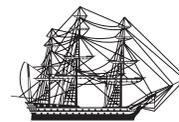


Time Diversification and Horizon-Based Asset Allocations

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Executive summary. Time diversification, the phrase used to refer to the concept that investments in stocks are less risky over longer periods than shorter ones, has been the subject of spirited debate for decades. While the foundation of the time diversification debate was laid much earlier, three works published successively in 1994—Mark Kritzman’s article “What Practitioners Need to Know . . . About Time Diversification,” Jeremy Siegel’s book *Stocks for the Long Run*, and Paul Samuelson’s article “The Long-Term Case for Equities—And How It Can Be Oversold”—seem to have set the inflection point for the discussion that continues today. Some of the finest investment minds have participated on both sides, without providing a conclusion.

Over the last few years the growing acceptance of life cycle investment products, such as target retirement mutual funds, has renewed interest in the topic. The objective of this paper is not to prove or disprove time diversification, but to evaluate whether the concept must be valid for a horizon-based asset-allocation framework to be viable and appropriate. Our findings suggest that there is little evidence to support the notion that time moderates the perceived volatility inherent in risky assets. However, we would expect the risk-reward relationships of the past to prevail in the future, and if that is the case, a longer investment horizon may support a willingness and ability to assume the greater uncertainty of equity-centric asset allocations. This may be true particularly for younger investors for whom the allocation to human capital and the risk posed by the erosion of purchasing power by inflation can reasonably be assumed to be greatest.

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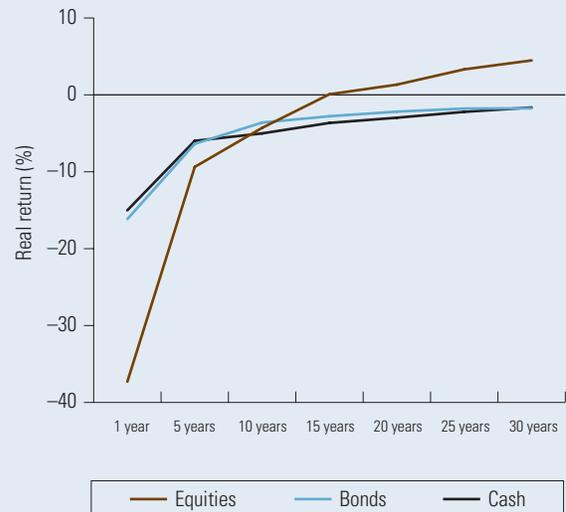
The debate: An overview

While this paper is not intended to provide an exhaustive review of time diversification literature, a brief summary of some of the more notable contributions is in order. Kritzman defined time diversification as “the notion that above-average returns tend to offset below-average returns over long time horizons.” However, he points out that while the annualized *dispersion of returns* moderates toward the expected mean, the *dispersion of terminal wealth* increases as investment horizon increases. He suggests that although the probability of losing money in stocks is lower over longer investment horizons than shorter ones, the size of the potential loss increases.

In *Stocks for the Long Run*, Siegel stated that for investment horizons of at least 15 years, historical returns suggested that stocks produced positive real returns in excess of both bonds and Treasury bills (Figure 1). In addition, Siegel added that “it is little known that in the long run, the risks in stocks are *less than* those found in bonds and even bills!” [Siegel’s emphasis.] The book’s conclusions supported the commonly held notions that younger investors should favor a portfolio heavily weighted in stocks to capitalize on the equity risk premium relative to bonds and Treasury bills and that, over long enough horizons, this equity risk premium was reliable.

Samuelson’s “The Long-Term Case for Equities—And How It Can Be Oversold” was published later in 1994 and rejected the premise that the risk of stocks decreased over longer time horizons. Not one to mince words, he stated that “it is an exact theorem that the investment horizon can have no effect on your portfolio composition.” Relying on utility theory, he said that investors want to maximize the utility of wealth, rather than expected return or terminal wealth. That is, investors should be interested in what happens to their wealth over time, not just at a point in time (such as at retirement). The practice of rationalizing high equity allocations for investors with longer investment horizons seems to have been common enough in the financial community to be considered “oversold” in Samuelson’s opinion.

Figure 1. Minimum periodic annualized real returns, 1926–2006



Note: For stock market returns, we use the Standard & Poor’s 500 Index from 1926 to 1970, the Dow Jones Wilshire 5000 Index from 1971 through April 22, 2005, and the MSCI US Broad Market Index thereafter. For bond market returns, we use the Standard & Poor’s High Grade Corporate Index from 1926 to 1968, the Citigroup High Grade Index from 1969 to 1972, the Lehman Long-Term AA Corporate Index from 1973 to 1975, and the Lehman U.S. Aggregate Bond Index thereafter. For returns on cash investments, we use the Citigroup 3-Month Treasury Bill Index.

Source: Vanguard Investment Counseling & Research.

Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

After these works appeared, a number of academics and practitioners joined the debate on either side, adding additional layers to this increasingly complex topic. Bodie (1995) used option pricing theory to illustrate how the cost of insuring against a stock return below the risk-free rate increased, rather than decreased, with longer contracts. Since higher option premiums suggested higher perceived risk for longer contracts, he concluded that time diversification was not evident.

A Note on Risk: Investments are subject to market risk. Investments in bonds contain interest rate, credit, and inflation risk. Target retirement funds are subject to the risks associated with their underlying funds.

Reichenstein and Dorsett (1995) modeled two sets of return projections, one based on the “random walk” assumption that is common among detractors of time diversification and another based on mean reversion, common among its supporters. Both models supported the notions that it is reasonable for investors with longer investment horizons to have larger allocations to risky assets (such as stocks) and that a portfolio’s relative risk depends upon the length of the holding period.

Evaluating the assumptions

Opinions on time diversification depend on the assumptions used to frame them. Fisher and Statman (1999) evaluated not only the time diversification issue, but the assumptions often used to rebut the concept:

- Stock market returns follow a random walk pattern.
- Risk aversion does not change as wealth changes.
- Investors’ future wealth depends only on their investment portfolios.

Fisher and Statman said that “the mathematical truth of [Samuelson’s] argument is that time diversification is false under specific assumptions.” Since acceptance of these assumptions is not universal, then the debate will likely continue. But does it have to?

While all three are strongly opposed to the suggestion that time diversifies risk, Kritzman, Samuelson, and Bodie also acknowledge that other considerations may justify incorporating an investment horizon when considering the risk posture—and therefore the equity allocation—of a portfolio. For example, contrary to the random walk assumption, an investor may believe that stock market returns follow a mean-reverting pattern, where periods of poor returns are followed by periods of better returns. Though a debatable topic itself, mean reversion would suggest that a longer investment horizon would better enable investors to weather adverse market outcomes if experienced at the outset of the investment strategy.

Samuelson’s utility argument is based on the standard finance assumption that investors are always risk averse and that therefore risk tolerance does not vary with wealth. However, he also notes that this may not always be the case and concedes that “people may be less risk-tolerant in absolute terms when they face poverty than when they are affluent.”

The work of Kahneman and Tversky (1979) also concluded that investors do not display constant risk aversion, but rather, behave as if they are risk averse in particular settings but not in others. Kritzman suggested that irrationality was one reason that an investor might adopt a time-based investment strategy, but behavioralists might note that investors are neither irrational nor rational, but “normal” (Statman, 2005). Investors commonly suffer from the behavioral bias of “recency,” embracing recent performance in their return expectations. To the degree that those recent returns are negative, they may find it tempting to change allocations to moderate the portfolio’s exposure to whatever asset class is expected to continue to underperform.

The returns for asset classes—whether for the short term or longer—are uncertain, and as such, investors willing to bear this uncertainty should be compensated for doing so. This compensation is determined not for them, but by them: The collective actions of market participants, using pricing mechanisms founded on very different objectives, investment horizons, levels of risk aversion, and valuation processes, determine the risk premium at any particular time. It is this process in particular that makes it likely that the risk premium *relationships* established in the past—long-term bonds yielding more than short-term bonds of comparable quality, for example, or the expected returns for stocks being greater than for either bonds or cash—should reasonably be expected to hold for the future.

The last assumption, that investors' future wealth is determined by the return on their portfolios alone, may serve in theory but fails in practice. Few investors inherit a portfolio and rely solely on its returns for growth. For most, future wealth will be the result of diligent savings and investment over a lifetime. The concept of human capital, an asset whose returns take the form of wages and other compensation, plays an important role and will be addressed later in this discussion.

The belief that "time heals all wounds" is certainly an illusion when it comes to investing, but it may benefit investors, nonetheless. If the risks borne by *diversified* equity investors are to be rewarded, as they have been historically, then the largest portion of the payoff for that risk might reasonably be expected to follow periods of market difficulty, when the risk of loss may be perceived to be great. Over time, risk premiums will vary with the current, as well as the expected, investment environment, and lower current prices suggest higher risk premiums and higher relative future returns. While it may be very difficult to capitalize on these shifting risk premiums through tactical allocation strategies (Tokat and Stockton, 2006), a cogent strategic asset allocation can serve as a logical anchor for investors, helping to keep them from reallocating their assets in response to volatility. The belief that a sell-off in equities is a short-term event in an otherwise long-term investment horizon may reinforce investors' convictions in their strategic asset allocations, and may help them overcome a reluctance to rebalance their portfolios.

Is there an inverse relationship between investment horizon and risk, as some might suggest?

If one defines risk by the standard deviation of returns, then the *measure* of risk will diminish with longer horizons. The standard deviation of annualized holding period returns (see Table 1) for any one-, three-, or five-year period would reasonably be expected to be greater than those for any 15-, 20-, or 30-year period. That being said, while the deviation in mean holding period returns will moderate considerably as the horizon increases (Table 1, middle panel), the year-to-year volatility remains high and unaffected by the holding period (Table 1, lower panel). For investors to realize a 30-year holding period, they must first endure thirty one-year periods. So which better describes the volatility experienced over the average 30-year period: the 1.38% standard deviation for the full 30 years, or the 18.55% average standard deviation year by year?

In large part, it is this disconnect between the expected lower risk of an investment in stocks over the long run and the expected higher risk of such an investment in the short run that creates doubt and can foster poor decision-making under stress. An allocation based on asset-class return expectations that seemed so reasonable at the onset of an investment may seem less palatable when the market turns down. A closer look at historical returns illustrates that year-to-year returns are commonly much different from those suggested by the past (Figure 2).

Table 1. Average annualized holding period returns and standard deviations for U.S. stocks, 1926–2006

Average annual returns (%) for various holding periods

1 year	3 years	5 years	10 years	15 years	20 years	25 years	30 years
10.45	10.96	10.41	11.12	11.23	11.42	11.44	11.30

Standard deviation of average annualized returns (%) for various holding periods

1 year	3 years	5 years	10 years	15 years	20 years	25 years	30 years
20.20	11.53	8.45	5.20	4.39	3.34	2.30	1.38

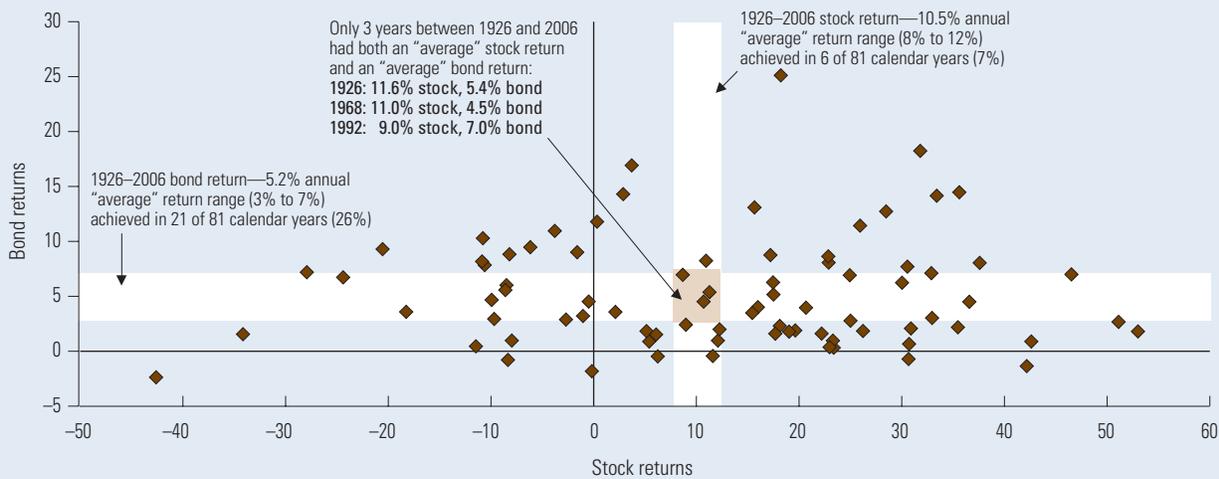
Average standard deviation of annual returns (%) for various holding periods

3 years	5 years	10 years	15 years	20 years	25 years	30 years
18.41	19.60	19.15	18.68	18.51	18.47	18.55

Note: Stocks represented by the S&P 500 Index through 1970; the Dow Jones Wilshire 5000 Index from 1971 through April 22, 2005; and the MSCI US Broad Market Index thereafter.

Source: Vanguard Investment Counseling & Research.

Figure 2. Returns are rarely average: Annual stock and bond returns, 1926–2006



◆ Represents each calendar year from 1926 through 2006 (81 points=81 years) plotted at the intersection of that year's stock return and that year's bond return. The vertical shaded area contains all years whose stock return was between 8% and 12%. The horizontal shaded area contains all years whose bond return was between 3% and 7%.

For stocks, returns reflect the S&P 500 Index through 1970 and the Dow Jones Wilshire 5000 Index thereafter. For bonds, returns reflect the Ibbotson Intermediate-Term Government Bond Index through 1972 and the Lehman Intermediate U.S. Treasury Index thereafter.

Source: Vanguard Investment Counseling & Research.

A Note on Risk: Past performance is no guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

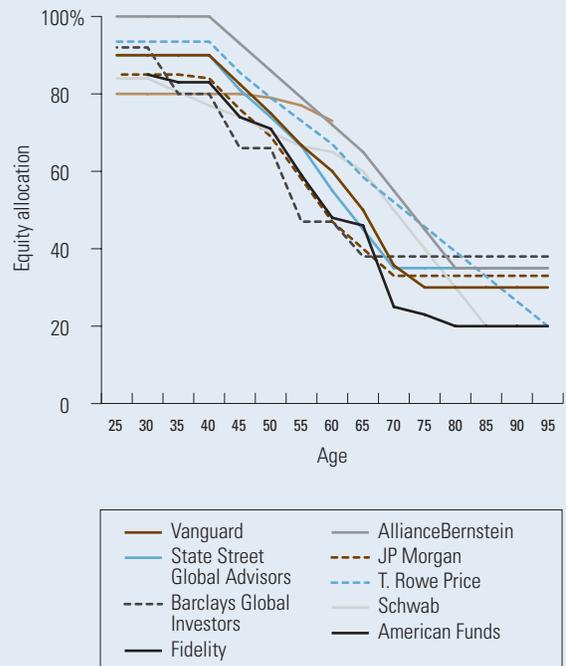
Other factors may warrant the use of an investment time horizon

Is it reasonable and appropriate for younger investors, or for other investors with longer investment horizons, to allocate a large portion of their portfolios to risky assets, particularly equities? For most investment strategies based on age or time, the longer the time horizon, the larger the relative weight of equities in the portfolio. Some horizon-based funds maintain a more or less static allocation; others, such as target retirement funds, moderate the equity allocation in a predictable manner as time passes and the target horizon approaches (Figure 3). Indeed, the investment horizon is considered by leading investment and financial planning professional associations to be a key factor in developing investment policy statements and asset allocations.¹ It is also often incorporated in the portfolio construction of the mutual funds being offered in defined contribution plans.

The horizon fund model for portfolio construction seems reasonable. To the extent that the historical perspective is representative of the risk-reward relationships of asset classes in the future, an investor's retirement contributions could benefit greatly from a significant equity weight.²

Of course, while investors with longer investment horizons may have more time to recover from market setbacks, they also have more time to experience them, and that experience may be more negative than history would suggest. Not every investor is equally prepared—either emotionally or financially—to contend with the uncertainty that comes with seeking returns above the risk-free rate.

Figure 3. Moderating equity allocations over time



Note: Allocations approximate the companies' asset-allocation strategy. The current allocations of the funds may be different because some firms will modify their allocations in response to changing circumstances.

Source: Vanguard and company websites.

1 For example, the CFA Institute and the Certified Financial Planner Board of Standards, Inc.

2 This is not to suggest that historical returns should be considered indicative of future returns, but to highlight that, absent philosophical or structural shifts in the financial markets, the rationale for risk premiums and the historical relationships between asset classes might be reasonably expected to continue into the future.

The importance of human capital

Often, a very long investment horizon suggests that an investor is in the early stages of building wealth. In that case, the investor's portfolio is typically small relative to his future wealth, and the portion of his portfolio represented by capital contributions is large. As a result, in the early stages of investing, portfolio growth depends more on contributions than market returns.

An investor with a larger commitment to equities may find it easier psychologically to contend with a market sell-off when his portfolio is relatively small and is accumulating value than later in life when the portfolio is larger, particularly if the assets are being eroded by spending. For example, a 25% market correction would likely be painful for younger and older investors alike. However, while the younger investor, presumably with less wealth accumulated, could readily replace the lost capital with earned income, a similar loss by an investor in retirement might be life-altering, assuming that their equity allocations were the same.

Human capital represents an asset of uncertain value, but one whose potential value is generally assumed to be greater earlier in life than later, as retirement approaches. In addition, it is generally accepted that labor flexibility—that is, people's ability to choose where, how often, and how long to work—is greatest when they are in the earlier stages of their careers. This flexibility may affect people's investment and consumption habits, and may induce them to assume more investment risk, at any age in the life cycle (Bodie, Merton, and Samuelson, 1992). At retirement, if a person stops earning wages, the human capital asset "expires," and labor flexibility is limited.

In this framework, human capital is often characterized as a bond-like asset whose value reflects the discounted value of residual lifetime income. (There are certainly exceptions to this generalization in which human capital may be more equity-like, such as for an investment banker whose compensation may ebb and flow with the tide of the equity markets.) If human capital is bond-like, then a younger investor may well be considered to be underweighted in equities, even if her investment portfolio consists entirely of equities. As the younger investor matures and human capital is paid down, the allocation to equities can reasonably be expected to moderate as well. This framework is consistent with the general asset-allocation changes in horizon-based investment strategies over time.

More tangibly, earned income from human capital provides capital for investment, converting a theoretical asset into material wealth. As a result, earned income can provide an alternative source for wealth creation, above and beyond investment returns. Declines in the value of a portfolio may be offset through additional capital contributions from earned income. While this does not erase the loss itself, the reallocation of income from consumption to savings can erase the effect of the loss on the portfolio's value. Without income—human capital—the loss can only be erased through market returns, which are beyond the investor's control. As a result, knowing that additional capital may be available if performance falters may provide some psychological support for younger investors who should know that losses of 20%, 50%, or even 75% or more are possible even in a well-diversified equity portfolio.³

³ While the worst annual loss for the Standard and Poor's 500 Index was -45% in 1931, the cumulative loss for the index for the four years ended 1932 exceeded -80%.

Table 2. Normal and inflation-adjusted returns, 1926–2006

	Nominal			Real (inflation-adjusted)		
	Average annual return	Percentage of years with negative returns	Highest annual loss	Average annual return	Percentage of years with negative returns	Highest annual loss
1926–2006 total returns						
100% Treasury bills	3.8%	0%	0.0%	0.8%	35%	–15.0%
100% bonds	5.2	9	–2.3	2.1	38	–14.5
100% stocks	10.5	30	–43.1	7.1	35	–37.3

Note: Stocks represented by the S&P 500 Index through 1970; the Dow Jones Wilshire 5000 Index from 1971 through April 22, 2005; and the MSCI US Broad Market Index thereafter. Bonds represented by the Ibbotson Intermediate-Term Government Bond Index through 1972 and the Lehman Intermediate U.S. Treasury Index thereafter. Cash represented by the Citigroup 3-Month Treasury Bill Index.

Sources: Ibbotson Associates and Vanguard Investment Counseling & Research.

The impact of inflation

Another compelling reason to correlate longer time horizons to larger equity allocations is inflation. As Siegel noted, historically, equities have provided higher real returns than bonds or cash alternatives. If the purpose of investing is to provide capital to fund future expenditures, such as where the portfolio's assets must replace a substantial portion of wages during retirement, then time horizon should be an important consideration (Table 2).

For most investors, these liabilities are not of fixed value, but are subject to inflation. In addition, the inflation-rate assumption for the liability (or stream of liabilities) should often be one based on an investor's unique circumstances, rather than that suggested by a common aggregate measure such as the Consumer Price Index (CPI). If the investor's liabilities inflate at a rate well in excess of the CPI, or are underestimated, then the real returns from lower-risk assets alone—such as money markets, short-term bonds, or Treasury inflation-indexed securities—may not preserve the required purchasing power of the portfolio. Therefore, for long-term planning, where the value of the liability stream is less certain, an allocation to assets with higher risk and higher real returns, such as equities, may be preferable and may increase the probability of maintaining the portfolio's purchasing power. For

shorter-term planning, the emphasis should be on the preservation of principal, because the inflationary impact is likely to be minor even if the liability's inflation rate is significantly underestimated.

Conclusion

The debate over time diversification has been long-running and remains unresolved. However, there is little empirical evidence to support the claim that time moderates the risks inherent in risky assets. In actuality, a longer investment horizon increases the magnitude of potential outcomes, both negative and positive. That being said, other factors may warrant the consideration of an investment time horizon in the asset-allocation process.

Risk premiums reflect the compensation for undertaking risk, on average, and it seems reasonable that the historical risk-return relationships will prevail over longer periods. This is not to suggest that the level of compensation received in the past will be received in the future or that an investor should expect to receive it over each and every time period measured; although no 20-year historical period has produced a negative cumulative return, there have been numerous annual periods within them that have.

Maybe more important for those portfolios with longer investment horizons, the historical equity risk premium has contributed to higher historical real returns for stocks than for bonds and cash, which may be critical for preserving the purchasing power of the portfolio. If the purpose of investing is to provide capital to fund future expenditures, then time horizon should be an important consideration. In other words, for investors with a long investment horizon, inflation risk may be of greater concern than capital risk, while for shorter-term investors, the opposite may apply.

The availability of human capital—through wages or other compensation—is also a significant factor for assessment. In essence, human capital provides a means for portfolio reparation, should the expected gain result in loss instead. Without human capital, such as in retirement, it would seem reasonable that, while investors might be willing to assume some risk, they would likely recognize that the downside risk in bonds or cash has been considerably less than for stocks. As a result, they might tend to moderate their exposure to riskier assets.

Regardless of the actual returns of various historical holding periods, the potential for a negative outcome—particularly after considering the uncertain effect of future inflation—remains. For investors with portfolios that have longer-term holding periods and incorporate historical risk and return relationships in their construction, understanding that significant losses are possible—and, arguably, probable—is essential for maintaining a well-considered asset-allocation strategy over the expected investment horizon. Prudence would suggest that investors preferring more certain nominal outcomes should limit their exposure to risky assets. Conversely, a longer investment horizon may support a willingness and ability to assume the greater uncertainty of equity-centric asset allocations, particularly for younger investors for whom the allocation to human capital and the risk posed by the erosion of purchasing power by inflation can reasonably be assumed to be greatest.

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