)	---	---	11.0%	122%	0.43	46%
G5	1-Mo. EMA	---	---	14.5%	93%	0.78	38%
G6	1-Mo. EMA (no bonds)	Death Cross	Money Market	13.2%	63%	0.77	27%
G7	Polymorphic Momentum	StormGuard-Armor	Money Market	15.4%	60%	0.96	32%
G8	Poly. Momentum (no bonds)	StormGuard-Armor	BMS - Fidelity	19.6%	63%	1.30	32%

Table 5. Performance Comparison of Various Fidelity Asset Class Strategy Configurations.

Data markers **G1** to **G8** of Figure 9 plot the CAGR and Relative Risk performance listed in Table 5 for each corresponding strategy. It is notable that the fund selection algorithms for all eight strategies succeeded in producing better returns than a basic portfolio of equally weighted funds. However, the only three strategies to successfully reduce Relative Risk additionally employed either [StormGuard-Armor](#) or the [Death Cross](#) as a market direction indicator (MDI) to better handle bear markets. The best performing strategy, G8, additionally implemented a complete [Bear Market Strategy](#) to further improve bear market returns. The BMS-Fidelity bear market

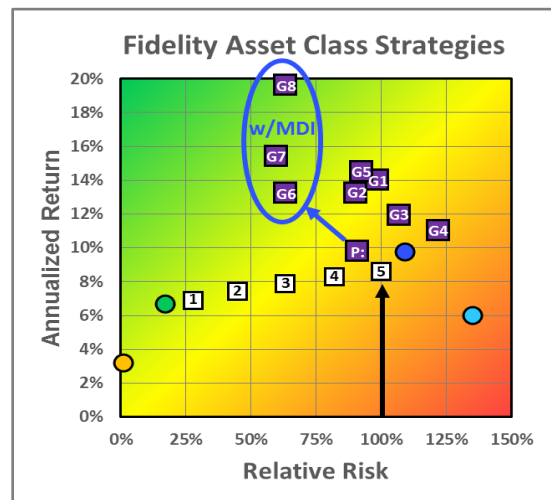


Figure 9. Strategies w/ Different Algorithms

strategy that it uses selects the best trending of eight candidate bond, treasury, and money market funds in order to provide the best opportunity for positive returns in a down market. Integral with the Automated Polymorphic Momentum algorithm utilized by strategy G8 is Forward-Walk Progressive Tuning, the gold standard in algorithmic credibility. Its walk forward through “out of sample data” begins on 11-19-2004 as posted on its chart in Appendix G.

Algorithmic prudence means thoughtfully and wisely selecting 1) a trend filter algorithm for bull markets, 2) a market direction indicator for knowing when to switch between bull and bear markets, and 3) a bear market strategy for achieving positive returns during down markets.

Prudent Portfolio Design

Prudent portfolios are designed to address both risk and return... with no tool left behind. The design of the ETF Prudence Portfolio below incorporates two additional tools; one addresses return, and the other addresses risk. The first tool simply expands the scope of candidate funds beyond basic asset class funds to include the more dynamic sector, country, and commodity funds, which provide opportunity for greater returns. The second tool is a Portfolio-of-Strategies framework where the top level portfolio holds a dynamically selected set of funds, each selected by one its underlying strategies. A Portfolio-of-Strategies provides additional risk reduction when the remnant volatility (equity curve bumps) of the portfolio's underlying strategies are poorly correlated.

The four underlying strategies “ETF US Diversified,” “ETF International,” “ETF Fixed Income,” and “ETF Sectors + Gold” (Appendix H1) form the “ETF Prudence Portfolio” (Appendix H2). The candidate funds for these strategies are identified in Table 6. These strategies are designed to select ETFs from different portions of the market to help reduce correlation and thus reduce overall portfolio risk.

Strategy: ETF US Diversified			Strategy: ETF International		
Guggenheim ETF S&P MidCap 40	RFV		iShares ETF MSCI Brazil Capped	EWZ	
StateSt ETF SPDR S&P 400 MidC	MDYV		Vanguard ETF Emerging Markets	VWO	
StateSt ETF SPDR S&P MIDCAP 4	MDY		StateSt ETF SPDR S&P Emerg As	GMF	
Guggenheim ETF S&P MidCap 40	EWMC		Barclays ETN iPath MSCI India	INP	
Guggenheim ETF S&P 500 Equal	RSP		iShares ETF MSCI Japan	EWJ	
StateSt ETF SPDR S&P 500 Grow	SPYG		StateSt ETF SPDR S&P MIDCAP 4	MDY	
iShares ETF S&P 100	OEF		Global X Mgmt ETF Southeast Asi	ASEA	
StateSt ETF SPDR S&P 500	SPY		iShares ETF MSCI Germany	EWG	
StateSt ETF SPDR S&P 500 Value	SPYV		iShares ETF MSCI EAFE - Extend	EFA-	
StateSt ETF SPDR S&P 400 MidC	MDYG		iShares ETF MSCI Sweden	EWD	
Guggenheim ETF S&P 500 Pure V	RPV		iShares ETF MSCI Singapore	EWS	
Guggenheim ETF S&P 500 Pure G	RPG		iShares ETF MSCI United Kingdo	EWU	
Strategy: ETF Fixed Income			Strategy: ETF Sectors + Gold		
PIMCO ETF Investment Grade Co	CORP-		StateSt ETF Tech Select Sector S	XLK	
iShares ETF National Municipal B	MUB		StateSt ETF Energy Select Sector	XLE	
iShares ETF Core US Aggregate I	AGG		StateSt ETF Financial Select Sect	XLF	
iShares ETF 3 7 Year Treasury Bc	IEI		iShares ETF Transportation Avera	IYT	
StateSt ETF SPDR Barclays Mortg	MBG		StateSt ETF SPDR Gold	GLD	
iShares ETF iBoxx \$ Hi-Yield Cor	HYG-		iShares ETF US Telecommunicati	IYZ	
iShares ETF 1 3 Year Treasury Bc	SHY		iShares ETF MSCI EAFE - Extend	EFA-	
			iShares ETF US Consumer Goods	IYK	
			StateSt ETF SPDR Dow Jones RE	RWR	
			StateSt ETF Health Care Sel Sect	XLV	
			StateSt ETF SPDR S&P Retail	XRT	
			iShares ETF US Home Constructi	ITB	

Table 6. Funds of the portfolio's underlying strategies.

The Relative Risk and Return performance for the ETF Prudence Portfolio **P:** and its four underlying strategies **F**, **D**, **I**, and **S** is plotted alongside the performance of the Consensus Risk Category Portfolios **1** through **5**. The value of applying the tools of Temporal Portfolio Theory is quite clear: *The ETF Prudence Portfolio has a return 3x greater, and risk 3x smaller than the standard Consensus Aggressive Portfolio **5**.* Now that's something to write home about!

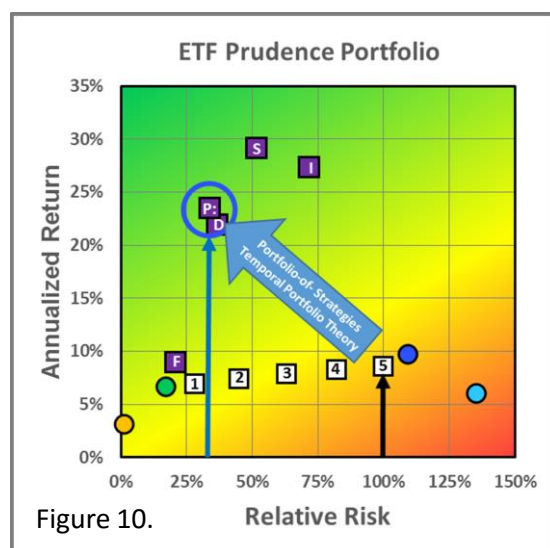


Figure 10.

P: ETF Prudence Portfolio
F: ETF Fixed Income Strategy
D: ETF US Diversified Strategy
I: ETF International Strategy
S: ETF Sectors + Gold Strategy

Why Temporal Portfolio Theory Matters

The Economic Policy Institute's March 2016 article "[The State of American Retirement](#)" paints a dire picture of American retirement savings. While the average retirement savings for families 45 to 55 years of age is \$102,000, the median retirement savings is only \$7,200. The discrepancy is because *nearly half of families do not participate in any retirement savings plan whatsoever*. According to Fidelity Investments, to be financially ready to retire by age 67, one should have approximately 10 times their final salary in savings. Arguably, the greatest investment risk facing most Americans is the possibility of either running out of money early, or needing to work forever to meet ends. While it's difficult for most people to catch up by increasing savings in the time remaining, alternative investment methods (such as TPT) can significantly change the picture.

Consider the case of someone 50 years of age with \$50K currently saved, contributing an additional \$6K/yr, expecting \$25K/yr from Social Security, planning for 2.5% inflation, and hoping to live to 100 years of age. Figure 11 illustrates that the estimated retirement age is tightly tied to investment returns. Simply putting retirement savings under the mattress guarantees the need to work until the bitter end. Even an 8% per year return means working until at least 80 years of age. However, earning 16% or more radically improves the prospects for retiring early and well.

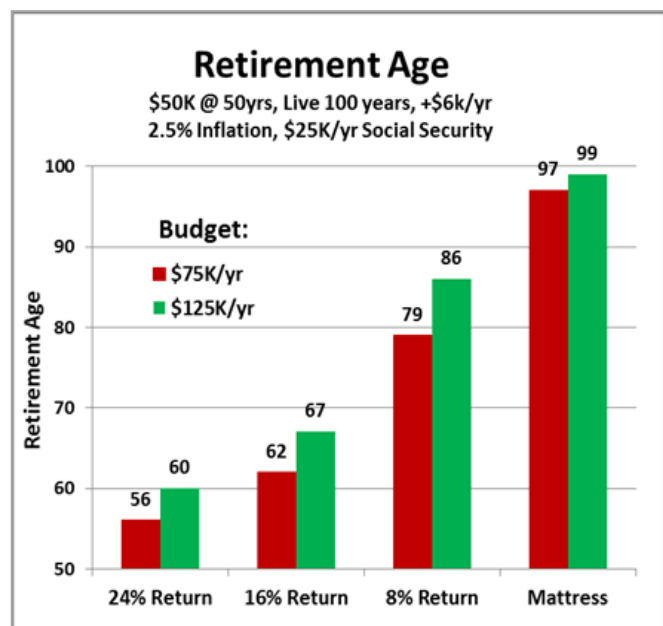


Figure 11. Retirement age depends on returns.

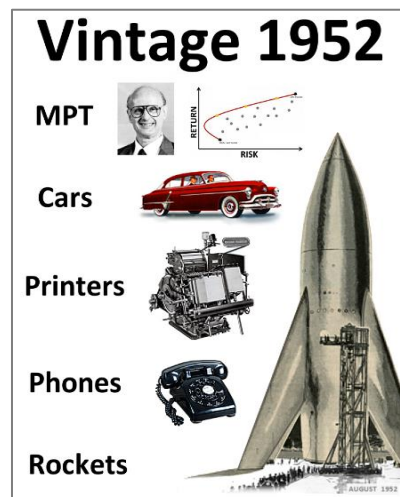
While, anyone of ordinary skill can purchase a target-date mutual fund that arguably produces 8% long-term returns from any one of numerous companies, it will be too little, too late for most Americans. Fortunately, *MPT's limited performance is not a mandate*. According to [UPIA 2\(b\)](#), professionally managed accounts require a standard of care that includes an "overall investment strategy having risk and return objectives reasonably suited to the trust," and [UPIA 2\(f\)](#) further requires that *"A trustee who has special skills or expertise ... has a duty to use his special skills or expertise."* The reason why Temporal Portfolio Theory matters is the point of Figure 11.

Satisfying the Prudent Man - Conclusion

Industry rules, regulations, and standards are silent regarding the definition of risk and amount of diversification required to satisfy a fiduciary risk audit. Fortunately, risk classification portfolios developed by industry leaders have stood the test of time with regulators and form a consensus set of risk category portfolios that can be quantified and used as standards in assessing other investment portfolios. *An advisor can now definitively quantify the relative risk of a client's portfolio to assess and defend its prudent design and satisfy his lawful fiduciary duty.*

While MPT was a giant leap forward for portfolio risk management when it was introduced in 1952, virtually all product designs of that era have long been relegated to the museum. However, the recent proliferation of MPT based target-date funds and Robo Advisor services makes it clear that MPT remains the industry standard for acceptable performance.

Unfortunately, MPT's performance will not be sufficient to meet the retirement objectives of most Americans.



Although MPT's assurance of achieving average returns puts a secure floor under its performance, it also puts a ceiling on it. Better performance requires better information. Fortunately, numerous Nobel Laureates have since contributed new tools for extracting better information from market data, including:

- Nobel Laureate Fama [confirmed](#) that momentum is pervasive in market data.
- Nobel Laureate Shannon [proved](#) signal-to-noise ratio determines the decision error rate.
- Nobel Laureate Van Vleck [developed](#) Matched Filter Theory, which optimizes signal-to-noise ratio.
- Nobel Laureates Kahneman & Tversky [redefined](#) risk through behavioral economics' Prospect Theory.

Collectively, these advancements, and others described earlier in this paper, are referred to as *Temporal Portfolio Theory*. Its five primary algorithmic components are:

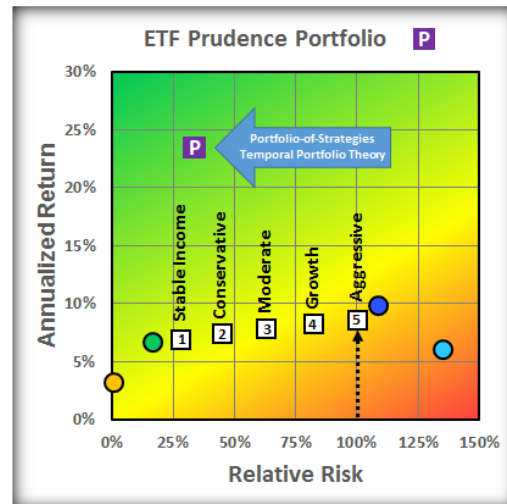
1. **True Sector Rotation:** Momentum used to identify trend leader and avoid the laggards.
2. **StormGuard - Armor:** Determines safety of market using three separate market views.
3. **Bear Market Strategy:** Alternate set of candidate funds used only during bear markets.
4. **Forward-Walk Progressive Tuning:** Uses out-of-sample data to establish performance.
5. **Portfolio-of-Strategies:** A layered framework that further reduces overall portfolio risk.

We believe industry analysts are correct:

- ***It's the technology-aided financial advisors that will eventually win the battle for clients.***

***New Tools
Change Old Rules!***

Temporal Portfolio Theory™
Its Performance Speaks for Itself



About the Author

Scott Juds is a Founder and Chief Science Officer of AlphaDroid Strategies of San Luis Obispo, CA, and Founder and CEO of SumGrowth Strategies of Seattle, WA. He holds an MSEE from Stanford University, a BSEE from the University of Wisconsin – Madison, and is a Registered Professional Engineer in the state of Washington. He is the named inventor on over 40 U.S. and foreign patents and is the published author of *Photoelectric Sensors and Controls: Selection & Application* (Marcel Dekker, New York, 1988). Scott has over 30 years' experience in both hands-on and executive-level positions, including Founder and President of piTech Engineering, a Seattle, WA engineering consulting firm; Founder and VP of Engineering of IDX Incorporated, an El Dorado, AR, company producing optically encoded coin acceptors and RFID payment systems; and Vice President of Advanced Engineering at EATON Corporation's Opcon division for industrial photoelectric sensor in Everett, WA. Scott's passion for improving investment algorithms utilizing cross-disciplinary mathematics from the field of electronic signal processing began in 1992 when he created a Quattro spreadsheet experiment that demonstrated trends in fact exist in market data. His long-term hobby eventually led to the 2009 launch of SumGrowth Strategies with its online SectorSurfer service for individuals, and the subsequent 2015 launch of AlphaDroid Strategies, a platform for financial advisors and wealth managers.



Appendix A

Authority	Risk Definition or Description
Webster's Dictionary Risk Definition	the chance that an investment (as a stock or commodity) will lose value .
Sharpe Ratio Standard Deviation	The Sharpe ratio is the 'excess' return of an asset over the return of a risk free asset divided by the variability or standard deviation of returns
Behavioral Economics Prospect Theory	In 1992 Kahneman and Tversky showed that for alternative decisions involving risk that losses hurt more than gains feel good (loss aversion).
Sortino Ratio Downside Deviation	The Sortino ratio takes the asset's return and subtracts the risk-free rate, and then divides that amount by the asset's downside deviation .
SEC Form ADV 2 Item 8 Methods, Strategies, Risk	Describe the methods of analysis and ... explain that investing in securities involves risk of loss that clients should be prepared to bear.
ERISA § 404(a) Prudent Man Std. of Care	(1)(C) ... a fiduciary shall discharge his duties ... "by diversifying the investments of the plan so as to minimize the risk of large losses , unless under the circumstances it is clearly prudent not to do so."
29 CFR § 2550.404a-1 Investment duties	(b)(2)(i) A determination by the fiduciary that the particular investment ... is reasonably designed ... taking into consideration the risk of loss and the opportunity for gain...
FINRA Rule 2111 Suitability	.05(a) "... reasonable diligence must provide the member or associated person with an understanding of the potential risks and rewards associated with the recommended security or strategy.
FINRA Rule 4210 Margin Requirements	(g)(1) Members must monitor the risk of portfolio margin accounts and maintain a comprehensive written risk analysis methodology for assessing potential risk ... over a range of market movements ...
UPIA 2(b) Standard of Care	...seeks an "overall investment strategy having risk and return objectives reasonably suited to the trust ."
UPIA 3 Diversification: Comments	The purposes of such a common or joint investment fund are to diversify the investment of the several trusts and thus spread the risk of loss ,
PBGC Press Release Jan 15, 2009	PBGC's Director Millard said the new investment policy "... substantially increases the possibility of full funding and has lower standard deviation , higher Sharpe ratios, and lower ultimate downside risk ."
PBGC Press Release Aug 18, 2008	PBGC's Director Millard said "the new policy's level of risk--standard deviation --is consistent with the best practices of other large institutional investors. Most important, it addresses the greatest risk of all: The risk that the PBGC could someday fail in its commitment to the 1.3 million Americans who depend on it "
Morningstar Risk Definition	An assessment of the variations in a fund's monthly returns, with an emphasis on downside variations , in comparison to similar funds.
NASDAQ Risk Definition	Often defined as the standard deviation of the return on total investment. Degree of uncertainty of return on an asset.

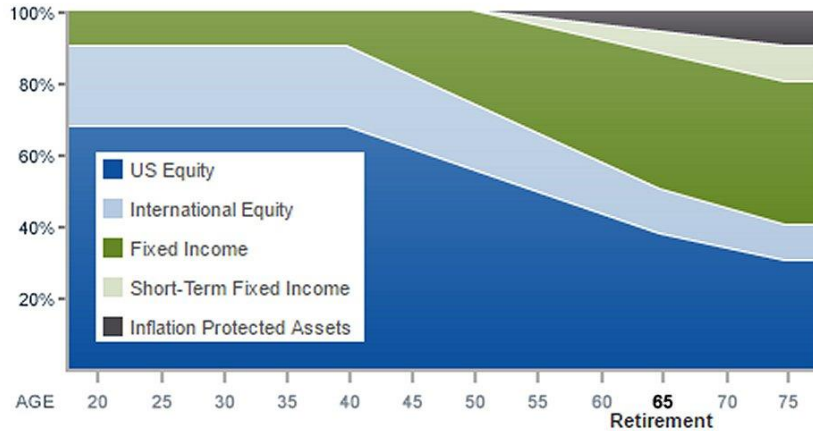
Appendix B

Authority	How Much Risk / Diversification
UPIA 2 Comments	It is the trustee's task to <i>invest at a risk level that is suitable to the purposes of the trust</i>
UPIA 3 Diversification	<i>A trustee shall diversify the investments of the trust unless</i> the trustee reasonably determines that, because of special circumstances, <i>the purposes of the trust are better served without diversifying.</i>
UPIA 3 Diversification: Comments	The message of Section 227(b) of the 1992 Restatement of Trusts, carried forward in Section 3 of this Act, is that <i>prudent investing ordinarily requires diversification. Circumstances can, however, overcome the duty to diversify.</i> <i>The object of diversification is to minimize this uncompensated risk</i> of having too few investments. There is <i>no automatic rule for identifying how much diversification is enough.</i>
ERISA § 404(a) Prudent Man Std. of Care	(1)(C) ... a fiduciary shall discharge his duties ... "by diversifying the investments of the plan <i>so as to minimize the risk of large losses</i> , unless under the circumstances it is clearly prudent not to do so."
PBGC Press Release Aug 18,2008	Most important, it addresses <i>the greatest risk of all: The risk that the PBGC could someday fail in its commitment to the 1.3 million Americans who depend on it"</i>
ERISA 29 USC § 1025 Reporting benefit rights	(a)(2)Statements(B)Additional Information(ii)(II) an explanation... of a well-balanced and diversified investment portfolio, including a statement of the risk that holding <i>more than 20 percent of a portfolio in the security of one entity</i> (such as employer securities) <i>may not be adequately diversified</i>
ERISA 29 USC § 1054 Reporting benefit rights	(j)Diversification requirements - individual account plans (4)(A)Investment options. The requirements of this paragraph are met if the <i>plan offers not less than 3 investment options</i> , other than employer securities, to which an applicable individual may direct the proceeds from the divestment of employer securities pursuant to this subsection, <i>each of which is diversified and has materially different risk and return characteristics.</i>
Dictionary.com Diversification Definition	the act or practice of manufacturing a variety of products, investing in a variety of securities, selling a variety of merchandise, etc., <i>so that a failure in or an economic slump affecting one of them will not be disastrous</i>
NASDAQ Diversification Definition	Investing in different asset classes and in securities of many issuers in an attempt <i>to reduce overall investment risk and to avoid damaging a portfolio's performance</i> by the poor performance of a single security, industry, (or country).
Morningstar Diversification Definition	<i>You can reduce risk and volatility in your portfolio</i> by investing in different types of securities — among stocks, bonds and short-term investments, which are unlikely to all move in the same direction.
Mark Twain Pudd'nhead Wilson	"Behold, the fool saith, "Put not all thine eggs in the one basket" - which is but a matter of saying, "Scatter your money and your attention"; but <i>the wise man saith, "Pull all your eggs in the one basket and - WATCH THAT BASKET."</i>

Appendix C

Risk Category Portfolio Examples

ASSET ALLOCATION OVER TIME FOR TIAA-CREF LIFECYCLE FUNDS



Your Portfolio Choices Compared

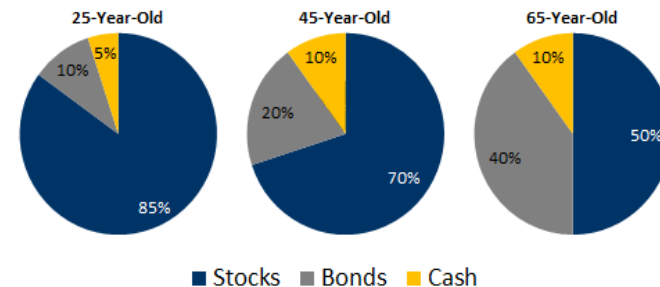
Fidelity Investments

Consider your risk tolerance, from conservative to aggressive, and find a Fidelity VIP asset allocation portfolio that most closely aligns with your tolerance for risk.

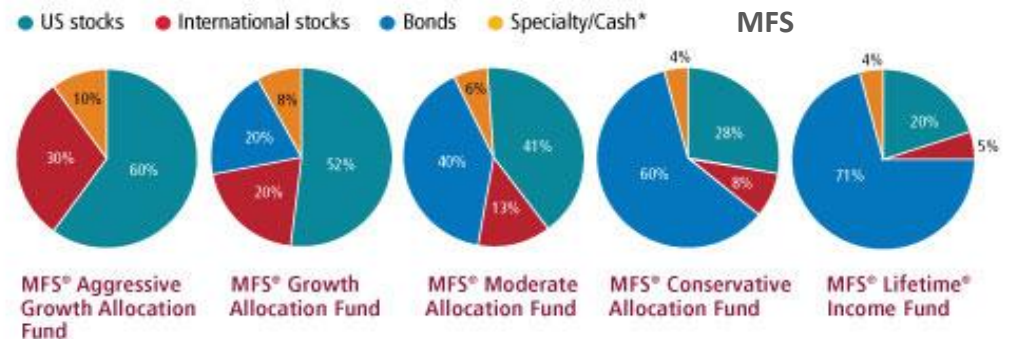
Investment strategy	Portfolio	Asset allocation
		Domestic equity funds International equity funds Fixed income funds Short-term funds
Conservative	VIP Funds Manager 20% Portfolio	14% 6% 50% 30%
Balanced	VIP Funds Manager 50% Portfolio	35% 15% 40% 10%
Growth & income	VIP Funds Manager 60% Portfolio	42% 18% 35% 5%
Growth	VIP Funds Manager 70% Portfolio	49% 21% 25% 5%
Aggressive	VIP Funds Manager 85% Portfolio	60% 25% 15%

AAII – American Association of Individual Investors

Aggressive Investor 90% Diversified Stock	Moderate Investor 70% Diversified Stock	Conservative Investor 50% Diversified Stock
Suggested Allocation Breakdowns	Suggested Allocation Breakdowns	Suggested Allocation Breakdowns
20% Large-Cap Stocks	20% Large-Cap Stocks	25% Large-Cap Stocks
20% Mid-Cap Stocks	20% Mid-Cap Stocks	10% Mid-Cap Stocks
20% Small-Cap Stocks	10% Small-Cap Stocks	10% Small-Cap Stocks
20% International Stocks	15% International Stocks	5% International Stocks
10% Emerging Markets Stocks	5% Emerging Markets Stocks	0% Emerging Markets Stocks
10% Intermediate Bonds	30% Intermediate Bonds	40% Intermediate Bonds
0% Short-Term Bonds	0% Short-Term Bonds	10% Short-Term Bonds
Allocations	Allocations	Allocations
10% Fixed Income 90% Diversified Stock	30% Fixed Income 70% Diversified Stock	50% Fixed Income 50% Diversified Stock
Portfolio Return	Portfolio Return	Portfolio Return
YTD: 3.5%	YTD: 3.6%	YTD: 3.4%
1 yr: -4.2%	1 yr: -1.8%	1 yr: 0.7%
5 yrs: 6.2%	5 yrs: 6.0%	5 yrs: 6.1%
10 yrs: 5.8%	10 yrs: 5.8%	10 yrs: 5.8%



Standard & Poors



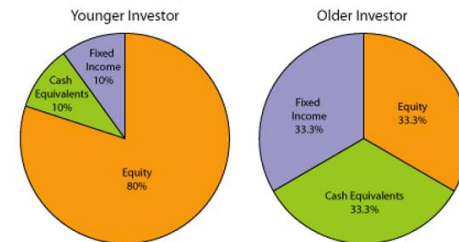
Appendix C (cont.)

Risk Category Portfolio Examples

Years until retirement		Stocks	Bonds	Cash
30 years		80%	15%	5%
12 years		60%	30%	10%
5 years		40%	40%	20%

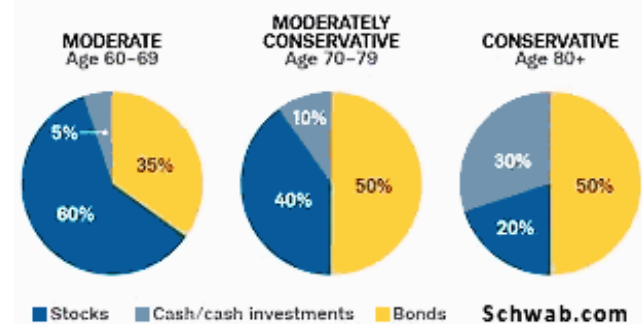
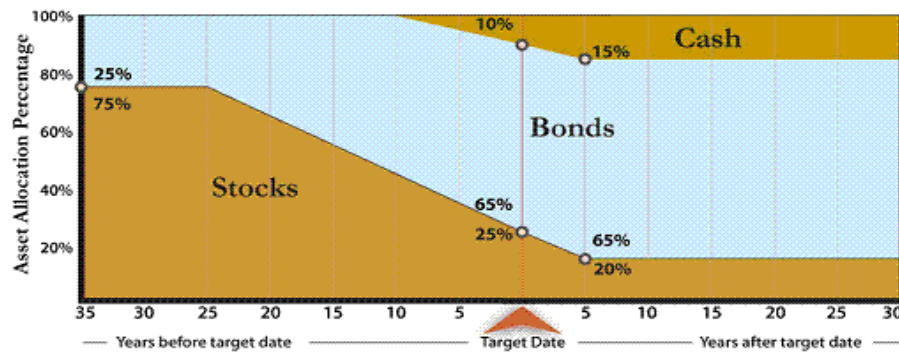
FINRA 401(k) Investing Reallocation

Sample Asset Allocations



FINRA 401(k) Investing Asset Allocation

SEC Investor Alert Bulletin: Target Date Retirement Funds



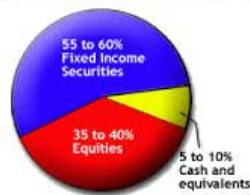
Schwab.com

Investopedia.com

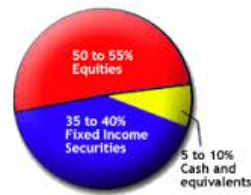
Conservative Portfolio



Moderately Conservative Portfolio



Moderately Aggressive Portfolio

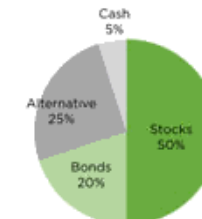


Very Aggressive Portfolio

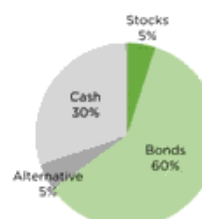


Market Allocations

Bull Market

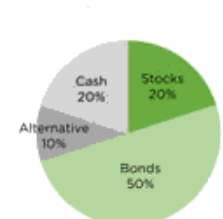


Bear Market



MarketWatch.com

Transitional Market



Appendix D

Temporal Portfolio Theory™ Summary

Modern Portfolio Theory is 65 Years Old

[MPT](#) (Modern Portfolio Theory) was developed long before computers were available for analyzing time domain data on a daily basis. This inherently limited MPT to long-term statistical analysis of portfolios and market data. With no temporal analysis functionality there could be no trend/momentum information; limiting MPT to buy-and-hold diversification models. However, today it has become widely accepted by [academia](#) and [industry](#) alike that harvestable momentum exists in market data. It's time to extend MPT's framework with temporal data analysis.

Temporal Portfolio Theory™ Introduction

Temporal Portfolio Theory extends MPT by integrating the cross-disciplinary sciences of [Matched Filter Theory](#), [Differential Signal Processing](#), [Fuzzy Logic](#), and [Holistic Risk Management](#) within a layered Portfolio-of-Strategies framework. Its primary operational components are briefly described below.

Automated Polymorphic Momentum™

Information Theory dictates that the probability of making an excellent investment decision is directly proportional to the [signal-to-noise ratio](#) of the employed momentum indicator signal. While [Matched Filter Theory](#) actually specifies the momentum filter shape and duration for optimum signal-to-noise ratio, [Differential Signal Processing](#) further reduces noise from the decision process. ***By owning only the trend leader and avoiding the laggards one can simultaneously improve returns and reduce risk.*** The term Polymorphic indicates that the momentum filter is both adaptive in shape and duration to accommodate (a) the diverse character of various equity classes (i.e. bonds, market indexes, sectors, REITS, and commodities), (b) the evolving character of the market, and (c) the evolving character of Strategies as funds with shorter histories begin to participate. An integral part of Automated Polymorphic Momentum is [Forward-Walk Progressive Tuning](#), which is the process of walking forward through out-of-sample data to show results that can be produced in the absence of hindsight. See our **NAAIM Wagner Award** paper: "[Automated Polymorphic Momentum](#)."

Risk-On Risk-Off Triple Assessment

Simple [Risk-On Risk-Off](#) market direction indicators, such as the [Death Cross and Golden Cross](#), typically use a moving average of S&P500 or advance/decline daily data to react slowly enough to avoid short-term whipsaw losses, but fast enough to respond to a true bear market. Unfortunately, they are still vulnerable to medium-term market declines. ***StormGuard-Armor achieves its remarkable performance utilizing three distinct views of the market:*** price-trend, volume-momentum, and value-sentiment. Twelve measurements combined by [Fuzzy-Logic](#) mathematics produce the final result.

Integrated Bear Market Strategies

When [StormGuard-Armor](#) signals that market conditions have become bearish, a [Bear Market Strategy](#) automatically takes charge and selects from a list of trusted safe harbor investments, such as money market funds, bond funds, gold bullion, or US treasuries. While money market funds are intrinsically safe, they offer virtually no growth opportunity during a bear market. Conversely, bonds, gold and treasuries offer growth opportunity, but are not reliably negatively correlated with the market. Integrated [Bear Market Strategies](#) automatically select the current best performing safe harbor fund.

Multi-Dimensional Risk Abatement

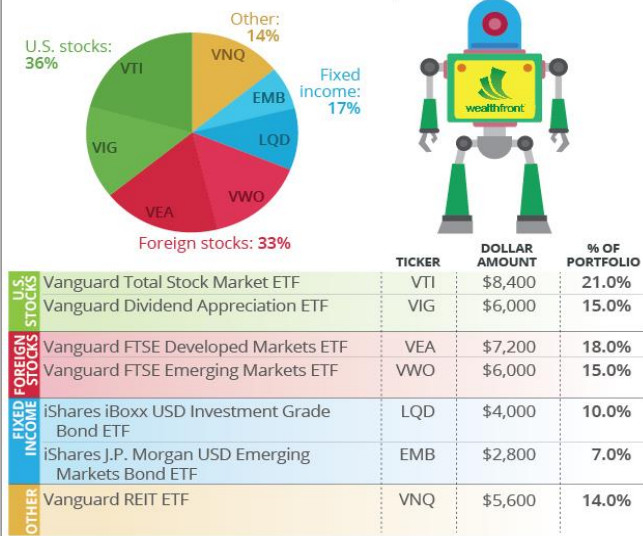
Risk is not a one-dimensional problem cured by a single act of diversification. It's a multi-dimensional problem, and diversification is just the start. There are numerous sources of risk to address that relate to companies, funds, strategies, markets, political events, natural disasters, and even personal behavior. Temporal Portfolio Theory embraces Holistic Risk Management as a means to abate risk on many levels, as described in our white paper: "[Conquering the Seven Faces of Risk](#)".

Appendix E

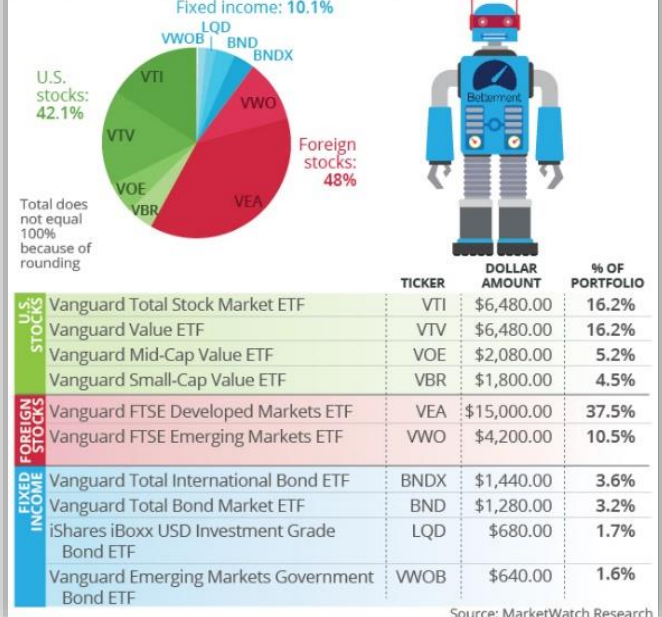
Robo Advisor and AAI Moderate Portfolios

([MarketWatch Research](#))

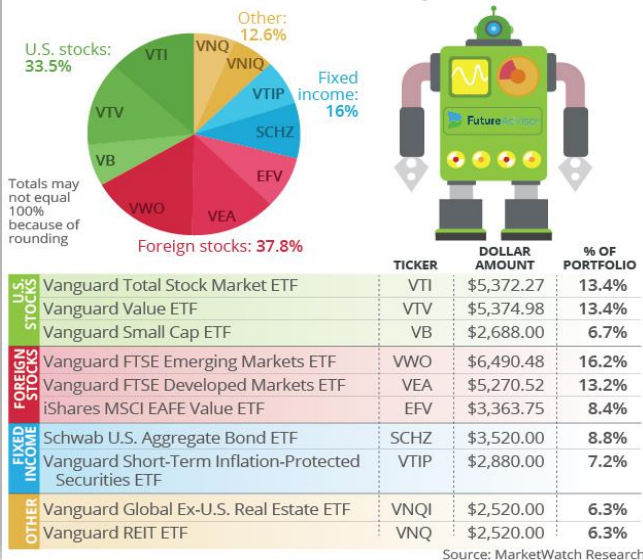
Wealthfront's recommended portfolio



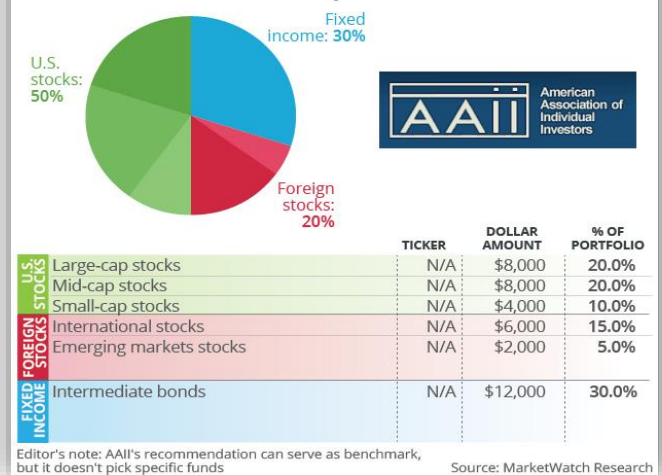
Betterment's recommended portfolio



FutureAdvisor's recommended portfolio

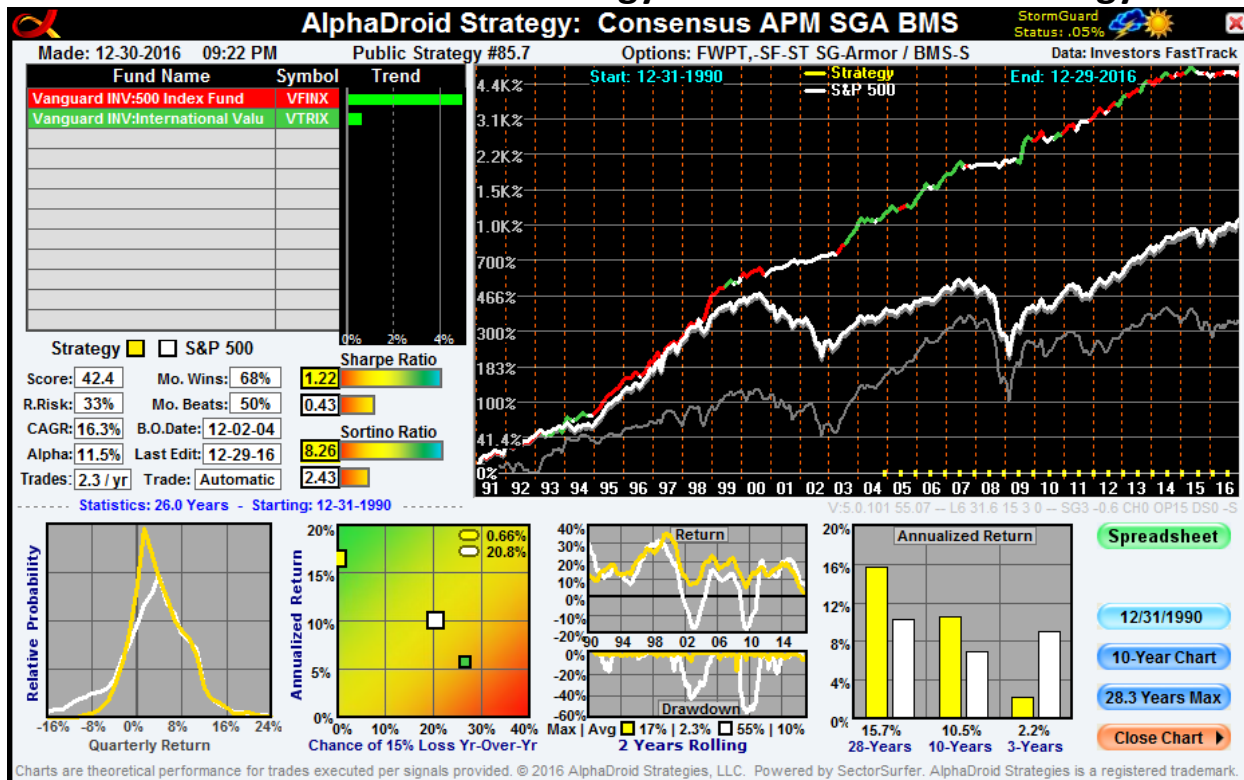


American Association of Individual Investors' recommended moderate portfolio

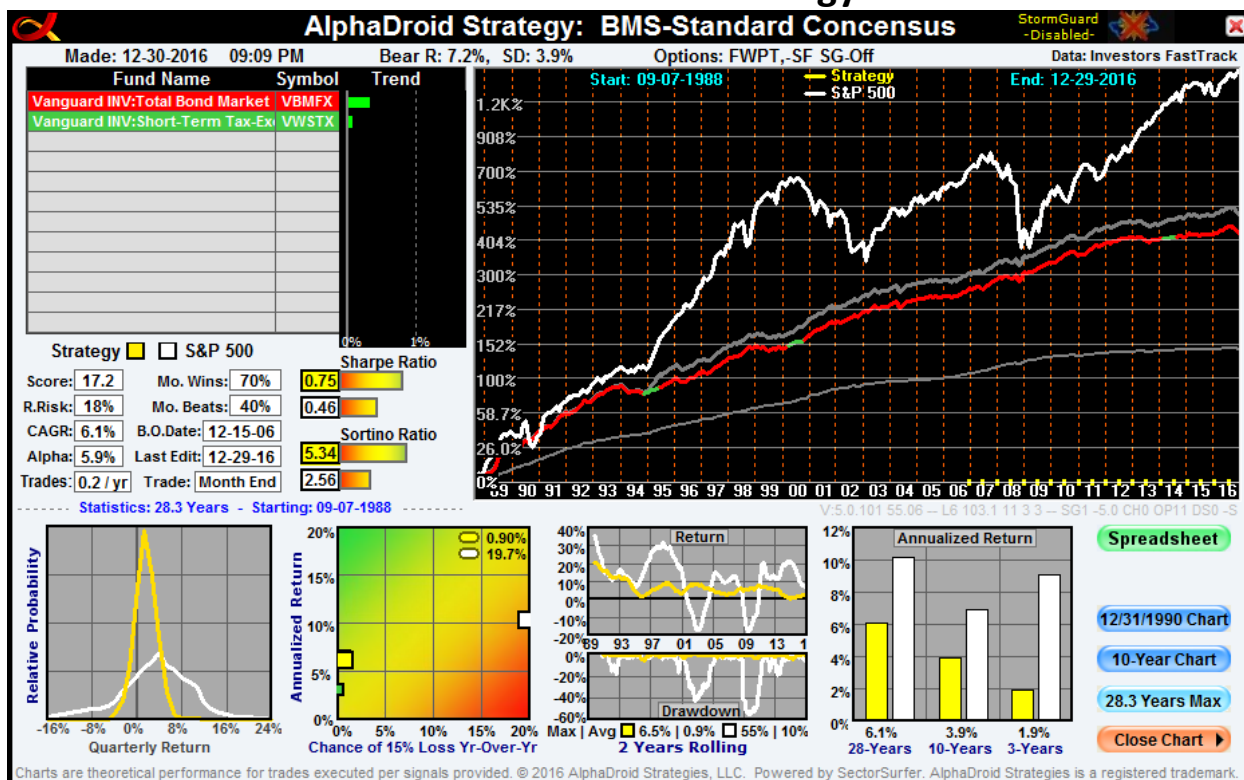


Appendix F-0

Consensus Funds TPT Strategy with Bear Market Strategy

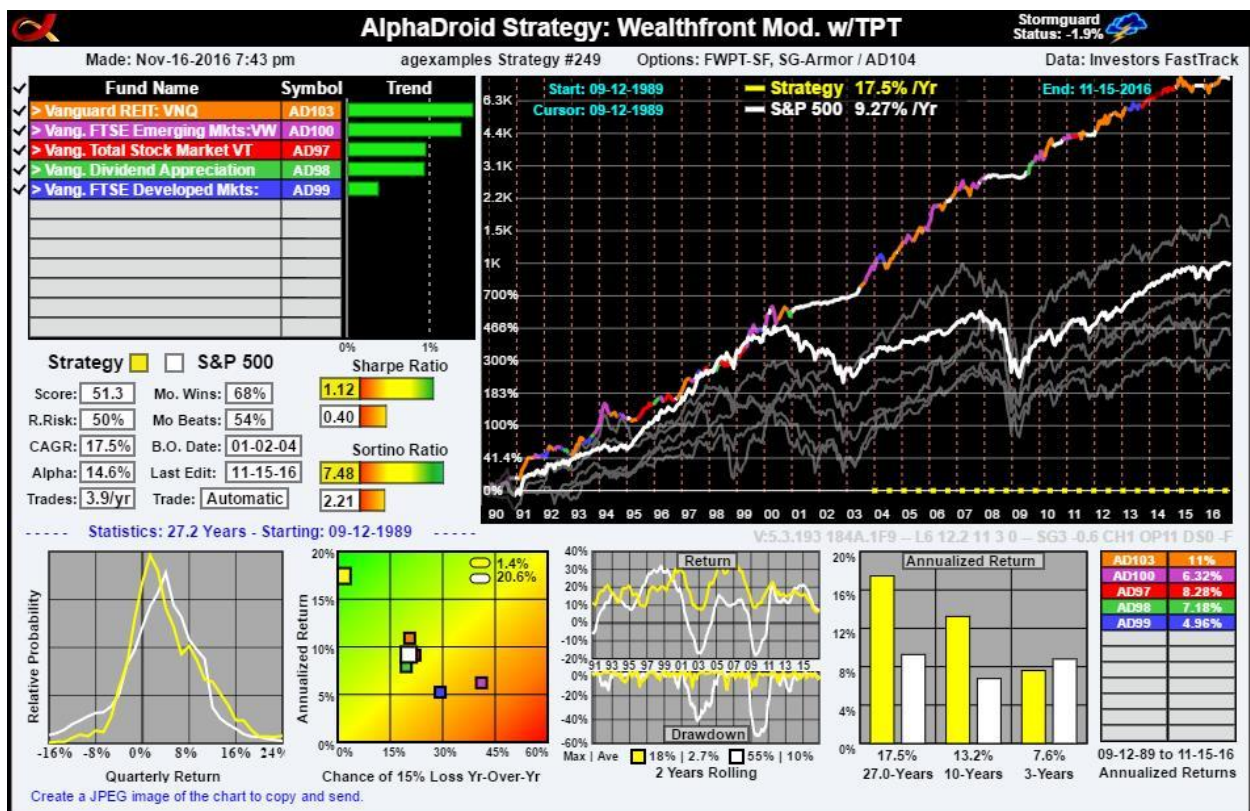
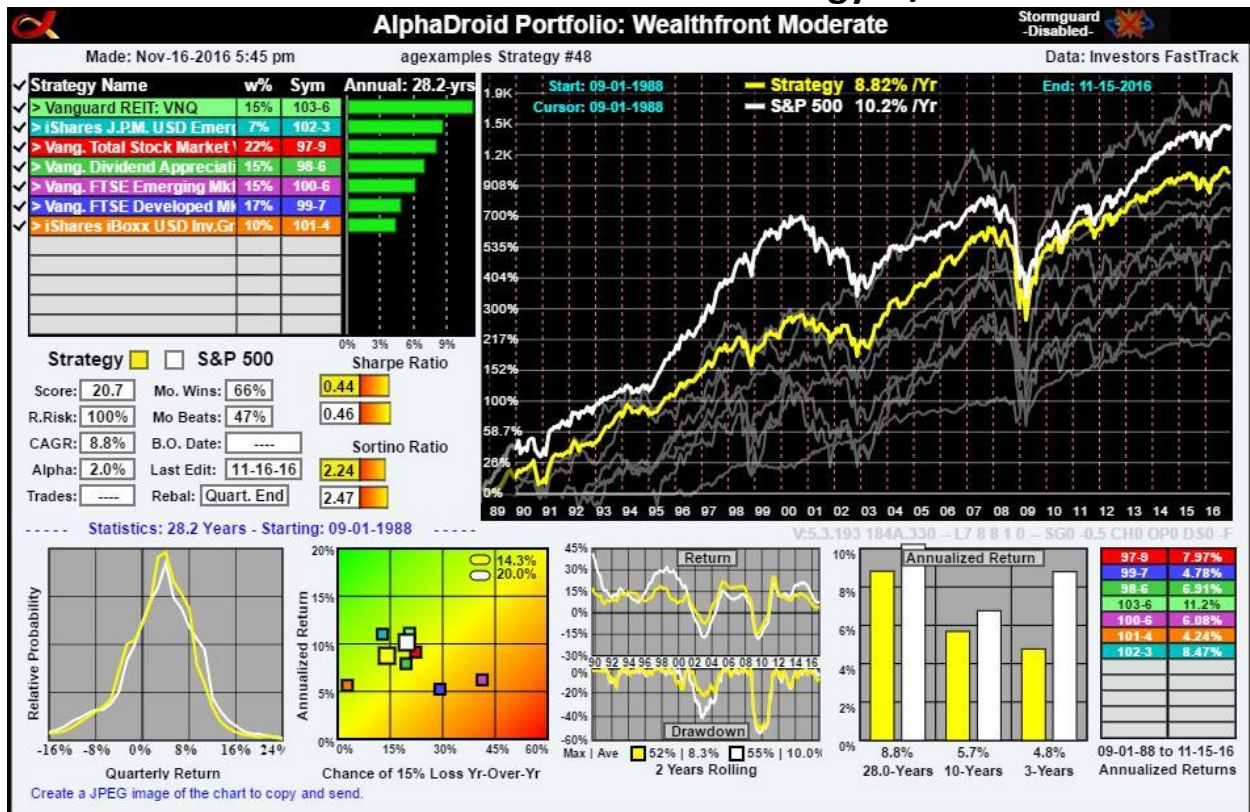


The Bear Market Strategy



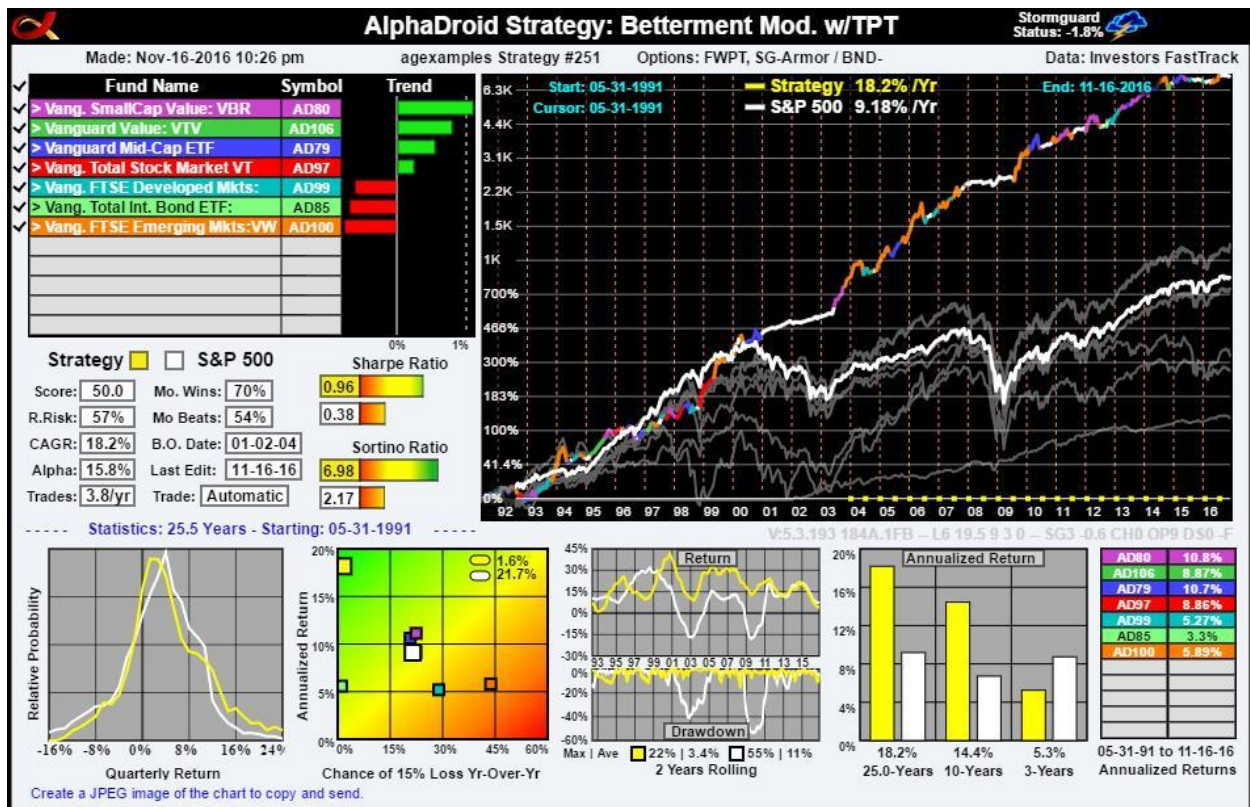
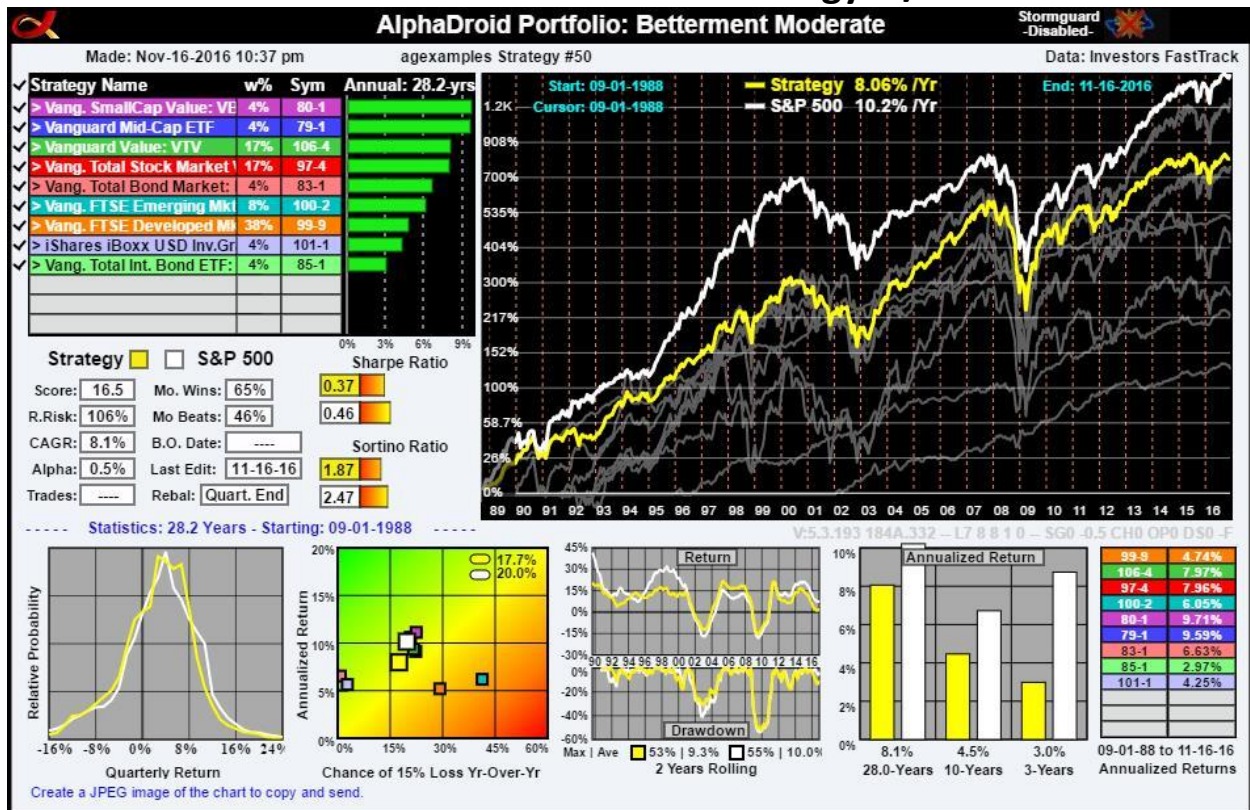
Appendix F-1

Wealthfront Portfolio vs. Strategy w/TPT



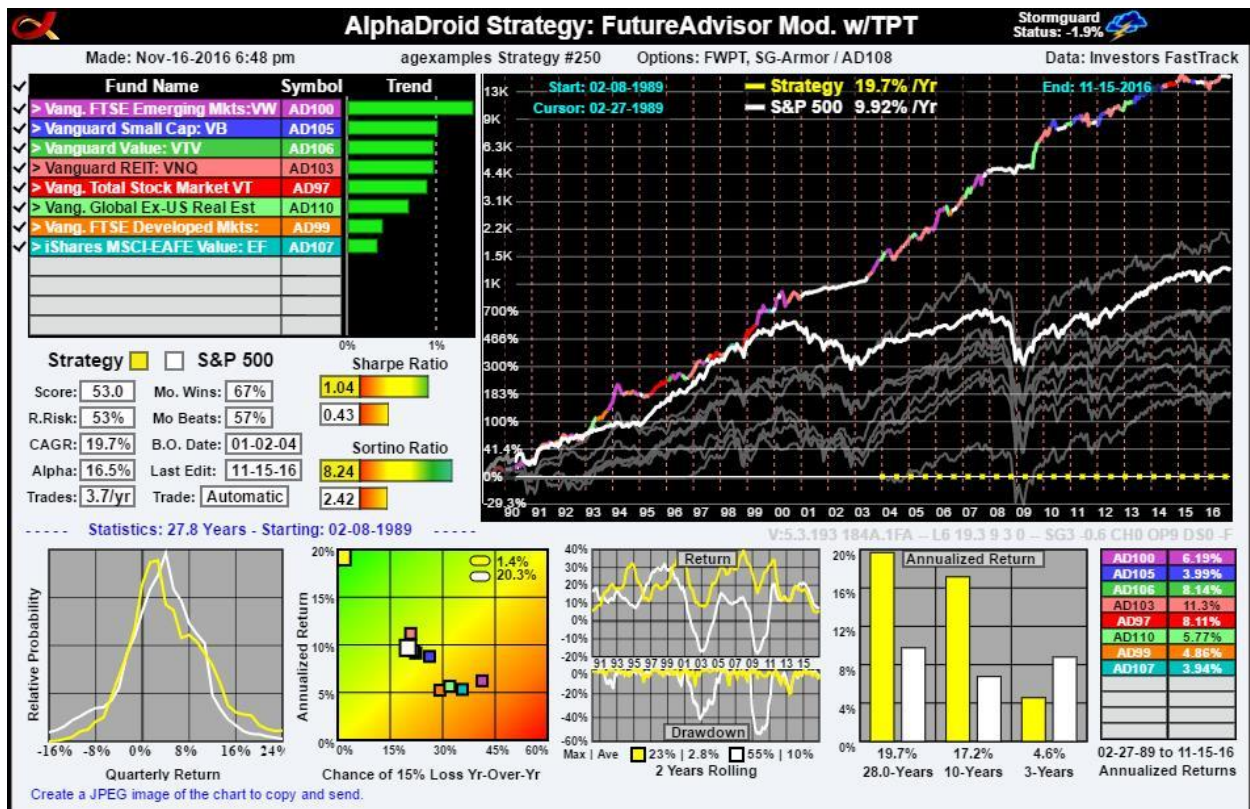
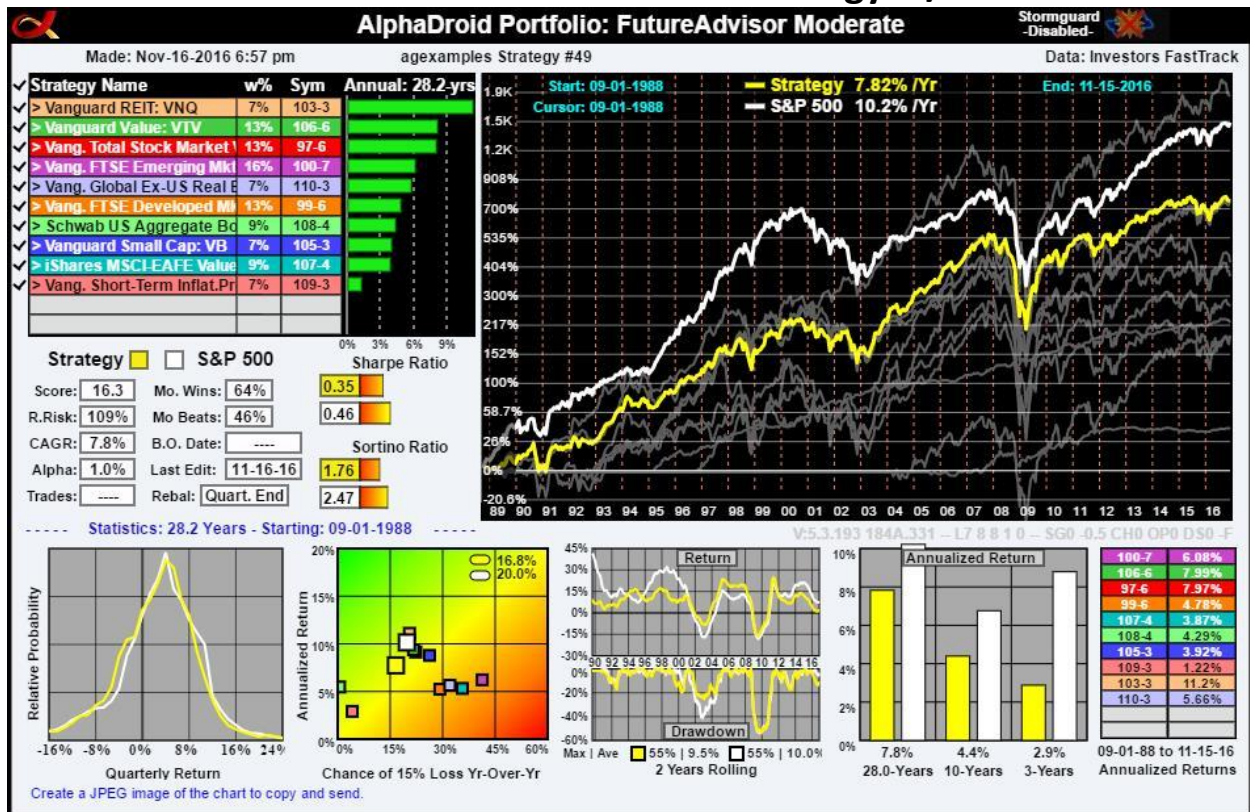
Appendix F-2

Betterment Portfolio vs. Strategy w/TPT



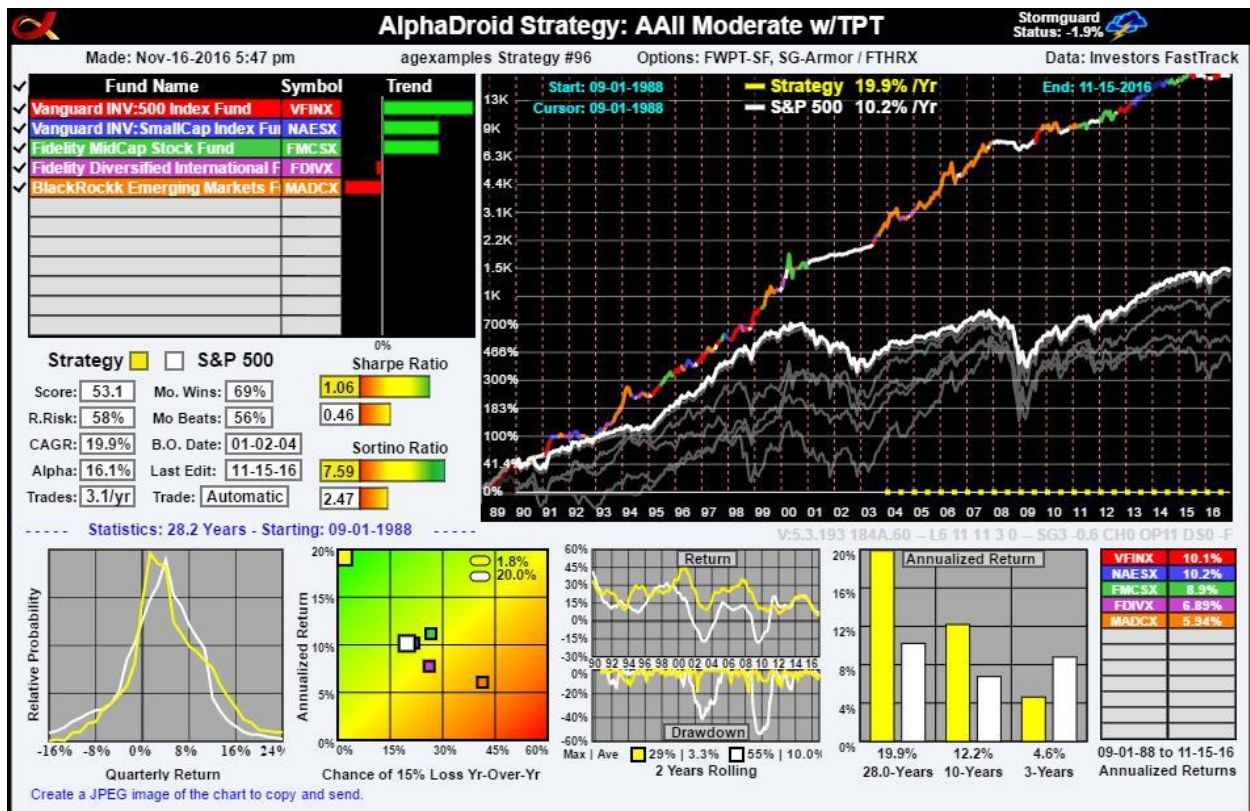
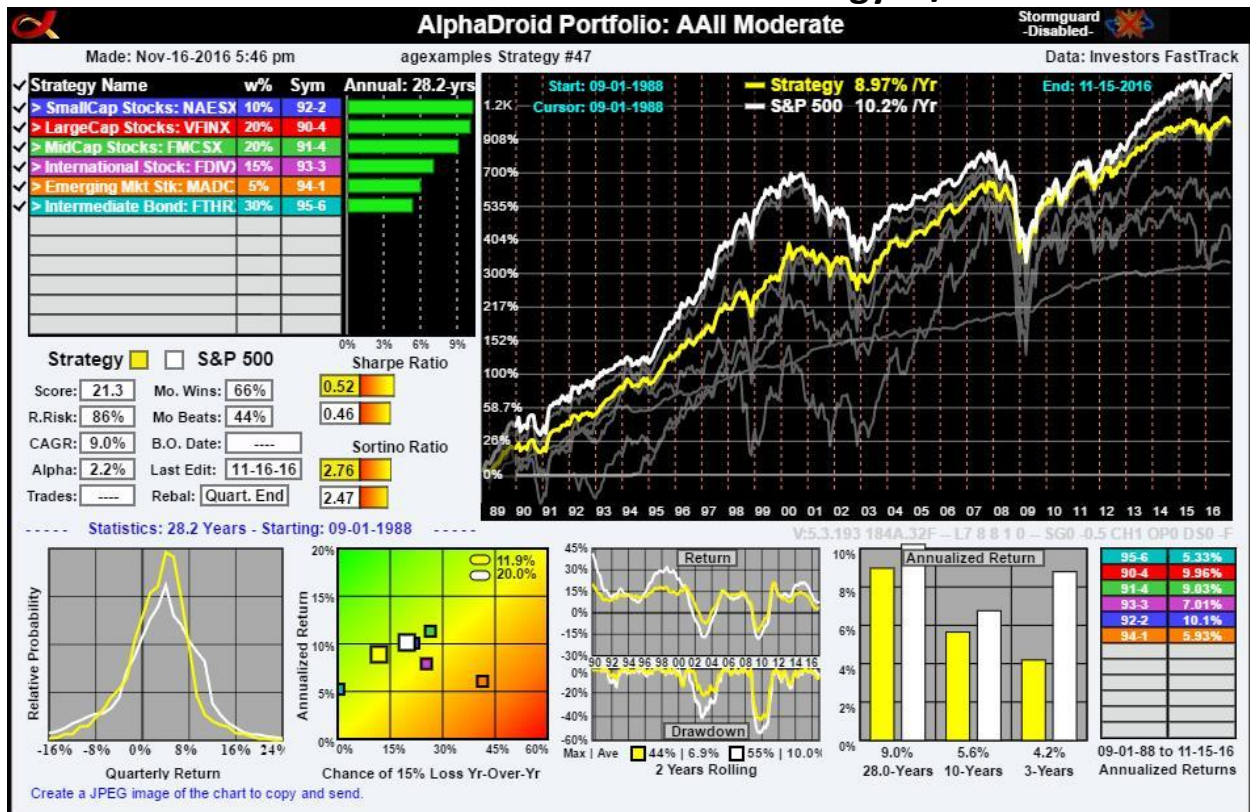
Appendix F-3

FutureAdvisor Portfolio vs. Strategy w/TPT



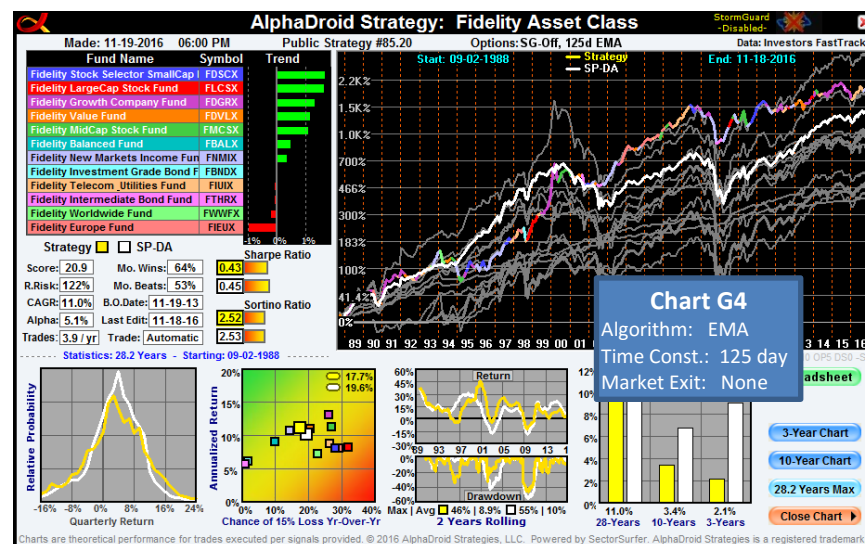
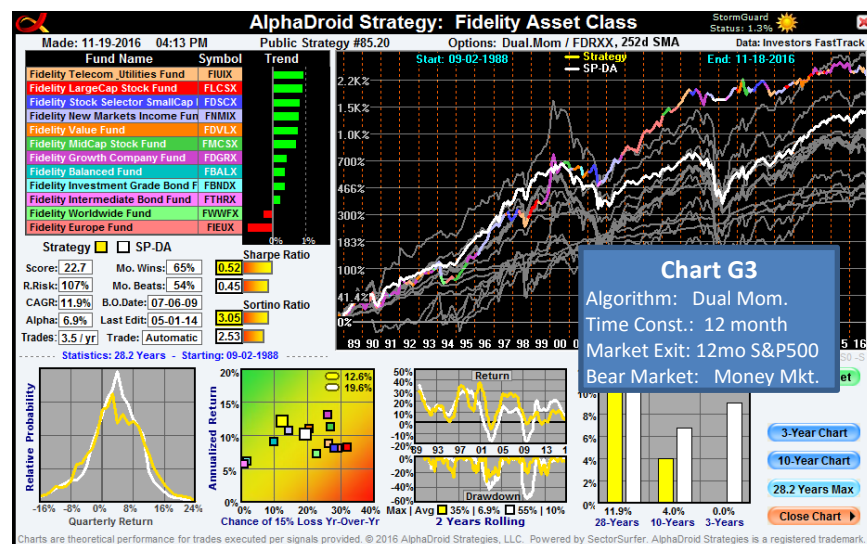
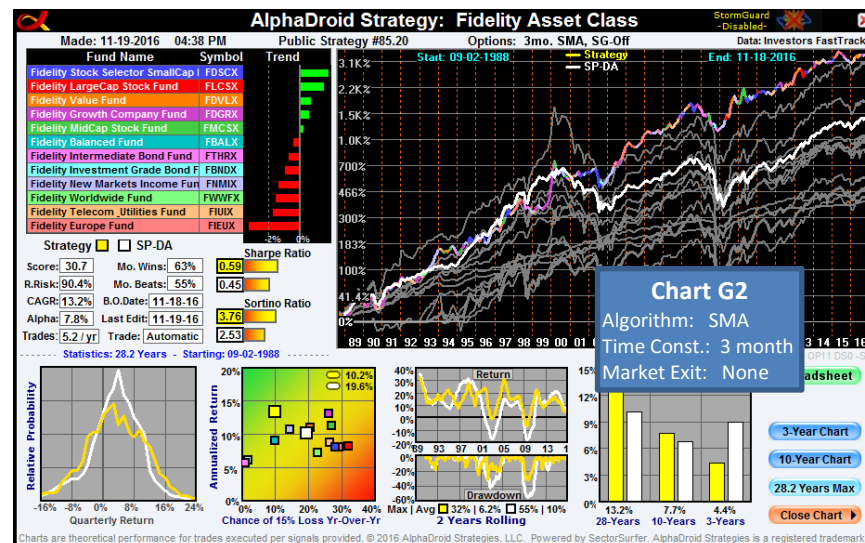
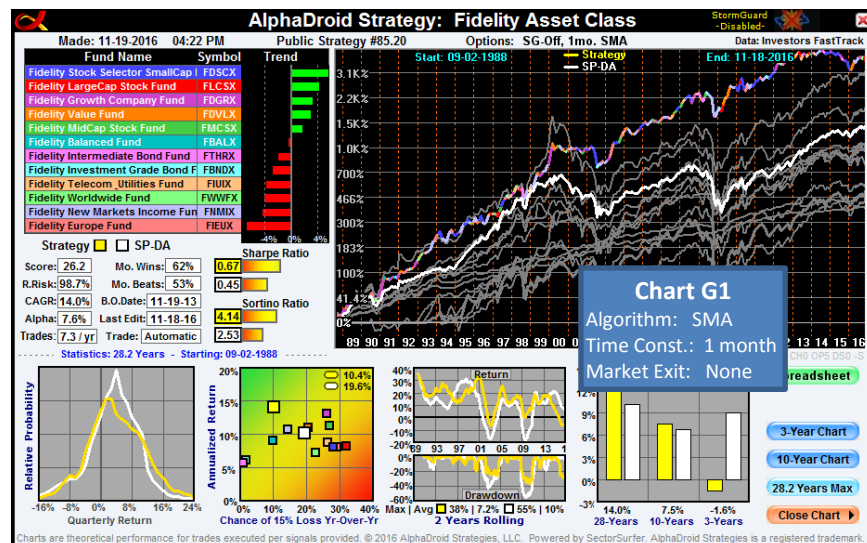
Appendix F-4

AAll Moderate Portfolio vs. Strategy w/TPT



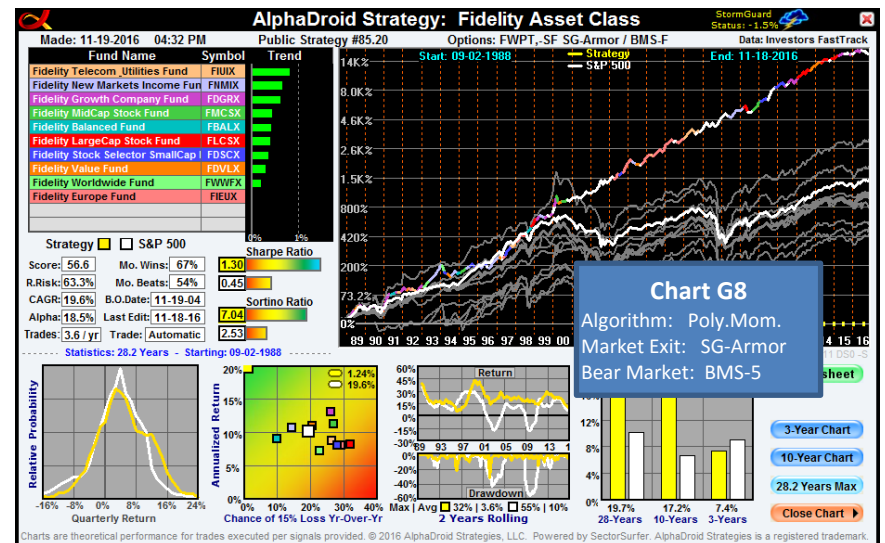
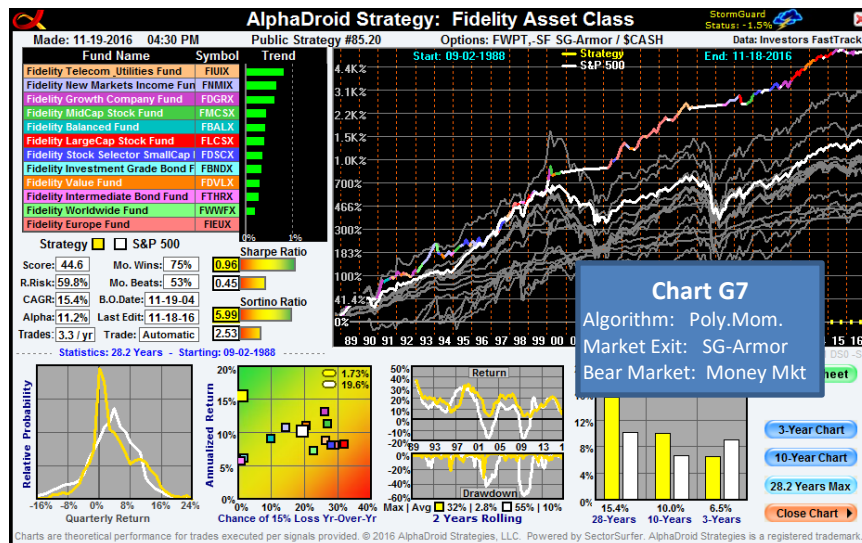
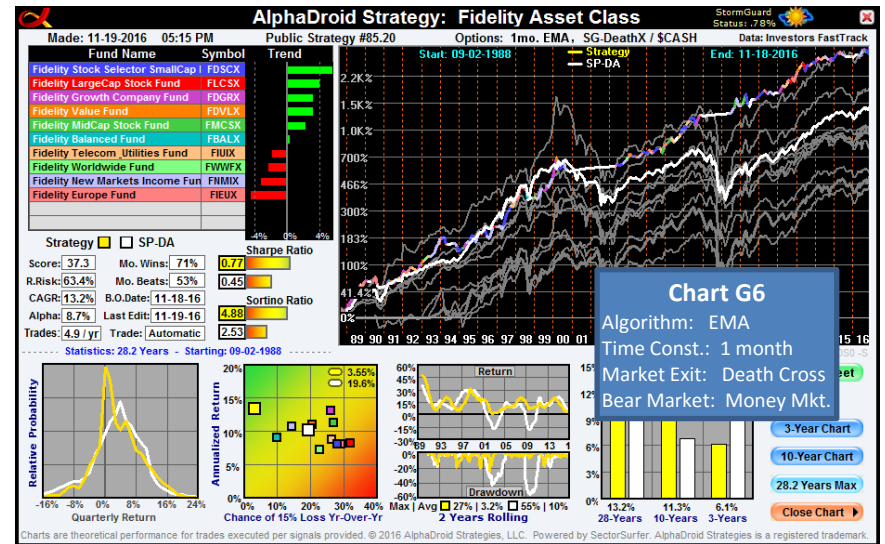
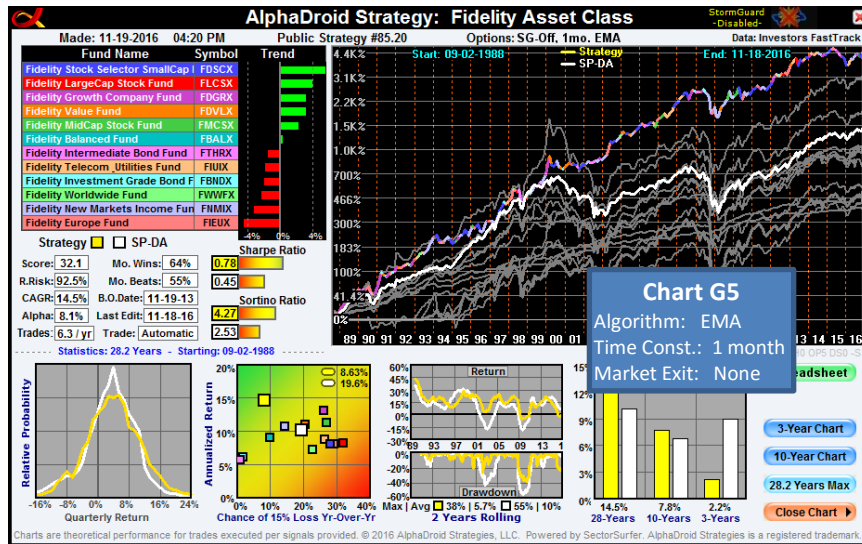
Appendices G1 to G4

Fidelity Asset Class – Various Strategies



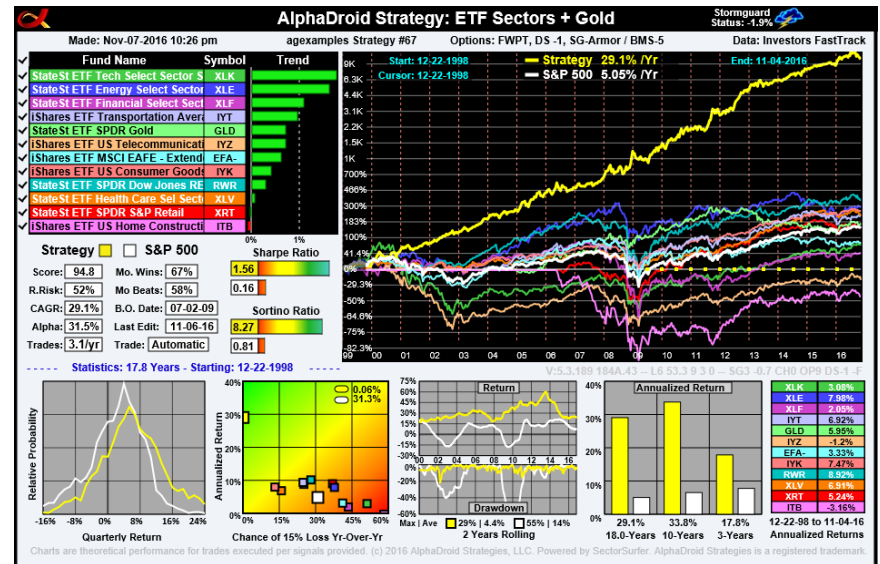
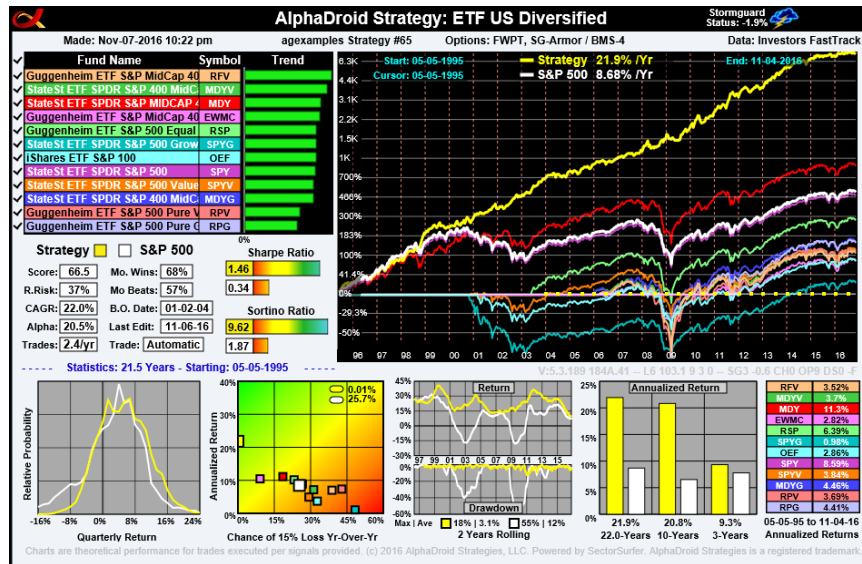
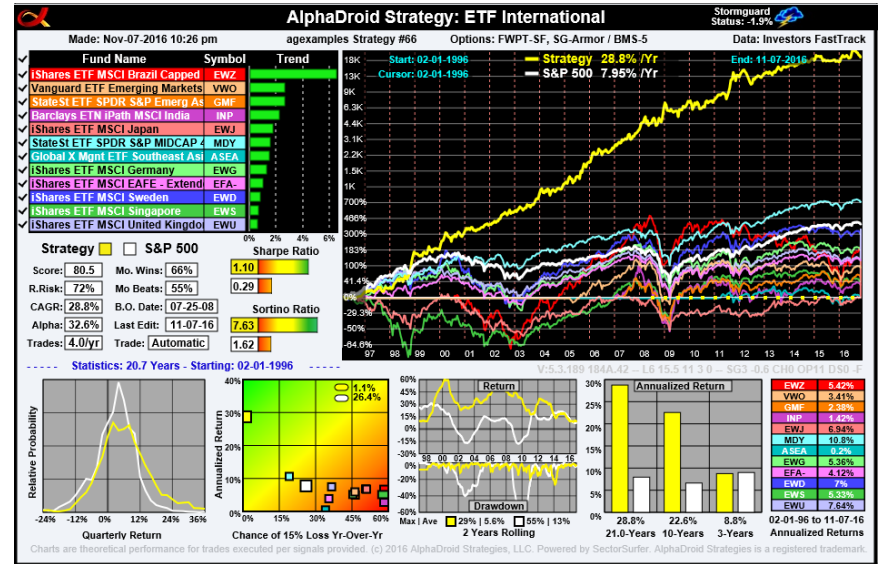
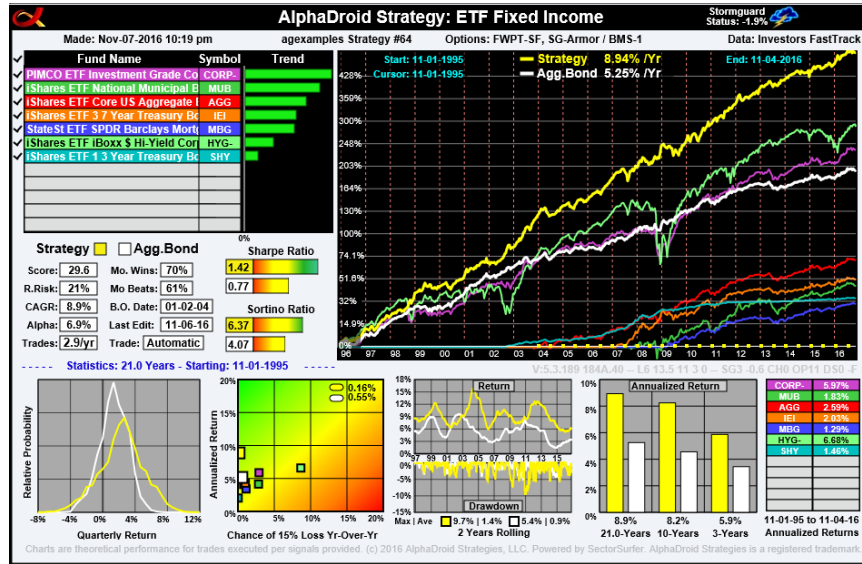
Appendices G5 to G8

Fidelity Asset Class – Various Strategies (cont.)



Appendix H-1

ETF Prudence Portfolio Underlying Strategies



Appendix H-2

ETF Prudence Portfolio

