

Diversifying a Concentrated Stock Position in 2023¹

by

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Introduction

Twenty years ago, we evaluated brokerage firms' recommendation that investors should diversify a concentrated stock position by buying additional stocks on margin [McCann and Luo, 2003].²

We found:

1. Borrowing against a concentrated stock position and buying additional stocks increases the investor's risk unless the returns to the securities bought are significantly negatively correlated with the returns to the concentrated position. The necessary condition for reducing risk will not be met if both the concentrated investment and the additional securities purchased are common stocks.
2. The more similar the securities bought are to the concentrated position, the riskier the resulting leveraged portfolio. In practice, the securities purchased to "diversify" are often quite similar to the concentrated position and the strategy amounts to little more than making additional investments in the concentrated position on margin.
3. The more an investor followed this bad advice, the worse the resulting portfolio.
4. In rare cases where the "leveraged diversification" strategy reduces risk, the leveraged portfolio's expected return is much less than the concentrated position's expected return. The recommended strategy either increases risk or dramatically lowers the expected return of the concentrated portfolio - or it does both.

Twenty years later, some brokers and advisors continue to recklessly recommend that their clients borrow against concentrated stock positions and purchase additional stocks to diversify. In this note, we use recent stock market returns to update our previous work which used data from the 1990s. We also extend the analysis to cover a larger universe of stocks and employ more sophisticated simulations. Our updates and

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² Throughout we will talk about this position as if it were a single stock but it could be any number of stocks so long as it is not well diversified.

enhancements show that this “hold, borrow, and buy some more” strategy remains inconsistent with basic principles of prudent investment management; leveraged diversification perversely increases risk and or lowers expected returns.

Our analysis of the leveraged diversification strategy applies to many other situations where investors are encouraged to borrow against their concentrated stock positions rather than sell some of the stock to fund purchases of real estate or other big ticket items.

Based on our forthcoming analysis of Form Ds and Form ADVs, registered investment advisors are placing their clients in illiquid private placements the advisors create and promote. For example, ICONIQ has sponsored 399 Reg D offerings and places 79.6% of its clients’ assets in illiquid investments.³ ICONIQ grew into a Silicon Valley powerhouse as a result of its management of the Zuckerberg wealth tied to Facebook (now Meta). The leveraged diversification strategy is even more risky if conflicted RIAs like ICONIQ are leveraging concentrated Silicon Valley stock positions using their sponsored illiquid private placements.

Intuition

The fundamental error in leveraged diversification is the misuse of rates of return and ignoring debit balances when dealing with long portfolios of different size. Consider an investor with \$1,000,000 invested entirely in a single stock with a 70% chance that the stock’s returns over the next month will be between +20% and -20%. Suppose this investor invests another \$1,000,000 using margin in a portfolio of other stocks and the range over which the enlarged portfolio’s monthly percentage returns will vary narrows to between +15% and -15%. The risk may appear to be reduced but the range of likely \$-value losses has actually gone up. After buying the additional securities, the reduced variation in percentage returns are being applied to the much larger \$2,000,000 portfolio in which the investor still only has \$1,000,000 in equity. Before buying the additional securities, there

³ ICONIQ’s Form ADV can be found here:
<https://reports.adviserinfo.sec.gov/reports/ADV/159198/PDF/159198.pdf>.

was a 70% chance that the investor's portfolio would be worth between \$800,000 and \$1,200,000 at the end of the month. After buying the additional securities, the range of likely outcomes widens to \$700,000 to \$1,300,000, which translates to a 50% increase in the range of returns on the investor's equity from $\pm 20\%$ to $\pm 30\%$ as a result of implementing the flawed strategy.

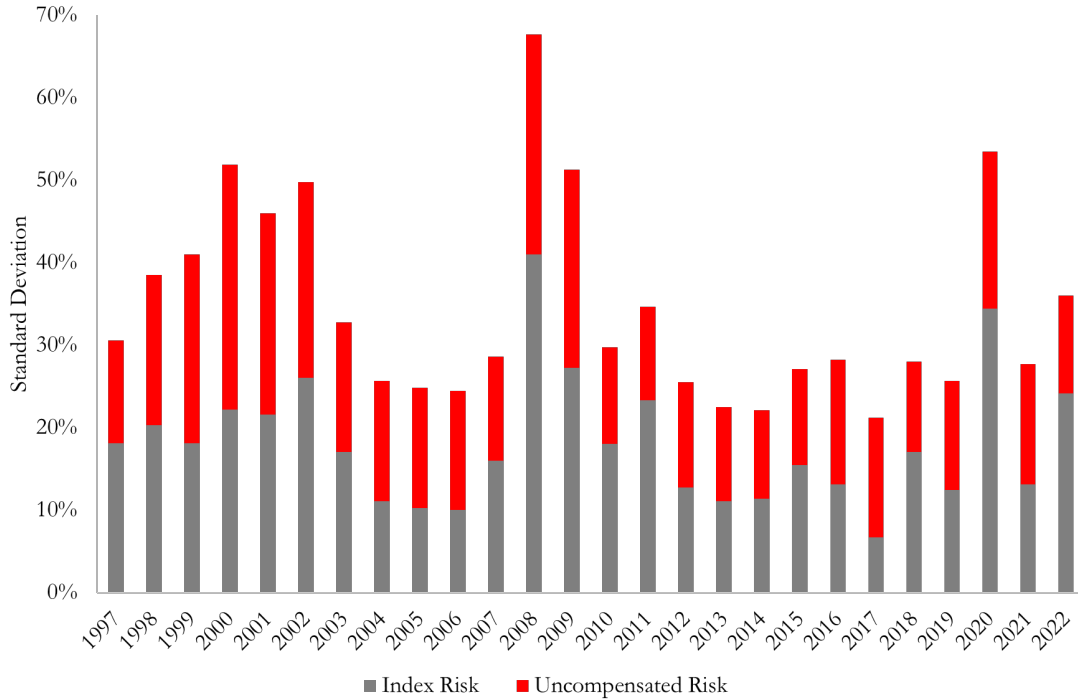
In our simple example, leveraged diversification increased risk because the 2:1 leverage increased the \$-amounts that could be lost even though the variation in the percentage returns to the more diversified \$2,000,000 securities portfolio was 25% smaller ($\pm 15\%$ compared to $\pm 20\%$) than the variation in the percentage returns to the \$1,000,000 concentrated stock position.

The riskiness of the investor's portfolio after leveraged diversification increases with 1) the amount of additional stocks bought on margin, 2) the volatility of the returns to the concentrated stock position, 3) the volatility of the returns to the additional stocks and 4) the correlation between the returns to concentrated stock position and the returns to the additional stocks purchased.

Unless the correlation between the returns to the concentrated stock position and the returns to the additional stocks purchased is significantly negative, the leveraged portfolio will be substantially riskier than the concentrated stock position. Correlation coefficients can range from -1 to +1 but the correlation coefficients between individual stocks and candidate additional stock portfolios will always be positive, and so the leveraged portfolio will always be riskier - typically much riskier - than the concentrated stock portfolio.

Less obvious, in many scenarios where leveraged diversification increases risk, it also lowers expected returns. That is, the strategy harms investors by both increasing risk and lowering expected returns. Leveraged diversification performs so much worse than simple diversification strategies because there is a lot of diversifiable and therefore uncompensated risk in single-stock portfolios as illustrated in Figure 1.

Figure 1: Uncompensated Risk of S&P 500 Stocks, 1997-2022



The grey bars reflect the standard deviation of daily returns to investing in the S&P 500 each year. The red bars reflect the average additional risk from investing in a single S&P 500 stock over and above the risk of investing in the S&P 500. Consistently each year, holding a single stock from within the S&P 500 is twice as risky as holding a portfolio of all 500 S&P 500 stocks. This additional risk is called “uncompensated” risk because it can be eliminated by holding the individual stock as part of the overall stock market portfolio. Investors do not earn any additional returns for bearing this diversifiable risk.

Simulations

We next report on extensive simulations we performed to demonstrate that a strategy of holding a concentrated position and borrowing to buy additional securities will virtually always increase risk.

Each year from 1997 through 2022, we generate 1,000,000 sample portfolios from the stocks in the S&P 500 at the beginning of the year.⁴ For each sample portfolio, we first randomly select a stock to serve as the concentrated position and then randomly draw 15 additional stocks from the remaining 499 stocks to create returns to equally-weighted, 15-stock portfolios. We calculate the returns and annualized volatilities each year for:

- 1) the S&P 500 (“100% Diversified S&P 500”),
- 2) a single stock (“Concentrated Single Stock”),
- 3) a portfolio that is 50% S&P 500 and 50% concentrated single stock position (“50% Diversified”),
- 4) the concentrated single-stock position plus 50% invested in a companion 15-stock portfolio bought on margin (“50% Leveraged Diversification”), and
- 5) the concentrated single-stock position plus 100% invested in a companion 15-stock portfolio bought on margin (“100% Leveraged Diversification”).

If a sampled concentrated stock stops trading before the end of the year, we end that simulation path and annualize the risk for all portfolios in the simulation path.⁵ If any of the 15 additional stocks purchased stops trading before the end of the holding period, the value of the dropped stock on the last trading date is invested in another randomly selected member not previously selected as the concentrated stock position or one of the 15 additional stocks purchased for this sample path.

We apply the WSJ Prime Rate + 3.0% as the margin interest rate to the leveraged portfolios for the days with margin debt. A margin call is applied whenever a simulated portfolio’s net value falls below 25% of its total asset value. On the margin call date, sufficient holdings are liquidated to pay down the margin debt and restore the portfolio to the original (100% or 50%) leverage.

These simulated portfolios - over 100 million portfolios in all – allow us to compare the results to holding concentrated stock positions, diversified stock portfolios, partially diversified portfolios and “hold, borrow and buy some more” portfolios. Only 1.3% of the

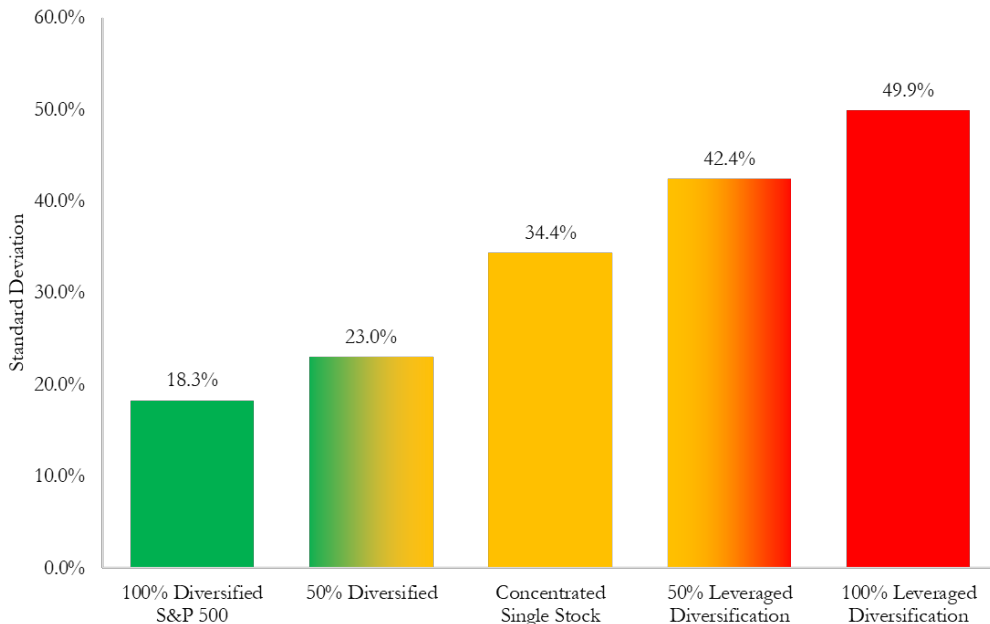
⁴ We get the same qualitative results if we use complementary portfolios of 10, 25 or 50 stocks.

⁵ We get the same qualitative results if we drop from the simulations any concentrated stock which ceases trading during the year.

26 million fully leveraged portfolios had less risk than the concentrated positions. Thus, the strategy if implemented would have increased risk 98.7% of the time between 1997 and 2022. On average, the fully leveraged portfolios were 45% more risky than concentrated stock positions. On average, the 50% leveraged portfolios were 24% more risky than concentrated stock positions.

Figure 2 illustrates the disastrous results of the leverage diversification strategy. Over the 26-year period from 1997 through 2022, the average risk of the concentrated positions was 34.4%. Borrowing 50% of the value of the concentrated positions to buy 15 additional stocks increased the investor’s risk to 42.4% and borrowing 100% increased the risk to 49.9%. Our empirical results show that following the “leveraged diversification” advice increased risk and the more investors followed the advice the worse the results. Leveraged diversification leads to portfolios that are nearly three times as risky, on average, as well diversified stock portfolios.

Figure 2: The Average S&P 500 Stock Had a 34.4% Standard Deviation of Daily Returns Compared to an 18.3% Standard Deviation for the S&P 500’s Daily Returns, 1997-2022



Instead of following this obviously flawed strategy, investors could have significantly lowered their risk without sacrificing much return by following traditional diversification strategies. Selling only half the concentrated stock position and buying a

diversified portfolio of stocks would have reduced the risk of the concentrated positions by 33.1%, from 34.4% down to 23%. Fully diversifying concentrated stock positions would have lowered the investor’s risk, on average by 46.8%, from 34.4% all the way down to 18.3%.

This dramatic result is not a function of the date we chose to start the analysis or of any particular year. Table 1 reports the results of our simulations for each year from 1997 to 2022. The leveraged portfolios were much more risky than concentrated stock positions in every year. The leveraged diversification strategy also has a high likelihood of receiving margin calls.

Table 1: Risk and Return by Strategy and Year, S&P 500, 1997-2022

Year	100% Diversified S&P 500		50% Diversified		Concentrated Single Stock		50% Leveraged Diversification		100% Leveraged Diversification		Margin Call for Leveraged Diversification	
	Return	Risk	Return	Risk	Return	Risk	Return	Risk	Return	Risk	50%	100%
1997	32.9%	19.8%	30.6%	21.7%	28.2%	30.5%	36.4%	33.8%	44.5%	38.2%	0.0%	0.2%
1998	27.6%	22.1%	20.8%	25.7%	14.0%	38.6%	15.0%	45.4%	15.1%	53.6%	0.7%	8.6%
1999	19.6%	18.2%	16.7%	24.6%	13.7%	41.2%	14.9%	44.6%	16.0%	50.0%	0.7%	3.9%
2000	-9.3%	24.4%	0.7%	31.2%	10.7%	51.8%	9.8%	58.8%	8.5%	67.5%	3.2%	13.2%
2001	-11.6%	22.2%	-5.6%	28.7%	0.4%	45.7%	-5.0%	53.8%	-11.6%	62.7%	6.0%	23.0%
2002	-21.4%	26.4%	-19.7%	31.7%	-18.0%	49.5%	-31.4%	63.3%	-44.5%	74.2%	14.2%	50.7%
2003	28.0%	16.6%	34.6%	22.1%	41.3%	32.6%	57.8%	38.0%	74.4%	45.1%	0.5%	1.2%
2004	10.5%	11.1%	13.6%	16.1%	16.7%	25.6%	21.3%	29.4%	25.8%	34.2%	0.0%	0.9%
2005	4.8%	10.3%	6.6%	15.3%	8.5%	24.9%	8.1%	28.7%	7.6%	33.6%	0.6%	1.5%
2006	15.5%	10.0%	15.7%	15.0%	16.0%	24.4%	18.4%	27.5%	20.8%	31.7%	0.2%	0.2%
2007	5.2%	15.7%	4.3%	19.4%	3.4%	28.2%	-0.6%	34.4%	-4.5%	41.6%	0.6%	4.8%
2008	-36.4%	40.9%	-37.5%	46.8%	-38.6%	67.4%	-62.7%	102.4%	-75.8%	115.69%	48.6%	95.6%
2009	26.1%	26.7%	35.1%	35.6%	44.2%	51.6%	60.0%	65.9%	64.7%	79.5%	4.1%	22.9%
2010	14.7%	17.9%	17.9%	22.0%	21.0%	29.6%	28.3%	37.3%	35.7%	46.2%	0.0%	0.0%
2011	1.9%	22.8%	1.4%	26.5%	0.8%	34.4%	-1.9%	47.1%	-5.2%	61.3%	0.1%	6.5%
2012	15.9%	12.7%	16.3%	16.9%	16.8%	25.4%	22.0%	29.5%	27.1%	34.4%	0.0%	0.6%
2013	32.1%	11.1%	34.5%	15.0%	36.8%	22.5%	52.0%	25.0%	67.2%	28.1%	0.0%	0.0%
2014	13.4%	11.3%	13.7%	14.8%	14.1%	22.1%	17.9%	25.8%	21.8%	30.3%	0.0%	0.3%
2015	1.2%	15.4%	-0.3%	18.7%	-1.9%	26.8%	-6.0%	33.4%	-10.1%	41.0%	0.6%	4.4%
2016	11.6%	13.3%	12.7%	18.4%	13.8%	28.1%	17.4%	33.3%	20.8%	40.0%	0.0%	0.5%
2017	21.4%	6.7%	20.1%	11.8%	18.8%	21.2%	24.6%	22.4%	30.4%	24.3%	0.1%	0.2%
2018	-4.3%	17.0%	-5.6%	19.9%	-6.9%	27.9%	-14.5%	34.1%	-22.2%	42.2%	0.0%	6.8%
2019	31.0%	12.5%	29.9%	16.7%	28.8%	25.7%	38.9%	28.2%	49.0%	31.6%	0.0%	0.2%
2020	18.2%	33.4%	13.9%	38.8%	9.6%	53.5%	7.7%	80.2%	-18.6%	93.6%	8.3%	72.7%
2021	28.5%	13.0%	28.8%	17.9%	29.0%	27.7%	40.3%	30.5%	51.6%	34.4%	0.0%	0.0%
2022	-18.1%	24.2%	-14.3%	27.2%	-10.5%	36.2%	-19.8%	49.7%	-29.5%	63.6%	0.9%	23.6%
Average	10.0%	18.3%	11.0%	23.0%	12.0%	34.4%	13.4%	42.4%	13.8%	49.9%	3.4%	13.2%

Table 1’s average returns and standard deviations may not be intuitive to everybody and don’t fully convey the significant increase in likelihood of large losses resulting from the leveraged diversification strategy. Table 2 reports the probability of losing more than 5% to 95% of equity in one year for the same five strategies presented in Table 1.

We have highlighted three rows reflecting the probability of losing more than 5%, 25% and 50% of equity in a single year to illustrate how to read the table. The probability of losing more than 25% in a year holding a diversified S&P 500 portfolio is only 3.8%. The probability of losing more than 25% nearly doubles to 6.7% if the portfolio is half invested in a diversified S&P 500 portfolio and half invested in a single S&P 500 stock and further increases to 12.7% if the portfolio is fully invested in a single S&P 500 stock. Borrowing 100% of the value of a single S&P 500 stock to buy an equal value spread across 15 additional S&P 500 stocks increases the probability of losing more than 25% of equity to 20.4%.

Table 2 also reports the 95% Value-at-Risk (“VaR”) for each strategy. 95% VaR is the maximum amount you are likely to lose 95% of the time. Equivalently, you are likely to lose more than the 95% VaR amount only 5% of the time. This standard risk measurement ranges from 22.2% for a diversified stock portfolio to 44.2% for a concentrated stock position and to 66.8% for a concentrated single stock position subject to the 100% leveraged diversification overlay.

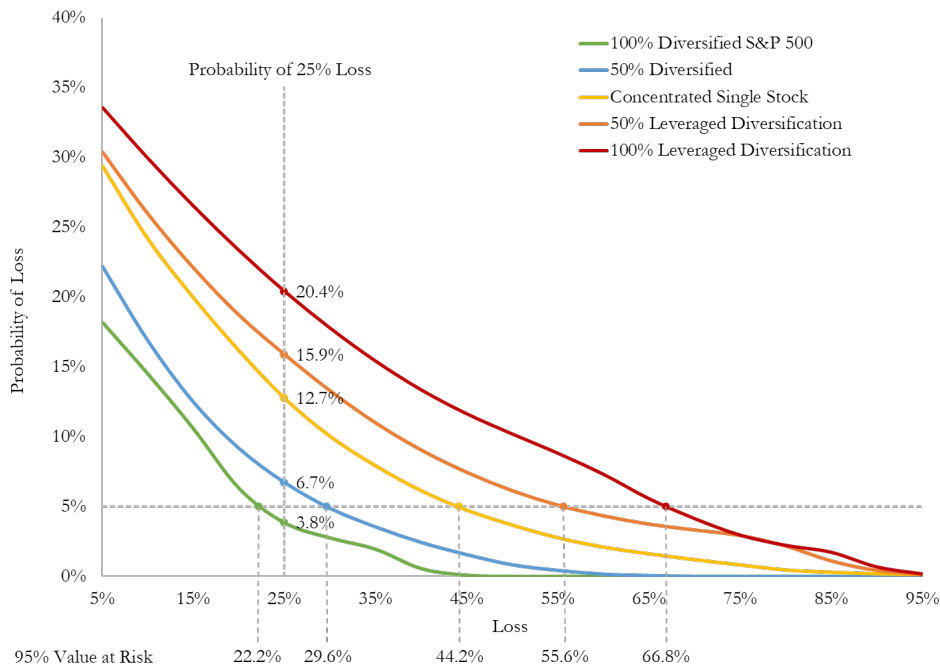
Table 2: Leveraged Diversification Increases Probability of Large Losses, S&P 500

Loss	Probability				
	100% Diversified S&P 500	50% Diversified	Concentrated Single Stock	50% Leveraged Diversification	100% Leveraged Diversification
5%	18.2%	22.2%	29.4%	30.4%	33.6%
10%	14.5%	16.9%	24.1%	25.9%	29.9%
15%	10.6%	12.5%	19.9%	22.1%	26.5%
20%	6.3%	9.2%	16.1%	18.7%	23.3%
25%	3.8%	6.7%	12.7%	15.9%	20.4%
30%	2.7%	4.9%	10.0%	13.3%	17.8%
35%	1.9%	3.5%	7.9%	11.0%	15.4%
40%	0.6%	2.4%	6.1%	9.0%	13.4%
45%	0.1%	1.6%	4.7%	7.4%	11.6%
50%	0.0%	0.8%	3.7%	6.1%	10.2%
55%	0.0%	0.4%	2.8%	5.1%	8.8%
60%	0.0%	0.2%	2.1%	4.3%	7.3%
65%	0.0%	0.1%	1.6%	3.7%	5.6%
70%	0.0%	0.0%	1.2%	3.3%	4.1%
75%	0.0%	0.0%	0.8%	2.9%	3.0%
80%	0.0%	0.0%	0.5%	2.2%	2.2%
85%	0.0%	0.0%	0.3%	1.1%	1.7%
90%	0.0%	0.0%	0.2%	0.4%	0.7%
95%	0.0%	0.0%	0.1%	0.1%	0.2%
95% VaR	-22.2%	-29.6%	-44.2%	-55.6%	-66.8%

Table 1 and Table 2 suggest a straightforward disclosure that could be made by any advisor recommending leveraged diversification: “If you follow my advice to hold your concentrated position, borrow an equal value and buy additional stocks to diversify, I can increase the expected return on your concentrated portfolio from 12.0% to 13.8% but the chance you will lose 25% in a year will increase from 12.7% to 20.4%. On the other hand, if you sell your concentrated single stock position and invest in a diversified stock portfolio, the expected return on your portfolio will drop from 12.0% to 10.0% but the chance you will lose 25% in a year will fall from 12.7% to 3.8%.”

The probability of losing more than 5% to 95% of equity in one year and the 95% VaR of the five strategies are also plotted in **Figure 3** for a visualized illustration of how traditional diversification cuts the risk of the average S&P 500 stock, while leverage diversification increases the risk.

Figure 3: Traditional Diversification Cuts the Risk of the Average S&P 500 Stock in Half; Leveraged Diversification Increases the Risk 50%, S&P 500, 1997-2022



The More Similar Additional Stocks Purchased, the Worse Leveraged Diversification

In the previous section, we selected the single concentrated stock and also the additional 15 stocks bought on margin from the S&P 500. In our experience, the concentrated stock positions subject to the flawed leveraged diversification strategy continue to typically be technology stocks or other stocks which have recently gone public. To more closely track the situations we observe, we re-ran our simulations using stocks from the S&P 500's technology sector and found, as we posited 20 years ago, that when the leveraged diversification strategy selects from stocks that are similar to the concentrated single stock, the results are even worse. Using 15 stocks drawn from the S&P 500 to diversify an S&P 500 stock increased risk by 45% on average. As shown in Table 3, using 15 stocks from S&P's technology sector to diversify a technology stock increased risk by more than 50% on average – from 42.1% to 64.7%.

Table 3 Risk and Return by Strategy and Year, S&P 500 Technology Stocks, 1997-2022

Year	100% Diversified S&P 500		50% Diversified		Concentrated Single Tech Stock		50% Leveraged Diversification		100% Leveraged Diversification		Margin Call for Leveraged Diversification	
	Return	Risk	Return	Risk	Return	Risk	Return	Risk	Return	Risk	50%	100%
1997	33.2%	19.8%	27.4%	29.6%	21.6%	48.4%	26.4%	54.6%	31.0%	62.3%	0.0%	2.3%
1998	27.5%	22.0%	38.0%	33.6%	48.5%	55.6%	66.7%	64.5%	79.8%	74.3%	1.8%	15.2%
1999	19.5%	18.2%	52.2%	33.8%	84.9%	57.0%	121.8%	60.9%	158.7%	67.4%	0.0%	0.1%
2000	-9.5%	24.5%	-15.0%	47.8%	-20.6%	82.8%	-36.0%	105.6%	-46.9%	122.1%	23.7%	59.1%
2001	-11.8%	22.2%	-14.3%	44.8%	-16.9%	81.7%	-33.1%	113.9%	-48.5%	129.8%	37.6%	79.6%
2002	-21.4%	26.3%	-33.4%	40.8%	-45.5%	76.9%	-73.7%	116.5%	-83.9%	130.2%	75.4%	98.3%
2003	27.8%	16.6%	52.6%	29.9%	77.4%	46.1%	112.4%	53.6%	147.4%	62.7%	0.0%	0.0%
2004	10.6%	11.1%	9.1%	21.6%	7.6%	37.7%	7.4%	48.0%	4.9%	59.6%	1.0%	14.2%
2005	4.7%	10.3%	3.5%	17.7%	2.3%	31.5%	-1.3%	38.3%	-5.6%	46.6%	0.0%	7.5%
2006	15.4%	10.0%	12.5%	18.6%	9.6%	32.0%	8.7%	38.1%	7.7%	46.2%	0.0%	1.1%
2007	5.1%	15.7%	3.4%	20.0%	1.7%	30.1%	-3.2%	36.3%	-8.0%	44.1%	0.0%	3.3%
2008	-36.4%	41.0%	-40.1%	44.8%	-43.7%	59.3%	-69.9%	100.8%	-80.9%	114.4%	58.7%	98.6%
2009	26.4%	26.6%	48.4%	34.2%	70.5%	46.0%	102.6%	57.0%	132.4%	69.8%	0.0%	1.9%
2010	14.6%	17.9%	16.1%	22.9%	17.5%	32.1%	23.2%	41.5%	28.8%	52.5%	0.0%	0.2%
2011	1.9%	22.7%	-2.0%	28.1%	-6.0%	38.9%	-12.1%	54.3%	-18.8%	70.3%	1.7%	14.2%
2012	15.7%	12.7%	13.9%	18.6%	12.1%	29.1%	15.0%	35.1%	17.5%	41.9%	0.0%	2.0%
2013	32.0%	11.1%	36.2%	16.5%	40.4%	26.1%	57.4%	28.7%	74.4%	32.2%	0.0%	0.0%
2014	13.3%	11.3%	16.0%	15.7%	18.8%	23.3%	25.0%	28.1%	31.2%	33.8%	0.0%	0.0%
2015	1.3%	15.4%	3.4%	19.3%	5.5%	27.6%	5.0%	34.7%	4.4%	43.2%	0.0%	2.1%
2016	11.6%	13.3%	15.5%	18.6%	19.4%	27.9%	25.8%	34.9%	32.3%	43.4%	0.0%	0.0%
2017	21.3%	6.7%	28.3%	12.8%	35.2%	21.3%	49.3%	23.2%	63.3%	25.8%	0.0%	0.0%
2018	-4.4%	17.1%	-2.2%	22.6%	0.0%	31.6%	-4.1%	39.7%	-8.2%	49.2%	0.0%	1.5%
2019	30.9%	12.5%	36.7%	18.7%	42.4%	28.0%	59.3%	32.6%	76.3%	37.9%	0.0%	0.0%
2020	18.4%	33.4%	23.8%	39.0%	29.2%	50.3%	39.1%	72.7%	34.9%	96.8%	2.8%	30.4%
2021	28.4%	13.0%	29.1%	19.4%	29.8%	30.2%	41.5%	35.2%	53.3%	41.2%	0.0%	0.0%
2022	-18.1%	24.2%	-21.1%	30.5%	-24.0%	42.1%	-40.2%	66.7%	-55.8%	85.7%	1.4%	63.9%
Average	9.9%	18.3%	13.0%	26.9%	16.1%	42.1%	19.7%	54.4%	23.9%	64.7%	7.9%	19.1%

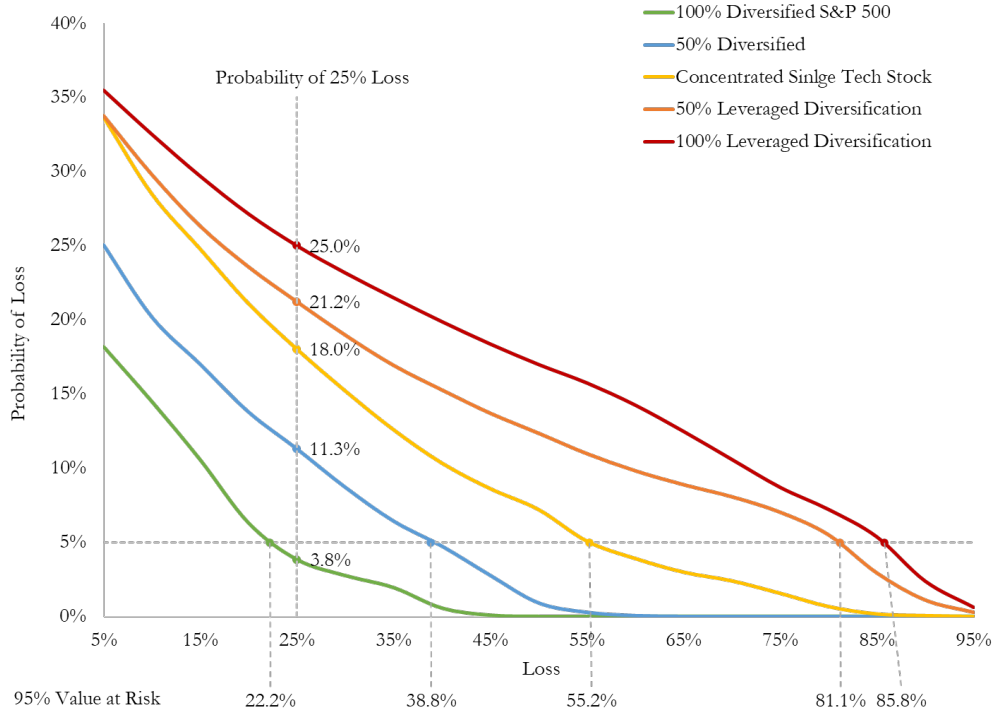
Table 4 and Figure 4 report the probability of losing more than 5% to more than 95% in one year for the same five strategies selecting stocks and from the S&P 500 Technology sector. The probability of losing more than 25% in a year holding a diversified S&P 500 portfolio is only 3.8%. The probability of losing more than 25% increases to 18.0% if the portfolio is fully invested in a single S&P 500 technology stock. Borrowing 100% of the value of a single S&P 500 technology stock to buy an equal value spread across 15 additional S&P 500 technology stocks increases the probability of losing 25% of equity to 25.0%. The 95% VaR for portfolios drawn from S&P 500 technology stocks are significantly higher than for portfolios drawn from all sectors of the S&P 500, further highlighting the importance of diversifying risky individual stocks.

Comparing the results in Table 4 to the results in Table 2 we can see that the leveraged diversification strategy performs even worse when applied to technology stocks than when applied across all S&P 500 sectors.

Table 4: Leveraged Diversification Increases Probability of Large Losses, S&P 500 Technology Stocks

Loss	Probability				
	100% Diversified S&P 500	50% Diversified	Concentrated Single Tech Stock	50% Leveraged Diversification	100% Leveraged Diversification
5%	18.2%	25.1%	33.7%	33.8%	35.5%
10%	14.5%	20.2%	28.5%	29.8%	32.5%
15%	10.6%	17.0%	24.8%	26.3%	29.7%
20%	6.3%	13.8%	21.1%	23.6%	27.1%
25%	3.8%	11.3%	18.0%	21.2%	25.0%
30%	2.7%	8.7%	15.2%	19.0%	23.2%
35%	1.9%	6.4%	12.6%	16.9%	21.5%
40%	0.6%	4.7%	10.3%	15.3%	19.9%
45%	0.1%	2.8%	8.6%	13.7%	18.4%
50%	0.0%	0.9%	7.2%	12.3%	17.0%
55%	0.0%	0.3%	5.1%	11.0%	15.7%
60%	0.0%	0.1%	3.9%	9.8%	14.2%
65%	0.0%	0.0%	3.0%	8.9%	12.5%
70%	0.0%	0.0%	2.4%	8.1%	10.6%
75%	0.0%	0.0%	1.6%	7.0%	8.7%
80%	0.0%	0.0%	0.7%	5.5%	7.2%
85%	0.0%	0.0%	0.2%	2.9%	5.4%
90%	0.0%	0.0%	0.1%	1.1%	2.4%
95%	0.0%	0.0%	0.0%	0.3%	0.6%
95% VaR	-22.2%	-38.8%	-55.2%	-81.1%	-85.8%

Figure 4: Traditional Diversification Cuts the Risk of the Average S&P 500 Technology Stock Even More; Leveraged Diversification Increases the Risk Even More, S&P 500 Technology Stocks, 1997-2022



Finally, we ran simulations using stocks from the NASDAQ 100 and found that when the leveraged diversification strategy selects from NASDAQ stocks to diversify a single NASDAQ stock on margin the results worse than selecting additional stocks from the S&P 500. Using 15 stocks drawn from the NASDAQ 100 to diversify a NASDAQ 100 stock generated portfolios that were 50% more risky than the single NASDAQ 100 stock average. See Table 5.

Table 5: Risk and Return by Strategy and Year, NASDAQ 100, 1997-2022

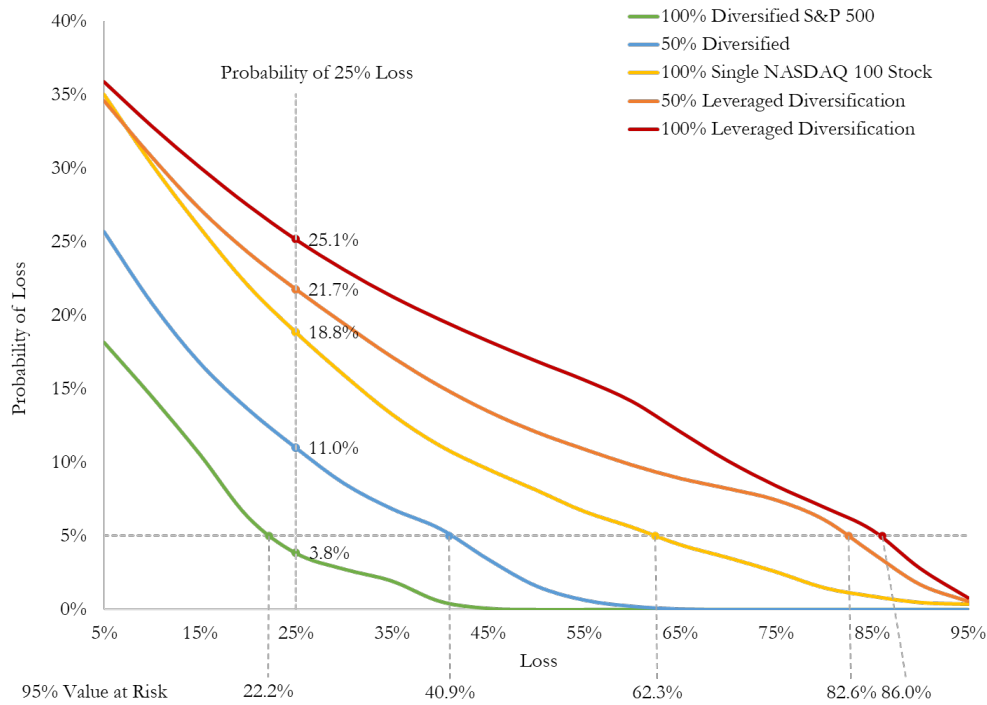
Year	100% Diversified S&P 500		50% Diversified		Concentrated Single NASDAQ 100		50% Leveraged Diversification		100% Leveraged Diversification		Margin Call for 50% 100% Leveraged Diversification	
	Return	Risk	Return	Risk	Return	Risk	Return	Risk	Return	Risk	50%	100%
1997	33.2%	20.0%	22.5%	29.6%	11.9%	52.6%	11.9%	59.9%	11.1%	67.3%	1.7%	14.0%
1998	28.0%	22.2%	31.6%	34.4%	35.1%	60.5%	45.7%	69.5%	52.4%	79.5%	6.7%	22.5%
1999	19.2%	18.3%	54.8%	35.0%	90.4%	60.4%	130.2%	65.7%	169.3%	73.8%	0.6%	2.7%
2000	-9.6%	24.3%	-12.1%	51.2%	-14.7%	91.6%	-27.0%	115.9%	-37.1%	135.2%	23.7%	52.5%
2001	-11.7%	22.2%	-18.4%	45.9%	-25.2%	93.2%	-45.1%	122.6%	-59.2%	137.8%	51.2%	82.9%
2002	-21.6%	26.4%	-31.4%	39.8%	-41.3%	77.2%	-64.7%	108.3%	-77.2%	121.9%	56.7%	94.3%
2003	28.1%	16.5%	41.8%	27.2%	55.6%	41.4%	79.7%	48.2%	103.8%	56.5%	0.0%	0.0%
2004	10.6%	11.1%	11.3%	20.5%	12.1%	35.2%	14.4%	42.8%	15.1%	52.1%	0.0%	7.1%
2005	4.7%	10.3%	4.2%	17.3%	3.7%	29.8%	0.8%	35.5%	-2.4%	42.9%	0.0%	2.8%
2006	15.3%	10.0%	13.2%	18.3%	11.1%	31.9%	11.1%	37.3%	10.9%	44.6%	0.0%	1.5%
2007	5.3%	15.7%	8.8%	21.4%	12.3%	32.6%	12.7%	37.9%	13.1%	44.5%	0.0%	0.6%
2008	-36.5%	41.1%	-39.2%	46.3%	-41.9%	64.1%	-66.0%	102.2%	-78.3%	117.9%	55.4%	96.0%
2009	26.4%	26.6%	43.8%	33.6%	61.3%	45.7%	88.7%	55.9%	114.7%	68.2%	0.0%	1.6%
2010	15.1%	17.9%	18.7%	22.2%	22.3%	30.6%	30.2%	38.2%	38.2%	47.3%	0.0%	0.0%
2011	1.9%	22.9%	0.3%	26.9%	-1.3%	36.3%	-5.1%	48.0%	-9.1%	61.2%	1.0%	6.7%
2012	16.0%	12.7%	15.3%	19.4%	14.6%	31.0%	18.7%	35.1%	22.6%	40.2%	0.0%	0.9%
2013	32.0%	11.1%	36.6%	16.1%	41.2%	25.2%	58.6%	27.4%	76.1%	30.3%	0.0%	0.0%
2014	13.5%	11.2%	16.7%	16.6%	20.0%	25.9%	26.8%	30.2%	33.6%	35.5%	0.0%	0.5%
2015	1.3%	15.3%	3.0%	19.8%	4.6%	29.4%	3.8%	35.5%	2.6%	42.7%	0.0%	2.8%
2016	11.7%	13.2%	9.3%	19.1%	6.8%	30.2%	6.9%	37.3%	7.1%	46.2%	0.5%	0.9%
2017	21.6%	6.7%	23.5%	13.8%	25.3%	24.4%	34.4%	25.2%	43.4%	26.9%	0.0%	0.0%
2018	-4.4%	17.0%	-4.6%	22.1%	-4.7%	31.9%	-11.1%	39.8%	-17.7%	49.6%	0.0%	5.6%
2019	30.8%	12.5%	33.0%	18.6%	35.1%	28.8%	48.4%	32.2%	61.8%	36.5%	0.0%	0.0%
2020	18.4%	33.4%	29.0%	38.1%	39.6%	49.0%	55.7%	67.4%	59.9%	87.6%	1.0%	20.7%
2021	28.5%	13.0%	24.2%	19.8%	19.9%	32.3%	26.6%	36.7%	33.3%	42.6%	0.0%	0.8%
2022	-18.1%	24.2%	-21.1%	31.1%	-24.1%	46.1%	-40.2%	69.6%	-54.5%	84.1%	11.3%	62.6%
Average	10.0%	18.3%	12.1%	27.1%	14.2%	43.7%	17.2%	54.8%	20.5%	64.3%	8.0%	18.5%

The probabilities of losing more than 5% to 95% of equity in one year selecting single stocks and 15-stock complementary portfolios from the NASDAQ 100 reported in Table 6 and plotted in Figure 5 are similar but slightly higher than the probabilities of various loss thresholds and the VaR results for the S&P 500 Technology sector reported in Table 4.

Table 6: Leveraged Diversification Increases Probability of Large Losses, NASDAQ 100

Loss	Probability				
	100% Diversified S&P 500	50% Diversified	100% Single NASDAQ 100 Stock	50% Leveraged Diversification	100% Leveraged Diversification
5%	18.2%	25.7%	35.0%	34.6%	35.9%
10%	14.5%	20.8%	30.2%	30.7%	32.8%
15%	10.6%	16.7%	25.9%	27.2%	30.1%
20%	6.3%	13.6%	22.0%	24.3%	27.5%
25%	3.8%	11.0%	18.8%	21.7%	25.1%
30%	2.7%	8.6%	15.9%	19.4%	23.1%
35%	1.9%	6.8%	13.3%	17.2%	21.3%
40%	0.6%	5.5%	11.1%	15.2%	19.7%
45%	0.1%	3.4%	9.5%	13.5%	18.2%
50%	0.0%	1.6%	8.1%	12.0%	16.9%
55%	0.0%	0.7%	6.7%	10.9%	15.6%
60%	0.0%	0.2%	5.6%	9.8%	14.1%
65%	0.0%	0.0%	4.4%	8.9%	12.1%
70%	0.0%	0.0%	3.5%	8.2%	10.1%
75%	0.0%	0.0%	2.5%	7.4%	8.4%
80%	0.0%	0.0%	1.5%	6.1%	6.9%
85%	0.0%	0.0%	0.9%	3.8%	5.4%
90%	0.0%	0.0%	0.5%	1.7%	2.8%
95%	0.0%	0.0%	0.3%	0.5%	0.8%
95% VaR	-22.2%	-40.9%	-62.3%	-82.6%	-86.0%

Figure 5: Traditional Diversification Cuts the Risk of the Average NASDAQ100 Stock; Leveraged Diversification Increases the Risk, NASDAQ100, 1997-2022



Conclusion

The leveraged diversification strategy is still being recommended to reduce risk today, twenty years after we first demonstrated that it *predictably* did exactly the *opposite*. In this update to our earlier work, we extended our analysis to cover the broader stock market using 26 years of daily returns. We also present more sophisticated risk measures and demonstrate the “hold, borrow, and buy some more” advice is always wrong.

How could such a flawed strategy continue to be recommended and followed in 2023? An investor might wish to defer paying capital gains taxes if the concentrated stock position has large, embedded capital gains even though the true benefit of deferring capital gains taxes is actually quite small in most cases. Perhaps, the stock has recently gone public and the investor/employee feels loyalty and confidence in the issuer. The investor may be a risk-taker. Neither taxes nor sentiment nor an appetite for risk-taking is likely to be a good reason to hold the concentrated position in light of the empirical evidence we have marshalled. An advisor facing an investor reluctant to diversify a concentrated position should at a minimum present the type of probability of loss analysis we present above so the investor can appreciate how likely it is she will lose 25% or even 50% of her wealth following the leveraged diversification strategy.

Of course, advisors and brokers who make more money if they advise more of their clients’ gross assets have an incentive to recommend a variety of borrowing strategies, including the leveraged diversification strategy. Rather than strenuously advocate for traditional diversification which will lower the risk and increase the risk-adjusted returns for most investors with a concentrated stock position, these conflicted advisors and brokers may present leveraged diversification and other borrowing strategies, understating the extraordinary risks attendant with following such bad advice. The conflicts are greater, and the advice worse, if the additional investments purchased to “diversify” are illiquid private placements.

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