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*A Commentary by Harley Bassman:*

# THE CONVEXITY MAVEN

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Value Concepts from the Credit Suisse Trading Desk
November 28, 2011

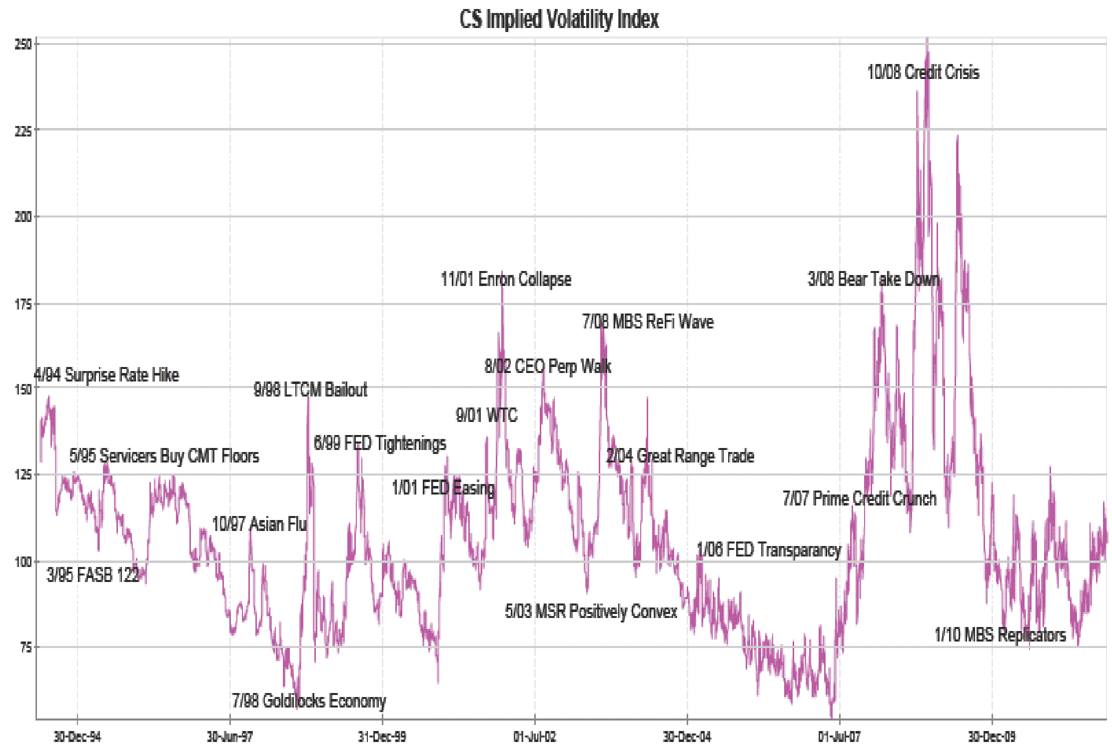
## "Wall Street Babylon"

Genesis ch11 v5-8

So Yahweh said, "Come, let us go down and confound their speech."
And so Yahweh scattered them upon the face of the Earth, and confused
their languages, and they left off building the city, which was called Babel
"because Yahweh there confounded the language of all the Earth."

The question we have received most repeatedly over the past few months: Why is the CS Blended Volatility Index (clever name pending) not higher? A panoply of prognosticators, modelers and technicians has opined that Implied Volatility must be headed north as global markets near a Sovereign Credit climax. How is it possible, they all say, that this Index can be at 102ish, somewhat under its 18 year average of 106, when it is clear that the markets are on the precipice of (.....fill in your metaphor for financial Armageddon here) !!!

Below, the –lilac line- is the life history of our Index. To remind you, it is the Implied Normal Volatility for a Yield Curve blended package of constant one-month Swap options. (Product description available upon request)



Source: Credit Suisse Locus

For instructive purposes, we have overlaid the key events that drove the Index to various peaks and troughs these past few decades. And we must admit, at first blush, it does seem strange that it is not more elevated considering the uncertainty surrounding all the vectors of risk: Economic, Political and International.

But this is where the concept of Volatility becomes somewhat slippery. Before we opine as to whether Implied Volatility is rich or cheap, let's make a quick detour and pull over at the Derivatives rest stop for a fast tune up on the basics of options.

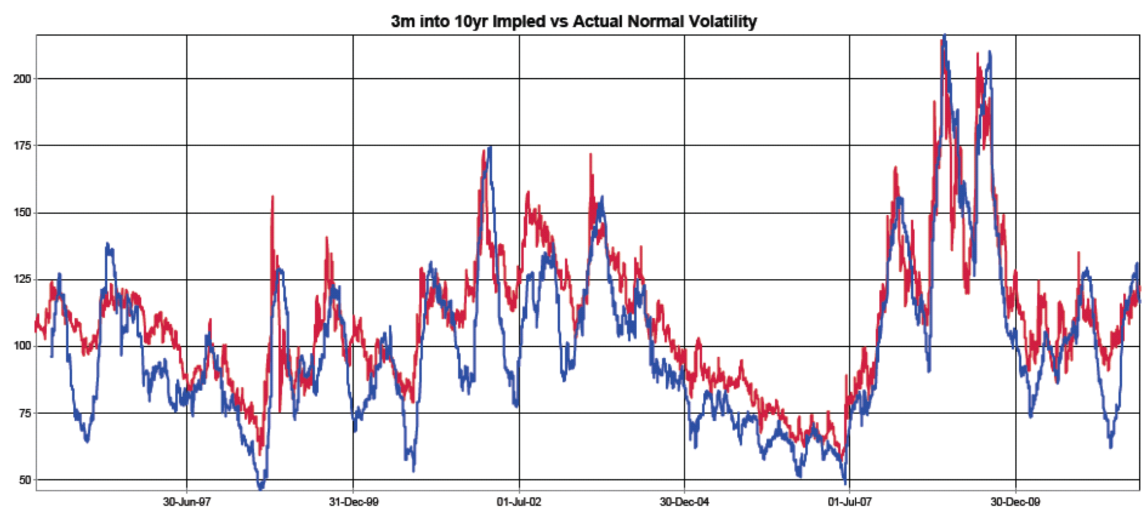
## Options 101

There are five inputs into an option model:

1) Asset Price
2) Strike Price
3) Time to Expiry
4) Risk Free Rate
5) Volatility

The first four are usually totally transparent. The magic in options pricing is figuring out the final parameter, Volatility. So what is Volatility? It is the measure of one Standard Deviation on your selected distribution. (Yes, that same boring concept you slept through during your high school Statistics class.) One Standard Deviation describes the distance from the mean (average) of the distribution that will capture 68% of the observations (a.k.a., marbles in the hat). So, if you have some distribution that has an average of 100 and a Standard Deviation of 15%, then you know that 68% of the observations (marbles) will fall between 85 and 115.

That may sound simple; nevertheless, it does NOT answer the question as to what Volatility one should select for pricing an option. So now we need to cross the hall to your old Economics 101 class. Recall the Random Walk theory: Sans any new information, the best guess for today's price is yesterday's price. So does it hold that picking yesterday's Actual Volatility is our best guess for tomorrow's Implied Volatility? Not surprisingly, the answer is affirmative.




Source: Credit Suisse Locus

In the chart above, the –red line- is the Implied Normal Volatility for a three-month into ten year swaption while the –blue line- is the similarly described

Actual (Realized) Volatility. It is this chart that forms the basis for the statement we ALWAYS make about options: "The highest correlation to Implied Volatility is Realized Volatility.

Although there are certainly plenty of gaps between the two, in the end, this concept makes perfect sense. Imagine Implied Volatility is the rent paid to own market risk. And Actual Volatility is the risk that the market delivers. In any sort of efficient market, if the difference between the rent paid (received) by the option buyers (sellers) and the volatility delivered by the market begins to deviate by too much, the rent (option price) will adjust accordingly.

Imagine an option buyer has paid 15% Implied Volatility for an option. If over the course of a few weeks the asset only Realizes 10% Volatility, the option long will lose 5% a day in Theta (time decay). At some point, our buyer will become frustrated and try to sell the option. However, a new buyer noticing that the asset is only Realizing 10% will probably not be willing to pay 15% Implied Volatility, but rather only 10%. Ipso facto, option prices will fall to reflect reality.

This process can work both ways. If an option seller is short at 15% and the asset Realizes at 20%, the seller will lose 5% daily. When he tries to cover his short to stop the pain, he will probably not be able to find a willing seller at 15% and Implied Volatility will rise. <u>The only exception will be if traders believe that the future will be substantially different from the past</u>. A classic example would be the period before a large event, like an FOMC meeting. Markets tend to slow down in front of the "news", then gap afterwards to reflect the updated information. This is the case where Implied Volatility can rise in the face of falling Actual Volatility.

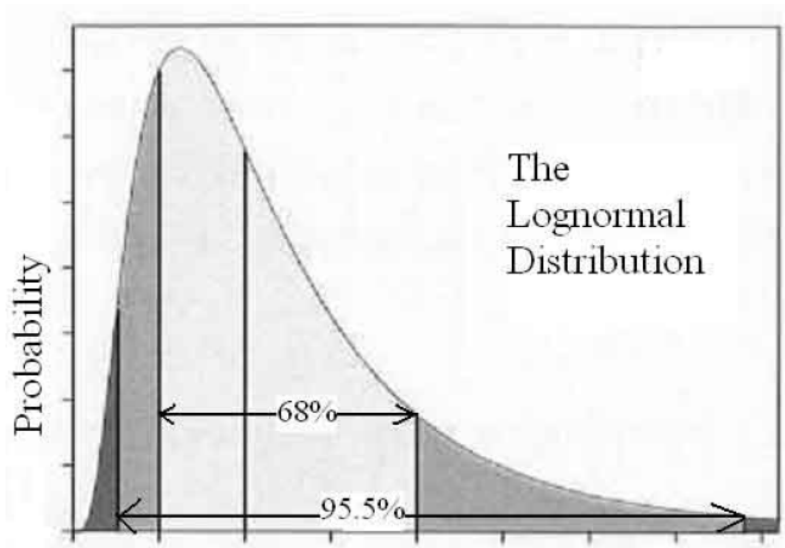
## Options 102

A small detail we have not yet discussed is that there is more than one type of distribution model. Just because a single Standard Deviation captures 68% of the "marbles" does not mean it captures the same marbles.

The original theory of contingent claims analysis was created to model option prices for stocks. A key feature of a stock price is that it can rise in an unlimited fashion but can only decline to zero. As such, a **Lognormal distribution** was chosen to best fit this concept.

The diagram on the next page is the standard Lognormal distribution. The center vertical line is the mean while the lines that radiate out locate each increasing Standard Deviation. The left side presses up hard to the y-axis since it cannot pierce zero while the right side tails out forever to capture the unlimited upside.

One might think that this would be the perfect distribution to use for bonds since interest rates (in general) cannot go negative while the upside is potentially unlimited. In fact, this was the case when options on Bonds first started trading. The modelers distributed the range of yield outcomes down the various decision tree paths in a pattern that resembled a Lognormal distribution. For this reason, it is often referred to as **Yield Volatility**.



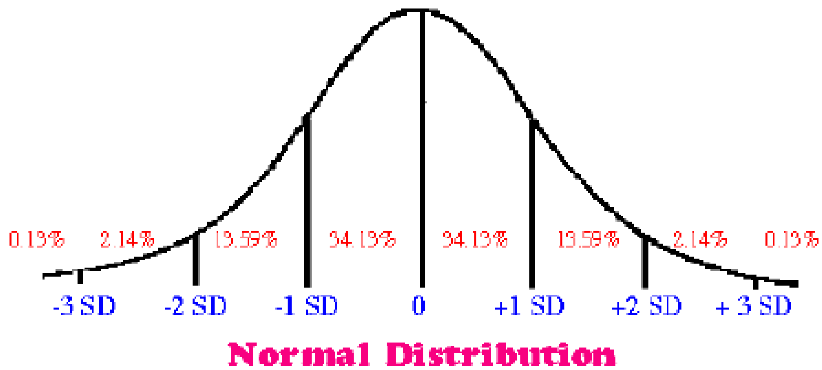

One of the interesting characteristics of a Lognormal distribution is that it effectively implies that Interest Rate Volatility is proportional to the Rate level. So the expected daily Rate change for a 10% bond would be double that of a 5% bond. Jot this fact down and we will discuss it in more detail shortly.

Options on Bonds started trading on the Chicago Exchanges in the early 1980s *Please do not remind me that I was there* ! And as it turned out, Bond yields did tend to Realize a Lognormal distribution. However, all this began to change soon after FASB 122 was enacted in 1995. This rule change transformed Mortgage Servicing Rights (MSR) from an off balance sheet intangible asset to an on balance sheet mark-to-market asset. Now exposed to the risk of unpredictable swings in the income statement, the public companies (that became the holders of MSRs) instituted hedging strategies. Whether they hedged by hand (delta management) or via the use of options, this new large risk was transmitted to the general markets.

One of the reasons Bond Yields followed a Lognormal distribution in the early years was that risk tended to increase as Rates rose. This was because investors were uniformly long Duration. Change occurred as a rapidly growing MBS market extended the impact of FASB 122. Suddenly, we had a huge investor group that faced greater risk as rates declined, namely, the MBS Servicers.

Concurrently, the GSEs began a program to grow their portfolios from the small Billions to the integer Trillions. Since the newly issued MBS the GSEs purchased had a greater risk to lower rates (negative Convexity) than higher rates, the risk distribution of the market no longer acted Lognormally.

By 1998, it became clear that Bond Yields were now carving out a distribution that looked much more balanced. The distribution that best describes this sort of symmetric risk is the well known Bell Curve, also known as a **Normal Distribution** (shown below). Volatility associated with this distribution of risk is known as **Normal Volatility** (also called basis point Volatility).




While one Standard Deviation still includes 68% of the marbles, there are a few key differences. Chief among them is that this distribution <u>implies that Rate Volatility is not correlated to Rate level</u>. This is insignificant if Rates remain in a confined range, but if Rates move meaningfully, this difference becomes keenly noticeable.

## Options 103

Let's hit one more important topic before we end this digression.

Write this down: Normal Vol = Yield Vol * Yield

This is how one traverses between Lognormal (Yield) Vol and Normal Vol.

So for example, if Rates are 5.0% and one believes that this Rate will follow a 22% Lognormal (Yield) distribution, that would map to a 110bp Normal Volatility. [110bp = 22% * 5%] At this instant, the one Standard Deviation range that captures 68% of the marbles is 3.90% to 6.10%.

Via the Yield Volatility paradigm, the 5.0% mean plus 22% of 5% creates the 6.10% upper edge while 5.0% minus 22% of 5% forms the lower boundary at 3.90%. Employing a Normal Volatility method, we can take this 5.0% mean Rate and add or subtract the 110bp value to reach a similar measure of 6.10% to 3.90%. This may sound trivial, except when you consider that once Rates move away from 5.0%, a 22% Yield Volatility will no longer map to a 110bp Normal Volatility. As such the boundaries of one Standard Deviation will differ and the Options calculator will produce dissimilar results.

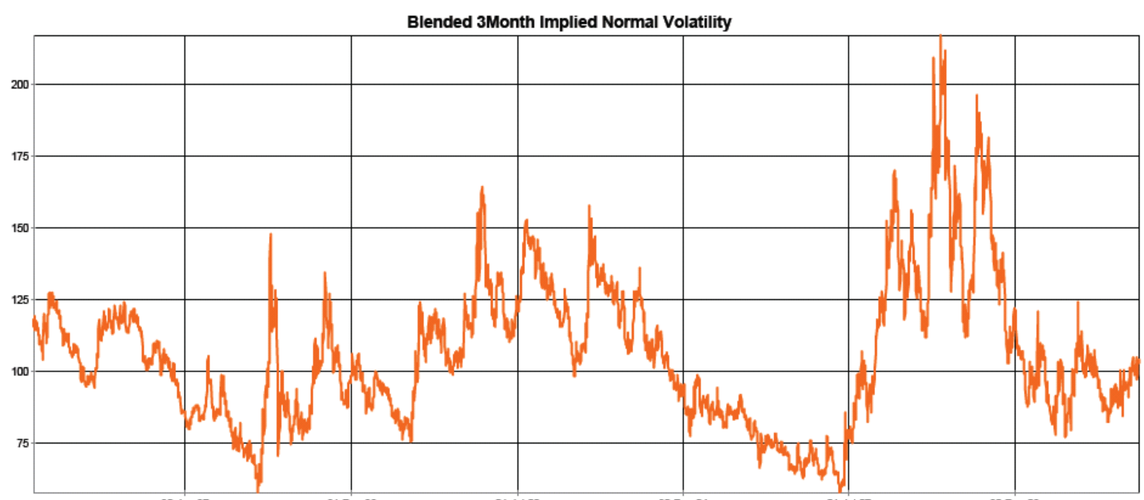
## Babbling about Volatility

Without going further into the details, with a little imagination you can see that how you view the world matters a lot for options trading. And the key point I will make is that there is no "right" answer. We often (delicately) refer to this as the Religion of Volatility trading. One just cannot say that one method is always superior to another. How you view the world, as noted by the risk distribution you choose, will determine how you value not only options, but also any security that has Rate correlated Convexity. For this reason, a diehard believer of one distribution might as well be speaking Sumerian to an ideologue of another.

So let's loop back to our original thought.

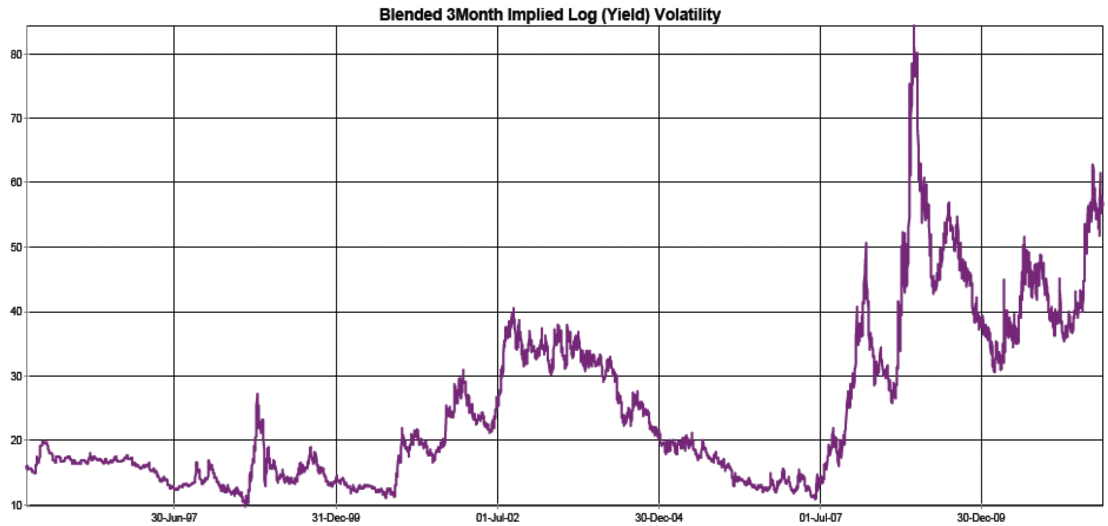
Considering the uncertainty revolving around the key drivers of risk (Economics, Domestic Politics, Global Relations), one could easily make the statement that the cost of insurance, as measured by the level of Implied Normal Volatility, is too low.

Below, the CS Volatility Index –the orange line- is strangely below its long-term average.



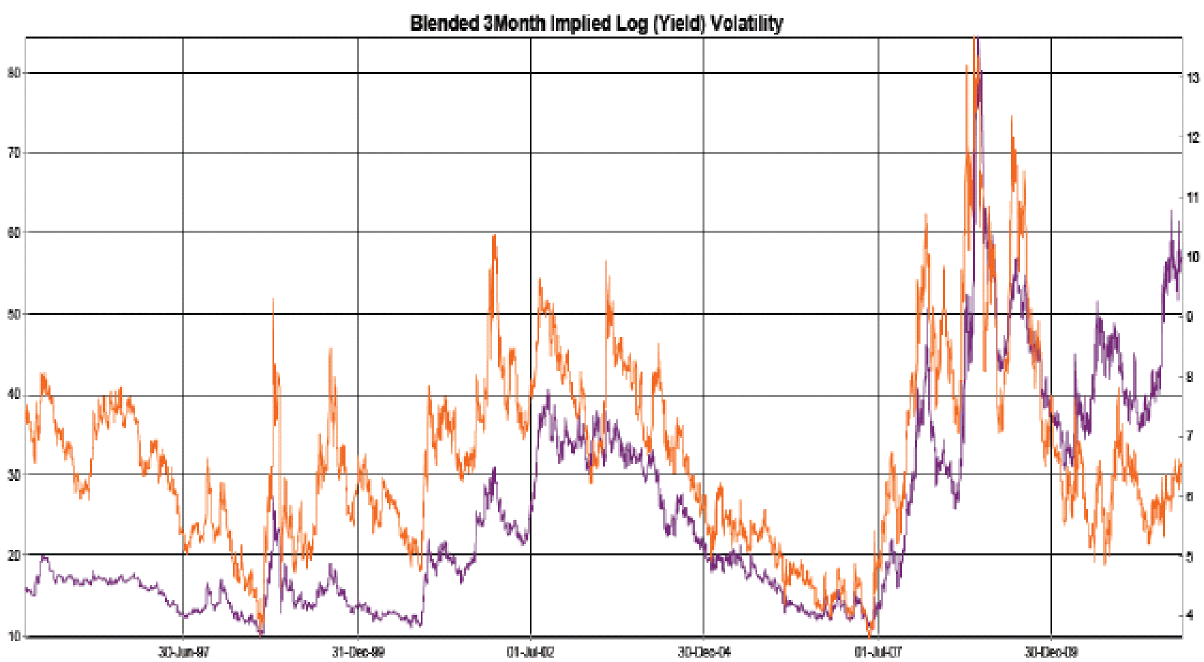

Source: Credit Suisse Locus

However, if we "translate" this exact data into the language of Lognormal Volatility, a rational person may no longer reach the same conclusion. Below, the –purple line- is CS Index described in the language of Yield Volatility. This version closed at 56.4%, almost 130% above its forever average of 24.8%. For statistics gurus, this is +2.02 SDs above the mean. Looking at this chart, it is hard to make the case that Implied Volatility is cheap. In fact, is sure looks rich.




Source: Credit Suisse Locus

To make this comparison easier, below we overlay the two charts, one on top of the other. Again, the –orange line- is our standard Normal view of the Index while the –purple line- is the Lognormal translation.




Source: Credit Suisse Locus

## What's the Catch.....?

OK, we have made you think a lot more than you care to in this Commentary; so we will now pre-chew the conclusion similar to how a mommy bird feeds her chicks.

That crunching sound you hear is two model distributions crashing into a wall. That wall would be the zero interest rate boundary. One small detail we did not expand upon earlier was that a while a Lognormal distribution is specifically designed to handle the fact that rates cannot meaningfully sink below zero, a Normal distribution makes no such claim. As such, an option model using a Normal distribution has plenty of "marbles" that have a minus sign chalked onto their side. Since this is not realistic, option traders must manually turn down their Normal Volatility input to hit the proper at-the-money option price.

Simply said, although a straddle is both a call and a put, the market effectively values the put higher than the call. An imaginative heuristic would be instructive.

A three month ATM payer on the five swap rate might cost 1 point. That works out to be 103Nv. This seems fine since Rates could potentially rise significantly. On the contrary, a call option should not cost nearly as much. After all, how low can rates go? There is not much room for a further decline, even if we go the way of Japan. So the call option must cost less, perhaps half a point which would model at 52Nv. However, put/call parity demands that the call and put options cost the same since one can convert one to the other via a "delta hedge". The market solves this problem just like King Solomon almost did: They cut the straddle in half. The market prices the straddle at 1½ points (3/4 point each) which creates a quoted Volatility of 77Nv for the package. This is why Normal Volatility tends to decline as Interest Rates approach zero – the market is creating the proper option price but must "squish" the model to make it fit.

Need further proof? Take a look at out-of-the-money options on Rates that are nearing zero. Since OTM options are not required to adhere to the "Rules of Arbitrage", they can vary wildly. As such, you will notice that OTM puts trade at much higher prices than OTM calls. *Presently, most of what we call "Skew" for a Normal Volatility distribution is actually a completely flat pricing structure in a Yield Volatility model.*

To reach a final conclusion, one needs to be bilingual. (Adam Garner is tri-lingual, but we can save that for another day.)

In the language of Normalized Volatility, the CS Index is being “artificially” depressed as a result of the “zero effect”. Specifically, the 20% weighted two-year tail component is clocking in at barely 57Nv. Meanwhile, the 40% weighted ten-year tail component closed at 116Nv, not too much above its long-term average of 109Nv. This creates the allusion of cheapness for the Index.

The zero effect causes our Lognormal (Yield) Volatility based measures to register too high. The ultra-low 2 year tailed options presently clear at nearly a 72% Lognormal Volatility; this creates a huge distortion to our calculations.

As Captain Kirk might have said as he neared the gravity vortex of a Nebula, “we need answers, mister,” that are not impacted by the FED induced “zero effect”. Fortunately, we have them. Thumb back to the earlier chart where we compared Implied Volatility to the Realized Volatility. The Implied Volatility Index closed at 102; compare this to the recent Realized Volatility of the components at 96. While this +6% premium is a tad less that the average spread of +9%, this is NOT a ratio that screams out: “Wrong Price !” In fact, “Fair Price” seems like a conclusion closer to the truth.

That said, “Fair Price” is only a good guess if one believes the forward risk profile of the markets will be similar to the recent past. Over the next few months, we will argue that you should be a net seller of Volatility as the surprise of the FED’s promise to hold rates unchanged until 2013 wears thin and the cold realization that 2012 could be a 2006 Redux seeps into our consciousness.

See our truly excellent: *“Volatility in a Low Rate Environment: Lessons from Japan”*, published on 11/15/2011, for a more expansive discussion of how low Rates will impact Convex Products. Click here >>> https://doc.research-and-analytics.csfb.com/docView?language=ENG&source=emfromsendlink&format=PDF&document_id=928595251&serialid=GY3%2bWnjtXBBsmiiw60LeOmsDdB%2fWn0TkU8BhYsa0r%2fs%3d

In conclusion, we would note that the New York Times recently explored current research that studies how the language you speak impacts how you think. Some words simply do not exist in various languages so people think differently.

And so it is with option trading: It just depends upon what language you speak.

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November 28, 2011

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