Compensate For Portfolio Drawdowns

by *Guy R. Fleury*

My last article (**Surviving Market Drawdowns**)[1] covered the need to exceed average market returns. It considered drawdowns and inflation which have long-term effects on stock portfolios. The article expressed the need to compensate, if not over-compensate, for these negative factors, which tend to dampen long-term returns and thereby act as a drag on performance.

Compensate For Portfolio Drawdowns will extend that perception by examining the impact of 5 of the most significant drawdowns of the last 40 years.

Historical Drawdowns

Over the past 40 years, we have had 5 drawdowns of significance.

Over the next 40 years, we might just have more of the same, maybe more.

The following table lists the 5 major drawdowns and their respective compensation factors to restore the portfolio's CAGR to its historical market average of about 10% over those 40 years.

Year	Drawdown	Compensation Factor	10% CAGR Scenario Correction Factor
1987	-34%	1.8333	$(1 + 0.5152) \times 1.10^2$
1990	-20%	1.5125	$(1 + 0.2500) \times 1.10^2$
2000	-49%	2.3725	$(1 + 0.9608) \times 1.10^2$
2008	-56%	2.7500	$(1 + 1.2727) \times 1.10^2$
2020	-34%	1.8333	$(1 + 0.5152) \times 1.10^2$
	Total	33.1685 or 3,316.85%	for total compensation.

[1] Also available as a **PDF file**

In total, and only considering the successive correction factors, 3,316.85% in gains were required over the 40 years in question to maintain the average at its 10% pace. That is quite steep for a recovery factor.

Graphically, the above table will produce a CAGR chart similar to Figure 1. Note that on the first drawdown, the portfolio would have gone slightly negative, and the correction factor returned the CAGR to its 10% average cruising speed. On each drawdown, compensation was performed according to the factors in the above table. Following all the corrections, the portfolio would end with an average 10% CAGR over those 40 years. It looks like a simple graph, but a tremendous amount of work would have been required to maintain this 10% CAGR over the period.

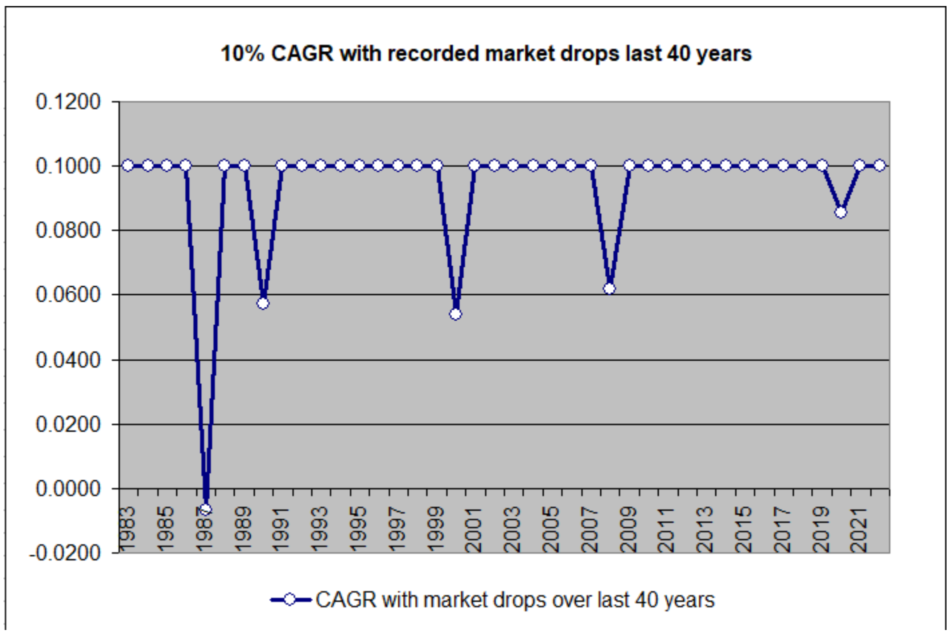

Figure 1: CAGR Rate with Corrections over 40 Years

Figure 1 is on the same basis as the last chart in the above-cited article which was presented as hypothetical. In that article, the impact of a single -50% drop was considered with its recovery factor which returned the CAGR to its long-term 20% level.

Here is that chart again and what was said for the 20% CAGR case:

> *This is to emphasize the point that it is not only bouncing back, it is recuperating what was also lost. The what should have been instead of the decline.*
>
> *To spread the recuperation over the next 15 years would require to increase the CAGR to 27.21% up to year 30. To get back on track by year 40 would need a lesser CAGR of about 24.27%. After reaching*

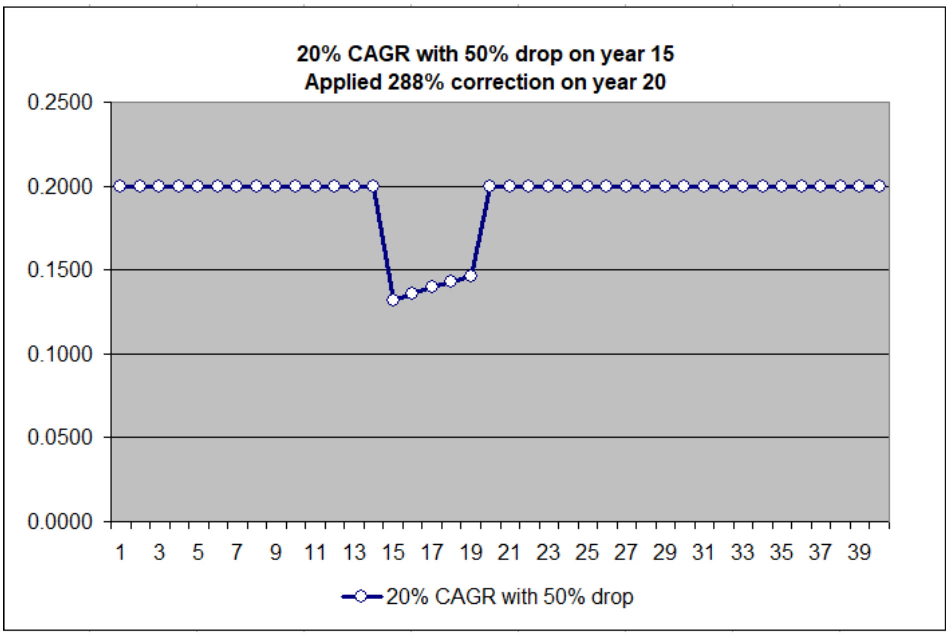

Figure 2: CAGR Rate with Drawdown in Year 15 and Correction in Year 20

> *those endpoints, you could go back to your 20% CAGR cruising speed, since you would have recuperated the -50% drawdown.*
>
> *If you found ways to increase your CAGR to either 27.21% or 24.27%, I would not go back to simply cruising at a 20% CAGR, I would keep on cruising at the new level. Why would you throw that added alpha away?*
>
> *From hindsight, it would appear easier to simply add some protective measures to hopefully bypass most of the impact of those dreadful drawdowns.*

Whereas here, we included corrections based on the historical data from the 5 drawdowns in the above table. Figure 1 shows the outcome of applying the same structured compensation factors in order to return the average CAGR back to its 10% long-term rate.

When looking at the final result in Figure 1, we have $\left[\frac{F(T)}{F_0}\right]^{\frac{1}{40}} - 1 = 0.10$ as should be expected after the corrections. Without the corrections given in the above table, the long-term picture would be quite different.

Applying all the corrections as given in the above table, we get for outcome: Figure 3. It is not a minor undertaking. You would need the equivalent of 3,316.85% in gains to maintain the long-term CAGR cruising at its average 10% rate.

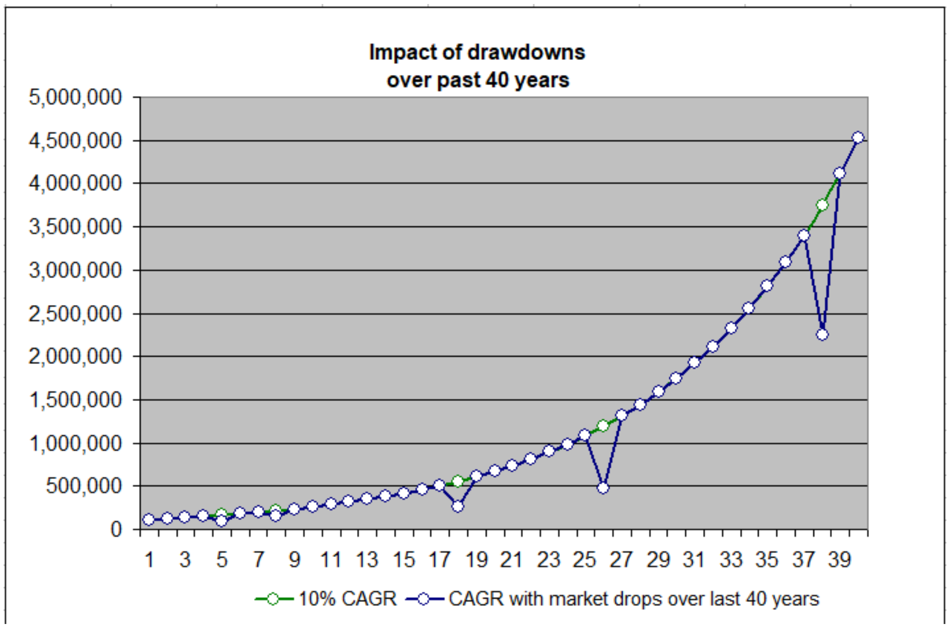

Figure 3: CAGR with Corrections over 40 Years

We can observe that the "dips" in Figure 1 seem to decrease with time, whereas their significance appears to increase in absolute terms in Figure 3. This should be expected, a 20% dip in your portfolio, in the beginning, represent a lot less in value than the 20% drop near the end of your portfolio when, for instance, it might be worth 10 times more than its initial value. We can say: $0.20 \cdot \$100,000 \ll 0.20 \cdot \$1,000,000$.

The 20% CAGR Case

If the average long-term CAGR of your trading strategy was more like 20%, it would again be the missed expected returns that would make the difference, not necessarily the drawdowns themselves since they would be the same as in the 10% scenario and would need the same correction factors as in the previous table and with the missed 20% returns[2].

Year	Drawdown	Compensation Factor	20% CAGR Scenario Correction Factor
1987	-34%	2.1818	(1 + 0.5152) $\times$ 1.20^2
1990	-20%	1.8000	(1 + 0.2500) $\times$ 1.20^2
2000	-49%	2.8325	(1 + 0.9608) $\times$ 1.20^2
2008	-56%	3.2727	(1 + 1.2727) $\times$ 1.20^2
2020	-34%	2.1818	(1 + 0.5152) $\times$ 1.20^2
	Total	79.1793 or 79,179.32%	for total compensation.

[2] The one missed during the decline and the one missed during the recovery.

That your portfolio has drawdowns does not change historical market data. You have to survive the phenomena, just as everyone else, if you can.

Figure 4 is about the same as Figure 1, except for the scale. The same goes for Figure 5, the scale on the left is much higher than the one in Figure 3.

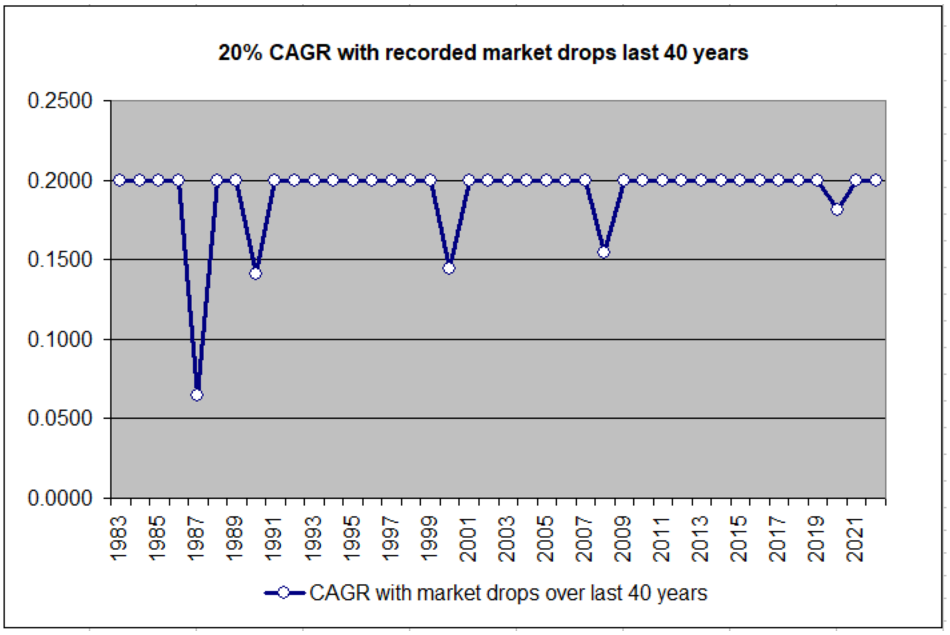

Figure 4: 20% CAGR with compensations over 40 Years

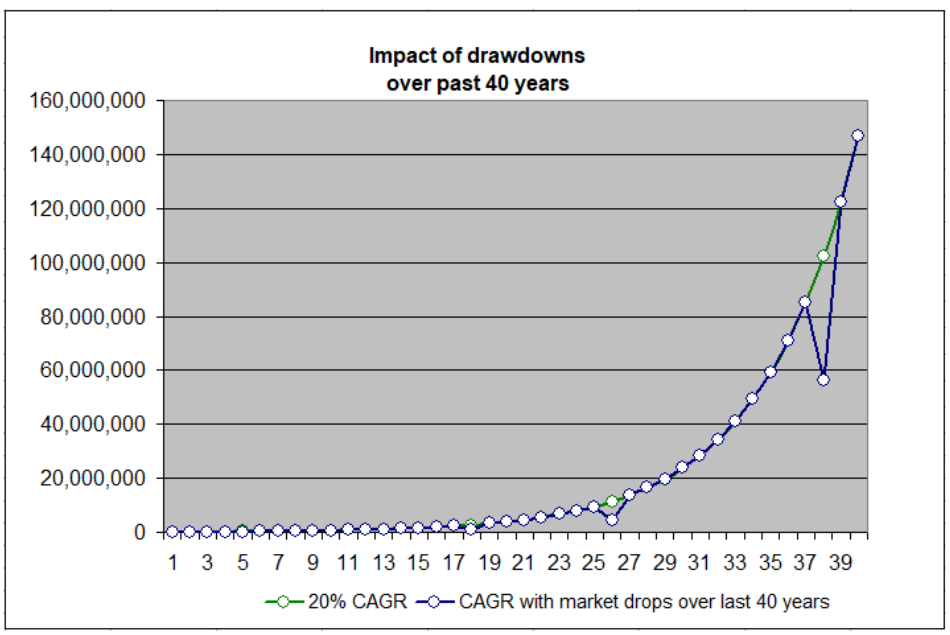

Figure 5: 20% CAGR over 40 Years with compensation factors

The table above shows the corresponding factors that went into the creation of

Figure 5. The real change was in the 20% per year that were lost during those declines. The drawdowns remained the same over the period.

The compensation factor required over those 40 years would need to total 79,179.32%, or its equivalent, distributed over the interval. And that becomes much harder to do.

You see someone maintain an average 20% CAGR over those 40 years, and you have a market wizard since somehow, he/she had to at least compensate for those 5 drawdowns.

Note that all that effort was just for 5 drawdowns of significance. Even more had to be done to also cover all the smaller drawdowns than the -20% recession level drop in 1990.

The Impact Of Not Compensating Or Correcting

Had you not corrected for the missed return years, the picture would be different. For instance, missing out to compensate on just one of those two years, the one during the decline or the one following it, would give the following chart:

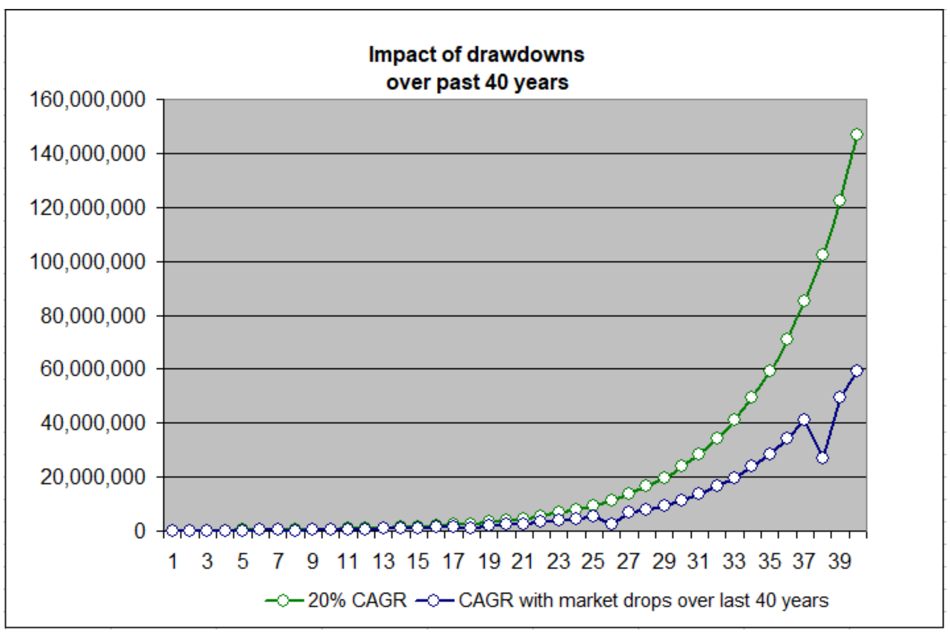

Figure 6: 20% CAGR over 40 Years with 1 year compensation

As can be seen, the impact is considerable over the long term. It gets worse if you do not compensate for the two years (that is the 1.20 factor in the above table) since it would result in Figure 7 below.

In that chart, the expected 20% gain for those years does represent quite a huge missed opportunity over the long run. Often, in some trading programs, corrective measures are not even considered. As if the programmer is wishing that the program will automatically take care of the problem all by itself, or that the market as a whole would compensate them for those drawdowns or missed opportunities. The market has no obligation to do so. Spoiler alert, it will not.

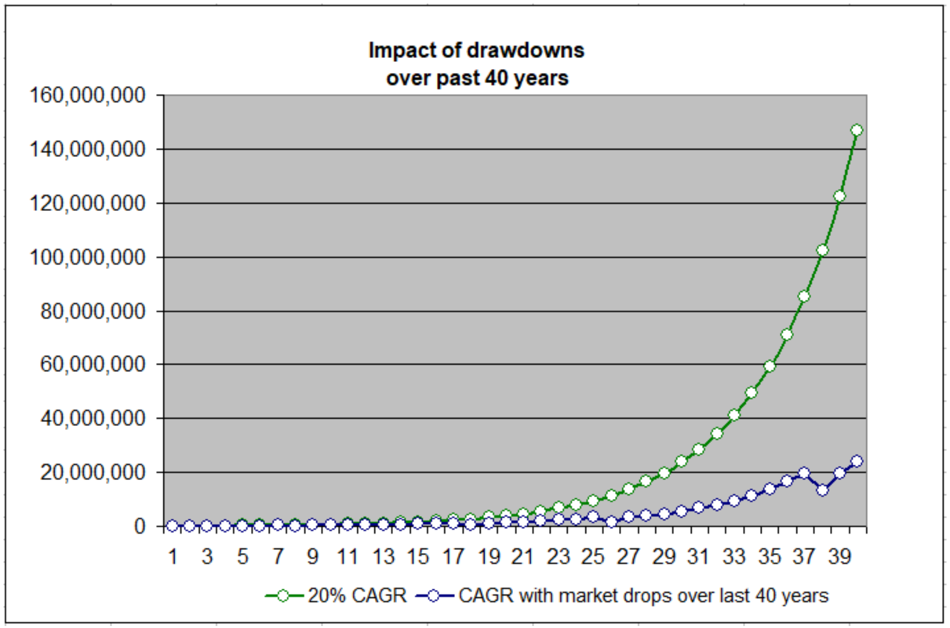

Figure 7: 20% CAGR over 40 Years with no 1.20 compensation

Without the compensation factor: $(1 + \frac{dd_i}{1 - dd_i})$ it would result in almost destroying what might be considered the strategy's alpha over those 40 years.

You had a 20% overall CAGR which due to 5 drawdowns was reduced to the equivalent of a 10.05% CAGR over those 40 years (see Figure 8). That is quite a different picture when compared to Figure 4.

The impact of those drawdowns is considerable over the long term. The overall portfolio performance would result in Figure 9 below.

We can see the impact of not doing the compensation for those drawdowns. And from it, we should conclude that there is a need to reduce the impact of those drawdowns as much as possible. At least, the endeavor should prove worthwhile, since there appears to be a lot on the line for not doing so.

Figure 9 gives a picture of what could have been (green line) to what was (blue line). The missed opportunity value is considerable, as it is the spread between those two lines.

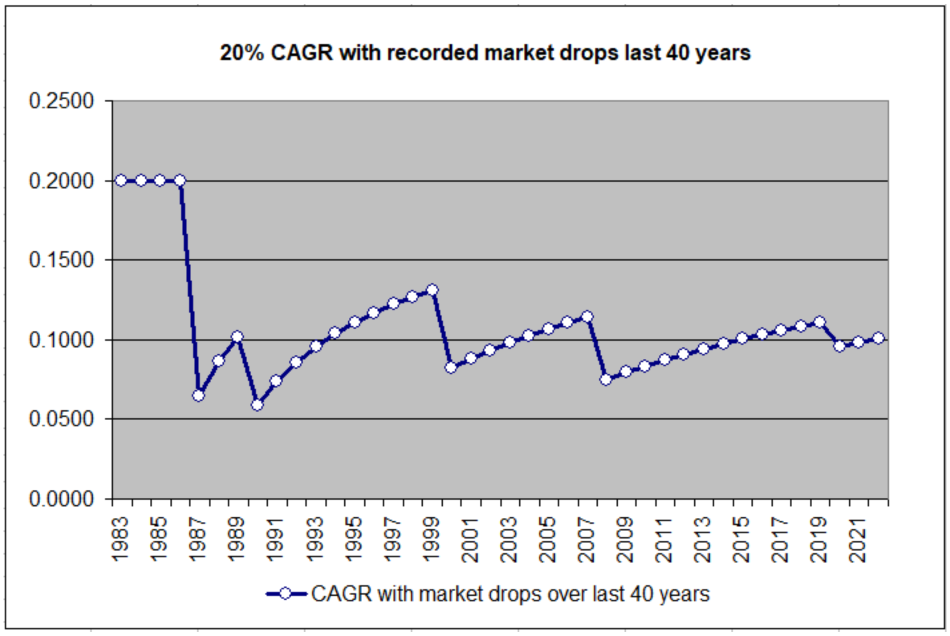

Figure 8: 20% CAGR over 40 Years with no compensation

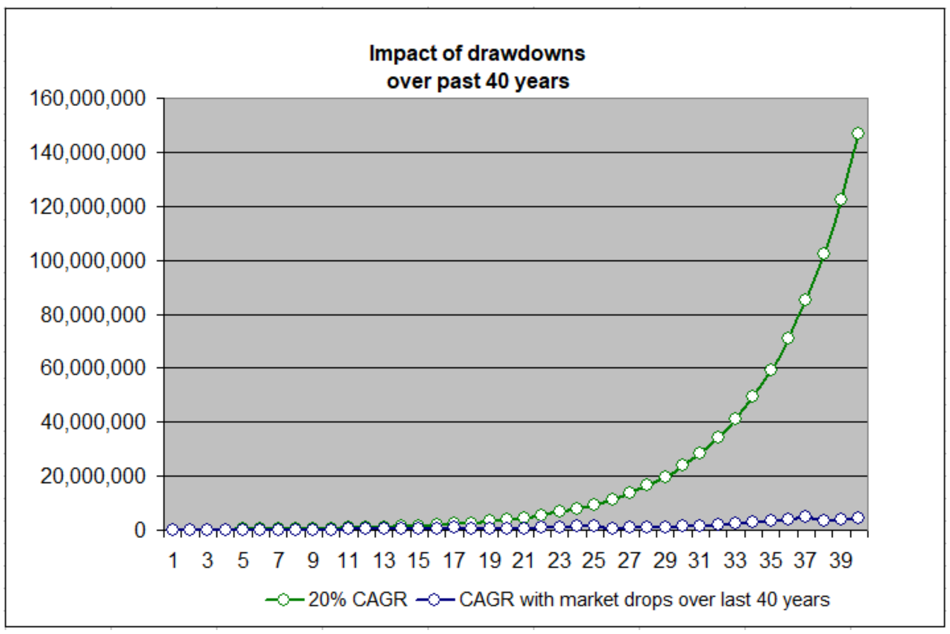

Figure 9: 20% CAGR over 40 Years with no compensation

Figure 10 tries to illustrate that the market's underlying CAGR is fluctuating over the period. In my Excel file, pressing on F9 would give a new green line as if randomly generated. This is to say that a portfolio CAGR will most likely have some randomness in its return distribution. Or that the blue line will not be as smooth as in Figure 8 but would look more like the green line.

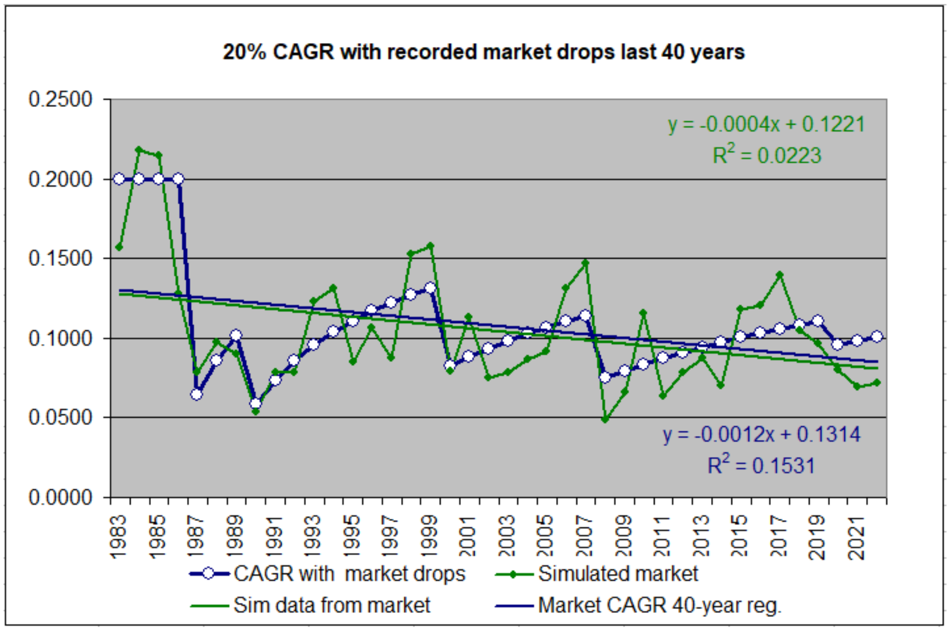

Figure 10: 20% CAGR with no compensation and market data

Over Compensating

That is the whole point. No matter what was thrown at you, for example, those 5 historical drawdowns which you could not have escaped, you still had to outperform the market average. We have shown in the charts and tables presented thus far the need to compensate not only for the drawdowns but also for the missed CAGRs, the one during the decline and the one during the recovery.

We had from the cited-article the following equation which showed the impact of a -50% decline over the investment period:

$$(1 \pm r_1) \cdot (1 \pm r_2) \cdots (1 - 0.50) \cdots (1 \pm r_{t-1}) \cdot (1 \pm r_t) = (1 + \bar{g})^t \cdot (1 - 0.50) \tag{1}$$

To compensate for the 50% drawdown required the following sequence of events:

$$F(t+2) = F_0 \cdot (1 + \bar{g})^t \cdot (1 - 0.50) \cdot [(1 + 1.00) \cdot (1 + 0.20) \cdot (1 + 0.20)]$$

Any of the historical drawdowns would need to be compensated in the same manner as was demonstrated in prior sections. Each time, we would have the following compensating factor to be inserted in Equation 1:

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

and this for each of the 5 drawdowns in order to put the CAGR back on track to maintain its 20% cruising rate.

Doing so generated Figure 4 and Figure 5 which totally compensated for those 5 historical market declines. But now, you want more...

These 5 compensating factors (cf_i) could be anywhere within Equation 1 and you would get the same final results. Equation 2 gives the value of the compensating factor based on the market drawdown within our trading strategy. And based on the similitude to the drawdown behavior in Equation 1, we can apply the correction factor anywhere within the portfolio return series.

So, to make it clear, the structure of the compensating factor cf_i would be the same that you want to handle a historical data point or that you want to compensate one in the future. The same formula would apply. And this starts to put some real pressure on your trading strategy which now has to compensate for something it has not even seen yet.

How do you resolve the problem? Not only do you want to compensate for those market declines, but you also want to over-compensate, and justifiably so.

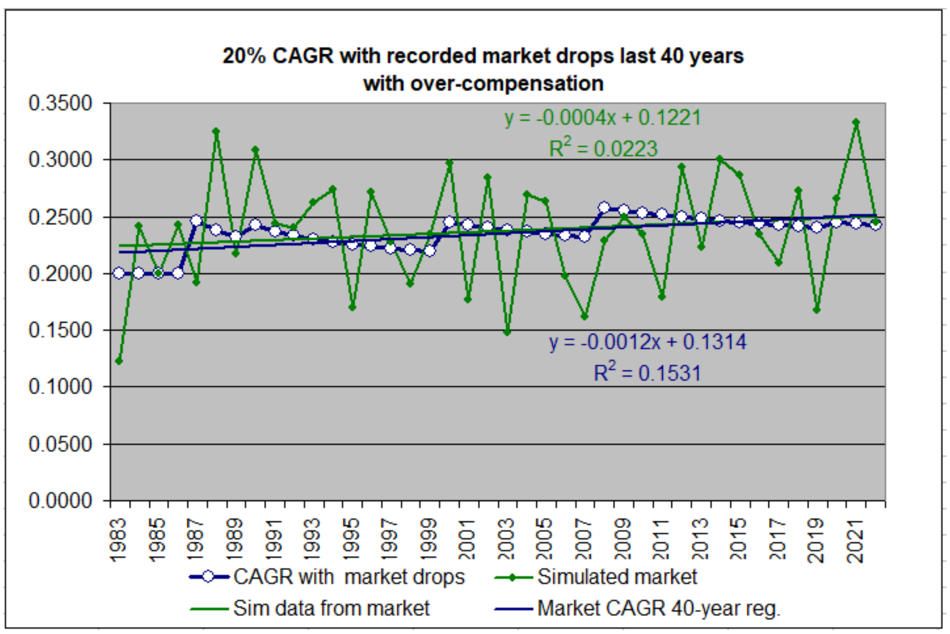

Figure 11: 20% CAGR with over-compensation and market data

Figure 11 is comparable to Figure 10 where no compensation was performed. In Figure 11, we have over-compensated for the declines and in doing so, we even raised the overall long-term CAGR.

Whether we are dealing with past or future data, it does not matter for Equation 2 as was stated earlier. Your strategy will need to anticipate or react to what is coming its way and over-compensate those drawdowns. It will not happen without your intervention. Nonetheless, some of the recovery is also part of the market's recovery.

Like saying that after a major decline, the market will go back up again and even surpass its previous high point.

Figure 12 shows the impact of over-compensating for the market declines. Now, the blue line is way ahead of the curve, which is where most probably you would like to have it going forward. It is the other representation of the data in Figure 11.

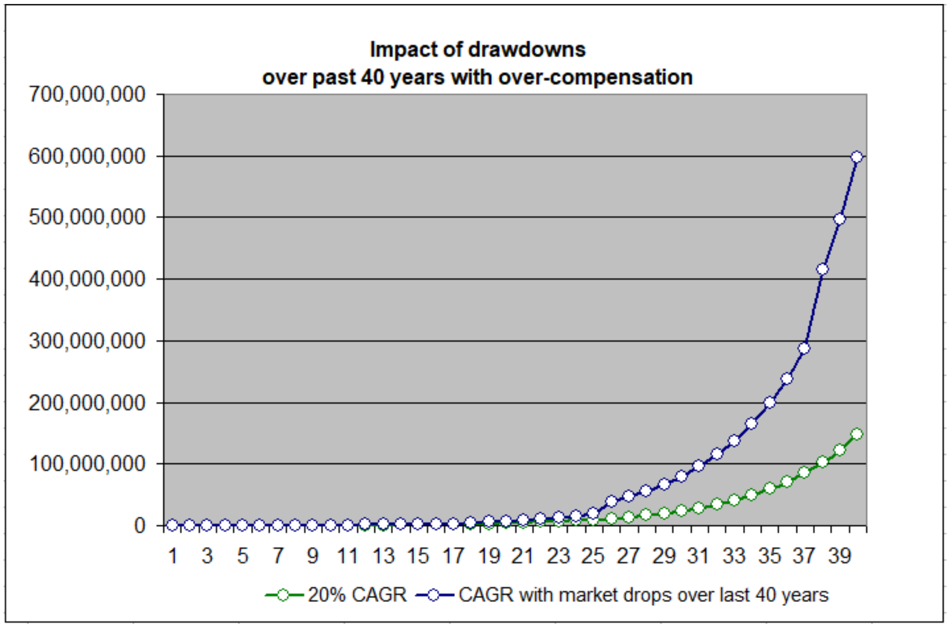

Figure 12: 20% CAGR portfolio with over-compensation

It all fits within Equation 2 which only needs a slight modification:

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

The over-compensating factor ocf_i is under your purview and should be incorporated in your stock trading strategy design. Note that Figure 11 has a rising CAGR over the period, and as such is in contradiction with the Law of diminishing returns. This note does say you can have an increasing long-term CAGR over extended time periods, as was illustrated over this 40-year interval. All the equations presented stand on their own.

Now you need to make your trading strategy do the same thing or thereabout.

There is this other consideration where you could start with $1 million as initial capital. Since you are dealing with equations, the outcome would be as illustrated in Figure 13.

But that is all up to you. You have the equations, and how your portfolio should behave to market drawdowns. You have the compensation factors, even the equation, to over-compensate those market declines. What is left is to incorporate those in your trading strategy and make it behave the way you want it to.

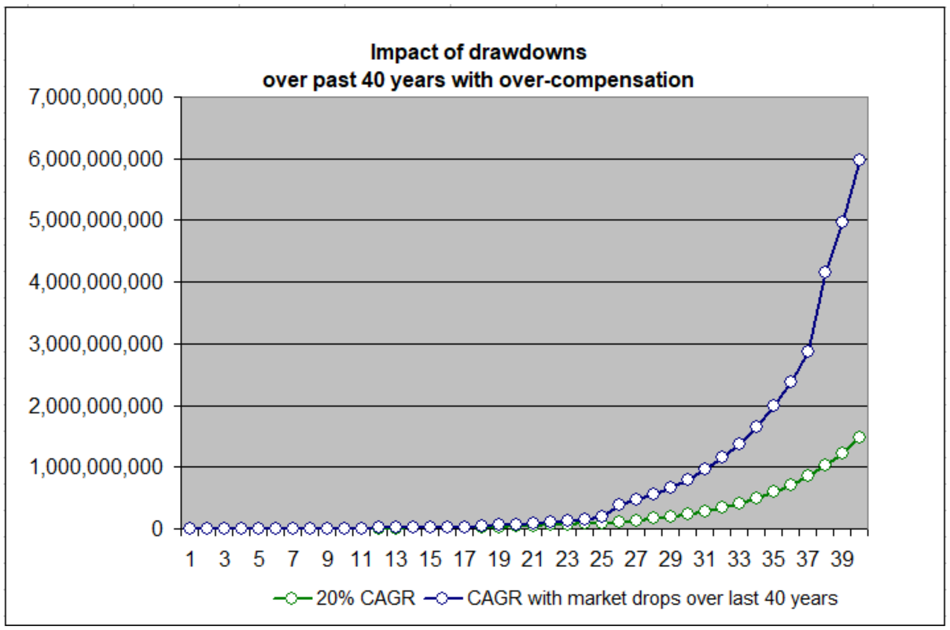

Figure 13: 20% CAGR portfolio with over-compensation and $F_0 = \$1M$

Building your retirement fund requires planning. You need to know what to do and where you are going. The above can be achieved by anyone. There are no mysteries or secret sauce in there, just a little math.

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