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SAFETY ZONES, DANGER ZONES, AND THE CRITICAL PATH

Visualizing U.S. Asset Class Returns Based on Time Horizons, Size, and Style

By Steven J. Huxley, PhD, and Brent Burns

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ABSTRACT

Many advisors struggle to get clients to focus on long-term investing and ignore the constant short-term noise spewed by the media. This paper provides a series of easily understood tables and figures that should help clients realize why financial advisors must use appropriate time horizons when formulating lifetime financial plans. It also explores the intuitive nature of dedicated portfolios for retirement, and the critical path that splits the future into "safe zones" and "danger zones."

The images use the same style box and color scheme that Morningstar uses for its Market Barometer. They are backed up technically with regression analyses to demonstrate that time horizons as well as size and value-growth dimensions are statistically significant in explaining return rates. The same is true for the probabilities of earning selected returns, such as chances of earning 10 percent or more over various time horizons. This paper also challenges what we believe are incorrect interpretations of volatility as risk in modern portfolio theory (MPT).

INTRODUCTION

Financial advisors face a daunting task when attempting to focus clients on investing for the long run. The general public is bombarded constantly with headlines touting the latest gyrations in stock prices. The heads of brokerage houses and/or large advisory services try to get their names in the media by making predictions about where the market is headed this year. This reinforces the perception that rational investing should focus on one-year time horizons with the thought that if professionals do it, it must be right. To the contrary, advisors must take the long-term perspective when building lifetime plans for their clients.

The media broadcasts and reports ignore the fact that day-to-day and even year-to-year fluctuations in the market are random noise in otherwise rather stable long-term trends. Conscientious advisors need to overcome this cacophony of short-term nonsense by educating clients that investment decisions should be made based on the data that cover the same time horizons as their plan covers.

A long history of works emphasizes the importance of a long-term perspective, beginning with Graham and Dodd (1934). Benjamin Graham then followed up on this topic in 1949 with the first edition of *The Intelligent Investor*, most recently updated by Jason Zweig, a *Wall Street Journal* columnist. Recent academic research has focused on improving the predictability of future returns over various horizons based on a variety of independent variables (Fama and French 1992, Barberis 2000, Campbell 2001, Campbell and Thompson 2008, Park and Sohna 2016).

Another avenue of research has been the affirmation, or challenge, to Paul Samuelson's original work on time diversity (Samuelson 1969, 1994), the resolution of which is yet to come. Samuelson suggested that the holding period has no influence on the riskiness of stock investments from a utility maximization standpoint. However, his conclusion relied on three critical assumptions, each of which has been challenged (Bianchi et al. 2016). Kahneman and Tversky's prospect theory also cast doubt on Bernoulli's expected utility theory, one of the bedrocks of economic theory that Samuelson relied on (Kahneman and Tversky 1979, 1992; Kahneman 2011).

Perhaps the most successful recent researcher to point out the need to focus on long-term investing is Jeremy Siegel in his seminal work, *Stocks for the Long Run* (Siegel 2014), which was first published in 1994 and is now in its fifth edition. Siegel concluded that investors should focus on holding periods of fifteen years or longer to reap the returns promised by equities relative to bonds. This paper buttresses his findings.

The work here differs from prior publications, however, in that its goal is much humbler. Following Siegel's lead, it seeks to answer the question "what happened" in a more visual way. It also follows the lead of Tufte (1992) who verified the old saying that "a picture is worth a thousand words." This paper does not try to answer the question, "Why did these things happen?"

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Aside from a few regressions testing the significance of length of the holding period on returns, there is no deep theory here. Its purpose is to assist advisors, especially those with substantial numbers of clients who are thinking about, approaching, or already into retirement, with charts, images, and statistics that demonstrate the differences between short-term and long-term investing. Hopefully, advisors who use these illustrations will find them useful to help squeamish clients become less vulnerable to the alarmist noise that pervades mainstream media.

Part 1 provides tables highlighting average, best, and worst returns for U.S. asset classes by size and style over one-, five-, ten-, fifteen-, twenty-, and thirty-year time horizons. The limit of thirty years conforms to the time horizon most retirement literature uses, and results beyond thirty years differ little from those shown here. The analysis represents an historical audit of actual returns for 1927–2017 rather than Monte Carlo simulations. Part 2 provides tables on the probabilities of each asset class earning annualized returns of at least −10 percent, −5 percent, 0 percent, 5 percent, 10 percent, 15 percent, and 20 percent over the same time horizons. Part 3 focuses on thirty-year time horizons, projecting the ending values for the most extreme asset classes to demonstrate the power of compounding (large-cap growth and small-cap value). Part 4 demonstrates why annual volatility becomes irrelevant when viewed from the thirty-year perspective of the critical path defined by the client's financial plan that separates the safe zone from the danger zone for ultimate success. Part 5 provides an example of a client with a $2 million retirement portfolio and how the critical path can be used to improve the probability of staying in the safe zone and meeting all financial goals.

PART 1: RETURNS BY ASSET CLASS AND TIME HORIZON

The taxonomy of asset classes by size (large cap, mid cap, and small cap) and style (value, core, or blend, and growth based on book-to-market value) was noted by Fama and French (1992) in their seminal paper on stock returns. Since that time, Morningstar has made the style box a common image depicting these nine asset classes in its Market Barometer of market fluctuations over time horizons ranging from one day to three years.[1] Only U.S. stocks are included in this study. All returns are nominal—inflation was not factored into any calculations.

Table 1 answers the question, "What have been the average, worst, and best returns over various holding periods

Table 1

AVERAGE, WORST, AND BEST PERFORMANCE FOR ONE-, FIVE-, TEN-, FIFTEEN-, TWENTY-, AND THIRTY-YEAR HOLDING PERIODS (ENDING YEAR FOR WORST AND BEST), 1927–2017

ASSET CLASSES: VALUE (V), CORE (C), GROWTH (G), LARGE CAP, MID CAP, SMALL CAP

1A: Average

	One-Year			Five-Year			Ten-Year			Fifteen-Year			Twenty-Year			Thirty-Year		
	V	C	G	V	C	G	V	C	G	V	C	G	V	C	G	V	C	G
Large	12%	9%	10%	12%	10%	10%	13%	10%	10%	13%	11%	10%	13%	11%	11%	13%	11%	11%
Mid	13%	12%	10%	13%	13%	10%	14%	13%	11%	14%	13%	11%	15%	13%	11%	15%	14%	11%
Small	15%	13%	9%	16%	14%	9%	16%	14%	9%	17%	14%	9%	17%	15%	10%	17%	15%	10%

1B: Single Worst

Large	−55%	−64%	−35%	−15%	−23%	−9%	−2%	−6%	0%	3%	−2%	1%	7%	1%	3%	10%	7%	8%
	1931	1931	1931	1931	1932	1933	2011	1939	2008	2015	1942	1943	2017	1948	1948	2015	1957	1958
Mid	−55%	−50%	−39%	−21%	−21%	−18%	−8%	0%	−2%	−2%	3%	1%	3%	6%	3%	8%	10%	8%
	1931	1931	1931	1932	1932	1932	1939	1937	1974	1942	1942	1943	1948	1948	1948	1957	1957	1975
Small	−53%	−49%	−49%	−24%	−21%	−24%	−2%	0%	−3%	1%	3%	0%	7%	6%	4%	11%	10%	6%
	1931	1937	1937	1932	1932	1932	1938	1937	1937	1941	1942	1974	1948	1948	1948	1957	1957	2010

1C: Single Best

Large	119%	79%	50%	43%	23%	31%	23%	19%	22%	22%	19%	20%	20%	17%	18%	18%	15%	13%
	1933	1933	1928	1936	1954	1999	1951	1958	1998	1956	1989	1999	1998	1998	1999	1961	2004	2004
Mid	124%	124%	95%	40%	41%	31%	27%	22%	19%	24%	20%	18%	21%	19%	17%	19%	18%	15%
	1933	1933	1933	1945	1936	1936	1951	1984	1984	1955	1989	1989	1961	1961	1999	2004	1961	2004
Small	132%	116%	149%	51%	42%	40%	33%	29%	23%	27%	25%	18%	24%	22%	17%	23%	20%	16%
	1933	1933	1933	1936	1936	1936	1984	1984	1984	1989	1989	1947	1994	1994	1952	2004	2004	1961

< −20%	−20% to −10%	−10% to 0%	0%	0% to 10%	10% to 20%	> 20%

Source: CRSP®, University of Chicago Booth School of Business.

historically?" Performance metrics represent the average compounded annual growth rates over the holding periods based on annual returns reported in the Center for Research in Security Prices (CRSP) database (Booth School of Business at the University of Chicago). For example, the 12 percent figure shown as the average for large value five-year holding periods was derived by calculating the compounded annual growth rate (CAGR) within each rolling five-year span from 1927–2017. These CAGRs were then averaged together, yielding 12 percent. The single worst five-year holding period lost 15 percent per year (1927–1931), and the single best gained 43 percent per year (1932–1936). The same process was used for all asset classes.

Table 1 uses the same sort of style box and colors that Morningstar does to depict the average, single worst-ever, and single best-ever returns over holding periods of one, five, ten, fifteen, twenty, and thirty years back to 1927, with all dividends reinvested. In this case, large-cap stocks consist of the top 20 percent by market capitalization (think S&P 500), mid-cap stocks the next 30 percent, and small-cap stocks the next 30 percent. Micro-cap stocks, the bottom 20 percent, are excluded because they constitute such a small percentage of the overall market (Securities and Exchange Commission [SEC], 2013). Micro caps generally have a market capitalization of only $200 to $300 million. Some, often referred to as penny stocks in the past, are now called "nanocaps," with less than $50 million capitalization (some may become the Apples, Googles, or Amazons in the year 2040, of course, but which ones?). In terms of style, firms with the highest 30 percent of book-to-market ratio were considered value; the next 40 percent, core; and the bottom 30 percent, growth, excluding micro caps.

As stated above, all returns are annualized, and for periods longer than one year, the average of the annualized returns over the holding period is shown. Green tones indicate positive returns, and red tones indicate negative returns. This visual seeks to summarize the range of returns investors have experienced over the past ninety-one years in a simple and concise manner.

SHORT-TERM VERSUS LONG-TERM AVERAGE RETURNS

Table 1A shows that the average returns are all positive. There are differences among the asset classes (small value is the winner, and small growth is the loser for every holding period), but all are positive by a good margin. This is because of the extremely long span examined, 1927–2017. Focusing on thirty-year holding periods, the best overall is a remarkable 17 percent for small value, and the worst is 10 percent for small growth. This suggests that investors who ignore doom-and-gloom headlines and remain fully invested in small value mutual funds or exchange-traded funds (ETFs) over thirty years could, on average, enjoy returns of 17 percent per year, a number that would surprise most clients. There is no guarantee that the next thirty years will achieve this, of course—there could always be a first time for any possible result.

SHORT-TERM VERSUS LONG-TERM WORST RETURNS

However, a 17 percent average can be misleading to those who do not understand statistics. This is where the educational challenge begins for advisors. A 17 percent average does not mean a constant 17 percent every year. To understand the range of possible outcomes, investors must consider variation around the average.

Table 1B shows the single worst-ever returns for all holding periods dating back to 1927. The true differences among holding periods now become clear. The worst one-year drop for any asset class was a loss of 64 percent for large core, which occurred in 1931. Not unexpectedly, all worst-ever returns for all asset classes over all one-year and five-year holding periods occurred during the Great Depression. To earn a positive return in any asset class, stocks must be held at least sixteen years.

Focusing on thirty-year holding periods, small value again wins with an impressive 11 percent per year for 1928–1957. Earning 11 percent or more per year simply by committing to a thirty-year holding period likely would surprise most who have not examined the data. It provides strong support to help clients focus on long-term investing. Again, there can be no guarantee about the future—there can always be a first time—but over the past ninety-one years, this is what the record shows. Small growth performed the worst at 6 percent per year (1980–2010), suggesting the name "growth" is an unfortunate misnomer. Value stocks outperform growth stocks in the long term.

SHORT-TERM VERSUS LONG-TERM BEST RETURNS

Table 1C reveals the single best-ever investing experiences. Small value stocks again beat the competition, with a 23 percent-per-year return during 1985–2004, while large growth came in at 13 percent over the same time span. Table 1C might be dangerous to show clients without making sure they understand that these thirty-year maximum returns occurred only once in the past ninety-one years and are highly unlikely to repeat.

We did not investigate the ergodicity of the data in this paper. There is only one ninety-one-year period, but had we limited the investigation to different lengths of spans within the ninety-one years, the data might have led to different conclusions. The assumption is that the averages are stationary and would arrive at the same conclusions even if different holding periods had been used. This is a shortfall of most

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empirical research that relies on historical audits rather than Monte Carlo analyses. Monte Carlo reveals what might have happened over the past nine decades, whereas historical audits reveal what actually did happen. There are good arguments on both types of studies. Some advisors prefer Monte Carlo because its results can be based on thousands or millions of possible sequences of returns. But one of its weaknesses is that it assumes the process of generating the returns is purely mathematical and insulated from any external factors, such as political events, discoveries of new technologies, paradigm shifts, changing autocorrelations, etc. Other advisors prefer historical audits because they are easier to explain to clients and reflect what actually did occur in the real world. It is true that an inherent weakness of the historical audit approach is that it provides only one small sample of what might have happened (what if Hitler had died as a child, or the assassin's bullet had missed Kennedy in 1963, etc.). It will be a major step forward in research when someone figures how to capture the best of both research techniques.

REGRESSION OF RETURNS AGAINST HOLDING PERIOD, SIZE, AND STYLE

On a technical note, three linear multiple regressions were run, one each for tables 1A, 1B, and 1C. Holding period was the first independent variable. To determine the marginal impacts of mid cap and small cap, large cap was used as the base case variable for the size factor. Growth was used as the base case for the style factor to estimate the marginal impact of value and core. Table 2 summarizes the results.

Average returns had the highest R-squared value at 80.1 percent. All explanatory variables have the expected directional impact and were statistically significant, including the holding period. This supports most advisors' contention that longer holding periods will produce higher returns regardless of the asset classes used. The coefficients suggest that the holding period adds five basis points to the return per year above what large growth stocks offer after controlling the other variables. Mid- and small-cap stocks add 1.49 percent and 2.18 percent, respectively. Value stocks add 4.32 percent, the strongest impact, and core stocks add 2.41 percent.

For the worst-case scenario, the effects of size and style are overwhelmed by the influence of the holding period and are no longer statistically significant. The holding period adds a hefty 1.74 percent per year to worst-case returns. This appears excessively high until one examines just how bad the worst returns are for one-year holding periods, where the average is –50 percent, with worst of the worst reaching down to –64 percent for large core funds, compared to an average of 9 percent for all classes combined over thirty-year holding periods.

In the best-case scenario, the holding period has a negative effect. This may seem counterintuitive, but spectacular returns sometimes are generated in a single year. The highest-ever return was 149 percent for small growth in 1933. Longer holding periods dampen or even wash out these high returns because of the inevitable regression to the mean over time. None of the other variables are statistically significant.

PART 2: PROBABILITIES OF RETURNS

Table 3 answers the question: "What are the chances historically of earning a return over various holding periods?" It follows the same asset class taxonomy as table 1 for data back to 1927. For example, small value stocks returned 20 percent or more in forty-two of the ninety-one years, or 51 percent of the one-year holding periods. But small value

Table 2

REGRESSION RESULTS FROM TABLE 1: RETURNS VS. HOLDING PERIOD, SIZE, AND STYLE

Y Variable	Average Return			Worst-Ever Return			Best-Ever Return		
X Variables	Coefficient	*P* Value		Coefficient	*P* Value		Coefficient	*P* Value	
Intercept	0.0820	4.8E-27	***	-0.3150	6E-09	***	0.5980	1.2E-07	***
Holding Period	0.0005	0.0012	**	0.0174	3E-13	***	-0.0239	8.2E-08	***
Mid Cap	0.0149	6.2E-05	***	-0.0019	0.964		0.0675	0.454	
Small Cap	0.0218	5.0E-08	***	-0.0032	0.939		0.1307	0.150	
Value	0.0432	4.9E-17	***	-0.0215	0.607		0.0987	0.275	
Core	0.0241	4.7E-09	***	-0.0224	0.592		0.0320	0.722	
R-Squared	80.1%			63.9%			41.9%		
Statistical Significance: *** *P* < .001 ** *P* < .01									

stocks earned more than 20 percent in only six of the sixty-two holding periods of thirty years, or 10 percent. To keep table 3 concise, only selected points (–10 percent, –5 percent, 0 percent, 5 percent, 10 percent, 15 percent, and 20 percent) along the entire distributions (which are concave and downward sloping) for each asset class are shown.

All asset classes achieved returns of 5 percent or more 100 percent of the time for thirty-year holding periods. Again, simply because it has never happened in the past does not guarantee it will not happen in the future.

Nearly all asset classes achieved a 90 percent probability of beating 5 percent over fifteen-year holding periods (mid growth and small growth were close at 87 percent and 83 percent, respectively). Small value had a 95 percent record of beating 10 percent over all fifteen-year periods, and a 100 percent over all thirty-year periods, consistent with its worst-ever return of 11 percent for any single thirty-year span from table 1. The odds of beating 15 percent decline to 74 percent for small value over any fifteen-year period.

But this still beats the 10 percent chance of growth funds beating 15 percent over any fifteen-year span.

REGRESSION OF PROBABILITIES AGAINST HOLDING PERIOD, SIZE, AND STYLE

Table 4 presents results of regressions using the data in table 3. The regressions are like those in table 2, but the dependent variable is the probability of earning a return, not the return itself. Table 4 presents returns only of 15 percent or more, 10 percent or more, and 5 percent or more because these are the returns that show the greatest variation in table 3.

For example, the regression for the chances of earning 5 percent or more has an adjusted R-squared of 78.5 percent. All coefficients are positive, as expected, and holding period is the most statistically significant by far. Value and core variables are statistically significant, but mid cap and small cap are not. Moving on to the probability of earning 10 percent or more, all the coefficients again have the expected positive signs and all are statistically significant, including mid cap and small cap. The same is true of the third set of regressions for 15 percent

Table 3

FREQUENCY OF RETURNS PER YEAR FOR ONE-, FIVE-, TEN-, FIFTEEN-, TWENTY-, AND THIRTY-YEAR HOLDING PERIODS, 1927–2017

ASSET CLASSES: VALUE (V), CORE (C), GROWTH (G), LARGE CAP, MID CAP, SMALL CAP

		One-Year			Five-Year			Ten-Year			Fifteen-Year			Twenty-Year			Thirty-Year		
		V	C	G	V	C	G	V	C	G	V	C	G	V	C	G	V	C	G
20% or more	Large	46%	32%	36%	23%	11%	8%	12%	0%	2%	6%	0%	1%	1%	0%	0%	0%	0%	0%
	Mid	42%	44%	36%	25%	16%	10%	15%	4%	0%	6%	3%	0%	4%	0%	0%	0%	0%	0%
	Small	51%	48%	36%	30%	22%	16%	27%	10%	2%	22%	5%	0%	18%	3%	0%	10%	2%	0%
15% or more	Large	53%	43%	43%	41%	31%	23%	44%	26%	17%	39%	22%	10%	32%	11%	7%	21%	2%	0%
	Mid	53%	56%	44%	47%	45%	33%	48%	35%	21%	51%	34%	10%	57%	32%	10%	61%	18%	2%
	Small	55%	58%	45%	60%	52%	30%	61%	40%	15%	74%	44%	10%	74%	47%	7%	79%	40%	3%
10% or more	Large	62%	56%	55%	59%	59%	54%	66%	57%	49%	65%	57%	49%	76%	58%	60%	100%	79%	58%
	Mid	60%	59%	58%	72%	71%	62%	74%	73%	60%	84%	84%	57%	92%	89%	61%	95%	100%	65%
	Small	58%	62%	52%	77%	71%	47%	82%	79%	46%	95%	90%	48%	97%	92%	49%	100%	98%	40%
5% or more	Large	65%	64%	66%	77%	74%	70%	85%	80%	80%	91%	91%	91%	100%	94%	96%		ALL	
	Mid	66%	65%	66%	80%	83%	77%	94%	94%	85%	95%	96%	87%	96%	100%	97%		100%	
	Small	70%	66%	62%	83%	85%	67%	96%	94%	78%	96%	96%	83%	100%	100%	92%			
0% or more	Large	74%	73%	77%	87%	85%	90%	99%	94%	99%	100%	95%	100%		ALL			ALL	
	Mid	73%	74%	73%	86%	91%	87%	95%	100%	93%	96%	100%	100%		100%			100%	
	Small	73%	70%	67%	89%	92%	83%	98%	100%	91%	100%	100%	99%						
–5% or more	Large	78%	84%	80%	93%	93%	95%	100%	98%	100%		ALL			ALL			ALL	
	Mid	79%	86%	81%	94%	95%	92%	96%	100%	100%		100%			100%			100%	
	Small	76%	80%	73%	93%	93%	91%	100%	100%	100%									
–10% or more	Large	86%	89%	86%	98%	95%	100%		ALL			ALL			ALL			ALL	
	Mid	85%	87%	86%	94%	97%	95%		100%			100%			100%			100%	
	Small	87%	85%	79%	95%	97%	94%												

0–10%	11–20%	21–30%	31–40%	41–50%	51–60%	61–70%	71–80%	81–90%	91–100%

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Table 4

REGRESSION RESULTS FROM TABLE 3: PROBABILITY OF EARNING 5 PERCENT, 10 PERCENT, AND 15 PERCENT VS. HOLDING PERIOD, SIZE, AND STYLE

Y Variable	Probability of Earning 5% or More			Probability of Earning 10% or More			Probability of Earning 15% or More		
X Variables	Coefficient	*P* Value		Coefficient	*P* Value		Coefficient	*P* Value	
Intercept	0.6590	2.4E-33	***	0.3630	1E-14	***	0.189	1.0E-05	***
Holding Period	0.0115	3.6E-18	***	0.0080	2E-07	***	-0.008	7.4E-06	***
Mid Cap	0.0314	0.119		0.1109	0.001	***	0.106	0.004	**
Small Cap	0.0239	0.233		0.0912	0.005	**	0.183	4.9E-06	***
Value	0.0543	0.009	**	0.2472	0.000	***	0.344	8.0E-13	***
Core	0.0472	0.021	*	0.2030	0.000	***	0.170	1.7E-05	***
R-Squared	78.5%			69.5%			72.6%		
Statistical Significance: *** *P* < .001 ** *P* < .01 ** *P* < .05									

or more, but the impact of the holding period now becomes negative. This is because, as holding periods stretch out to thirty years, the chances of earning 15 percent or more dwindle for all asset classes except small value stocks (see table 3).

PART 3: ENDING VALUES OVER THIRTY-YEAR HOLDING PERIODS—THE UGLY DUCKLING

Everyone is familiar with the story of the ugly duckling that turns into a beautiful swan over time. Small value is the ugly duckling when it comes to short-term volatility. Many advisors pass on it because of its short-term ugliness. But give it time to grow and it becomes a beautiful investment.

One problem with tables on annual returns is that they fail to convey the cumulative impact over long spans of time. Figure 1 shows the ending values of the best-, average-, and worst-case scenarios for a $1 investment over all thirty-year holding periods dating back to 1927 for all nine asset classes. Cumulative ending values make the true power of the compounding effect over time more visually obvious than quotes of annual rates.

In the case of small cap value, its best thirty-year holding period (1975–2004) generated a remarkable rate of return: 22.78 percent (rounded to 23 percent in table 1). Each dollar invested at the end of 1974 would have been worth $472 at the end of 2004. Small value's average return of 17.10 percent would have led to a $114 ending value in table 1B. Over the worst thirty-year span, 1928–1957, $1 would have earned 10.98 percent per year, accumulating to $23. This $1 investment duckling would have been more beautiful than all the other little investment ducklings—what a happy 30-year ending!

Figure 1

ENDING VALUE OF $1, THIRTY-YEAR HOLDING PERIOD, ALL ASSET CLASSES, 1927–2017

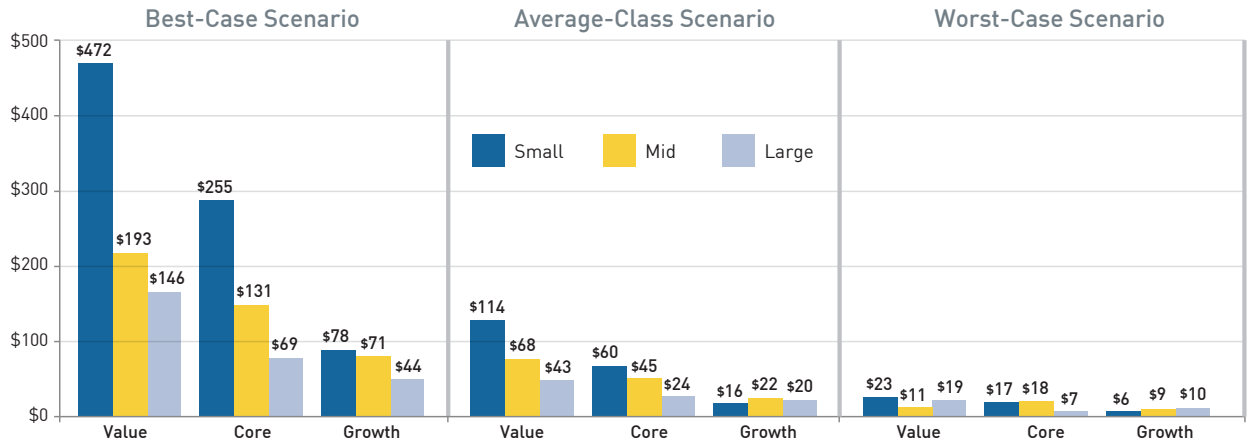


Figure 2 plots the path the small value investment would follow over time. Figure 2A illustrates the path for only the best, average, and worst thirty-year holding periods. The yellow lines in figure 2B display the paths for all holding periods that fall between the best and worst. Each of the other asset classes would have similar plots leading to their figure 1 ending values.

PART 4: THE CRITICAL PATH®

The white dotted line in figure 3 plots the path a portfolio should follow over a person's lifetime to meet all financial goals, some of which are displayed as examples. The critical path gives clients a better perspective of how their portfolio should behave over the long run:

- It serves as a benchmark for a lifetime financial plan stemming from a client's capital needs analysis.
- It requires determining the cash inflows into the retirement portfolio that will be needed during the accumulation phase and the cash outflows that will be needed during the distribution phase to meet all goals.
- It is unique to each client and divides the future into a safety zone and a danger zone.

SAFETY ZONE VERSUS DANGER ZONE

The safety zone is the entire area on or above the critical path. As long as the portfolio's value stays in this area at each point in time, the portfolio is on or above target, according to the plan. It means clients can consider themselves financially safe.

But if the portfolio drops below the critical path, there is a risk that the portfolio may not recover. Historically, minor drops below the path tend to be temporary, but the greater the drop, the less likely the portfolio will recover. A rule of thumb is to consider a drop of 20 percent or more below to warrant a complete review of the plan. But analyzing the factors and relationships among withdrawal rates, inflation assumption, asset allocations, etc. and the sensitivity of drops below the critical path would require another article.[2]

CHALLENGING MODERN PORTFOLIO THEORY

The critical path challenges the common but incorrect interpretation of MPT that defines risk as volatility, especially during the retirement phase, when funds are being withdrawn from the portfolio. Consider the two paths in figure 4. The yellow path tracks a portfolio with a high allocation to equities. It is rather volatile but is well into the safety zone. Volatility above the critical path does not matter. It is harmless. Even during major downswings, if the portfolio remains in the safety zone, it will meet all goals as defined in the client's original financial plan that generated the critical path in the first place.

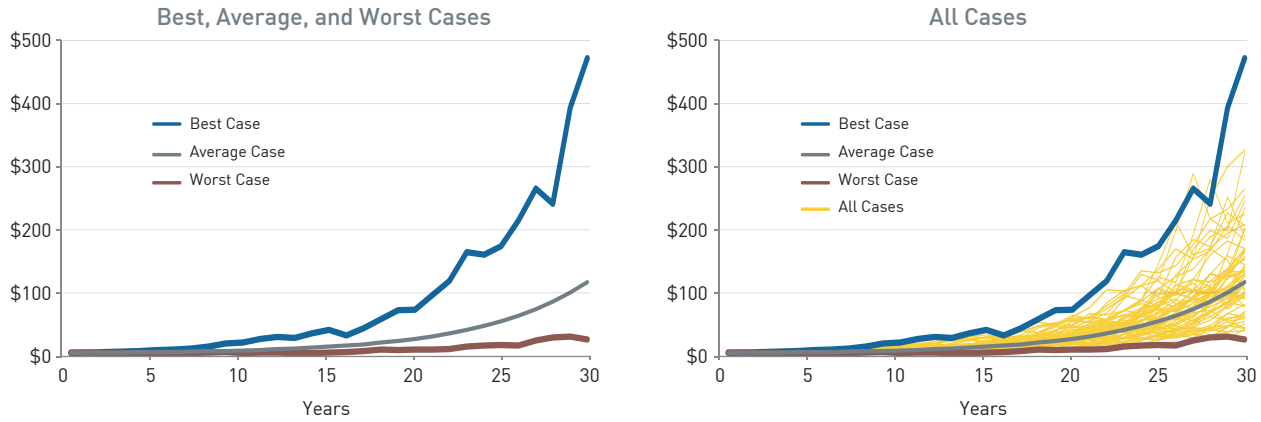
Contrast this with the blue line portfolio. It contains perhaps 60 or 70 percent bonds to subdue volatility. But thanks to lower long-term returns, it falls below the critical path into the danger zone. Clearly, the market ups and downs are muted. But equally clearly, it is not on track to meet its goals. It is a far riskier portfolio—in the true sense of the word risk—than its yellow counterpart. In fact, it is headed for bankruptcy.

Some might point out that the problem is that the critical path itself is too high. But that is saying that the clients must accept a lower standard of living just so they can diversify by having bonds in their portfolio. This could be especially harmful to clients with small portfolios struggling to meet their financial goals. Blindly adopting such a flawed strategy would be a case of the volatility tail wagging the retirement dog.

Also consider a retirement portfolio based on dedicated portfolio theory rather than MPT (covered in Part 5). In this case, the bond portion of the retirement portfolio consists entirely of individual bonds held to maturity, laddered in just the right quantities and maturities so their coupons and

Figure 2

$1 INVESTED IN SMALL VALUE OVER ALL THIRTY-YEAR HOLDING PERIODS, 1927–2017



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redemptions provide cash flows needed for income. Then volatility in this income portfolio should not be counted in terms of the overall portfolio volatility. But MPT would ignore this fact and count the income portfolio's volatility anyway, thereby overstating the true degree of volatility. As long as the bonds represent less than a majority of the overall portfolio, this reduction in the standard deviation (that is, counting the bond portion as having zero volatility) would have only a minor impact on the measure, but the reduction would not be negligible.

Once clients have the critical path perspective, they can judge the true position of their portfolio relative to where it needs to be. If the value of their assets remains in the safety zone, they can ignore screaming headlines of yesterday's dip in the stock market, knowing such volatility is immaterial to their lifetime plan—it will not harm them. Worry and fear due to portfolio fluctuations should be significantly reduced.

PART 5: A STRATEGY FOR USING THE CRITICAL PATH TO IMPROVE RETIREMENT PERFORMANCE

Dedicated portfolios are designed primarily for the retirement phase. They consist of two components. The income component consists of individual bonds held to maturity in just the right quantities and maturities to match a stream of inflation-adjusted income over a specified time horizon. The growth component consists of equities designed to grow as fast as possible to provide the funds needed to replenish the income component.

EXAMPLE OF A DEDICATED PORTFOLIO

For example, consider a retiree with a $2 million portfolio who wants to withdraw $100,000 plus inflation over the next thirty years.[3] The advisor wants to protect that income stream over a series of eight-year horizons.[4] That is, the initial income portfolio will be laddered to generate the withdrawals needed from coupons and redemptions over the next eight years. As each year passes, this year's maturing bond will be due for replacement with a new eight-year bond to maintain the horizon. This will continue over the next three decades.

By buying and holding individual bonds to maturity, the retiree's income stream over the next eight years is immunized from market volatility. This income portfolio of individual bonds may go up and down in value, but the fluctuations are meaningless because the bonds are held to maturity. Investment-grade corporate bonds can be used to minimize the risk of default or federal government bonds avoid it entirely.

Each year of the income portfolio's time horizon will require about 5 percent of the portfolio. Thus, an eight-year span will require about 40 percent of the portfolio. The other 60 percent can be allocated to a growth portfolio of equities such as those discussed in earlier parts of this paper (or other

Figure 3

THE LIFETIME PORTFOLIO'S CRITICAL PATH

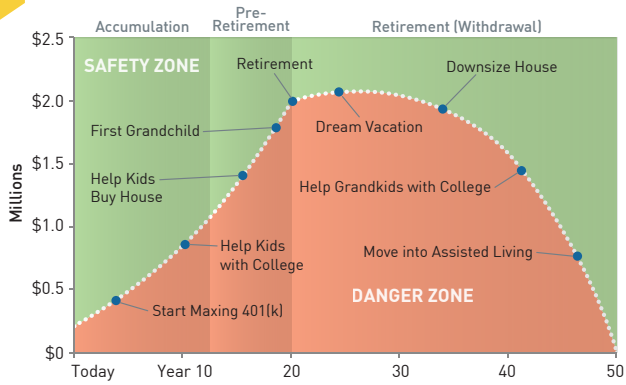
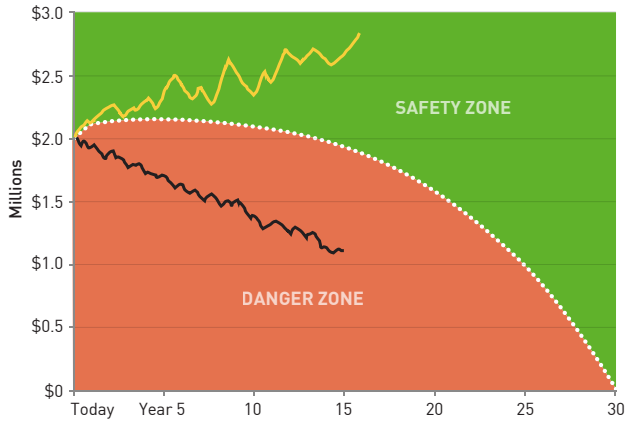


Figure 4

TWO PORTFOLIO PATHS: SAFE WITH HIGH VOLATILITY AND DANGEROUS WITH LOW VOLATILITY



fast-growing investments). Sales from this growth portfolio will provide the money needed to replenish the income portfolio as its bonds mature and the cash is withdrawn for income. Replenishment is achieved by buying a new eight-year bond: rolling the income portfolio forward to extend it back out to the original eight years.

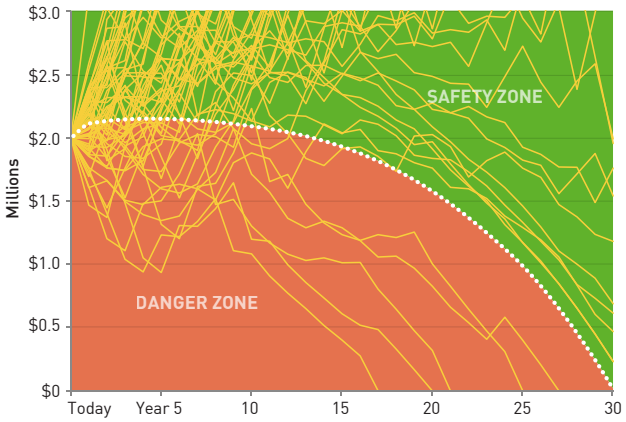
Rolling the income portfolio forward can be thought of as a form of portfolio rebalancing. But the rebalancing is not designed blindly to maintain a fixed ratio of stocks to bonds. It is engineered to preserve the secure income portfolio's time horizon, the holding period over which the cash flows will be protected.

WHAT IF THE MARKET IS DOWN?

What if the market happens to be down when equities need to be sold out of the growth portfolio? This is where the critical path provides guidance and lights the way. If the

Figure 5

TRACKS FOLLOWED BY AN EQUITY PORTFOLIO DESIGNED FOR SEVEN TO FIFTEEN YEARS OVER EACH THIRTY-YEAR TIME HORIZON SINCE 1927



overall portfolio is above the critical path in the safety zone, there is no problem. Stocks can be sold from the growth portfolio, the financial plan will remain undisturbed, and life goes on as usual.

But if the overall portfolio drops below the critical path, the rebalancing can be postponed to allow the market to recover. Wait a year to see if the portfolio rises back above the critical path. If not, wait another year. In fact, the client could wait up to seven years more before selling any equities. In this fashion, sequence risk is diminished. (No bear market has ever lasted eight years.)

With this time perspective, growth portfolios can be designed to match the same time horizon as the income portfolio. That is, the growth portfolio can be designed to target the same general time frame as the income portfolio. Longer income horizons allow for more small-cap value (or similar) stock allocations commensurate with the term structure of equity returns shown in tables 1 and 3. This time-segmented approach presents an integrated strategy that links the investment portfolio directly to the financial plan that generates each client's critical path.

THE MINIMAX PRINCIPLE FOR BUILDING EQUITY PORTFOLIOS

Figure 5 displays the critical path for an eight-year dedicated portfolio of individual bonds for the example above ($2 million with a 5 percent initial withdrawal rate). A growth portfolio was built with equities to optimize returns specifically for a seven- to fifteen-year time horizon.

Most optimizers in finance seek to maximize the average return or the risk-adjusted average (Huxley et al. 2016). But it can be argued that a more conservative algorithm is better for retirees based on the minimax principle.

This algorithm, first posited by Von Neumann and Morgenstern (1947), uses proprietary mathematical programming, focuses on the worst return over the seven- to fifteen-year horizon (other time horizons are possible that correlate with the time horizon as the financial plan), and determines the allocation that maximizes it. That is, it makes sure its worst-case scenario is as least bad as possible so it would do as little damage as possible. It typically contains a strong allocation to small and value funds.[5]

In figure 5, each yellow line tracks the path of this minimax growth portfolio over each of the sixty-two rolling thirty-year periods since 1927 (1927–1956, 1928–1957, etc.). The most recent thirty-year period was 1988–2017. The five lines that failed to survive began in 1927, 1928, 1929, 1930, and 1937—all immediately before or during the Great Depression. The failures assume the clients made no changes in their withdrawals regardless of the obvious declines that were occurring in their portfolios. Either they had a poor financial advisor who was not paying attention, or they ignored the advisor (or perhaps they did not mind moving in with their kids).

All other years survived, meaning the portfolio had a 92 percent chance of success. The average annual return rate of this overall portfolio over all thirty-year periods would have been 9.8 percent for the overall portfolio, including both bonds and stocks, despite the withdrawals.

Contrast this experience with figure 6. The same rules were followed, but in this case, the growth portfolio was designed for only one- to three-year spans. The portfolio contained high allocations to large and growth stocks. The failures now include three more failing thirty-year spans starting in 1931, 1934, and 1936, plus the original five. This corresponds to a lower 85 percent chance of success and a lower 7.5 percent average return over all sixty-two time periods. As in figure 5, the failures assume that clients ignored the warning signs that were obvious as the portfolio dropped in value, continuing to withdraw at the same rate until the portfolio was exhausted. In reality, they would likely have reduced their spending early on to maintain solvency.

In either case, figure 5 or figure 6, the critical path proves a vital tool for clients to visualize what was happening to their portfolio, and how it meshed with their overall financial plan. Conversations between the advisor and client would be guided by reviewing the big picture with the critical path and the portfolio's performance relative to that path rather than some external benchmark, such as the S&P 500 Index.

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CONCLUSION

Advisors face a constant battle with the news media over the proper perspective when it comes to investing. The media's goal is usually to grab the public's attention. Because the stock market changes every day, it provides a convenient, steady, and reliable source for reporters and broadcasters to create fear or confidence—never mind that the daily blips up or down are, in fact, random. In truth, reporters and broadcasters are reporting the daily flip of a coin and imbuing it with more significance than it warrants.

To help fight this battle, this paper provides figures and tables to help advisors explain the importance of adopting a long-term perspective when judging portfolios. Part 1 illustrated the best, worst, and average returns over holding periods of one to thirty years. Part 2 examined the probabilities of earning given levels of return over the same holding periods. Part 3 demonstrated the ending values of various asset classes over a thirty-year holding period. Part 4 displayed the critical path a portfolio must follow to meet the goals specified in the client's financial plan. Part 5 illustrated how comprehensive long-term planning can make a client's retirement experience a success.

The importance of the proper visual display of quantitative information as presented here stems from Edward Tufte, considered by some the father of modern information design and data visualization. Tufte is a U.S. statistician and professor emeritus of political science, statistics, and computer science at Yale University. His work on visualization culminated in a book, *The Visual Display of Quantitative Information* (1982, with later editions in 2001 and 2009), where he traced the history of statistical graphics back to the year 1100, and presents 250 illustrations of good and bad graphical design. Tufte's work spawned a new industry in visualization software that drives the imagery of big data analytics such as Tableau, Google Analytics, and Microsoft Power BI. He ultimately published several books on graphical analytics, all of which have been highly praised.

How best to present information and illustrate complex ideas is a challenge that advisors must deal with in every meeting with clients. Images can help in this effort by allowing people to envisage and understand reality, one of the primary duties of a financial advisor and, indeed, the primary goal of all education.

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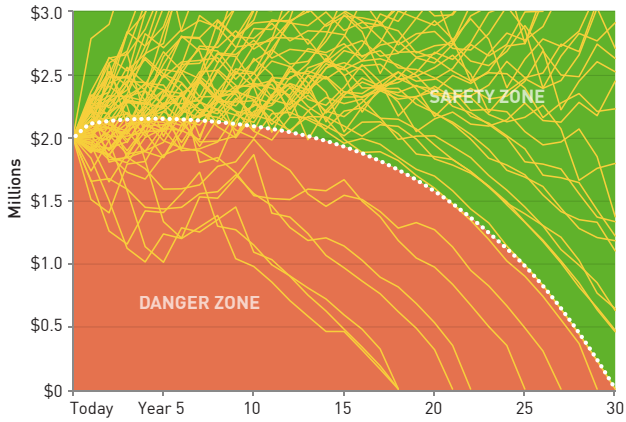
Figure 6

TRACKS FOLLOWED BY AN EQUITY PORTFOLIO DESIGNED FOR ONE TO THREE YEARS OVER EACH THIRTY-YEAR TIME HORIZON SINCE 1927



ENDNOTES

1. See http://www.morningstar.com/markets.html.
2. More about the critical path can be found in Huxley and Burns (2004).
3. The absolute size of the portfolio could be smaller or larger as long as the withdrawals are proportionally equivalent—at or below a 5 percent initial withdrawal rate.
4. If the client is wealthy enough (or frugal enough) to allow for a fifteen-year income portfolio to be built, the client will enjoy the benefits of true long-term returns.
5. Funds offered by Dimensional Fund Associates were used for the one- to three-year and seven- to fifteen-year growth portfolios because their returns tend to be the most highly correlated with pure asset returns. The actual portfolios used for the comparisons also included international and emerging market funds.

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