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Barbell Portfolio

I am a big fan of the work of Nassim Taleb. I've read his *Incerto* book series, and I think that these are some of the best books I've ever opened. In one of those books, *Antifragile,* the author explains the idea of barbell risk exposure: to always cover your downside, but be exposed to the upside. Success (an ill-defined term; read "non-failure") only happens if, and only if, one is "alive" - healthy, not bankrupt, financially independent, etc. Therefore, the most important part of life is not to "reach the Moon," but rather to "not die."

Speaking in financial terms, this idea translates as "the most important goal is not to make a lot of money, but to avoid losing it all." This is the goal of this paper - to create a portfolio that is covered against unlikely but devastating events yet exposed for unlikely but enriching ones. This type of portfolio is referred to as "barbell portfolio," coming from the image of a barbell, on one side of which there are a lot of weight discs, while on the other there are few but heavier. In finance terms, it means to put most of one's funds into exceptionally safe securities that only cover inflation, and put the rest into unreasonably risky investments that have enormous upside and little costs. It also means that mid-risky securities must be avoided at all costs since the risk and return of these investments is most certainly incorrectly computed due to the underlying distribution of security returns.

Before we move on to constructing such a portfolio, a note about the distributions and statistical interpretation of the calculations. Most of the analytical tools we have so far are based upon the idea that securities' returns are normally distributed. For normal distributions, we use such tools as mean, variance, standard deviation, and hypothesis testing. However, the returns aren't normally distributed - it is enough to look at kurtosis and skewness of these returns to infer that they are, in fact, thick-tailed. Thick-tailed distributions imply that the probability of very unlikely events is smaller, but the outcome can be devastating. (Again, the upside is limitless as well, but addressing the downside is of bigger importance.) And the tools of normal distribution used on non-normal distributions will lead to misinterpretation and underestimation of risks. However, this knowledge will allow me to exploit kurtosis and skewness and get the desired upside.

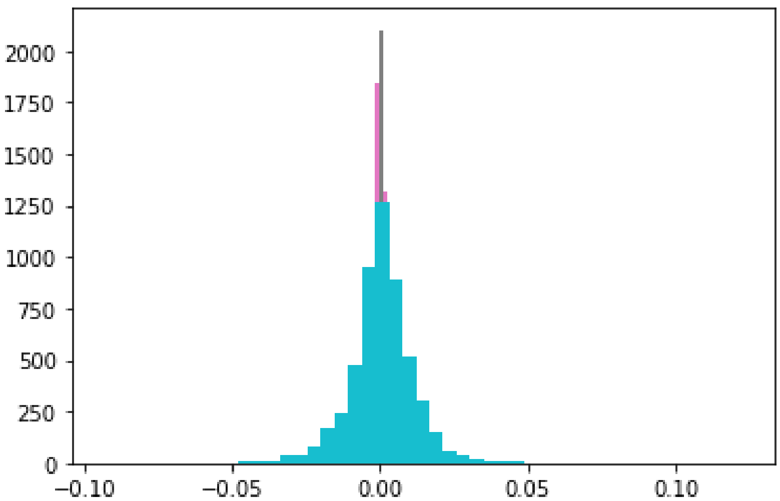
Now, as was mentioned before, this portfolio has two sides - left and right, super safe and super risky. Left side will have 85% of weight on the portfolio, while the right side - 15%. For the left side, I picked a mixture of TIPS - treasury inflation-protected securities - ETFs (TIP and LTPZ, 40 and 10% weight on the side respectively), short-term bonds ETFs (SHV, VGSH, VCSH, SHM, BSV, BIL, and BWZ, each taking 4.29% of the side's weight), and gold futures (GC=F, remaining 20% of the side) - all of these investments have proven to be safe investments in the past, and I will provide calculations later. For the right side I tried to pick the riskiest investments I could possibly pick: a mix of emerging market bonds ETFs (EMSH, EEM, and VWOB), high-yield bonds (SPHY, BSJO, and HYG), the so-called "meme stocks" (AMC and GME), and cryptocurrencies ETFs (GBTC and ETHE). Each of these securities takes 10% of the right side's weight.

One might ask me, "Why not invest in startups? They seem to be the riskiest of all!" While that is true, I couldn't find a way to make an unbiased set of IPOs. Because one doesn't know how an IPO will perform in its first and subsequent days, it is basically a blind investment (not exactly, but I hope you get the point). Therefore, I have to put myself in the same situation, simulating a random pick of an IPO to invest in. However, there is an inherent hindsight bias in my choice:

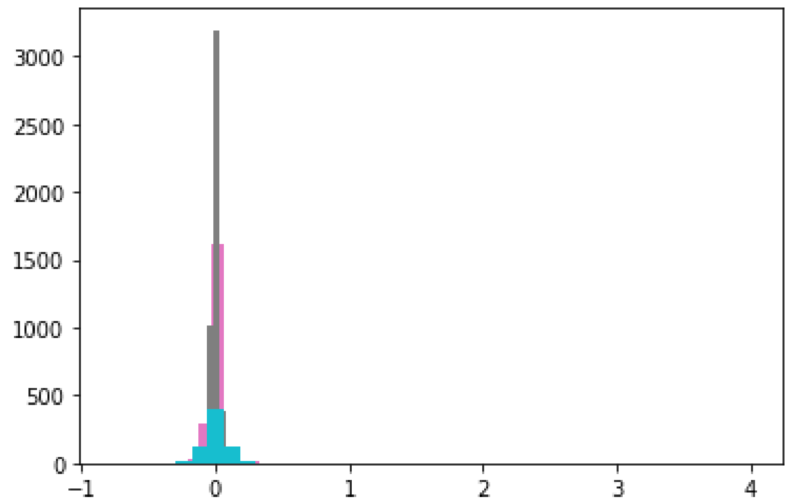
since I already know the results, picking good stocks will unfairly inflate the return on my portfolio, while picking bad stocks just doesn't make any sense, and I couldn't find any sort of database of IPOs to randomly pick from. This is why I decided to leave IPOs out of the portfolio.

Now, it's time to calculate basic statistics of each individual stock, of the sides, and of the portfolio as a whole. First things first, I wanted to make sure that the distribution of returns on these securities is indeed non-normal, so I calculated kurtosis and skewness and got the following picture:

Left side



Right side



A couple of observations. First of all, both distributions have big kurtosis: 27 on the left side and 145 on the right. Huge kurtosis on the right side means that the returns of low-probability events will have a much greater effect on the returns. This, combined with much higher than average positive skewness means that these low-probability events are more likely to occur on the positive side of the returns distribution, which is exactly what we wanted - this is the positive Black Swan exposure. Now, upon examining the left side's returns, we can observe that it is more normally distributed than the right side, and the greater weight is given to those securities with lowest variances and returns; to those that cover inflation and a little above that. It protects us against negative Black Swan exposure.

We can also confirm these observations by looking at the means and standard deviations of the sides: the left side's mean and standard deviation are 4.62 and 7.38, while the right side's are 51.19 and 67.25. This reaffirms Taleb's idea of giving a lot of weight to the safest securities and little weight to the riskiest securities with big potential payoffs.

The overall portfolio statistics are as follows: mean - 9.82, standard deviation - 13.39, kurtosis - 0.3, skewness - 39.02.

Now that we've calculated descriptive statistics, it's time to make a couple of hypotheses just to reaffirm our observations. I used 7 tests:

1. Is the left side's mean return equal to 0?
2. Is the right side's return equal to 0?
3. Are mean returns from both sides of the portfolio equal?
4. Is the left side's variance equal to 0.009?
5. Is the right side's variance equal to 1.198?
6. Are variances of both sides of the portfolio equal?
7. Is there a correlation between the sides?

My sample size for the left side is 3050, and for the right side - 676. The reason why the right side's sample size is much smaller is due to the technicalities with dropping N/A values in Python. This function leaves only those data points, the rows in which are non-N/A only. And since ETHE ETF's data was only available from mid 2019, all other securities time-series have to start from mid 2019. The left side's time-series starts from ~2010.

Since both sample sizes are bigger than 30, and the population variances are unknown, I will use t-statistic in tests 1 and 2 with degrees of freedom equal to 3049 for the left side and 675 for the right one. Since test #3 has two sample means, I will also use t-statistic, though with a slightly different calculation of the degrees of freedom (3721). Test 4 and 5 are χ^2 statistic tests. Test 6 uses F-statistic since two variances are compared. The last test is a non-parametric test on correlation. The results for these test are as follows:

1. P-value = 0.017. We conclude that there is enough evidence to reject the null hypothesis (mean annual return for the left side = 0)
2. P-value = 0.011. We conclude that there is enough evidence to reject the null hypothesis (mean annual return for the right side = 0)
3. T-stat = -1136.28, cutoff = -1.96. Since our t-stat is on the left of the cutoff value, we conclude that there is enough evidence to reject the null hypothesis (mean annual return is equal for both sides).
4. χ^2 =299464.95, cutoff = 3178.57. Since our χ^2-stat is on the right of the cutoff value, we conclude that there is enough evidence to reject the null hypothesis (variance for the left side = 0).
5. χ^2 = 67434.79, cutoff = 736.55. Since our χ^2-stat is on the right of the cutoff value, we conclude that there is enough evidence to reject the null hypothesis (variance for the right side = 0).
6. F-stat = 135.396, cutoff = 1.147. Since our F-stat is on the right of the cutoff value, we conclude that there is enough evidence to reject the null hypothesis (variance for both sides is equal).
7. Correlation = 0.0567, p-value = 0.14. Correlation coefficient shows that there is no correlation. P-value in this case doesn’t matter because Pearson test for correlation assumes normal distributions, and in this case they aren’t. Hence, p-value is meaningless.

The hypothesis test showed a couple of things. We learned that the mean annual returns are not 0 for either side, nor are they equal to each other. Same can be said for each side’s variances. It reaffirms our belief that two sides have absolutely different risk/return profiles. Finally, we made sure that there is no correlation between the sides of the portfolio because correlation would defeat the whole purpose of an antifragile portfolio.

In conclusion, the barbell portfolio is indeed antifragile - it protects against negative Black Swans yet provides exposure to positive ones. In plain English, it means that the worst case scenario isn't bankruptcy but a relatively small loss, while the best case scenario is limitless positive return. Even though analytical tools based on the normal distribution are flawed when used on non-normal distributions, and the inferred interpretation often underestimates risk, the barbell distribution allows one to not care about these flaws. On the other hand, it exploits these flaws in its favor. The applicability of this type of portfolio extends outside of the finance field because the idea behind it is present in our day-to-day life, and I wish that more things in our society - products, industries, city planning, government policies, etc. - took it into consideration during the decision-making process.