The Convexity Maven

A Commentary by Harley Bassman

February 23, 2021

"Seeking Treasure with Convexity"

Long-time readers of these Commentaries are well aware that modesty has never been my strong suit, even when my ramblings were finely vetted by the somewhat constipated legal advisors and compliance officers employed by corporate Wall Street.

And while I am being honest, let me further reveal that my membership in the 1% is mostly owed to making every effort to be long Convexity – both personally and professionally. So, I beg you not to be fearful as we traverse the topic; I promise, if you can drive a car you already appreciate the concept, even if you cannot speak a word of Greek.

Notwithstanding that my parents believe I spent most of my career as a stockbroker, I was indeed able to explain to them the concept of Convexity.

Imagine you are placing a bet on a coin flip, and if you win you receive $3 and if you lose, you pay $2. Assuming the odds of winning or losing are the same, this would be a Positive Convexity bet because <u>the payoff is not linear</u>. Conversely, again assuming a fair coin flip bet of equal odds, if you could lose $5 and only win $4, that would be a Negative Convexity bet. And for completeness, a game where you would win or lose equal amounts is a zero Convexity (linear) bet.

It is for this reason <u>Convexity is often defined as "unbalanced leverage"</u>. It is the unbalanced prefix that is key; the return profile is not linear. The payoff function can have a bend or kink, but more often it is curved, hence its description as 'convex' (or sometimes 'concave' for negatively convex).

Clearly, if one could make positive Convexity bets for no "cost", this would be terrific, but usually these sorts of bets, or investments for purposes of this Commentary, are not available.

While it is bad form to engage a gambling paradigm on Wall Street, it can be helpful to use a familiar pastime for illustration. When one plays Roulette at most casinos, there are 38 numbered slots on the wheel, yet a winning $1 bet only pays out $35. As such, over the course of time, one stands to win $350 versus losing $380 (or some multiple) in exchange for free drinks and a discount ticket to the floor show.

To make this a truly "fair" endeavor, the price of a $1 bet should be 94.6 cents. Thus, I have only visited Atlantic City once, when I was kidnapped for my bachelor party 33 years ago, but that's another story.

Similarly, on Wall Street, prices of securities adjust to make investments "fair", or at least as fair as consensus allows.

Hark back to mid-2018, when the FED (Federal Reserve Bank) had loosened its grip and bond prices were somewhat normalizing. Shown in the table below, the US Treasury seven-year note closed at par (100) to yield 3.00% while the most liquid MBS (Mortgage-backed Security) FNMA 4.0% bond traded at 101.11.

September 14, 2018		**Tsy 7-year**			**FMNA 4.0%**	
	Price	**Yield**	**Px Change**	**Price**	**Yield**	**Px Change**
100bp lower	106.51	2.00%	6.51	105.11		4.000
50bp lower	103.19	2.50%	3.19	103.23		2.120
	100	3.00%		101.11	3.77%	
50bp higher	96.92	3.50%	-3.08	98.61		-2.500
100bp higher	93.95	4.00%	-6.05	95.83		-5.280

Notice the UST exhibits positive Convexity as its price rises more than it declines for equal changes in yield. On the contrary, the MBS is negatively convex as its price declines 32% more than it rises for equal 100bps rate changes. Most important, notice that the MBS sported a yield of 3.77% versus 3.00% for the UST; this was the additional yield offered for a negatively convex profile.

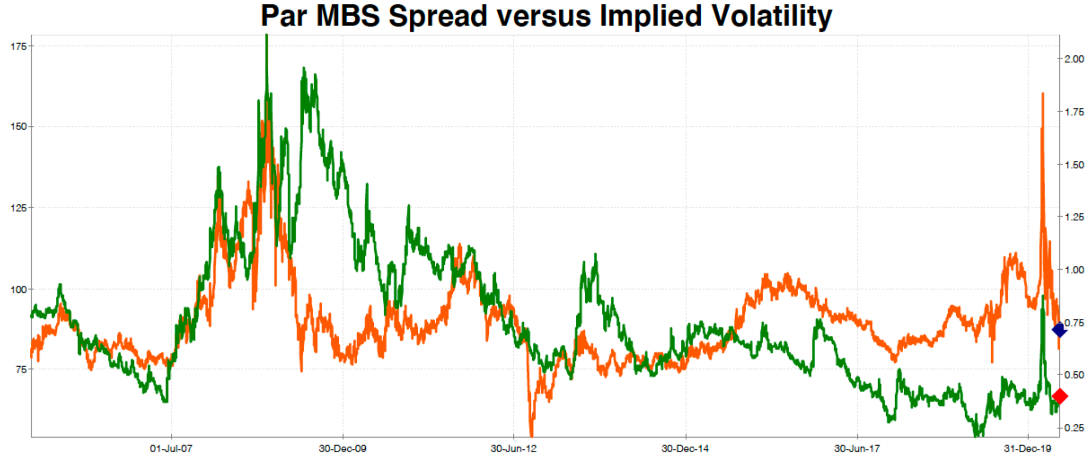
Let's skip over why I do not offer yields for the MBS in the various scenarios and dig a little deeper into the concept of Convexity. The reason Wall Street hired Physics PhDs in the 1990s was that we literally needed rocket scientists to figure out how to value the Convexity of various securities. We knew the price (yield) for a risk-free bond that matured in seven years, but we did not know how much extra yield was required to make one indifferent to owning a negatively convex security; in other words, to make it a "fair bet".

In the case above, it seems that 77bps was the number, but what if that was not the "fair" price, rather just the market price. Thus, Wall Street created what is known as the Option Adjusted Spread (OAS). The idea was to use various algorithms to model the fair value and compare that to the market price.

As a quick review, a MBS is simply a no credit risk bond with an embedded prepayment option. This is the option owned by the homeowner (borrower) to pay off the loan anytime over the thirty-year term. Mortgages can be paid off early for many reasons, including moving for a new job, a divorce, or an early transition to the grave; but the most common reason is that interest rates decline, and the homeowner can refinance into a lower rate.

As such, the greater the Volatility of interest rates, the more likely rates might move enough to enable a refinance, and thus the more valuable the embedded option. Since the MBS owner (investor) is short the option, a larger option value will decrease the value of the MBS, and so widen its spread to USTs.

Par MBS Spread versus Implied Volatility



Unless otherwise noted, the Source for all charts: Credit Suisse LOCUS

While not the only driver, notice the similar paths of the -hala line- spread (77bps in our example) vs the -matcha line- Implied Volatility, which roughly translates into the price of the option. (Note: I cut off the chart in April 2020 since the heavy hand of the FED has scrambled most valuation metrics.)

Prior, I noted that if you drive a car, you already have an intuition of Convexity.

Imagine you are in a parked car; you are at a location that does not change as time passes. You start to drive and reach a of speed 20mph (miles per hour). If you maintain this speed, your location will change by 20 miles every hour. Next you accelerate to 30mph, 10mph faster than before.

When you are traveling at 20mph, that is a measure of how your location changes over time. In math terms, this is the "first derivative" which measures the change of one variable (location) relative to another (time). In physics, this is called velocity. Increasing your velocity from 20mph to 30pmh is the change of the change, which in math is the "second derivative", and in physics it is known as acceleration.

In options, the first derivative is called the Delta, which is the change in the option price given a change in the asset price. The second derivative is called Gamma, this is the change in the Delta for a change in the asset price.

XYZ stock is priced at $100; the at-the-money (ATM) call option is trading at $7. The delta of an ATM option is 50%, so if XYZ rose by $10 to a price of $110, the option price would rise by $5 (50% of $10) to a price of $12.

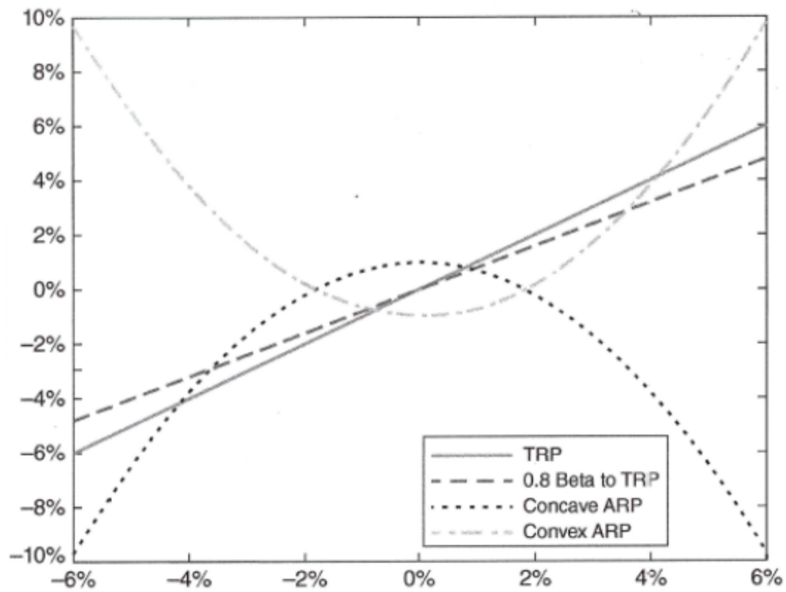
Here is the hard part, let's say the gamma (convexity) is 10%, so as XYZ rose to $110, the delta increased from 50% to 60%. So now if XYZ rises another $10 from $110 to $120, the option price would rise by $6 (60% of $10) to $18.

The delta measures the change of the option prices as the asset (stock) price changes. The gamma (convexity) measures the change of the delta as the asset price changes.

Convexity is a measurement of the change of the change. The quicker the change (acceleration or deceleration), the greater the Convexity.

The chart below is somewhat helpful, such a pity it fails to use fun colors. Please note that the definitions of "TRP" and "ARP" are not important. I will also give credit for this chart to David Berns, PhD, our CIO at Simplify and the author of the recently published "Modern Asset Allocation for Wealth Management".

The solid line (TRP) is a non-convex (linear) asset; a 6% change results in a 6% return, positive or negative. The dashed line is also not convex, it is the result of multiplying the base return by 80%. This would be the return of a portfolio that sold 20% of its assets and kept the balance in cash; sort of a reverse "leverage".



The mixed dash/dot line (Convex ARP) mimics a portfolio return where one has purchased both a call (upside performance) and a put (downside performance). Notice how both sides increase at an increasing rate – it is positively convex. Of course, such a terrific profile is not free, <u>the cost to add this feature is the price paid for the options</u>. The nadir of this "horseshoe" is below the zero-point TRP line. If the asset price does not change, the options expire worthless, and your return is reduced by the price of the options.

In contrast, the dotted line's (Concave ARP) apex is above the zero-point of the TRP, this is the premium received for options sold, the maximum profit. The risk is the loss incurred if the asset's price moves a lot (volatility) in either direction.

When one <u>sells an option</u>, the most one can make is the price of the option, while <u>the potential loss is infinite</u>.

When one <u>buys an option</u>, the most one can lose is the price of the option, while <u>the gain is unbounded</u>.

Over the course of my career, **I have preferred a risk profile of unlimited gain at the cost of a limited loss**...and I always accept a free option.

Leverage is not Convexity

Notwithstanding that I defined Convexity as "unbalanced leverage", there is a significant difference. While a bit eye-throbbing, the table below can be useful.

Last October, the S&P500 closed at 3265, or 326.5 on the listed SPY ETF.
The first set is the profile return for 1000 shares of SPY purchased for $326,500.
The second set is a similar dollar investment in a two-to-one leveraged ETF.
The third set is the purchase of the December 2021 call option, struck at 325.
The fourth set is this same option after six months of time decay (April 30, 2021)
The fifth set creates an apples-to-apples comparison after six months; the funds not spent for the option are kept in cash. ($82,500 + $244,000 = $326,500)

October 30, 2020							
	-30%	-20%	-10%		10%	20%	30%
SPY Price	**228.55**	**261.2**	**293.85**	**326.5**	**359.15**	**391.8**	**424.45**
1000 Shares SPY	$228,550	$261,200	$293,850	**$326,500**	$359,150	$391,800	$424,450
	-$97,950	-$65,300	-$32,650	**$0**	$32,650	$65,300	$97,950
	-30.0%	-20.0%	-10.0%	**0.0%**	10.0%	20.0%	30.0%
2x levered SPY	$130,600	$195,900	$261,200	**$326,500**	$391,800	$457,100	$522,400
	-$195,900	-$130,600	-$65,300	$0	$65,300	$130,600	$195,900
	-60.0%	-40.0%	-20.0%	0.0%	20.0%	40.0%	60.0%
25 SPY Dec 2021 Call	$2.73	$8.03	$17.92	$33.00	$53.04	$77.22	$104.57
Strike = 325; Ivol = 25.25%	$6,825	$20,075	$44,800	**$82,500**	$132,600	$193,050	$261,425
413 Days to expiry	-$75,675	-$62,425	-$37,700	$0	$50,100	$110,550	$178,925
	-91.7%	-75.7%	-45.7%	0.0%	60.7%	134.0%	216.9%
20 SPY Dec 2021 Call	$0.76	$3.71	$11.37	$25.48	$46.06	$71.83	$101.17
Strike = 325; Ivol = 25.25%	$1,900	$9,275	$28,425	$63,700	$115,150	$179,575	$252,925
231 Days to expiry	-$80,600	-$73,225	-$54,075	-$18,800	$32,650	$97,075	$170,425
IVol = 25.25%	-97.7%	-88.8%	-65.5%	-22.8%	39.6%	117.7%	206.6%
20 SPY Dec 2021 Call	$0.76	$3.71	$11.37	$25.48	$46.06	$71.83	$101.17
Strike = 325; Ivol = 25.25%	$245,900	$253,275	$272,425	$307,700	$359,150	$423,575	$496,925
231 Days to expiry	-$80,600	-$73,225	-$54,075	-$18,800	$32,650	$97,075	$170,425
Including uninvested Cash	-24.7%	-22.4%	-16.6%	-5.8%	10.0%	29.7%	52.2%

The -wenge lines- are the total dollar (portfolio) value; the -xanadu lines- are the dollar change in value; the -glaucous lines- are the percent change in the dollar value; and the -falu lines- are the projected prices of the option.

The second set demonstrates "leverage" as a uniform increase in return, the gains and losses are amplified by a factor of two. In contrast, the return profile for the option is not linear, it increases at a different rate than it declines. Notice the third set's returns of +60.7% vs -45.7% and +134.0% vs -75.7%.

Leverage amplifies a return in a linear fashion; Convexity bends the return to be unbalanced; and is measured as the gap between the up and down returns. Convexity is measured as that difference, the greater the gap, the more convex.

Who wants to be a Billionaire?

Included in the curriculum for most first year MBA candidates is the concept of modeling a company as an option where the strike price is the amount of Bonds they have issued, and the Equity (stock) is a call option on the business.

The bond holder's gains are limited to the interest paid, and a bankruptcy can result in a total loss. On the contrary, the stockholder's gains are infinite while the losses are limited to the price of the shares.

Thus, it should not be a surprise that most billionaires earned their wealth via stock ownership; their return modeled as a perpetual call option; they are long Convexity. Conversely, the bond holder is effectively short a put option.

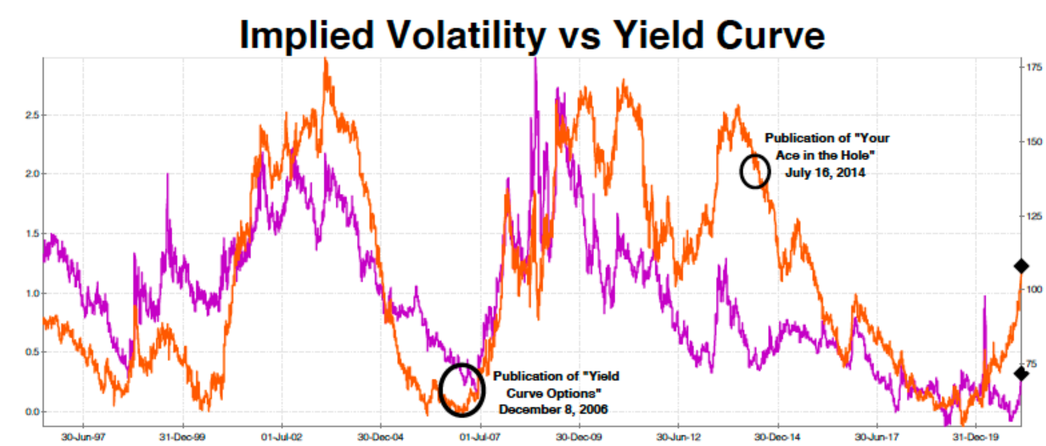
A few Macro comments:

The shape of the Yield Curve is quite informative, which is why the FEDs heavy hand is so problematic; it is muffling the feedback loop of information to policy makers and investors.

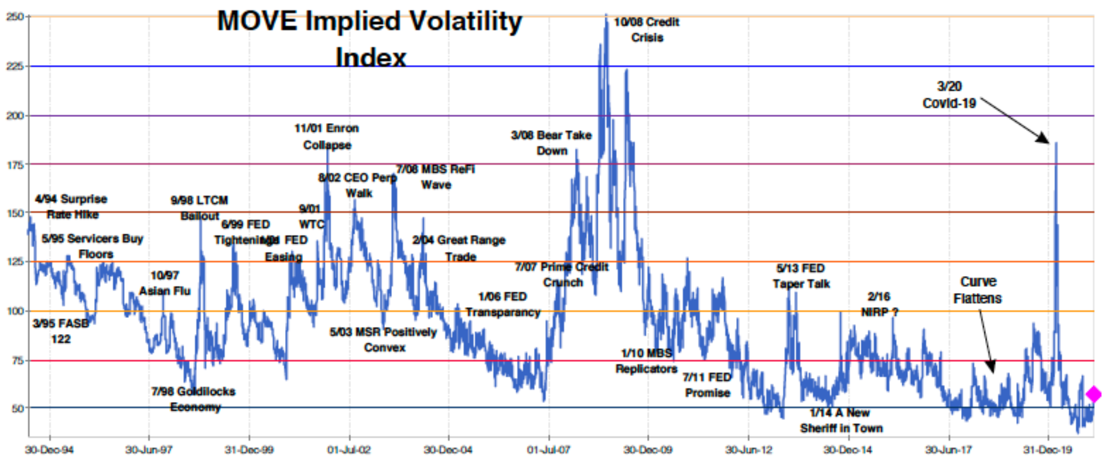
The single best predictor of a recession has been the Yield Curve; and you may recall that in November 2018 I warned that a recession might occur in early 2020. ("A Guide to the Perplexed" – November 15, 2018)

Similarly, the best correlation to Implied Volatility is the Yield Curve, for reasons detailed in "Your Ace in the Hole", July 16, 2014.

Below, the -jabuticaba line- of Implied Volatility for interest rates is still hugging the lows, while the -lychee line- shape of the Yield Curve has steepened significantly.

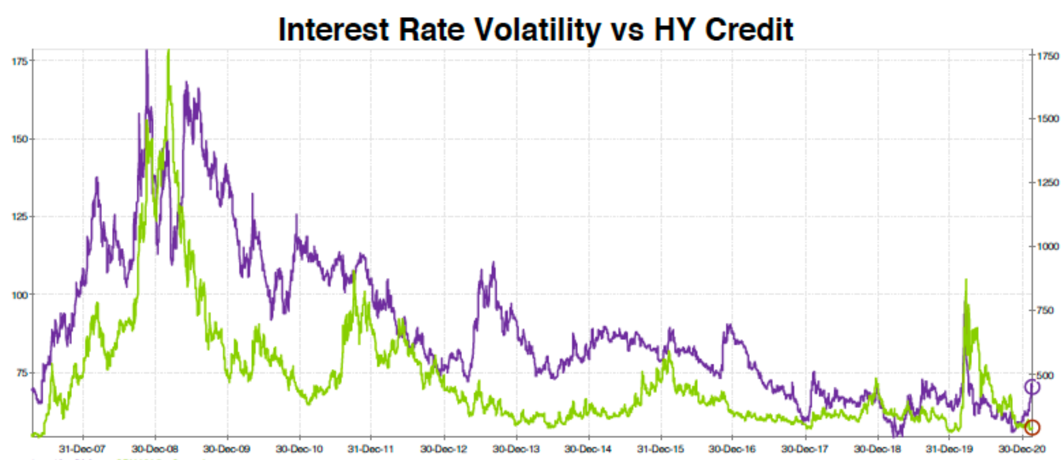


The recent rise in long-term rates will likely retrace at bit, but the Fiscal tsunami on the horizon will not let the curve flatten. As such, <u>it is Implied Volatility that is the "wrong price"</u>, so expect the -rambutan line- MOVE Index to ascend.



If this happens, the expansion of Implied Volatility will course through the financial markets, <u>placing at risk the High Yield (Junk bond) sector</u>.

A Credit bond can be constructed as a long position in a UST combined with a short position in a Credit Default option. An increase in the -mangosteen line- of Implied Volatility will pressure wider the -turmeric line- of High Yield spreads.



The FED has promised to hold short-term rates to near zero until 2023, they are also buying 120bn/month of UST+MBS and are jaw-boning fears of harmful inflation lower. This combination has pressed the MOVE Index below 50, a forever record low; and their implicit FED put has reduced the VIX to near 20, kissing its long-term average.

The FED has its lips tightly wrapped around a financial balloon being inflated by a combination of expansive Fiscal and Monetary policy, so for the record I will say that **Implied Volatility for financial assets is too low.** This is not a dire prediction of imminent danger, rather a simple statement of fact.

If one wants an outsized return, long Convexity tends to be a superior profile.

Of course, it does depend on the price of the option. Thus, the common thread of my Convexity Maven commentaries - sourcing mispriced long-convexity exposure that aligns with my macro-economic view.

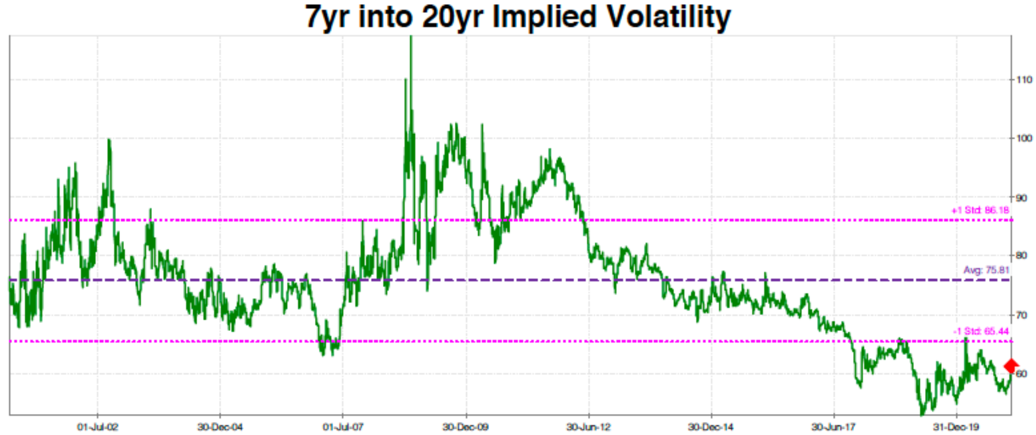
If you want to invest in a manner similar to mine, this is a terrific start.

Harley S. Bassman
February 23, 2021

@ConvexityMaven

And as a teaser, stay tuned as I am noodling a way for non-professionals to soon own -celeriac line- ultra-long-dated Volatility.

7yr into 20yr Implied Volatility



Your comments are always welcome at: harley@bassman.net
If you would like to be added to my distribution, just ping me.

For reference literature on the financial markets - particularly about options and derivatives - I will immodestly direct you to my educational archive at:

http://www.convexitymaven.com/themavensclassroom.html

If you still have kids in the house, please take a vacation that is more interesting than the Four Seasons, Costa Rica – life is not a dress rehearsal. Turn off the Crackberry (did I just date myself ?) and explore with the family. You don't need to break the bank, rent an RV and see the U.S. We traveled with our four kids on five incredible RV trips.

http://bassman.net

If you are an institutional investor, I can highly recommend:
Jordan Brink at Morgan Stanley and Hunter Davis at BNP