

# Return, Risk and Probability of Success

## By: Frank Armstrong

### Why manage risk?

Investors focus with a laser-like intensity on a single factor of investment success: rate of return. It's simple to understand and reduces the entire multidimensional problem to a single number. A good strategy, or investment manager, has a high rate of return. A bad strategy or investment manager has a low rate of return. If only life were that simple!

By focusing on rate of return and ignoring risk, investors may actually torpedo themselves. High-risk strategies, even those that have high returns, may actually decrease the chance of an investor having a successful experience. Within a wide band investors may be far better served to focus on managing risk than stretching for additional return.

Few investors have an intuitive feel for the impact of risk. Just mention standard deviation and most of them will hit their zone right out. It would be helpful if we replaced the term standard deviation with relative risk rating. It also should be required that fund managers place equal emphasis on risk rating along with rate of return and publish relevant comparative data for the appropriate indexes.

Managing risk isn't nearly as glamorous as generating excess returns. But, excess returns are elusive while basic risk management is easily achieved.

In a previous article we demonstrated that diversification reduces risk without compromising rate of return. An investor choosing between two strategies with equal expected returns would certainly prefer the one with a lower risk. Lower risk not only reduces the dispersion of returns it increases both median and average returns. High-risk strategies may produce a few winners with outsized returns, but many more investors will experience substandard and unsatisfactory results. Investors are concerned with the certainty of results. After all, if you are a dead broke it's a small consolation that somewhere else is an investor who struck it rich.

### An accumulation example

Here's a table showing the distribution of returns for at different theoretical risk levels. We assume a 10% average return, a one hundred thousand dollar beginning balance, 30 year time frame, standard deviations of 10%, 20% and 30% respectively. Feeding these assumptions into a Monte Carlo simulator shows just how important managing risk is.

Standard Deviation	Average Return	Best Case	Worst Case	Median
10%	\$1,730,329	\$ 7,569,806	\$186,925	\$1,534,396
20%	1,699,584	25,313,829	16,146	1,060,438
30%	1,641,217	65,208,720	1,171	585,919

As you can see, as risk levels increase while holding rate of return constant, results become skewed. The average returns are virtually identical. But, both the best results and worst become more extreme. A few trials yield mega results, balancing out the trials that fall under the average. Importantly, the median result decreases precipitously as risk increases. More and more trials fall below the average result. This lower median return is the “cost” of the higher risk strategy.

This finding is consistent with the widely understood concept of variance drag. Because of variance drag, average (arithmetic) returns are always above compound (geometric) returns by an amount which increases as the volatility of the portfolio increases. Only in the case of no volatility are they the same. Volatility reduces the returns that investors care about, the compound return that ends up in their pockets.

Because there are no withdrawals in the above illustrations, none of the portfolios crash and burn. But, when we introduce systematic withdrawals the probability of portfolio failure increases with the withdrawal rate. During down markets so much capital is consumed at depressed prices to fund disbursements that the portfolio may self liquidate. So, it’s essential that wherever there are systematic withdrawals from a portfolio, risk should be vigorously controlled. Higher risk leads to predictably higher portfolio failures. Retirees, charitable institutions, endowment funds, and defined benefit pension plans must exercise prudence when managing their funds or risk portfolio blow out.

**Risk is amplified with systematic withdrawals**

Here’s a table showing the results at various risk levels for a portfolio taking systematic withdrawals. We assume a \$100,000 beginning capital, \$6000 dollar a year withdrawal beginning year one, 30 year time horizon, and 10%, 20% and 30% standard deviation. We will call successful any portfolio with \$1 remaining after 30 years.

<b>Standard Deviation</b>	<b>Average Remaining Capital</b>	<b>Best Case</b>	<b>Worst Case</b>	<b>Median Remaining Capital</b>	<b>Probability of Failure</b>
10%	\$749,508	\$ 4,801,855	\$0	\$615,244	1%
20%	759,208	18,387,065	0	318,072	21%
30%	782,699	50,637,405	0	52,577	43%

**A real case postmortem**

Recently I analyzed a case where a retiree age 49 rolled over a single stock from her qualified retirement plan and failed to diversify it. For the ten years preceding the rollover that stock had had a standard deviation of 37.97%. Her broker estimated the future returns at 10% to 12% and commented that it was a great company. Additionally, the brokerage had a very high “target price” estimate over the near future. The value of the portfolio at rollover was \$1,365,383, and an \$80,000 annual withdrawal was agreed on from the IRA.

Poorly diversified portfolios pick up a boat load of uncompensated risk. But, in this case, the totally undiversified portfolio had a supertanker load of additional risk. The broker's estimate approximated the return of the S&P 500 but the risk was a large multiple of the index's risk. The difference is by definition uncompensated. The goal of any investment manager is to ruthlessly eliminate any uncompensated risk.

In this case, the entire value of the portfolio was lost. But, how predictable was that result? Was it a bolt from the blue, or a highly likely outcome of a totally unsuitable portfolio design?

Using Monte Carlo analysis we can get a very good indication of the range of possible outcomes for such a risky strategy. Because the retiree was so young, we believed that a minimum of 40 years was the appropriate time horizon. We accepted for purposes of the analysis the broker's 11% average expected return assumption for the stock.

<b>Year</b>	<b>Probability of Success</b>	<b>Median Capital Remaining</b>
10	86	\$1,062,257
20	59	\$547,294
30	48	\$0
40	42	\$0

It's highly unlikely that an informed investor would have opted for a strategy that offered a 58% chance of being dead broke before their projected life expectancy. Easily obtainable portfolios would reduce those dreadful possibilities to insignificance. In this case, the Monte Carlo analysis provides us with a powerful intuition that the strategy is fatally flawed. It can't tell us whether any particular individual will succeed or fail, but it can point out that this strategy is insanely risky and highly unlikely to meet the investor's goals.

At the time, the 10 year standard deviation of the S&P 500 index was 16.83%. Merely buying the index would have radically improved the probability of success. For purposes of this analysis we guesstimated the expected rate of return at the same 11% the broker was using for the stock. It is within a few basis points of historical returns and simplifies the comparison.

<b>Year</b>	<b>Probability of Success</b>	<b>Median Capital Remaining</b>
10	100	\$2,122,404
20	97	\$4,079,624
30	92	\$8,764,128
40	88	\$19,277,076

Using readily available index funds we can diversify globally to reduce the risk of the equity portfolio. We demonstrated this in our previous article: “How Much Diversification is Enough?”

However, it’s inappropriate to have a full equity position in a retiree portfolio. Diversification between equity and high quality short term fixed income allows for further risk reduction and provides a store of value to fund withdrawals during the inevitable market declines that one would expect over a forty year time horizon. A simple 60% global equity/40% short term bond portfolio has the following expected return and risk profile: 9.24% expected return with an 8.26% standard deviation. While it does reduce the rate of return, it dramatically reduces the risk, and improves the probability of success.

<b>Year</b>	<b>Probability of Success</b>	<b>Median Capital Remaining</b>
10	100	\$1,964,305
20	100	\$3,390,054
30	100	\$6,667,003
40	99	\$13,876,898

Intelligent people can disagree on the exact composition of alternative suitable portfolios. There is nothing magic about the portfolios I prepared. The key takeaway from the exercise is that **ANY** reasonably prudent diversification would have been preferable to a concentrated stock position. This train wreck did not have to happen.

The Monte Carlo simulation simply demonstrates the probability of any risky strategy to self liquidate over time if subject to withdrawals. A few bad years can consume so much capital that the fund implodes under the pressure of continuing disbursements.

Individual company failure risk is not captured by the standard deviation of returns of the stock. It’s an additional wildcard. Any company can be tomorrow’s Enron or Global Crossing. It’s not likely that you could spot imminent failure just from studying past returns and volatility. Fortunately, individual company failure risk can be completely diversified away in a prudent portfolio.

### **Summary**

Diversification is the cardinal rule of investment management. Diversification reduces risk and increases the probability of a successful outcome for the investor. Concentrated stock positions violate every principle of modern portfolio practice standards. They are neither suitable nor prudent for the vast majority of investors.

Prudent diversification reduces risk without sacrificing expected rates of return. Global diversification is the gold standard for prudence in equities. A portfolio must be tailored to the liquidity needs risk preferences and time horizon of the client. Short term high quality bonds provide a store of value without significant market risk to meet those liquidity needs.

Over a reasonable range, reducing risk is more important than chasing incremental returns. The appropriate portfolio is the one that offers the highest probability of success rather than the highest return regardless of the risk level. In many cases, investors may even increase their chance of a successful outcome by opting for a portfolio with lower returns and risk.