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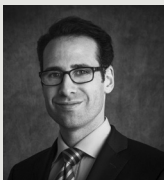
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Credit Risk Management: Observations from Real-Life Examples

By Olivier Sarfati

ONE TAKEAWAY OF THE 2008-2009 credit crisis is that correlation between normally uncorrelated assets can reach 100%. This, in turn, makes diversification a mediocre hedging strategy at best. To make matters worse, assets that should have been correlated, like a CDS and a bond on the same issuer, ended up de-correlating, at least momentarily, as

basis traders unwound their positions. These were exceptional times, yet, just the kind a risk manager needs to prepare for.



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Figure 1. Increasing 6m Correlation to S&P 500

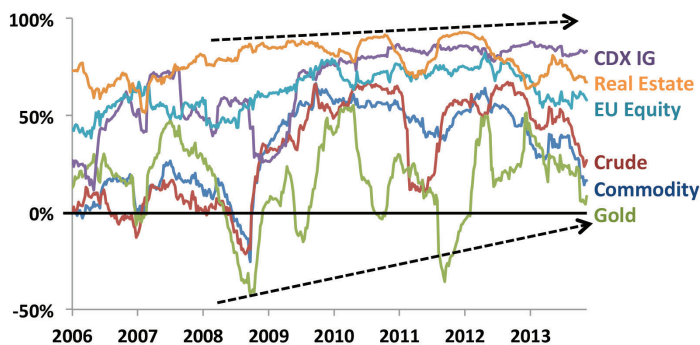
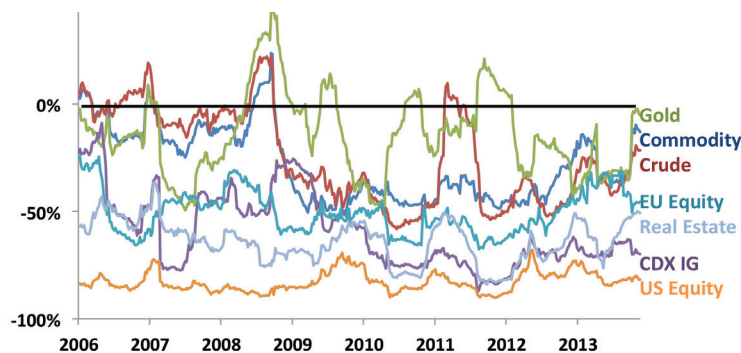


Figure 2. Negative 6m Correlation to VIX



While equity fund managers have been using equity options to manage risk for years, it occurred to us that investors exposed to credit risks (insurance companies for instant) were less accustomed to doing so. The purpose of this article is to share with fellow risk or asset-managers a few strategies to manage credit risks in their portfolios.

To start with, we have some interesting observations that came up from real-life examples of advising clients on how to hedge their portfolio. Namely:

1. Higher correlation while it can be a negative, can be used in the risk-manager's advantage
2. Put options or volatility derivatives such as VIX calls can be efficient hedges as they provide well-needed convexity.
3. Liquidity matters: a good hedge has to protect against mark-to-market risk, and has to be monetizable if need arises.

The first requirement for a hedge is to be correlated, or become correlated in times of crisis, with the asset to hedge. Figure 1 shows the rolling realized correlation of a few selected underlyings vs. the S&P500.

As expected Gold demonstrated negative correlation at the onset of the crisis, but unexpectedly it became positively correlated in 2009. Such variability makes it a risky hedge. Before 2008, European equities appeared more correlated to U.S. equities than U.S. Investment Grade credit spreads. A possible explanation is that in 2006, 2007 and early 2008, flows into credit structured products were so large that they compressed the IG index regardless of economic news. After 2008, supply and demand flows became more balanced and credit spreads correlated strongly to the S&P500. Consequently, credit managers looking for hedges were no longer restricted to buying protection on just the IG (investment grade) or the HY (high yield) index, via options or tranches, but they could also consider derivatives on the S&P500, benefitting from one of the most mature and liquid market.

Figure 2 shows that the VIX is also strongly correlated, albeit negatively this time, to U.S. equities, U.S. credit spreads and Real Estate stocks. This essentially opens the suite of VIX derivatives to risk managers. As this article details later, the VIX, or more accurately the tradable instruments on the VIX, offer more convexity than SPX options, which is a characteristic looked for by Credit PMs.

“The 2008-09 crisis made the case for SPX hedges and VIX calls for both Equity and credit PMs alike”

There are also a number of hedging instruments, such as variance swaps, best-of-puts, or timer puts to name a few, that have been used by savvy investors for managing risk. In the interest of brevity, this article will focus on most common hedging practices.

CASE STUDY: BACKGROUND INFORMATION

To make things more concrete, we recounted below an actual analysis we ran in 2012 for an asset manager, client of Citigroup. To respect the client’s anonymity, we changed all the relevant data. However, we described the steps of our analysis as it happened and showed results largely in line with the real life example.

Standard Asset Management, whom we will refer to as SAM, reached out to Citi for advice on hedging the systemic risk in one of their portfolios. The assets in scope totalled \$10bn across hundreds of corporate bonds for which they provided the exact inventory. We asked for historical valuations of the portfolio to better assess the risk, but the data were not available. Most of these bonds had limited liquidity so finding historical daily valuations five years after the fact was not an option. One way to circumvent this problem was to create a proxy index for SAM’s portfolio, essentially finding

a liquid portfolio that would match the investment profile of today’s inventory assuming that it would have matched it historically.

The ideal building blocks for a proxy are the IG and the HY CDX indices. There are three reasons for this:

- i. Both indices are highly liquid and easy to trade
- ii. Historical data are trustworthy and available—at least from 2005 onward
- iii. IG and HY are respectively strongly correlated to the S&P500 and the Russell 2000 indices as seen in Fig 3 and 4. So a combination of them will be correlated to equities, which opens the door to more hedging strategies.

We observed the credit spread distribution of SAM’s book and found that a proxy made of 85% of the IG CDX and 15% of the HY index was a good match. The average credit spread of the proxy (214 bps) is very close to that of SAM’s portfolio (218 bps). Comparing each credit spread bucket showed very similar results. The sector distributions were similar too.

Of course, there are a number of technical challenges along the way. For example, new CDX indices are issued every six months and constituents change over time as companies default, get downgraded or upgraded. Therefore, while SAM’s portfolio is similar to the current indices today, we do not know what SAM’s holdings were five years ago.

For additional caution, we compared the composition of SAM’s holdings with the S&P500, as shown in Figure 6. The reason is that while correlation may have been strong in the past, future correlation is not guaranteed. For example, a meaningful difference in sector exposure would introduce a tracking error risk if a given sector dispersed away from the index. It turned out that SAM was overweight Financials (18% more than S&P500) and underweight IT (15% less than S&P500). Given that neither financials nor IT firms were trading at lofty valuations at the time of our analysis, SAM felt comfortable with just an SPX hedge and did not feel the need to address the Financial/IT mismatch.

Figure 3. 5Yr. CDX Is Spread vs SPY Spot

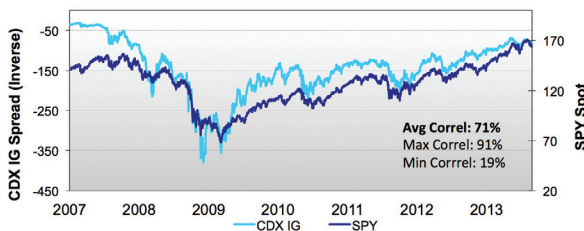
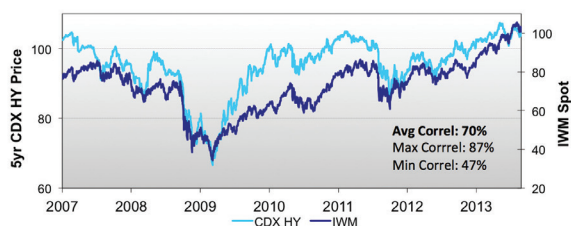


Figure 4. %Yr CDX HY Price vs IWM Spot



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Figure 5. SAM's Corporate Credit Exposure

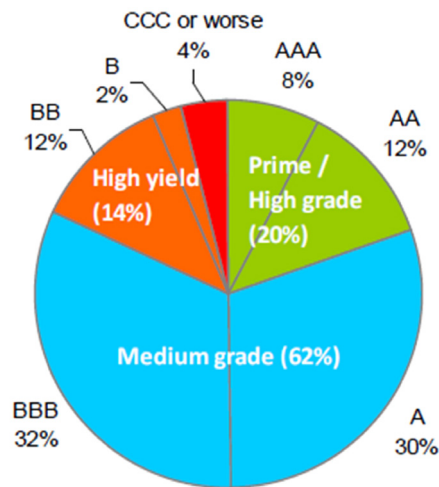
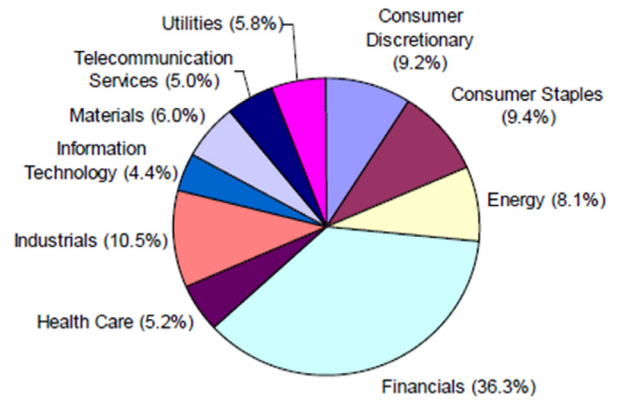
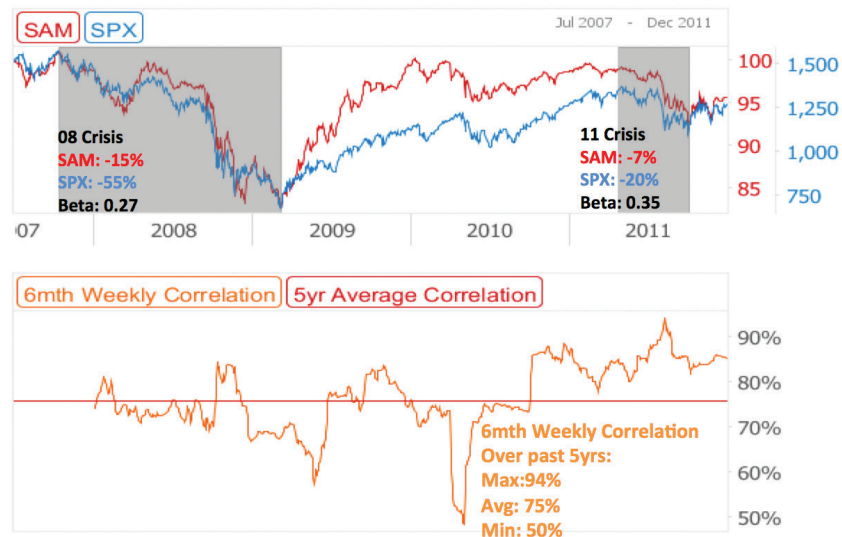


Figure 6. SAM's Sector Distribution



The chart below shows how SAM's proxy portfolio is highly correlated to the S&P500. Adding a component on the Russell 2000 barely added to the correlation results, so we only kept the S&P500 component. The average correlation is 75% over the five year period of time from 2007 to 2011, as seen in Figure 7. The correlation is even higher during the time of crisis, i.e. 85-95% in late 2011.

Figure 7. SAM vs SPX Performance & Correlation since 2007



“Equity put options and VIX options are attractive hedges for credit portfolios.”

Possible Hedging Solutions

To see how using SPX as a hedge ranks vs. other options, we took a pragmatic approach and listed six hedging strategies:

- i. Sell positions. Simple & Effective. Risk is removed and so is upside exposure. Not mentioning the prohibitive bid-offer for doing so, the main drawback is that SAM is in the asset-management business and cannot justify charging fees on cash.
- ii. Buy protection on the IG index (and the HY index). Three drawbacks: the hedge can become very costly if IG tightens, shorting IG is negative carry, and, there is a basis risk between the index and SAM’s holdings.
- iii. Buy protection on a CDX tranche. Not optimal either given the limited liquidity in tranches and the correlation exposure.
- iv. Buy a put on a popular FX carry trade such as AUDJPY. The premise being that at times of crisis, popular carry trades get unwound all of a sudden. Buying puts on such carry trade makes sense to hedge systemic risk.
- v. Buy puts on the SPX (or the Russell)
- vi. Buy calls on VIX futures.

Clearly, the last two make the most sense: both use exchange-listed products with no counterparty credit risk. They are characterized by high liquidity and great transparency. They are “close” to the IG/HY risk (as opposed to a JPYAUD trade which seems more far-fetched). In addition, VIX options would enable SAM to benefit from convexity.

The risk is a breakdown of the correlation between credit and equities. This could happen should there be dramatic releveraging of companies such that credit spreads widen while stocks go up. Given the financing environment in 2012, SAM thought there were limited chances of this happening.

EQUITY OPTION STRATEGIES

There were three options strategies that SAM retained for discussions with its board: an SPX put, an SPX put spread and an SPX put strip. All had one year maturity.

SPX Put:

The strike price was chosen to be 90% of current spot price and maturity was one year. It provides a long Vega exposure during the life of the trade. And at maturity, it provides a linear hedge if S&P500 were to go down more than 10%. Efficient but expensive (4.9% of the notional).

SPX Put Spread:

Buy a 90% put and sell an 80% put to lower the cost to 2.9% of notional. Cheaper, but protection is now limited to a max drop of 20%.

SPX Put Strip:

Buy an SPX put at 90%, at 80% and at 70%; all at the same maturity, each with 1/3 of the notional of the previous two strategies. The Put Strip is cheaper (3.0% of notional) than a single put and bears long convexity features. The major concern is that the hedge does not kick in until SPX moves down meaningfully.

As SAM favored a tail risk hedge, the Put Strip got the most votes.

Figure 8. Comparison of the performances of the put option strategies

Performance at Expiry (based on \$1bn Notional)

SAM's portfolio	Premium	-20%	-15%	-10%	-5%	0%	+5%
SPX		-73.3%	-55.0%	-36.7%	-18.3%	0%	18.3%
Put	\$48.7mm / (4.9%)	63.3%	45.0%	26.7%	8.3%	0.0%	0.0%
Put Spread	\$29.2mm / (2.9%)	15.0%	15.0%	15.0%	8.3%	0.0%	0.0%
Put Strip	\$29.8mm / (3.0%)	53.3%	35.0%	16.7%	2.8%	0.0%	0.0%

Return at Expiry (based on Premium Outlay)

SAM's portfolio	Premium	-20%	-15%	-10%	-5%	0%	+5%
SPX		-73%	-55%	-37%	-18%	0%	18%
Put	\$48.7mm / (4.9%)	1300%	924%	547%	171%	0%	0%
Put Spread	\$29.2mm / (2.9%)	513%	513%	513%	285%	0%	0%
Put Strip	\$29.8mm / (3.0%)	1787%	1173%	559%	93%	0%	0%

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VIX PRODUCTS HEDGING STRATEGIES

SAM was also very intrigued with VIX products. While they had heard about the VIX, they had not traded VIX derivatives yet.

The “Fear Gauge” & VIX Products

The VIX Index measures the market’s expectation of the 30-day rolling SPX volatility implicit in the prices of front-month and second-month SPX options strips. It is also known as the “Fear Gauge” because of its negative correlation with SPX. Indeed, the correlation between the returns of VIX Index and those of SPX is about -85% since 2010.

Meanwhile, as shown in Figure 9, regression using weekly returns shows that VIX returns are positively convex with respect with SPX returns, as a large downward move in SPX corresponds to an even larger move in VIX Index, and thus is favored by risk/portfolio managers.

However, unlike other equity indices, which are a weighted sum of tradable components, VIX is only a real-time statistic and is not a tradable instrument. This is because of the rolling feature (dynamically changing weight between front-month and near-month options) and its nonlinear calculation method.

Figure 9. VIX vs SPX Weekly Return*

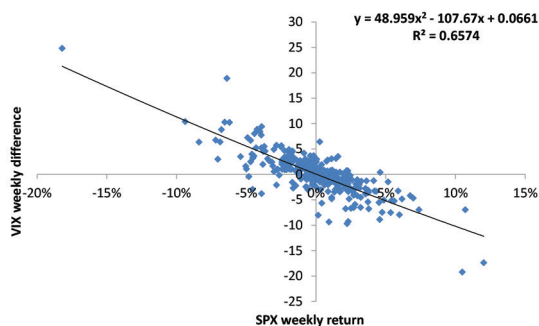
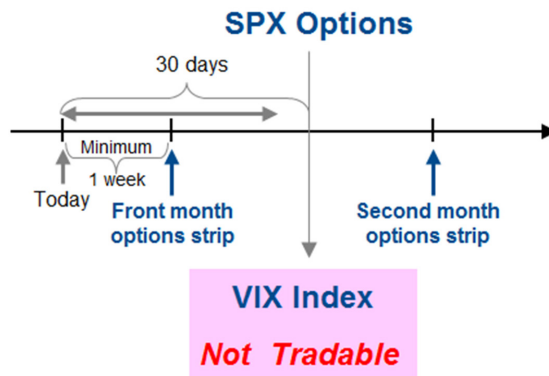


Figure 10. VIX Index Calculation



While the VIX is not tradable, investors can trade VIX futures, or options on futures, or ETNs based on VIX futures or even options on these ETNs. The futures reflect the market’s expectations of the level of VIX in the future, one to nine months ahead respectively. VIX futures saw a slow start when they were first introduced in 2004. But trading activity increased dramatically since 2009, with the advent of VIX ETNs making the VIX derivatives of the deepest market.

“VIX futures are generally in Contango, but can be in Backwardation at the time of a crisis.”

Figure 11. VIX vs CDX IG Spread¹

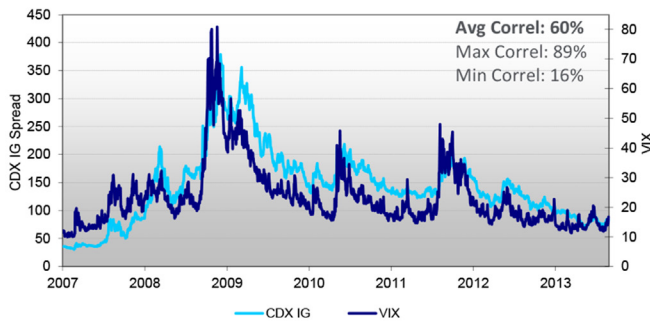
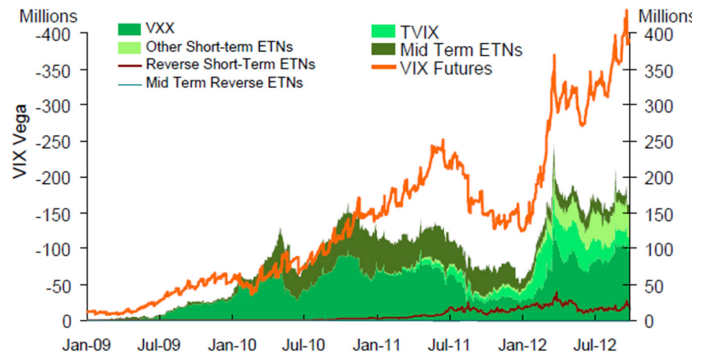


Figure 12. Trading Activity on VIX Products

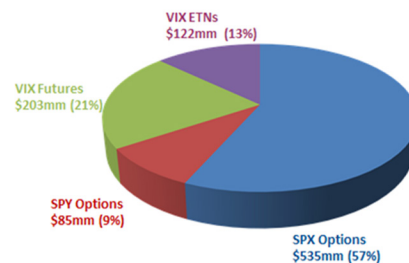


Now, measured by Vega, trading activities of VIX products are one-third the size of first two SPX options, as shown in Figure 13.

Figure 13. Market Share of VIX STPs & VIX Futures vs SPX-linked options

	Total Vega Outstanding (mm)	Total Vega in first 2 months (mm)	Total equivalent Option Notional (bln)	Total equivalent Option Notional 1st 2m (bln)
SPX	\$1,980	\$535	\$1,930	\$660
SPY	\$280	\$85	\$110	\$305
VIX Futures	\$345	\$203	\$336	\$198
VIX ETPs	\$125	\$122	\$122	\$119

Short Term (Aug & Sep)



VIX futures are generally in Contango, where the term structure is upward sloping, but the term structure inverts at times of crisis. As shown in Figure 14 and Figure 15, VIX Spot over 1st-month VIX future ranges from -5% to 11.5%, with an average of -0.8%, and is negative 94% of the time. 1st-month over 2nd-month future range from -5.5% to 7.5%, with an average of -1.1%, and is negative 87% of the time. This is an important observation because at times of crisis, the term structure inverts and goes in Backwardation. Strategies that benefit from a shift from Contango to Backwardation allow to hedge against systemic risk.

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Figure 14. VIX Index – 1st Month VIX Future Spread vs SPX

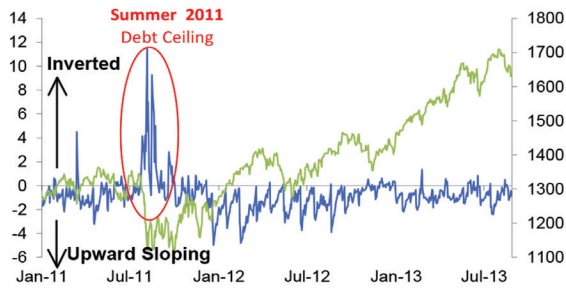


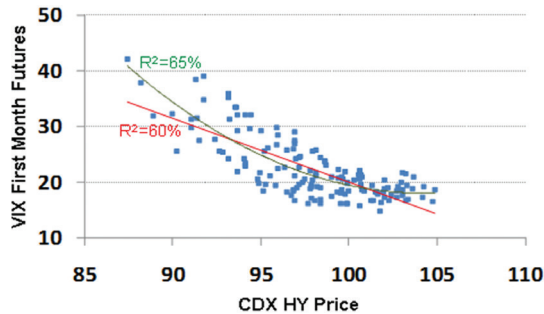
Figure 15. 1st - 2nd Month VIX Future Spread vs SPX



Hedging High Yield Portfolios with VIX futures

The high average correlation of 71% between a synthetic HY portfolio and VIX futures allows us to hedge a HY credit portfolio using a portfolio of VIX futures. Further regression analysis showed that \$1mm Vega of VIX futures would be enough to hedge \$100mm HY portfolio. Besides high correlation, VIX futures are an appropriate hedge because of their convex relationship with HY portfolio (Figure 16).

Figure 16. VIX – 1st Month Futures vs CDX HY Price



“VIX Calendar call spread benefit from inversion of the VIX term structure during crisis.”

Using VIX options to hedge systemic risk

Buy a short-dated VIX call; Sell a long-dated VIX call

Most of the time, the VIX futures term structure is upward-sloping. However, VIX futures prices are more volatile at the front end than at the back end. During times of crisis, short-dated VIX futures prices tend to rise more than the increase in long-dated futures inverting the term structure. (Figure 14 and Figure 15) The spread between 1st-month VIX futures and 2nd-month VIX futures turned positive in times of crisis (Figure 17). During the Flash Crash, for example, front-month futures prices jumped as much as 12.4 pts, while 4th-month futures prices went up by 6.2pts from May 3 to May 7 in 2010. A similar market event is likely to knock the short-dated option in the calendar call spread strategy in the money, while the long-dated option is still out of the money.

One thing to note when trading VIX options is that it’s best to close or to roll the position a week before expiration, since options prices are very volatile towards the expiry.

S&P500 PUTS OR VIX CALLS?

A further look into hedging S&P500 with S&P500 puts and with VIX calls shows that historically VIX calls have worked better than SPX puts.

The chart below shows the efficient frontiers for two portfolios using the X-Axis for Risk and the Y-Axis for return:

1. Long S&P500 hedged with a variable notional of 1-month 125% VIX calls.
2. Long S&P500 hedged with a variable notional of 1-month 95% SPX puts.

The conclusions from this chart are quite dramatic. The first portfolio has a traditional shape efficient frontier graph with an optimal hedge ratio of 22% VIX calls. However, the second portfolio does not have an optimal point. While risk is reduced as the hedge increases, returns become more negative.

Figure 17. VIX 1st-month Futures vs 2nd -month Futures

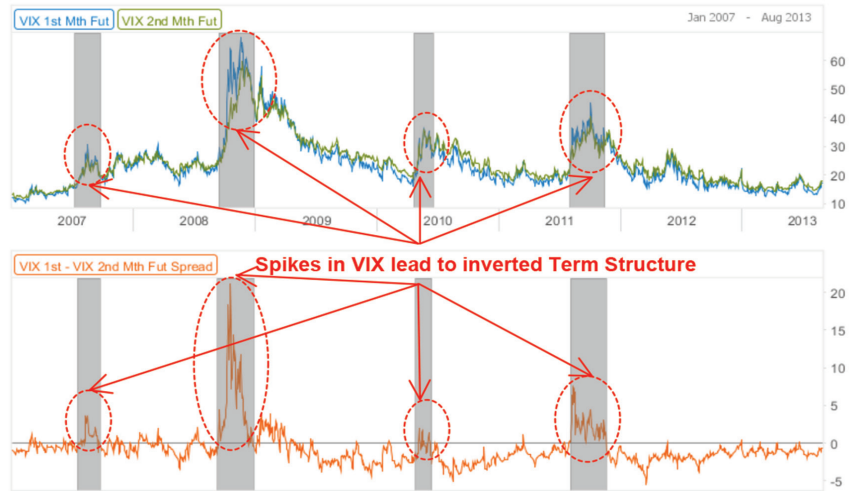
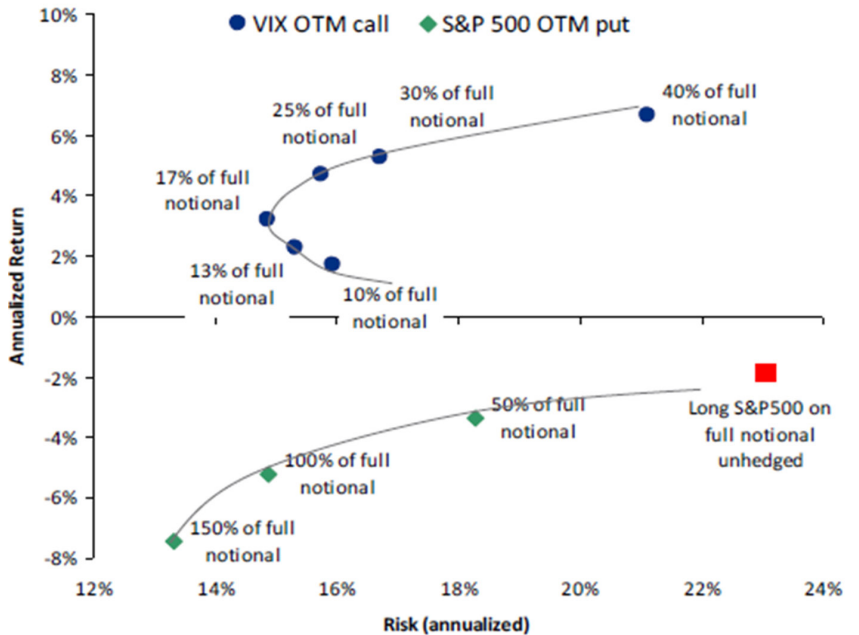


Figure 18. Efficient Frontier of 1m 125% VIX Calls vs 1m 95% SPX Puts



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This result indicates that for the time period considered, SPX puts were too expensive compared to VIX calls in light of the benefit they would provide. While this was the case in the past, the relative cost/benefit analysis evolves over time. So it's helpful to get equity derivative experts' opinions as to which one is cheaper at the time of your hedging. ■

ENDNOTE

- ¹ Negative carry refers to a situation where the cost of holding a security exceeds the yield earned, and therefore is not desirable for investors. When an investor buys protection on IG index, he/she makes coupon payments on a quarterly basis to the protection seller, thus having negative carry.
- ² In an FX carry trade, an investor sells a currency with a relatively low interest rate to finance buying another currency yielding a higher interest rate to capture the difference between the rates.

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