The Cost of Concentration

VOLATILITY DYNAMICS IN SINGLE-ASSET PORTFOLIOS

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Portfolio concentration can be a puzzling topic. The general wisdom is to avoid unnecessary portfolio concentration through thoughtful diversification. Yet, many investors view concentration as a desirable portfolio attribute when employed responsibly. Indeed, many respected investors manage a highly concentrated portfolio because they believe strategic concentration will support the portfolio's returns. However, highly concentrated portfolios often are not the result of conscious portfolio management decisions. This suggests that a portfolio entirely composed of a single asset may introduce risks that an investor may be unaware of.

There's an adage in the wealth management industry that says concentration builds wealth while diversification preserves it. While we praise successful entrepreneurs whose wealth largely consists of their own company's stock, we often forget those who were not so lucky. This survivorship bias leads us to potentially underappreciate the risk involved in a single-asset portfolio.

In this paper, we will show that the costs outweigh the benefits of maintaining a concentrated position. Our analysis reveals that selling the position and reinvesting the after-tax proceeds in a diversified portfolio is expected to generate a higher portfolio value at the end of a long-term investment horizon. This is a result of volatility, which represents a significant cost to portfolio growth over long periods.

Our analysis begins by defining concentrated positions and suggesting why an investor might prefer to maintain a single exposure. We then briefly review modern portfolio theory and the concept of efficient diversification followed by an evaluation of the cost of volatility on compound returns. We conclude with a Monte Carlo simulation to evaluate the long-term consequences of different investment strategies.

What Is A Concentrated Asset Position?

A concentrated asset position is a single asset, such as a stock, bond or real estate property, that represents a significant portion of an investor's net worth. While most investors consider a position greater than 15% or 20% of total net worth to be significant, it is not uncommon for a single asset to represent most or all of an investor's wealth. For example, this situation could arise by someone working for a single company for a substantial amount of time and holding a lot of that company's stock in their personal account.

This can create problems. Holding a single asset often leaves an investor heavily exposed to risks specific to that asset, such as bankruptcy in the case of a stock or default in the case of a bond. And, as we will explore later in this paper, the increased volatility associated with maintaining a single asset position may affect the portfolio's long-term compounding potential.

Selling off a concentrated position can also be challenging. The asset may be illiquid, such as real estate or private equity, or the investor's cost basis may be so low that the tax consequences of selling are difficult to overcome. If the asset is a publicly traded stock, the liquidity for that stock may be thin enough that selling in any significant quantity could drive the price lower. Material ownership may require SEC filings as a secondary offering to facilitate the transaction, and transfer restrictions may also apply to public and private holdings.

These instances make managing these types of positions a difficult task; however, investors may wish to maintain a large exposure for several reasons. The most common reason is control: investors prefer the voting power and influence that come with owning a large stake in a company. Some investors may also feel a sense of loyalty to a long-term employer and view significant ownership as a commitment to the firm. If the stock has performed well, the investor may believe the trend will continue and decide to hold on. Others who inherited their positions may feel an emotional attachment due to a family connection or history. These tendencies must be individually evaluated in the context of what is ultimately best for the client. In most cases, maintaining a large position could be detrimental from a risk management perspective, possibly exposing the client to an elevated risk of total investment loss. It also should be noted that concentrated holdings could often end up in the hands of a trustee or other fiduciary, whether as a result of death, incapacity, or lifetime transfer, who often must by law diversify immediately.

Diversification and Modern Portfolio Theory

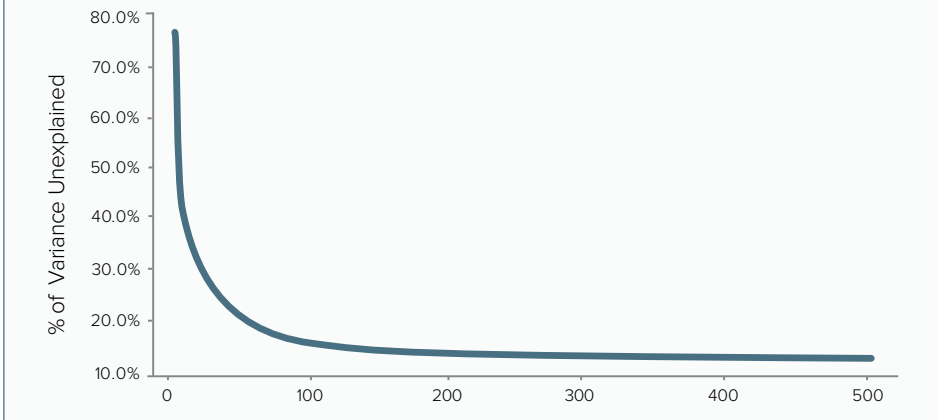
A core tenet of modern portfolio theory is the concept of efficient diversification. When we view investment risk as a result of price variability, we can break it down by source: systemic risk (price variability originating from the macroeconomy at large) and asset-specific risk (price variability originating from factors unique to that particular asset). Every asset's "total risk" is composed of these two risk sources in varying proportions. When uncorrelated assets are combined into a portfolio, their price movements generally tend to offset one another, and the portfolio's risk could be lower than the average risk of the individual assets. Diversification typically reduces the effect of asset-specific risk in the portfolio, leaving the investor with exposure mainly to systemic risk and lower absolute portfolio risk. In other words, the failure of a single position should not significantly affect our expected portfolio value as such outcomes should be canceled out by the movement of other portfolio assets.[1]

[1] Source: Bodie, Z., Kane, A. & Marcus, A. (2019). Essentials of Investments. New York, NY: McGraw-Hill Education.

Figure 1 illustrates the effect of diversification on the blend of stock-specific risk and systemic risk. This shows how the proportion of total risk not explained by movements in the broader market (and thus attributed to stock-specific factors) decreases as we add more assets to the portfolio.[2]

FIGURE 1 **PORTFOLIO RISK ATTRIBUTED TO STOCK-SPECIFIC FACTORS DECREASES WHILE THE NUMBER OF ASSETS INCREASES**

Median "unexplained variance" of 10,000 randomly and sequentially constructed portfolios of S&P 500 constituents vs. the broad S&P 500 Index



Calculations by Fiduciary Trust International using data sourced from FactSet as of 8/18/2020

A portfolio of only a few stocks derives most of its risk from stock-specific factors. This leaves an investor significantly exposed to the risk of total capital loss. As the portfolio moves more toward the broader market index, the proportion of stock-specific risk decreases to just over 10% of total portfolio risk. At this point the investor is much less exposed to the risk of any one investment going to zero.

As we add stocks from a given index to a portfolio, the portfolio looks a lot more like the index. We end up trading idiosyncratic risk[3] for the market rate of return. The key is not to approach idiosyncratic risk blindly, but in a calculated manner.

The Long-Term Cost of Volatility

Variability of periodic returns[4] could could have a punishing effect on long-term compound returns. This is a result of the asymmetrical impact of periodic returns on the value of an investment. Due to the math of percentages, applying gains and losses of equal percentages in succession does not bring the portfolio back to its starting point, but instead leaves it with a lower value.

To illustrate, imagine a portfolio valued at $100 million that is expected to return an average of 0% over the long term with symmetrical volatility. Many would assume that the portfolio will maintain its $100 million value over time. But let's dig a bit deeper. If the portfolio experiences a 10% loss followed by a 10% gain, the correct math would lead us to a final portfolio value of $99 million—less than our starting point and counter to our assumption of breaking

[2] In a linear regression, "unexplained variance" refers to the variation in the dependent variable that is not explained by the independent variable. In our example, we ran a CAPM-style regression where the individual asset's returns are the dependent variable and the market's returns are the independent variable. The R2 statistic measures the explained variance, while 1-R2 measures the unexplained variance. Explained variance is the "systemic" portion of risk, while unexplained variance is the stock-specific portion of risk.

[3] Idiosyncratic risk is a type of investment risk that is endemic to an individual asset (like a particular company's stock), or a group of assets (such as a particular sector's stocks), or in some cases, a very specific asset class.

[4] "Periodic returns" refers to a series of percentage changes in a portfolio's value over time, measured in regular intervals such as monthly.

even. Repeat this pattern for a very long time and the portfolio steadily declines in value as a result of volatility alone.

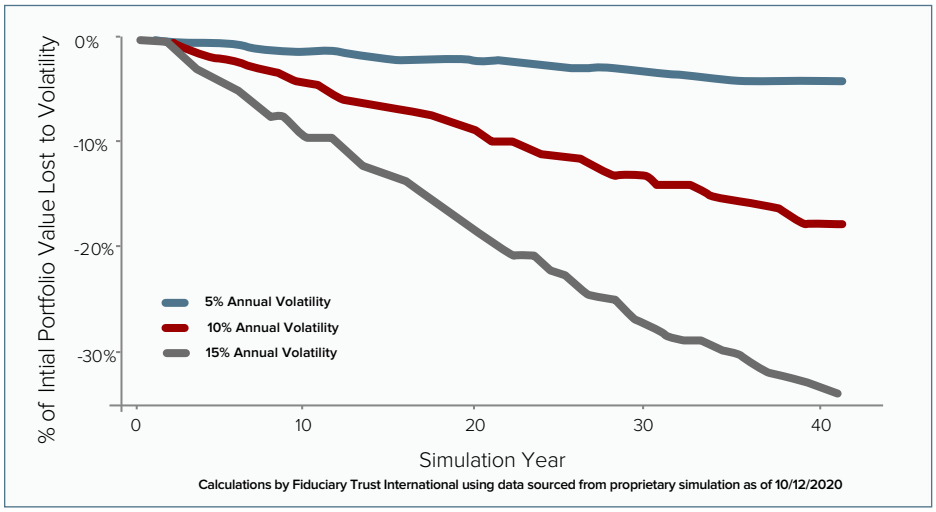
Maintaining the assumption of symmetry from above, Figure 2 captures the effect of volatility on portfolio growth, independent of any skew in the return distribution.[5]

Holding the portfolio starting value and expected annual return constant, we see that increasing expected volatility leads to a faster decline in portfolio value as a result of volatility alone and absent any securities transactions. At 15% annual volatility, (roughly the annual volatility an investor might expect from a well-diversified equity portfolio[6]) the portfolio in our illustration has lost more than 30% of its starting value by the 40th year.

We can estimate this volatility drag[7] and thus the "effective compound return" of a portfolio using the method shown below.

FIGURE 2 | **INCREASES IN PORTFOLIO VOLATILITY CAN LEAD TO FASTER DECLINES IN PORTFOLIO VALUE OVER TIME**

Median value lost to volatility for 10,000 simulated portfolios (by volatility assumption)



EQUATION 1 | ***The Cost of Volatility on Compound Returns***[8]

$$\textit{Compound Return} = \textit{Arithmetic Return} - \frac{1}{2}\sigma^2$$

For a portfolio with an expected long-term average return of 10% and volatility of 15%, the effective compound return is 8.9%. This means that an investor can expect to lose 1.1% per year to price movements. While many investors understand this cost in the short run, its long run consequences can be underappreciated and frequently overlooked. Maintaining a concentrated position with significant volatility could be extremely costly given that investors could earn the same or similar expected return with significantly lower volatility by diversifying their investments. This translates into a higher long-term compound return purely from limiting the variability of our portfolio.

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[5] Return distributions in practice are typically skewed (asymmetrical). The model above makes the simplifying assumption that returns are symmetrically distributed as any asymmetry would conflate the measurement of the cost of volatility.

[6] The annual standard deviation of monthly S&P 500 index returns since 1/31/1988 is 14.4%.

[7] Volatility drag refers to the difference between arithmetic and compound investment returns.

[8] Source: Bouchey, P., Nemtchinov, V., Paulsen, A., & Stein, D. (2012). Volatility Harvesting: Why Does Diversifying and Rebalancing Create Portfolio Growth? The Journal of Wealth Management, 15(2), 30.

Concentrated Positions in Context: A Monte Carlo Simulation[9]

The following hypothetical scenario analyzes a fictional client's concentrated stock position. The client in this example is a retired executive of ABC Industries ("ABC"). She has amassed a $100 million position in ABC's publicly traded stock over her long and successful tenure at the firm. We assume that the investor's cost basis is zero, meaning that the entire position is subject to long-term capital gains tax, and that the position represents the entirety of her liquid net worth.

We also assume that the company is a well-established, large-capitalization company and exhibits average risk and return characteristics relative to its category index, the S&P 500 Index. For simplicity, we assume the client has no restrictions on selling her investment and that trading costs, both explicit and implicit, can be avoided. The client specified a 40-year investment horizon and the goal of maximizing the expected liquidation value[10] of her estate at the end of that horizon.

Our goal is to compare the results of maintaining the $100 million position (the "hold" strategy) versus selling the entire position and investing the after-tax proceeds in a diversified equity portfolio (the "sell and reinvest" strategy). The S&P 500 represents the diversified portfolio in our simulation. Using a 23.8% long-term capital gains tax rate[11], we assume starting portfolio values of $100 million ("hold" strategy) and $76.2 million ("sell and reinvest" strategy), respectively.

Table 1 displays our assumptions regarding the risk and return characteristics for the hypothetical stock and the broad market index.

TABLE 1 | ***Risk & Return Assumptions***

	ABC Industries[12]	S&P 500 Index[13]
Expected Return	15.0%	11.0%
Expected Volatility	35.0%	14.0%

Further, we assume that maintaining this concentrated position carries a non-zero probability of total investment loss. Keeping with the assumption that ABC exhibits average risk relative to its category index, we estimate this probability to be 0.15% in any given year.[14]

We conducted a simulation of 10,000 independent return streams to compare the portfolio value of the two strategies at the end of the 40-year investment horizon. Figure 3 shows the results. The solid lines represent the median liquidation value of the 10,000 simulated portfolios at each year for each strategy, and the shaded areas represent the range between the top and bottom quartiles[15] of the 10,000 simulated portfolios at each year for each strategy.

[9] A Monte Carlo simulation is used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. It is a technique used to understand the impact of risk and uncertainty in prediction and forecasting models.

[10] The after-tax proceeds from the portfolio if the entire portfolio were sold and converted into cash, accounting for cost basis.

[11] Source: IRS. 23.8% is inclusive of the 3.8% Net Investment Income Tax, which may apply to individuals with significant investment income.

[12] Source: FactSet. Average of current S&P 500 constituents' since-inception annual return and standard deviation using monthly returns, as of 07/31/2020.

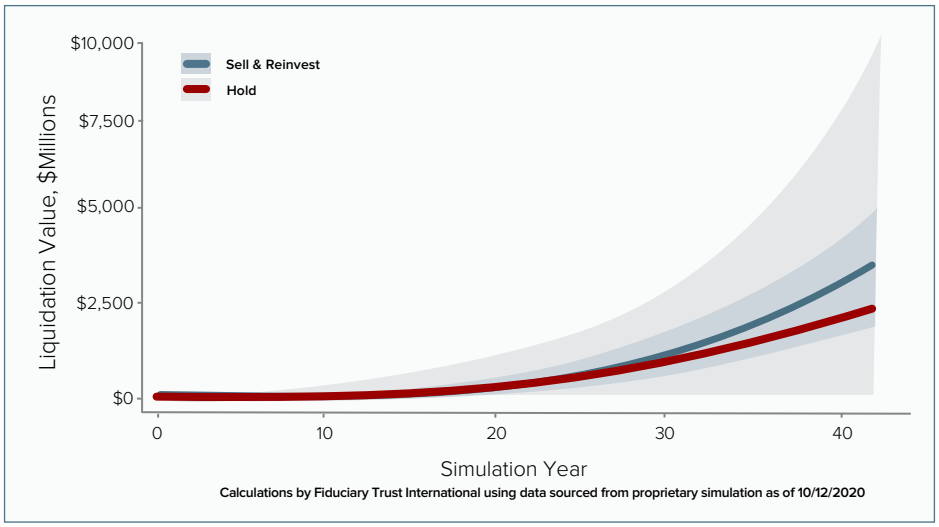
[13] Source: FactSet. Annual return and annual standard deviation using monthly returns since 1/31/1988, as of 07/31/2020

[14] Source: Bloomberg. Average of current S&P 500 constituents' 1-year probability of credit default from Bloomberg's credit risk model, as of 07/31/2020.

[15] "Top quartile" portfolio means 25% of the 10,000 simulated portfolios are valued above this portfolio; "bottom quartile" portfolio means that 75% of the 10,000 simulated portfolios are valued above this portfolio. "Median" portfolio means 50% of the 10,000 simulated portfolios are valued above this portfolio.

FIGURE 3 ENDING PORTFOLIO VALUES ACROSS TWO STRATEGIES

Median liquidation value of 10,000 simulations for each strategy. Shaded region represents interquartile range of 10,000 simulated portfolios for each strategy



After 40 years, the "sell and reinvest" strategy generated a greater median liquidation value versus the "hold" strategy. We attribute this to the mathematical relationship identified earlier in Equation 1 between volatility and compound growth rates over a long horizon.

TABLE 2 *Effective Compound Returns by Strategy*

	ABC Industries (Hold Strategy)	S&P 500 Index (Sell and Reinvest Strategy)
Effective Compound Return	8.9%	10.0%

The estimate calculated in Table 2 illustrates that even though ABC is expected to generate a higher average annual return than the broad market, its volatility reduces its expected compound return such that it is more than one full percentage point *below* that of the broad market index. As a result, it was only a matter of time before the "sell and reinvest" strategy produced better returns than the "hold" strategy. The long-term cost of volatility was indeed greater than the short-term explicit cost in the form of capital gains taxes.

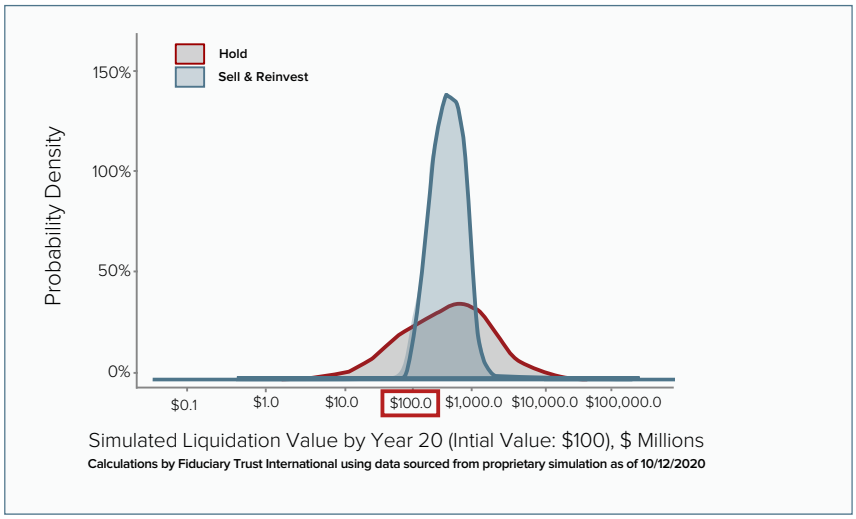
It is important to note the extreme difference in the dispersion of outcomes between the "hold" strategy and the "sell and reinvest" strategy. Because an individual stock is so much more variable than a diversified portfolio, it is entirely possible that the "hold" strategy results in an ending value many times the size of the median result of the "sell and reinvest" strategy. However, the opposite can also be true. An investor may be much more likely to lose an entire investment by maintaining the "hold" strategy. Selling and reinvesting may not only have a higher expected portfolio value at the end of the investment horizon but could also lead to fewer surprises along the way as the trajectory of portfolio growth is much more consistent.

What about losses?

Pure variability is not the only lens through which to consider the risk of an investment. At the end of the day, we are trying to avoid losing money. We can estimate this risk of loss by how many simulated portfolios fell below certain thresholds over different horizons. Figure 4 illustrates the probability density of potential outcomes by the 20th simulation year, separated by strategy.

FIGURE 4 DISTRIBUTION OF POTENTIAL OUTCOMES BY YEAR 20

Probability density plot of liquidation values of 10,000 simulated portfolios for each strategy



Maintaining the "hold" strategy produced a significantly wider dispersion of outcomes by the 20th simulation year, while the "sell and reinvest" strategy produced much more concentrated outcomes over the same period. We can get an idea of the relative occurrence of significant negative outcomes by comparing the area under the left tails of the two distributions. While the left tail of the "sell and reinvest" strategy falls quickly to zero, the left tail of the "hold" strategy remains elevated further to the left, signifying a much higher probability of extremely negative events and higher overall uncertainty of outcomes. Maintaining concentrated stock positions could present uncertainty and mitigating such uncertainty may improve our expected portfolio growth over a long investment horizon.

What if the stock's volatility assumption is too high or too low?

We have shown that under what we believe are reasonable assumptions, selling a concentrated position and reinvesting the proceeds in a broad market index could be beneficial from a risk mitigation perspective. But what if we changed our assumptions, such as the volatility of ABC's stock or the applicable capital gains tax rate?

Holding ABC's return assumption constant at 15%, we varied ABC's annual volatility input in our simulation from 20% to 50% (85% of S&P 500 companies fall within this range[16]). Assuming the investor chose the "sell and reinvest" strategy, we plotted the additional liquidation value each year versus the "hold" strategy. Positive values mean that the "sell and reinvest" strategy produced a greater liquidation value than did the "hold" strategy.

[16] Source: FactSet. Percent of current S&P 500 constituents with individual since-inception annual volatility in this range using monthly return data as of 7/31/2020.

FIGURE 5 **HIGHER ANNUAL VOLATILITY MEANS A HIGHER DRAG ON COMPOUND RETURNS**

Value added by “Sell and Reinvest” strategy vs. "Hold" strategy (by volatility assumption)

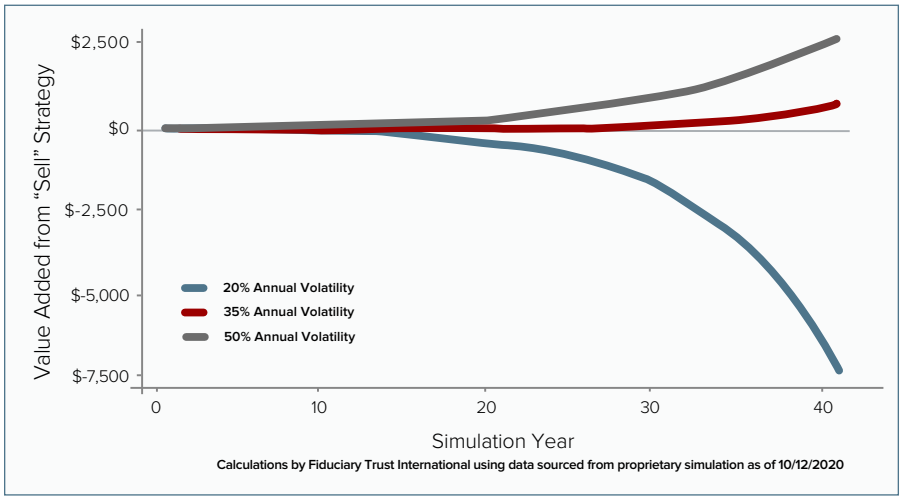


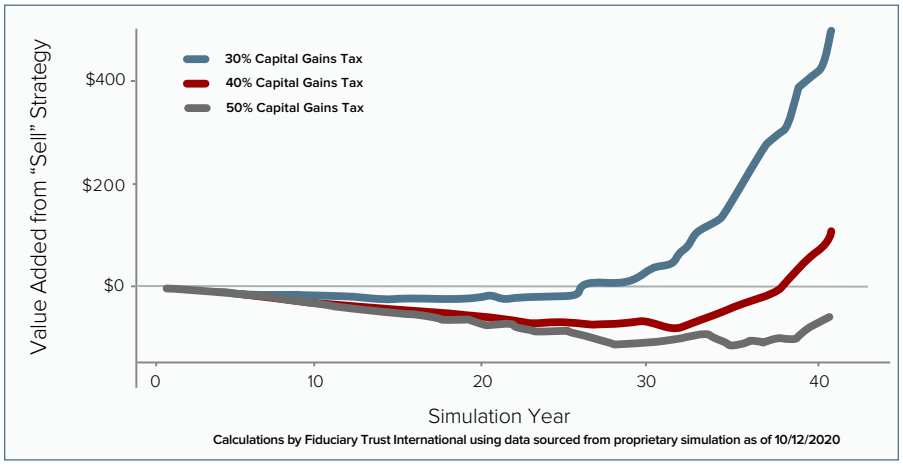
Figure 5 confirms our mathematical model of the cost of volatility. As the expected volatility of the “hold” strategy increases, so does the drag on long-term compound growth, and we are almost always better off selling and reinvesting the proceeds in a broad market index. Higher volatility levels from the “hold” strategy means that the “sell and reinvest” strategy is value additive in the long run as it helps to reduce the long-term cost of volatility on portfolio growth.

What if the capital gains tax is higher or lower?

Next, we varied the capital gains tax rate input in our simulation from 30% to 50%. Higher tax rates mean more of the starting value of the portfolio must be forfeited at the onset of our simulation and will, thus, take longer to recover. Assuming the investor chose the “sell and reinvest strategy,” we plotted the additional liquidation value each year versus the “hold” strategy. Again, positive values mean that the “sell and reinvest” strategy generated more value than the “hold” strategy.

FIGURE 6 **LOWER CAPITAL GAINS TAXES INCREASE ATTRACTIVENESS OF “SELL & REINVEST” STRATEGY**

Value added by “Sell and Reinvest” strategy vs. “Hold” strategy (by tax rate assumption)



This confirms our intuition—low tax rates make it relatively less costly to sell and reinvest a stock position, leading to more positive outcomes at the end of the investment horizon. On the other hand, higher tax rates are increasingly costly to the “sell and reinvest” strategy, potentially prohibitively so if the upfront tax cost exceeds the long-term cost of volatility. Our assessment of future tax rates plays in here as well; if we believe tax rates will rise in the future, it may be more advantageous to sell today to capture more value than we would if we sold in the future.

Going "All In" Can Be Risky

Concentrated asset positions may present many challenges to the portfolio management process. While concentration can be a profitable risk exposure when employed in a responsible, strategic manner, more often than not concentrated positions could present more risks than an investor may be prepared to bear. The added volatility associated with a concentrated position could weigh on compound returns over time. We believe that stock-specific risk could be reduced through diversification, which we aim to leverage to improve long-term portfolio risk-adjusted returns. Maintaining a single asset position may also carry a very wide dispersion of outcomes—ranging from an extreme gain to an extreme loss. Our end goal is to construct portfolios that minimize surprises.

Biographies

Jack Tobin
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Quantitative Risk and Analytics, Advisory Solutions Group, supports quantitative research initiatives and maintains proprietary portfolio and risk management models. He also ensures exposure risk metrics are accurate and timely for use by FTI's investment professionals. Previously, Jack worked as an intern for two firms in the finance industry, Amundi Pioneer Asset Management and Summit Partners LP. Jack received his Bachelor of Arts in Economics from Northeastern University, magna cum laude. Jack has passed Level II of the CFA Examination.

John Raus, CFA
Vice President, Sr. Research Analyst

Quantitative and Risk Analytics, Advisory Solutions Group (ASG), manages ASG's Quantitative & Risk Analytics team. He oversees quantitative research initiatives, development of proprietary portfolio and risk-management models, and a wide range of analytics across the Research and Portfolio Management groups. He also leads Athena's asset allocation and simulation-based frameworks. Previously, John was the head trader for Ellington Management Group's long/short equity hedge fund, where his responsibilities included portfolio trading, idea generation, and maintenance of proprietary risk management systems. Prior to this, he worked in Ellington's Quantitative Strategies Group, where he researched and traded various medium and low-frequency systematic strategies. John received his Bachelor of Arts in Economics from the College of the Holy Cross. John is Co-author – Choosing the Right Asset Mix: Guidance for Individuals with New Wealth, September 2019; Chartered Financial Analyst (CFA) Charterholder; Member, Stamford CFA Society.

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