Portfolio Drawdown Protection

by *Guy R. Fleury*

Portfolio Drawdown Protection will cover how we can partially protect our stock portfolio from market drawdowns.

Will be shown that even a portfolio level trailing stop-loss can limit the damage drawdowns can inflict on long-term performance.

Any drawdown should be considered as a drag on any portfolio's overall return since we not only have to recuperate the downfall, we also have to replace the lost opportunity that occurred during those market declines.

We need some more background to the process. First, we will consider how we can further raise the portfolio's long-term CAGR, and then, add protective measures. Doing the reverse, meaning, adding protective measures first, will tend to curtail, from the start, our ability to increase performance beyond certain levels due to the very early limits we want to impose on our trading strategy.

Let the strategy rise as much as it can, and then, set the limits you will find acceptable in your own trading scenario. If this makes your trading strategy produce a little less, so be it.

There is a price to pay for portfolio protection. We do not need to kill our future CAGR just because we want a little protection.

My two previous articles (**Compensate For Portfolio Drawdowns**)[1] and (**Surviving Market Drawdowns**)[2] dealt with ways to first survive portfolio drawdowns, then compensate for them, and ended with over-compensating to increase overall long-term portfolio returns.

Compensate For Portfolio Drawdowns used the 5 most significant drawdowns of the last 40 years to demonstrate what would be needed to do the job of maintaining

[1] **Compensate For Portfolio Drawdowns** is available as a **PDF file.**

[2] **Surviving Market Drawdowns** is also available as a **PDF.**

a 20% CAGR over the entire period. Was even provided the equations to do so.

Portfolio Drawdown Protection will concentrate on the protective measures alluded to in those two articles. An attempt to show that protective measures, even if often small, can uncover opportunity costs and could also bring huge rewards.

The last article **Compensate For Portfolio Drawdowns** showed it was not enough to just compensate for drawdowns, meaning getting back to even. There remained a need to do even better, to over-compensate. Doing so provided a means to increase one's long-term CAGR (compounded annual growth rate).

In the series of articles: *a trading strategy of interest*,[3] we used a plain QQQ weekly rebalancing program to make the point that you could have bought QQQ outright some 12 years prior and would have done slightly better than trading QQQ's 100 constituent stocks. The trading strategy had over 60,000 trades over the period, more than enough trades to use the words "on average" it did this or that.

By the very nature of that program, 99^{+}% of trades were executed as a consequence of the weekly scheduled rebalancing on the 100 stocks part of QQQ.

Portfolio Equations

The portfolio's value equation enabled comparing a Buy & Hold scenario to its payoff matrix trading counterpart using the same initial capital:

$$F(t) = F_0 \cdot (1 + \bar{g})^t \; > \; F_0 + \sum^{N} (\mathbf{H_{QQQ}} \cdot \Delta \mathbf{P}) \tag{1}$$

You would have had a higher overall return using the Buy & Hold scenario than having rebalanced weekly QQQ's 100 stocks. This was demonstrated in those 7 articles and notes where 44 simulations were performed to validate each of the points being made.

The difference was not that huge, it represented maybe something in the order of 1% or so but still amounted to significant money over a 40-year period. It also demonstrated that you could tend to the long-term CAGR but not necessarily exceed it, which should be the whole purpose of trading instead of just holding QQQ for the duration.

In **A Trading Strategy Of Interest** the chart showed that over the long term, the expected average CAGR tended to the actual average: $\lim_{t \to T} \mathsf{E}[\hat{g}] \to \bar{g}$.

Why would you trade if your trading strategy, whatever it is, would be mathematically

[3] See list of related articles page 14.

expected to do less than its equivalent Buy & Hold scenario and this, using the same initial capital? This should take away any motivation for trading that particular strategy. You would get better results by simply choosing to do a lot less work. A single trade compared to $60{,}000^{+}$ for the trading strategy.

We will show that we can reverse the greater sign in Equation 1 by producing:

$$F(t) = F_0 + \sum^{N} (\mathbf{H} \cdot \Delta \mathbf{P}) \gg F_0 \cdot (1 + \bar{g})^t \tag{2}$$

The difference in those two equations is small, just one character "$\gg$", but what a difference it will make. The first part of Equation 1 says that whatever our trading strategy, it can all be expressed as an average growth rate $\bar{g}$ applied over so many years. Whereas the payoff matrix says, no matter how you will trade over the entire trading interval, all the profits and losses will be a result of that very trading, no matter how many trades will be made.

Drawdown Compensation

We can restate *equation* 2 from **Compensate For Portfolio Drawdowns**):

$$cf_i = (1 - dd_i) \cdot \left[(1 + (1 + \frac{dd_i}{1 - dd_i})) \cdot (1 + 0.20) \cdot (1 + 0.20) \right] \tag{3}$$

which gave the i^{th} compensation factor cf_i to be applied following a drawdown of -dd_i to restore the CAGR to its cruising speed of 20% per year. The 20% per year might seem high, but it was, nevertheless, the outcome of the QQQ rebalancing strategy as presented in the 7 related articles listed on the last page. So, it is not deemed as that hard to get.

In order to get back on track after each of the drawdowns (dd_i) we had to apply this correction factor cf_i which redressed the CAGR to its prior state. These cf_i factors would be inserted in the series of yearly returns to replace the drawdown years.

$$(1 \pm r_1) \cdot (1 \pm r_2) \cdots cf_i \cdots (1 \pm r_{t-1}) \cdot (1 \pm r_t) = (1 + \bar{g})^t \cdot (1 - dd_i) \tag{4}$$

It did not matter where the compensation factor cf_i would be inserted in the series, since it would not change the final outcome. We could even break cf_i into its components and scatter them all over Equation 4. All 4 components of cf_i are multiplicative and are used to replace each down year -dd_i.

The same component structure could apply going forward, even if we did not know when they would occur or how many there would be. Already, we did not know the value for the returns ($\pm r_i$) for any of those years anyway. Going forward is not the same as using some historical data. Nonetheless, going forward, we will always be able to say $\pm r_i$ since it will be an unknown.

We could generalize by allowing the equation to adapt to the strategy's built-in long-term expected growth rate $\hat{g}$ and simplify Equation 3 to:

$$cf_i = (1 - dd_i) \cdot \left[(1 + (1 + \frac{dd_i}{1 - dd_i})) \cdot (1 + \hat{g})^2 \right] \tag{5}$$

where $(1 + \hat{g})^2$ represent the missed return opportunities: the one that occurred during the decline and the one missed during the recovery. As was demonstrated in the prior article, this has a major impact on final returns moneywise.

Over-Compensation

Was also addressed in the previous article **Compensate For Portfolio Drawdowns** the concept of over-compensation, which would overshoot the recovery target and thereby improve performance.

$$cf_i = (1 - dd_i) \cdot \left[(1 + (1 + \frac{dd_i}{1 - (dd_i + ocf_i)})) \cdot (1 + \hat{g})^2 \right] \tag{6}$$

The over-compensation factor ocf_i becomes part of the mechanics of the trading system being elaborated [4]. It is like telling your trading strategy to give you this much extra performance. The impact will depend on the ratio of $\frac{ocf_i}{dd_i}$.

The objective of cf_i in Equation 6 is to over-compensate for the portfolio decline proportional to the actual drawdown dd_i. And the over-compensation factor ocf_i will make this happen. It will start to provide an explanation for Equation 2 since this move with $ocf_i > 0$ is sufficient to over-compensate the drawdowns and seriously overcome the Buy & Hold scenario.

This is the same as *equation* 7 in **Compensate For Portfolio Drawdowns**. Just to recall, it produced Figure 1 below.

As was also stated: the over-compensating factor ocf_i is under our purview and should be incorporated into our strategy design. We need to make our trading strategy respond to this thing or thereabout.

The side effect of applying the over-compensation factor ocf_i is to see a rising CAGR over the period, as was expressed in *Figure* 12 of the cited article and which is reproduced below as Figure 2.

We should not be surprised by a rising CAGR. It was the reason for the over-compensation and its direct impact would have to be this rise in CAGR over the period, otherwise, something would not be consistent with the equation.

[4] Refer to my 2014 paper **Fixed Fraction** where it was discussed in more detail.

As Figure 2 expressed, the CAGR would not be as smooth as the blue line but be more erratic like the green line. This, however, would not change the outcome.

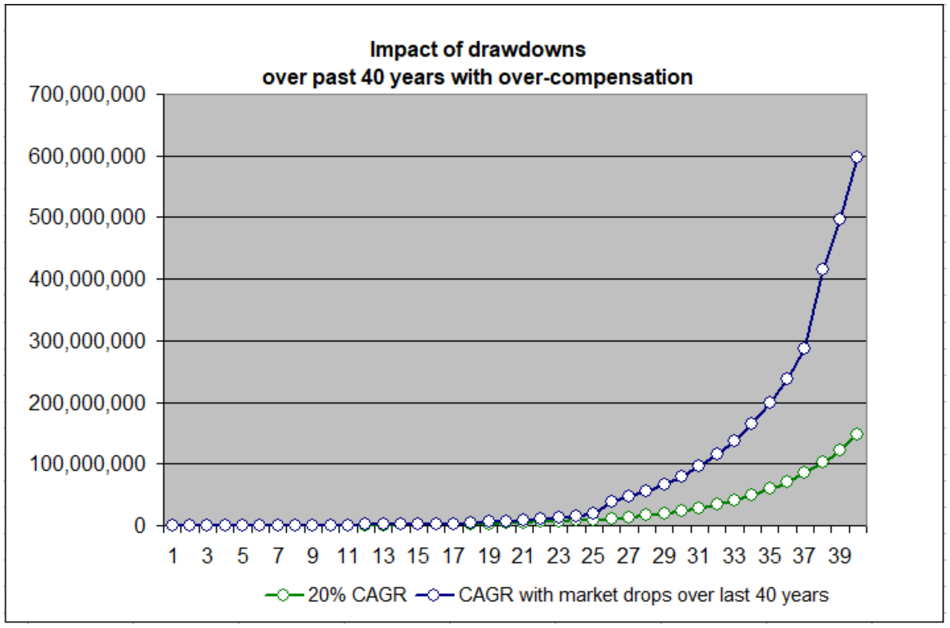

Figure 1: 20% CAGR portfolio with over-compensation

The endpoints would be the same since: $\left[\frac{F(T)}{F_0}\right]^{\frac{1}{40}} - 1 = \bar{g}$. By raising the over-compensation factor ocf_i, we raised $F(T)$, the final outcome. That was the whole purpose of raising $F(T)$ over the period. It was to increase the overall CAGR.

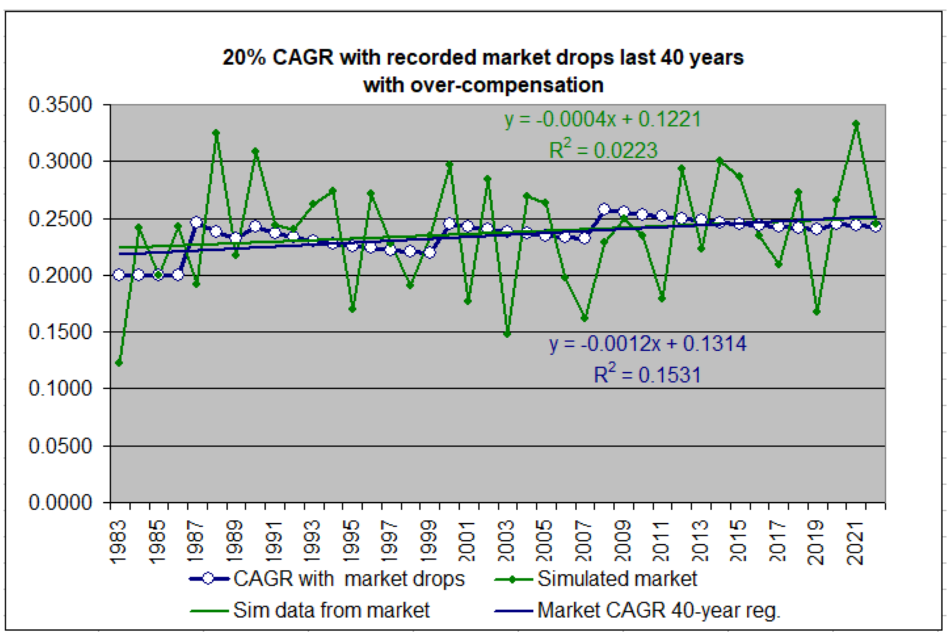

Figure 2: 20% CAGR with over-compensation and market data

Gaining Control

Since we are the ones designing this over-compensation factor, we technically gain some control over our portfolio's behavior. Meaning that we could modulate this over-compensation factor ocf_i to suit our views of the market. Increasing ocf_i in a general upside market and decreasing it during market downturns. This could be giving us some outside control over the trading strategy and in a way help us regulate what we want to see as outcome for our portfolio.

Figure 1 should be put back into context. Without the over-compensation, the outcome would have been as presented in *Figure* 7 of **Compensate For Portfolio Drawdowns**. That chart is reproduced as Figure 3 below.

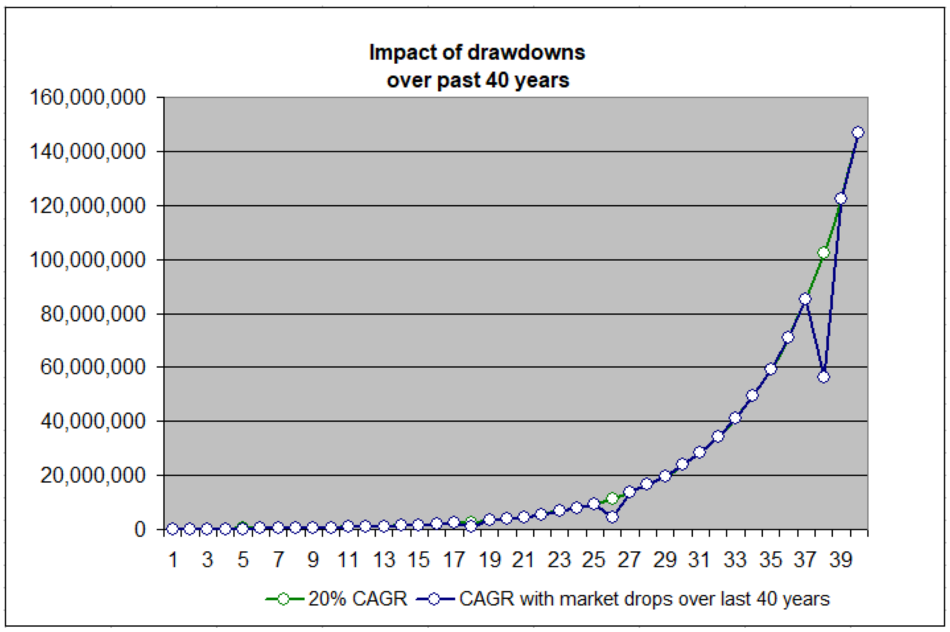

Figure 3: 20% CAGR over 40 Years with compensation factor

The over-compensation had quite an impact on the portfolio's ending value. We are in a compounding return environment, and every bit of added CAGR anywhere on the curve will propagate forward. It is not just the immediate impact that is considered, it is that it will also be compounding for the rest of the time interval until you reach $F(T)$ your portfolio's termination time or liquidation date.

The payoff matrix of Equation 2 is responsible for all the added performance, and $\bar{g}$ had to rise as a result to maintain the equal sign. You did achieve a higher return on your portfolio, but it is the trading, and only the trading, that generated the added return.

Raising The Over-Compensation Factor

Raising the over-compensation factor by 20% ($ocf_i \cdot (1 + 0.20)$) generated Figure 4.

The request was not for much. Compare Figure 4 to Figure 3 to Figure 1. All we have is a difference in scale. The green line on those charts is the same and ends with the same value. And yet, Figure 4 made $400 million more when compared to Figure 1. And this, by increasing the over-compensation factor by 20%. We have not changed the strategy in doing this, we simply made the decision to compensate a little more. All the trades still occurred at the same times on the same dates at the same prices. The difference, evidently, has to be in the position size of each trade.

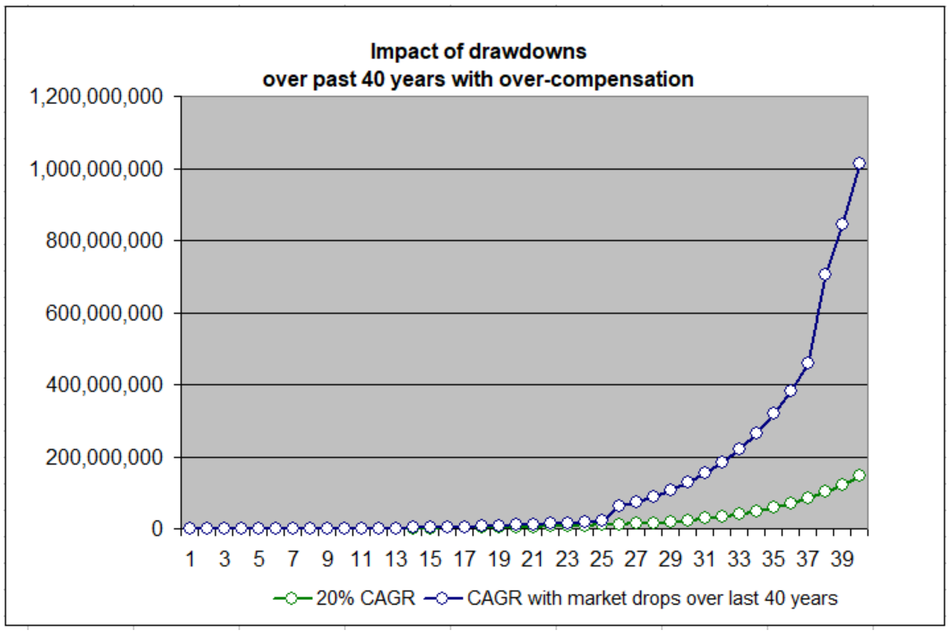

Figure 4: 20% CAGR with over-compensation factor raised 20%

That over-compensation decision is not made by the program, it is something we design in the trade mechanics of that program since we are the architects of how the strategy is going to behave. We force it to do what we want.

Some might think that raising the over-compensation factor will be hard to do, when in fact, it is rather simple. Your trading strategy, whatever it is, has an average long-term profit target that it tends to. It is often expressed as a statistical equivalent or part of the strategy's metrics. A strategy simulation can easily provide this number. And what you need to do is have your strategy raise that number, increase its average profit target by 20%.

If your average profit target was 10%, then find ways to raise it to 12%. How hard could that be in a generally rising market, which is what we have had over the past 12 years?

Administrative Decisions

Raising the over-compensation factor another 16% would result in Figure 5 below.

All we did was raise the average profit target. This is not a fixed profit target, but rather the overall average of the trade dynamics of the trading program. It is not as easy as saying: set the profit target at 15% instead of 12%. We are dealing with the average outcome of the strategy's trade mechanics. Sometimes you will accept a higher profit margin and sometimes less, but overall will still request that "on average" you get the higher average.

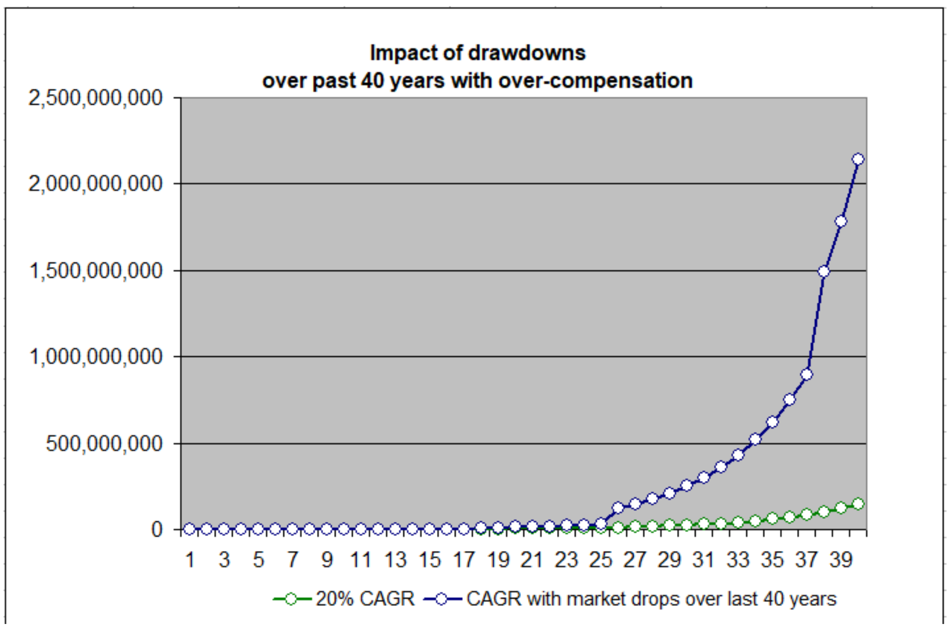

Figure 5: 20% CAGR with over-compensation factor

Is there much in those modifications to the trading strategy? Well, not that much, but in a way, we are setting grounds for controlling the path of our trading strategy using simple requests that could even be set from outside the trading program. As if having the program respond to our appraisal of market conditions, to our administrative decisions.

We are setting trading procedures that will respond to what our program has not seen yet, knowing that it will overcome what is thrown at it.

The one thing that needs to be considered more is the long-term view of the problem.

The difference between a 10% and a 12% average profit target is relatively small. The same goes for going from 12% to 15%. It is even easier to achieve in a rising market. But the point is that you would have to persevere with the same objectives and focus for the duration of the portfolio, and in this case, some 40 years.

The First 20 Years

What does it look like over the first 20 years? Based on Figure 5, the curves appear as almost flat, and yet, if those curves were not there, the rest of the curves would not be there either.

Figure 6 is zooming in on the first 20 years. Already, the over-compensating curve (blue line) has taken over the green line (the 20% CAGR curve). The overall curves are still as displayed in Figure 5 above.

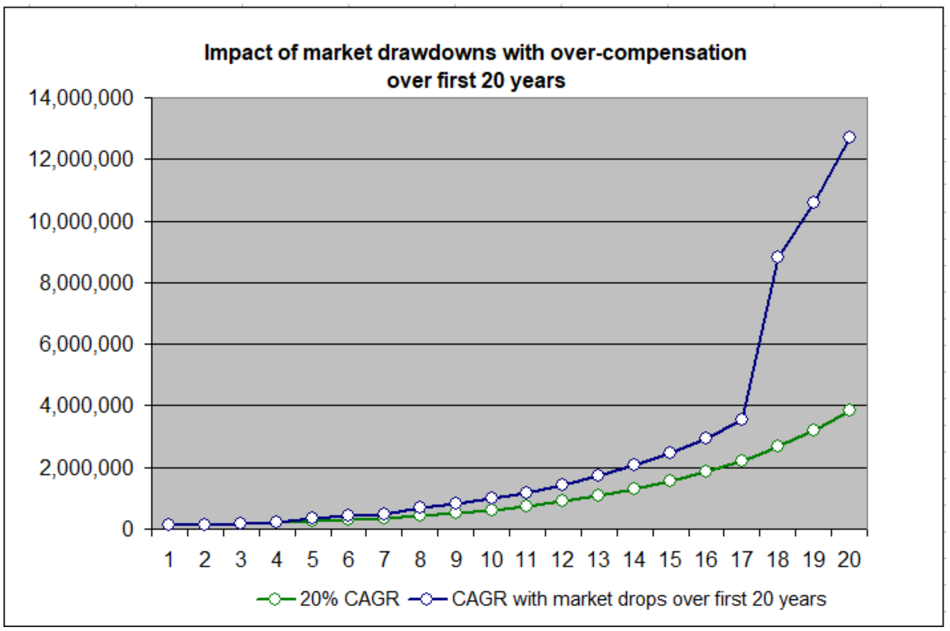

Figure 6: 20% CAGR with over-compensation factor first 20 years

We changed Figure 2. Not by much, but Figure 7 does show the increase in CAGR over the period. It ended with a 28.31% CAGR for those 40 years. A 41.55% in CAGR terms over the period. At times, it went even higher as it oscillated around its long-term upward trend.

Once again, the green line represents the CAGR's evolution over the period and is different from Figure 2 since it too was randomly generated. But it does not change the final picture. Each drawdown was over-compensated and the added profits compounded over the rest of the trading interval. Each drawdown, with its over-compensating factor, pushed profits higher and higher. All contributing to the final outcome.

Finally, we get to the protective measures.

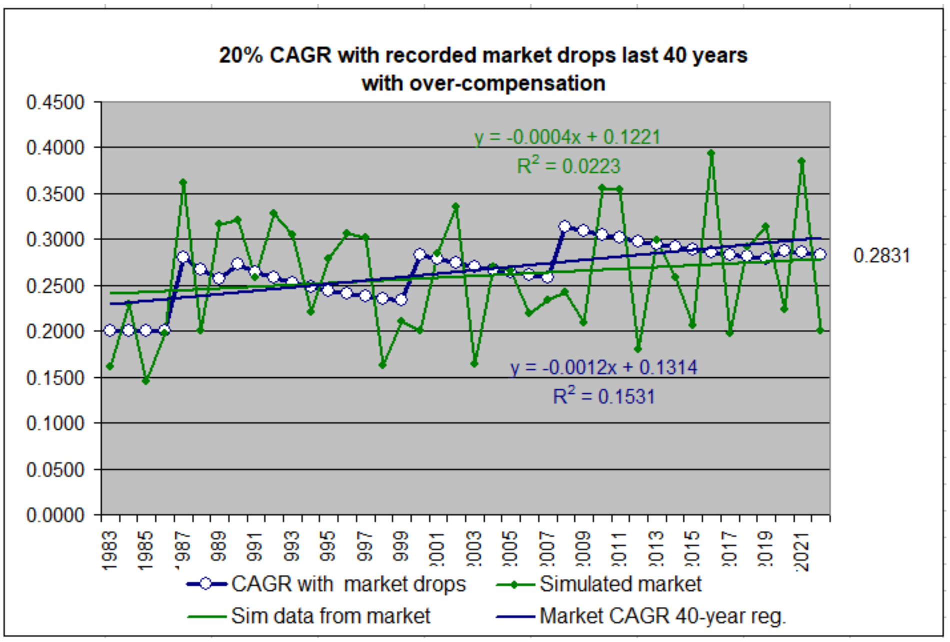

Figure 7: 20% CAGR with over-compensation

Protective Measures

Drawdowns had a major impact on this trading strategy. It was shown in the preceding article that even if the trading strategy was designed for a 20% CAGR over the long term, it could be cut in half, if not corrected, due to these drawdowns.

In the preceding section, performance was increased by over-compensating for the drawdowns, and it was relatively easy to do so. But there is more we can do. And that is to reduce the magnitude of those drawdowns. Meaning, we could add some downside protection.

Say we adopt the simple procedure of getting out if the market drops by -20%. This way, you will not suffer higher drawdowns than this -20% mark.

We cannot escape the drawdowns, but we can dampen their impact. For instance, as noted, a -20% portfolio level stop-loss would spare the portfolio from anything that would go below that since you would be out of the market by executing it.

We could bring a slight change to Equation 6 and have the following:

$$cf_i = (1 - 0.20) \cdot \left[(1 + (1 + \frac{dd_i}{1 - (dd_i + ocf_i)})) \cdot (1 + \hat{g})^2 \right] \tag{7}$$

where the initial drawdown would be limited to -20%.

But the problem is more complicated than that. A global portfolio level trailing stop-loss would do this initial job, but then, how would you time the re-entry? I will leave that question open for now.

The market drawdowns will occur, whether we participate or not. We will need to introduce a timing component to the rebalancing program. The objective will be to find when would it be a proper time to get back in the market and by what proportion. Should we go all in and get full exposure on re-entry, or should we go step by step to fully invested over some predetermined interval? Those answers will also have an impact on the outcome.

It would appear that Equation 7 is not sufficient. We need a better representation of the problem. The trailing stop-loss thing is relatively easy. Any trading software can do that. What is left to determine is dd_i. There is the one from the market itself, which you cannot escape as still in Equation 7, and this other one, which is the how much we would have participated in the recovery section of the curve.

Figure 8 is the outcome of applying Equation 7 with a trailing stop-loss of -20%. Instead of supporting the whole decline, only the first -20% of those drawdowns were endured. However, since we did not change the dd_i fraction of Equation 7, this implies that the strategy benefited from having perfect timing for its re-entry signal. We will need to change that and be more realistic. There are methods that can still give us the major part of that recovery. So, for now, let's say we should get a little less than what is displayed.

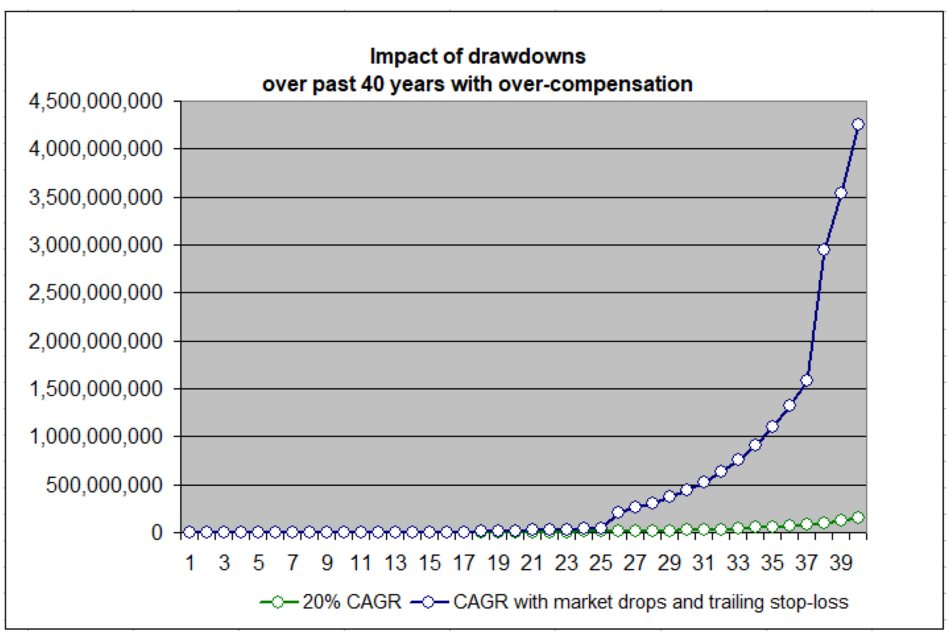

Figure 8: 20% CAGR with over-compensation and trailing stop-loss

One of the drawdowns had no impact since it was already at the -20% level. So changing it to -20% would not have made any difference. Nonetheless, limiting the drawdowns, using a simple procedure (trailing stop-loss) proved to be worthwhile by more than doubling the portfolio outcome (see Figure 8).

Say you find it reasonable to have a -10% trailing stop-loss. That is easy to implement as well, simply reduce the initial drawdown in Equation 7 to 0.10.

$$cf_i = (1 - 0.10) \cdot \left[(1 + (1 + \frac{dd_i}{1 - (dd_i + ocf_i)})) \cdot (1 + \hat{g})^2 \right] \quad (8)$$

Compared to Equation 7, the difference does not appear to be that considerable. What would be the impact over those 40 years?

Using the same scenario as before but with the slight change in the trailing stop-loss from 0.20 to 0.10 (see Equation 8) generated Figure 9. So, the big question is: how come?

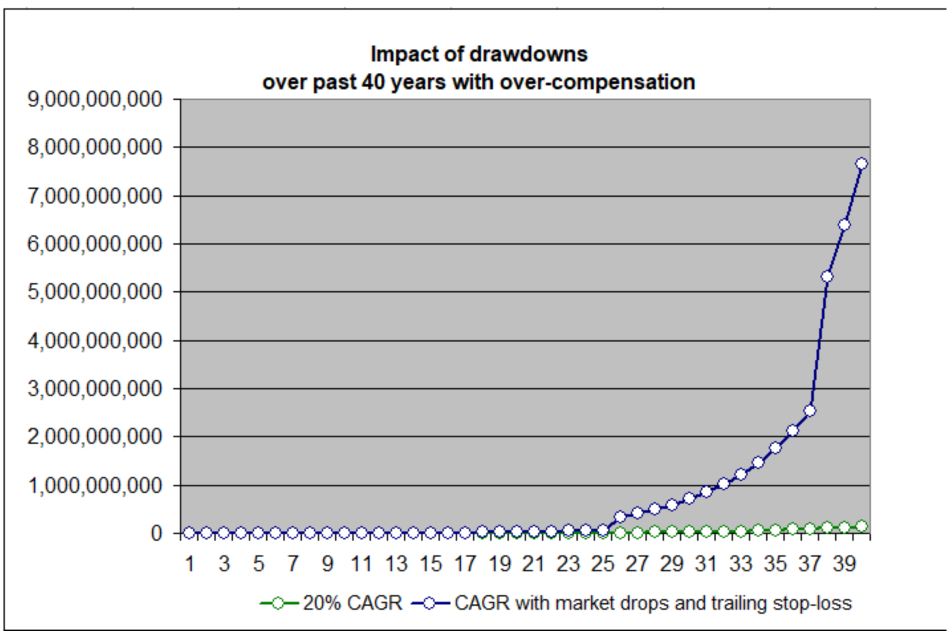

Figure 9: 20% CAGR with over-compensation and 10% trailing stop-loss

Strategy Requests

We have seen quite a progression from Figure 1 to Figure 4, Figure 5, Figure 8, and finally to Figure 9. All of it based on minor modifications to the compensation factor cf_i over the trading interval. Underlying the portfolio was this $\bar{g} = 0.20$ growth rate shown as the green line in either Figure 1 or Figure 9.

These changes are part of what we can request our trading strategy to do. We can set what will be our global trailing stop-loss, including our average re-entry point after a major decline. We can determine by how much we want to over-compensate for the most recent drawdown and what would be the general policy applicable to future drawdowns.

We are the ones to determine how we will behave in that erratically evolving stock market. Sure, we will have drawdowns going forward. What we need to learn is how to take care of them and benefit from the process. That part is up to us.

Note that even if you have those nice equations, it would still take 40 years to get there, whatever the level you would settle on in terms of general stop-loss and over-compensation factors. In the end, you are the one to make those decisions, and they do have an impact on your overall portfolio performance.

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A Trading Strategy Of Interest – PartI II

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My Books on Amazon:

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Beyond the Efficient Frontier. *Amazon*, 2018.

From Zero-Beta to Alpha Generation. *Amazon*, 2017.

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