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Derivative Focus

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Mythbusters – “LSD” (Leverage, Shorting, Derivatives) can be reasonable

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Short volatility positions can earn risk premia

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Derivatives are full of mystique and myth. They are blamed for the failure of firms and are credited with the making of fortunes. Derivatives are both misunderstood and maligned.

Perhaps no one better illustrates the nuance involved in derivative exposure than Warren Buffett. Many assume he thinks derivatives are toxic, remembering a comment in one of his annual reports about “financial weapons of mass destruction”.[1]

What may be surprising is that Berkshire Hathaway has been a large user of derivative products, typically ‘selling volatility’ in equities or credit. Mr Buffett has described the positions as “insurance-like”, i.e., reasonable to the extent the premium received more than compensates for the risk underwritten.

The “weapons of mass destruction” comment referred to systemic risks created by inappropriate counterparty exposure across firms, not the investment properties of derivatives *per se*. Otherwise, he would not have made such heavy use of them.

Systematic derivative strategies can be reasonable, offering attractive risk-adjusted returns and good diversification relative to traditional asset classes. In essence, leverage, shorting and derivatives as a package, the “LSD” of finance, may be more reasonable than you think.

“Selling volatility” using derivatives is largely about earning volatility risk premia (VRP). And VRP is similar in spirit to the risk premia one earns from equities, credit, MBS, or even government bonds. VRP may be a risk premium that is more highly compensated than more conventional risk premia for a given level of assumed risk.

In this report, we try to debunk a few of the myths associated with derivatives. In particular, we aim to address the following:

- Myth 1: Selling volatility is a choice.
- Myth 2: Volatility sellers almost always get hurt in the end.
- Myth 3: Smart money only buys volatility.
- Myth 4: Implied-to-realised volatility ratios are good signals.
- Myth 5: Sell options when implied volatility is high.
- Myth 6: Crisis hedges always cost carry.

Harvesting volatility risk premia through derivative exposure is an activity one should not avoid. Once we see how vapid the myths are, it should be clear that there is no reason to avoid it any longer.

Myths 1 and 2: selling volatility is a choice, volatility sellers almost always get hurt in the end

In this section, we make two observations:

[1] Berkshire Hathaway Annual Report 2002, p 13. http://www.berkshirehathaway.com/letters/2002pdf.pdf

1. At the current time, almost every asset class has short volatility, especially vanilla equity, credit, MBS or government bond exposure.

2. Volatility exposure pays a positive risk premium that appears to be higher than more conventional risk premia for a given unit of risk.

"Never sell volatility" is an old saying. Like many old sayings, it is often assumed to be true. And few have bothered to investigate seriously whether or not the data support it.

This statement has several problems. The first and most fundamental problem with "never sell volatility" is that it assumes one has a choice, whether or not to sell volatility.

This is a romantic notion floating around, that investors have such a choice. The reality is messier. When it comes to selling volatility, investors have no real choice.

All asset classes are short volatility
Virtually all asset classes are short volatility in some form or another, especially when interest rates are low. Credit, equities, MBS and government bonds all have this property. In general, if you are making a return, you probably sold someone some sort of option.

Volatility sellers seem to earn a risk premium
This brings us to the second big problem with "never sell volatility" as a statement. The idea that volatility sellers almost always get hurt is contradicted by most empirical studies that we have seen or conducted ourselves. Selling volatility seems to earn a risk premium, by whatever method one uses, e.g., shorting straddles or variance swaps or forward volatility agreements.

So, almost all investors are short volatility. But not everyone is aware of this. And of those who are aware that they are short volatility, not everyone is aware that some forms of volatility offer better compensation than others.

So the key questions investors should ask themselves are the following:

1. Are you aware that you are already short volatility?

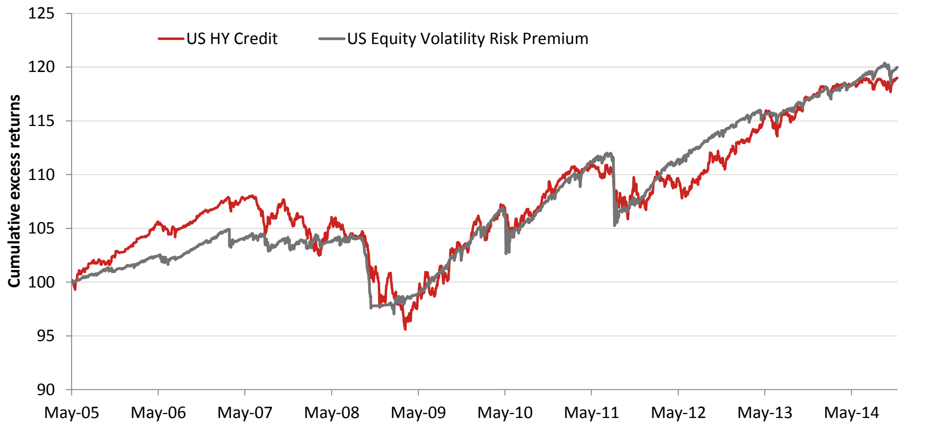
2. Are you aware that some form of volatility offers higher compensation than others?

3. Are you pro-actively seeking to allocate to the volatility exposure that pays the highest possible compensation for risk assumed?

Credit
Robert Merton (1974)[2] showed that a long credit position can be viewed as holding a short put option on the assets of the firm. The idea is that credit would pay a spread so long as the assets of the firm remained higher than the level of debt assumed. In this case, no default would occur. But if the assets of the firm were to fall in value to a level lower than the amount of debt, a default would occur and the investor could lose everything.

[2] Merton, Robert C., On the pricing of corporate debt: the risk structure of interest rates, Journal of Finance, Vol. 29, (1973) 449-470.

Fig. 1: Long credit is like short equity volatility



Source: Bloomberg, Nomura. HY Credit is CDX HY on-the-run index. US equity volatility risk premium is short variance swaps on S&P 500.

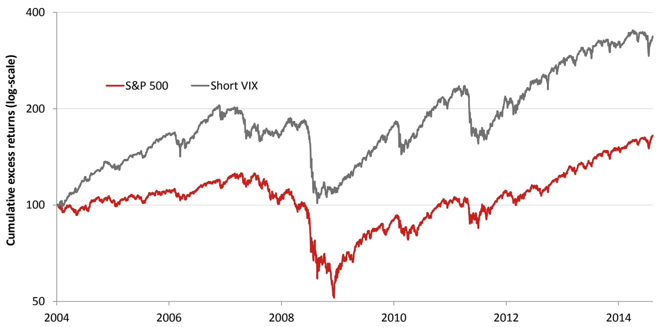
This intuition is easy to see in the data, as shown in Fig. 1. It shows the excess returns of the CDX High Yield credit index and the excess returns of a short variance swap position in the S&P 500, i.e., the US Equity Volatility Risk Premium index in the chart. There is a striking similarity between credit exposure and short equity volatility exposure.

This seems perfectly consistent with Merton's framework, which is consistent with the original Black-Scholes results.

Equity

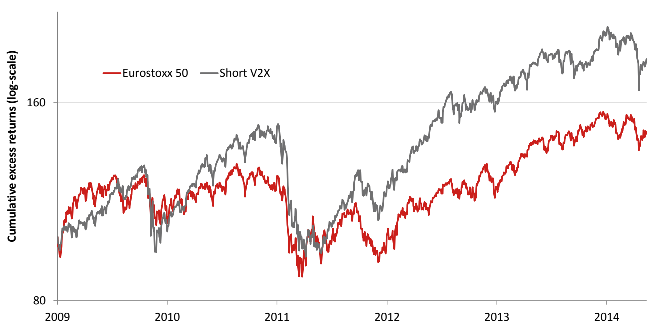
The original Black-Scholes framework considered equity shares a long call option on the value of the firm. But empirically, long equity exposure also looks very similar to short equity volatility exposure. This can be seen in Figures 2 and 3.

Fig. 2: Long S&P 500 is like short VIX, but earns less



Source: Bloomberg

Fig. 3: Long Eurostoxx50 is like short V2X, but earns less

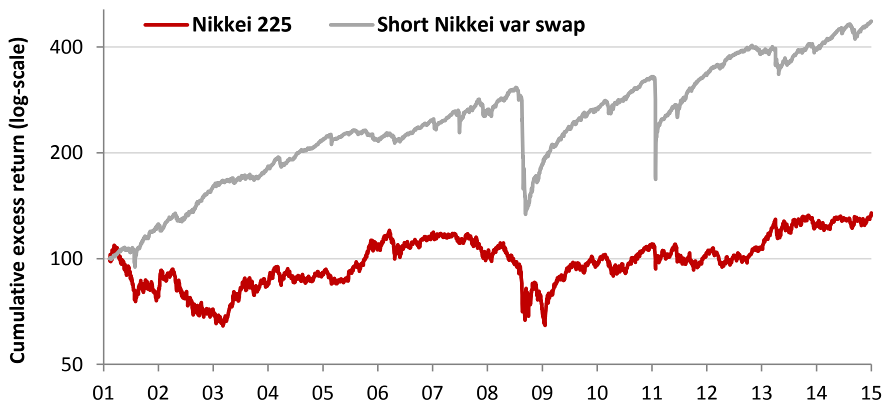


Source: Bloomberg

Short equity volatility exposure is clearly not an arbitrage. It suffers when there is a market crisis, just like regular equity exposure. In that sense, short equity volatility exposure has a sort of beta.

But while short equity volatility exposure looks like long equity exposure in general terms, it seems to earn a higher risk premium for a given level of risk exposure. We see this result in Japan equity data as well. Short variance swap positions on the Nikkei 225 outperform vanilla long exposure by a considerable margin (see Fig. 4).

Fig. 4: Long Nikkei underperforms short Nikkei volatility exposure



Source: Bloomberg, Nomura research

One might ask why the observed ‘short volatility’ behaviour of equity markets is so different from the ‘long volatility’ intuition of Black-Scholes. There are several possible explanations.

Stochastic volatility

Black-Scholes assumed constant volatility. In reality, equity-implied volatility is variable. In addition, its variability has a definite pattern – rising when equity levels decline and falling when equity levels rise. In other words, implied volatility has a negative beta to equities themselves (which is sometimes called rho in a Heston model capturing the correlation between stochastic volatility and stochastic equity returns). Hence, a short equity volatility position could reasonably be expected to have a positive beta and earn a risk premium.

Jump-risk

Black-Scholes assumes a Brownian motion price process. This would have no jumps or other discontinuities. In reality, many firms can suffer negative jumps, sudden price falls triggered by accounting scandals or disasters. Merton (1976)[3] was the first to incorporate jumps into pricing frameworks. As such, equity shares could be seen as long positions in call options, but with short exposure to negative jump risk and a knockout at default. The short knockout can make short volatility dependence dominate. More recent studies look at jump risk in prices and volatility as more accurately capturing observed patterns.

Interest rates

During downturns, central banks tend to cut rates and government bond yields fall causing bond prices to rise. This feature of bonds being a form of insurance is common to most recessions. Similarly, during downturns, volatility tends to increase as economic uncertainty increases and risk premia rise. This negative correlation between yields and volatilities is a common feature of the normal business cycle.

At the zero-interest-rate-bound (ZIRB), the behaviour is turned on its head. In a low yield curve environment, rates are typically bounded at zero by a cash-and-carry constraint. The ZIRB leads to a positive correlation between rates and volatility, with higher volatility leading to higher yields, and lower volatility leading to lower yields. Although Denmark, Switzerland, and Germany have tested the cash-and-carry constraint, it nonetheless significantly changes the behaviour of rates, inducing a short-optionality in bonds.

This is what Fischer Black predicted would happen in his 1995 paper, "Interest rates as options."[4] While not explicitly in this paper, the following model captures the spirit of his view:

Say x_t is the shadow rate[5] and r_t is the short rate, then

$$dx_t = \mu(x,t)dt + \sigma dW_t$$

[3] Merton, Robert C., Option pricing when underlying stock returns are discontinuous, Journal of Financial Economics, 3 (1976) 125-144.

[4] Black, Fischer, Interest Rates as Options, Journal of Finance, Vol. 50 No. 5, (1995). Available at SSRN: http://ssrn.com/abstract=7012.

[5] Shadow rate is defined as the short rate without the cash-and-carry constraint. It is akin to the target rate derived from the Taylor Rule, which may often be negative.

$$r_t = max(0, x_t)$$

Hence, the zero coupon bond yield slope depends on volatility:

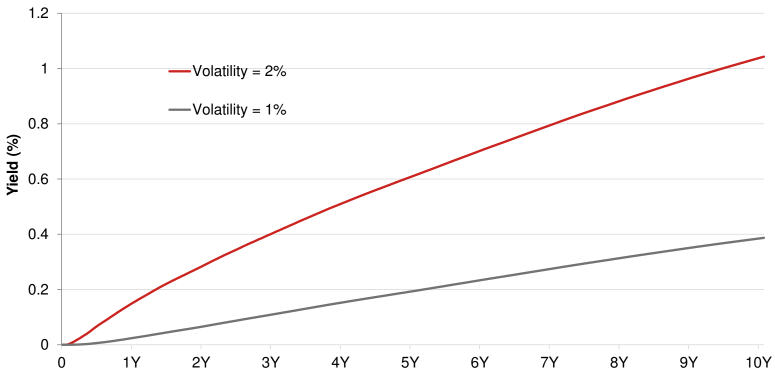
$$y_T = -log\left(E_T\left[exp\left(-\int r_s ds\right)\right]\right) \sim \sigma\sqrt{T}$$

And thus

$$y_{T_1} - y_{T_2} \sim \sigma\left(\sqrt{T_1} - \sqrt{T_2}\right)$$

In such a world, higher volatility leads to steeper curves and higher yield levels. We can see this in the simulation in Fig. 5.

Fig. 5: Zero coupon bond yield curve simulation, following Black's 1995 model

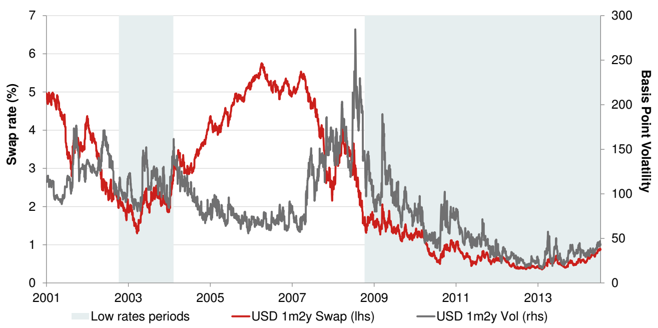


Source: Nomura research

This change in the correlation between yields and volatility is evident in the data, and when interest rates are low, we have seen a positive correlation between volatility and the level of interest rates.

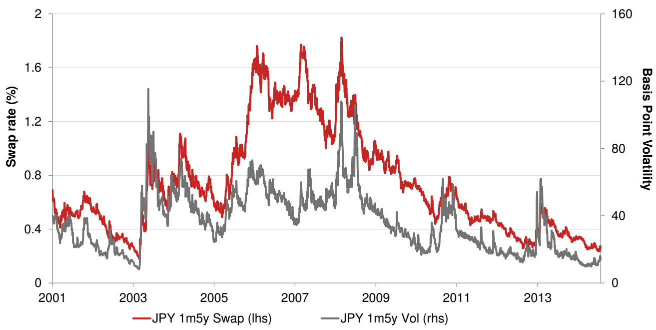
This positive correlation has existed in USD rates when they are low, but not when rates are higher, as shown in Fig. 6. In Japan, this positive correlation has been continuous as rates have been low (note that the y-axis in Fig. 7 is much lower than that in Fig. 6).

Fig. 6: USD rates and volatility co-move when rates are low



Source: Bloomberg, Nomura research

Fig. 7: Co-movement is even stronger in JPY rates



Source: Bloomberg, Nomura research

Another consequence of the ZIRB is the change in skewness of returns. Under normal circumstances, investors think of government bonds as providing diversification from equities. Although equities have negative skewness in their returns, government bonds have had positive skewness, as if they were 'long volatility'.

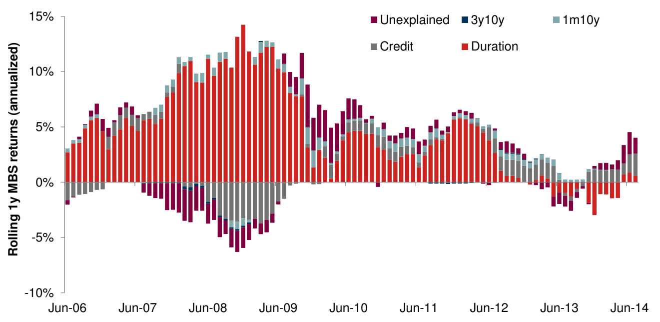
But in a low-yield environment, the upside of government bond returns becomes increasingly capped, while the downside remains high. Long bond positions can earn carry as long as the yield curve is upward-sloping, but they can lose much more if yields rise dramatically.

As such, government bond positions resemble short put options in a low-yield environment, with small upside and large downside. During the ZIRB period in Japan, Japanese government bonds have resembled short put positions, with a negative skewness of around -1.5. Over the same sample period, US Treasury equivalents would have had a positive skewness in returns.

US mortgage-backed securities (MBS)

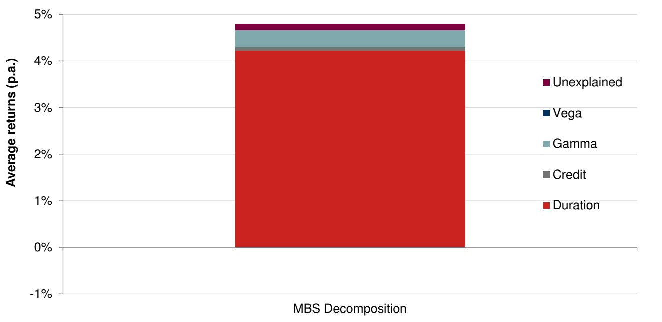
The US mortgage market is one of the largest single-product markets in the world. MBS investors are clearly short volatility as homeowners can easily refinance and have the right to prepay their fixed-rate mortgages at par. This is approximately equivalent to the MBS investor being short receiver swaptions, as homeowners have a strong incentive to prepay their mortgages when rates fall.

Fig. 8: Duration is the main driver of MBS returns



Source: Citi Yieldbook, Nomura research

Fig. 9: Short optionality drives the outperformance of MBS



Source: Citi Yieldbook, Nomura research. Sample period: Aug 2005 – Jul 2014.

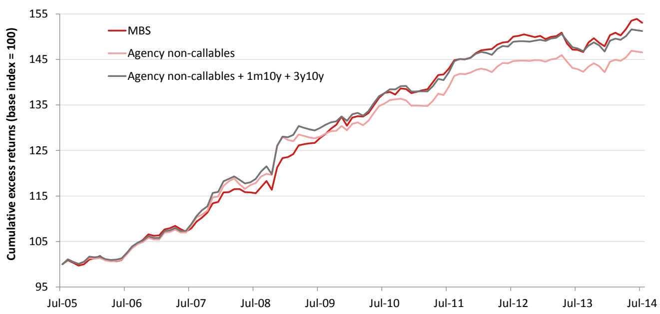
Figures 8 and 9 show that duration is the largest driver of MBS returns, but volatility is a significant contributor, as can be seen in Fig. 9.

We can approximately replicate MBS returns through combinations of agency non-callables, for the duration and credit exposure, and short volatility exposures. Following MBS market tradition, we use short positions in USD 1-month-10-year swaption straddles for gamma and 3-year-10-year swaption straddles for vega. As shown in Fig. 10, this combination captures a large part of what is going on in MBS in normal market conditions.

But this raises an interesting question. By owning MBS, investors are short volatility in certain parts of the rate volatility surface, e.g., 1m10y and 3y10y in the example above. But how do we know that is the best part of the volatility surface to short? Are there other parts of the volatility surface that would pay us more?

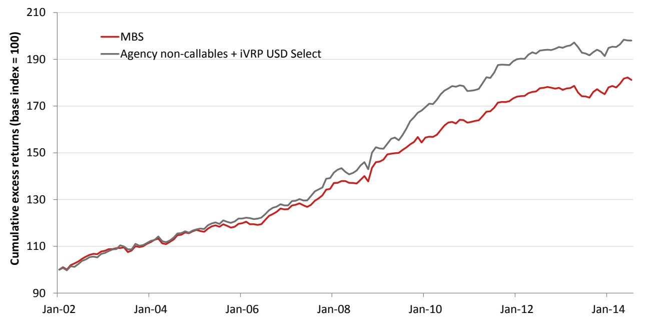
This is equivalent to an insurance company asking what type of insurance will provide the highest premium given the underwriting risk. As interest rate volatility exists in many dimensions, this is a complicated question to answer. But we think relatively simple methods can identify which parts of the surface are more attractive. We illustrate one such method, iVRP Select, in Fig. 11.

Fig. 10: Duration and short optionality replicate MBS returns



Source: Citi Yieldbook, Nomura research. Agency non-callables returns are adjusted to match the same duration as MBS

Fig. 11: Replacing standard MBS optionality with iVRP Select outperforms



Source: Citi Yieldbook, Nomura research

iVRP stands for interest rate volatility risk premium. The 'select' element of iVRP is a simple screening of possible short-swaption straddles based on estimates of expected risk premia.

In each of these asset classes, it is clear that investors have no choice over whether they sell volatility, as they are all effectively short volatility. But, as we have suggested, it may be that the basic asset classes are not, in and of themselves, the optimal means of being compensated for a short volatility position.

Myth 3: smart money only buys volatility

We all know the cliché narrative about derivative exposure. The smartest money of all, Warren Buffett, claims derivatives are "weapons of mass destruction". A related narrative says that derivatives triggered the failure of Lehman Brothers and Bear Stearns in 2008.

The real story is more complex. Berkshire Hathaway was a large user of derivatives, going short volatility. And Lehman Brothers was long volatility through these transactions, having bought optionality from Berkshire, as had many other banks. Specifically, Berkshire sold worst-of-equity index basket options to Lehman Brothers taking in a premium of several hundred million dollars.[6]

As Berkshire Hathaway had no Credit Support Annex (CSA) with Lehman Brothers, it did not have to post collateral, although it marked to market its options. This meant that it could use the proceeds, a form of insurance premium, to fund its larger business.

Mr Buffett acquired a portfolio of such short volatility positions through trades with Lehman Brothers and other counterparties. He described them in insurance-like terms. *"Though it's no sure thing, [we] believe it likely that the final liability will be considerably less than the amount we currently carry on our books (USD7.5bn). In the meantime, we can invest the USD4.2bn of float derived from these contracts as we see fit."*

Most investors are not able to enter into contracts without CSAs, and would have to put up collateral. Even Berkshire Hathaway is unable to enter into the same agreement terms post-crisis. Because of the need to post daily margin, investors can reduce the volatility of this marginable amount by delta-hedging and we recommend doing so on a daily basis. The resulting strategy is less extreme than Mr Buffett's original trades, but it offers considerable value nonetheless.

Volatility risk premia from selling gamma

Selling volatility is like offering insurance to the market. As with all insurance, this should come with a premium. In a consumption CAPM framework, all insurance products (those whose payoffs have a negative covariance with consumption, paying more in low consumption states) must have a negative premium, and selling insurance offers steady upside premium for the risk of insuring low-consumption states.

As Mr Buffett said, "Our insurance-like derivatives contracts, whereby we pay if various issues included in high-yield bond indexes default, are coming to a close…almost certain to realise a final 'underwriting profit' on this portfolio…This successful result during a time of great credit stress underscores the importance of obtaining a premium that is commensurate with the risk."[7]

Shorting volatility and delta hedging also offers a premium. We call this 'shorting gamma' or monetising the 'volatility risk premium'. Effectively, we sell tail risk insurance, and seek a gain commensurate with this risk.

Suppose we sell an option and delta-hedge continuously. We can calculate the hedge ratio using implied volatility σ_{imp}, which is different from the realised volatility σ_{Real}, then the P&L of the position can be shown to be:

$$E[P\&L] = \int_0^T \frac{1}{2}\Gamma(t)\left[\sigma_{Imp}^2(t) - \sigma_{Real}^2(t)\right]dt$$

where Gamma, $\Gamma(t) = \partial^2 C(S,t)/\partial S^2$ is positive for a long call or put position, and negative for a short position (see for example Carr-Madan[8]).

In academic literature, there are other characterisations of the resulting premia, depending on the underlying model, but all empirical findings report the same positive premium from selling options and delta-hedging.

The ex ante risk of the position is proportional to Gamma as well, as

$$Var[P\&L] \approx \int_0^T \frac{1}{2}\Gamma^2(t)\sigma_{Imp}^4(t)dt$$

[6] Matt Levine, Lehman Brothers Maybe Sold Warren Buffett a Rainbow, Bloomberg View, 6 Feb 2014 and quoted sources.

[7] Berkshire-Hathaway, Annual Report, 2011. http://www.sec.gov/Archives/edgar/data/1067983/000119312512081960/d307508dex991.htm, p 17.

[8] Carr, Peter, and Dilip Madan. "Towards a theory of volatility trading." Option Pricing, Interest Rates and Risk Management, Handbooks in Mathematical Finance (2001): 458-476.

With this result in hand, we can now tackle some misconceptions about short volatility positions that investors often have, including many derivative ‘experts’.

Myth 4: implied-to-realised ratios are good signals

Many derivative ‘experts’ look at implied/realised volatility ratios to determine whether to go long or short gamma. Using interest rate swaptions as an example, they might look at 1m10y implied volatility (the standard deviation of the 10y swap rate implied by swaption prices over the next month) relative to the realised standard deviation of the 10y swap rate over the past month. This forward-backward approach has difficulties, but it is popular nonetheless. One example of this is displayed in Fig. 12.

Fig. 12: USD 1m10y implied/realised volatility ratio looked attractive on 21 Nov 2014

		Underlying								
		1Y	2Y	3Y	5Y	7Y	10Y	15Y	20Y	30Y
Expiry	1M	1.69	1.39	1.39	1.33	1.36	$\boxed{1.55}$	1.58	1.59	1.63
	3M	0.39	1.15	1.11	1.08	1.09	1.11	1.10	1.08	1.06
	6M	1.09	1.31	1.27	1.24	1.23	1.22	1.18	1.16	1.13
	1Y	0.77	1.04	1.09	1.14	1.19	1.21	1.18	1.17	1.14

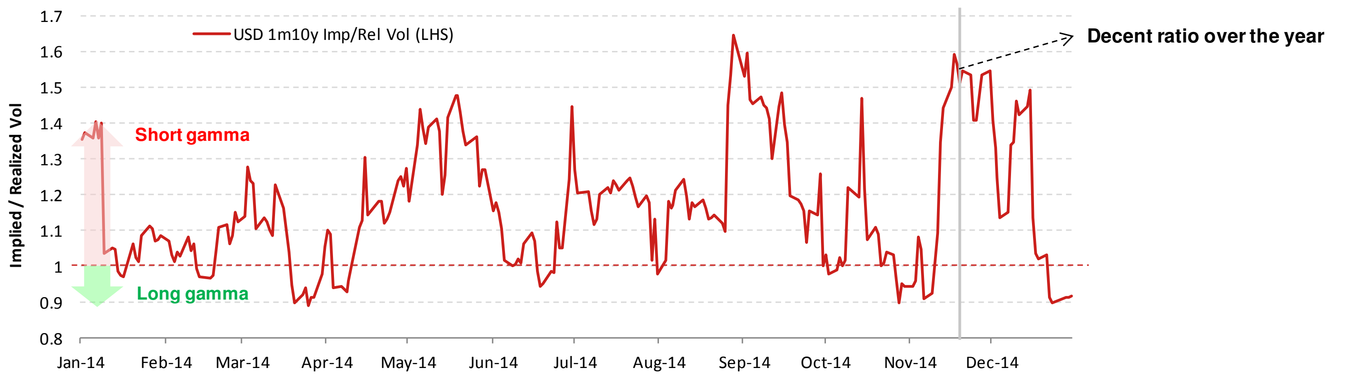
Decent ratio across the board

Source: Bloomberg, Nomura research

As shown in Fig. 12, the 1m10y implied/realised ratio looked high relative to other points on the volatility surface (the two-dimensional grid is expiries by forward underlying tenors).

The ratio also looked good relative to its own history, as shown in Fig. 13.

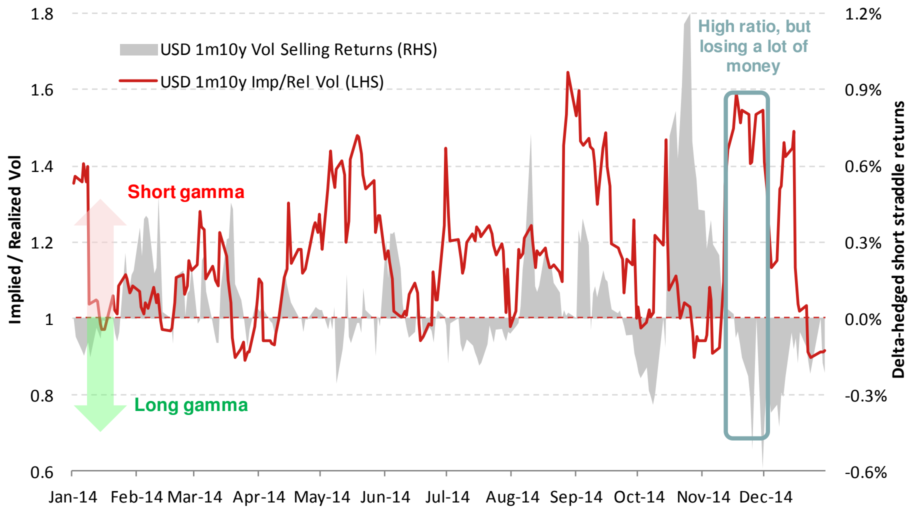
Fig. 13: USD 1m10y implied/realised volatility ratio looked attractive on 21 Nov 2014



Source: Bloomberg, Nomura research

But in spite of these positive indications, this specific instance turned out poorly as we can see in Fig. 14.

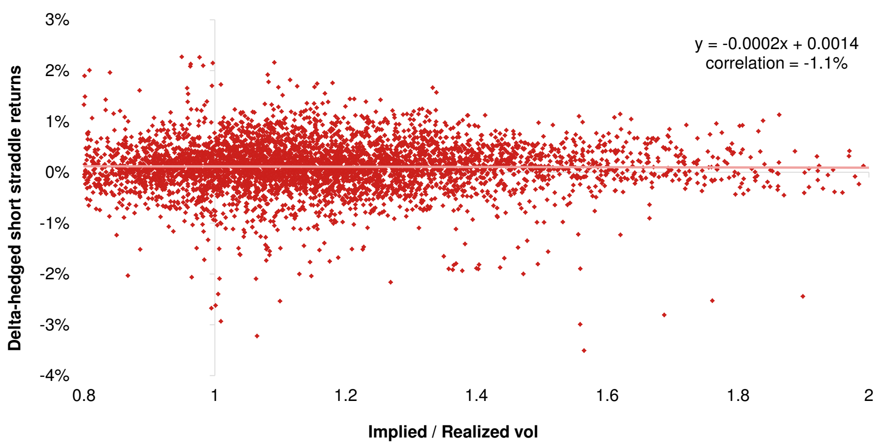
Fig. 14: But despite promising signals, severe drawdowns occurred later



Source: Bloomberg, Nomura research

This is not an unlucky or isolated case. As shown in Fig. 15, implied/realised ratios have almost no predictive power on subsequent returns to short gamma.

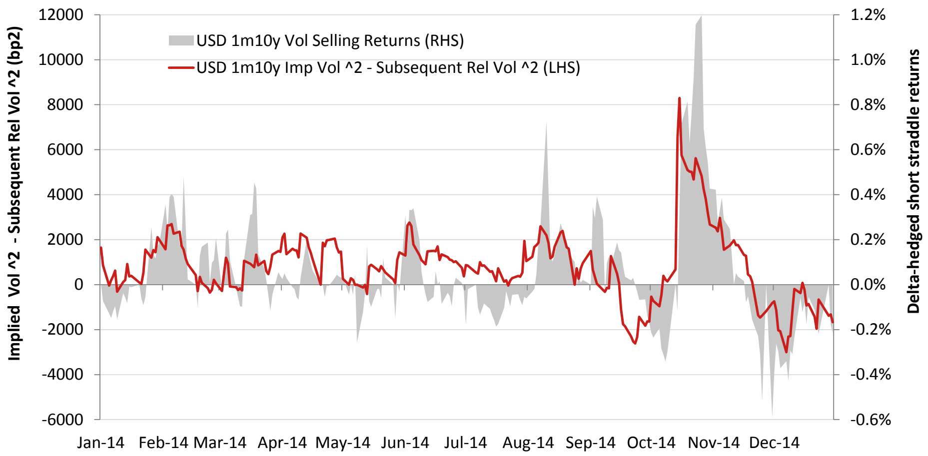
Fig. 15: No link between implied/realised volatility ratio and gamma-selling returns



Source: Bloomberg, Nomura research

There have been a number of reasonable models that propose to forecast volatility risk premia. Some use GARCH terms and implied volatilities, together with exogenous variables such as VIX slope, to forecast future realised volatilities. But here we look at ex-post explanations of P&L. As we have shown in the equations earlier, one of the primary drivers should be the difference between the squares of implied and realised volatility. We see this in Fig. 16.

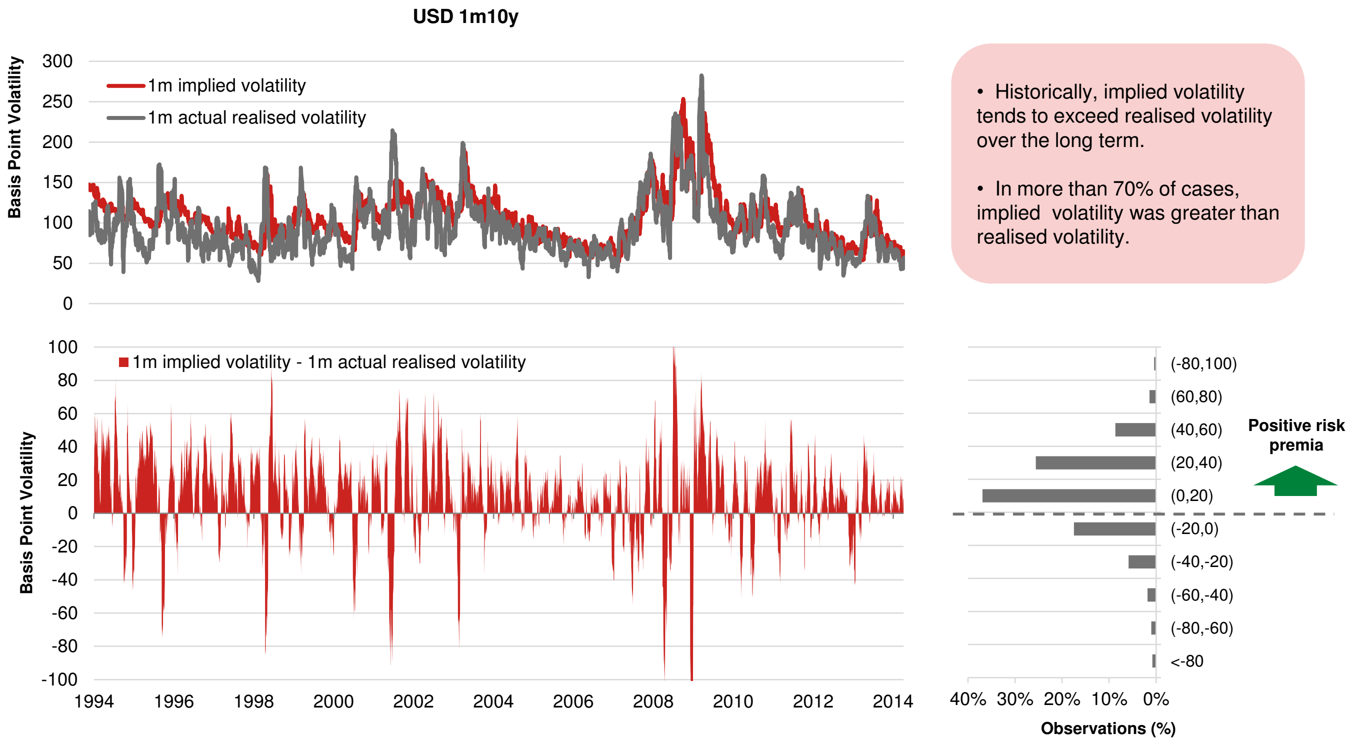
Fig. 16: The squared difference between implied and subsequently realised volatility is the key driver of short gamma performance



Source: Bloomberg, Nomura research

In general, implied volatility is larger than realised volatility more often, as we can see in the charts in Fig. 17.

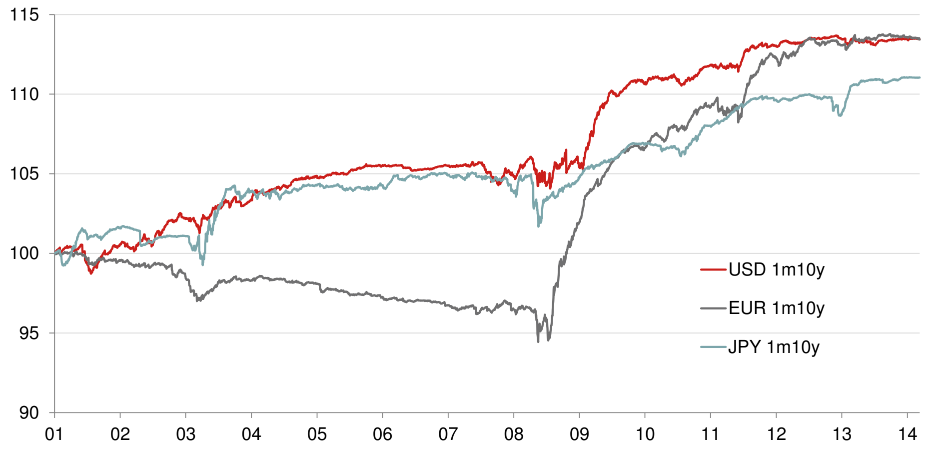
Fig. 17: Implied volatility is usually larger than subsequently realised volatility



Source: Bloomberg, Nomura research. The 1m10y swaption straddle implied volatility used in the above analysis is derived from the price of an ATMF 1m10y swaption, and the realised volatility is computed as being the actual realised volatility of the underlying 10y forward swap from the start date to the expiry date of the corresponding swaption straddle. The analysis is done on a daily basis and based on historical data from May1994 to September 2014.

Monetising this difference, we can obtain the volatility risk premium through selling swaption straddles daily and delta hedging daily. The resulting strategy is iVRP or Interest Rate Volatility Risk Premium. We see the performance for the 1m10y in Fig. 18.

Fig. 18: iVRP strategies capture volatility risk premium in rates

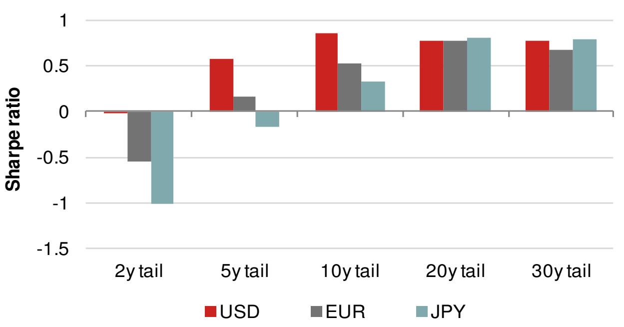


Source: Nomura research

We have chosen to sell a constant amount of risk in swaptions daily (i.e., a constant gamma). We have also chosen to delta hedge daily. In both cases, performance was tested vs. alternatives of less frequent hedging vs. more frequent hedging. In contrast, many short gamma strategies have delta targets (i.e., they are not rehedged until the delta drifts from zero by about 5% or 10%, etc.). We have not chosen a delta target primarily as these can be over-fit to history, as a wide range of high delta target is optimal in mean-reverting market conditions, while a narrow range or low delta target is far better in a trending market. Instead, we choose to delta hedge daily, rather than to optimise to a backtest.

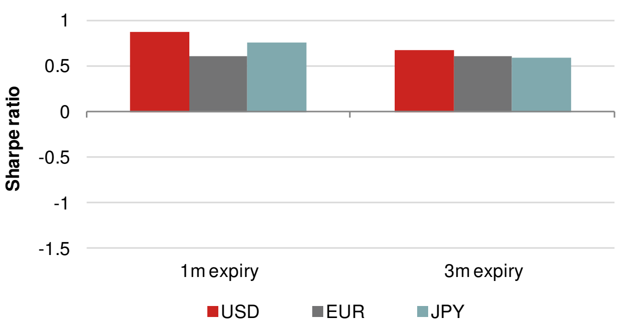
One immediate consequence is that in general longer tenors perform better, as do shorter expiries, and this outperformance persists across G3 rates (confirming Duyvesten-De Zwart's results[9]). We can see this in Figures 19 and 20.

Fig. 19: Across tenors, longer tenors do better



Source: Nomura research. Each tail portfolio contains swaptions on 1m/3m expiry (equal notional). The sample period is January 1995 to April 2014 for USD; January 1999 to April 2014 for EUR; January 1997 to April 2014 for JPY.

Fig. 20: Across expiries, shorter expiries do better



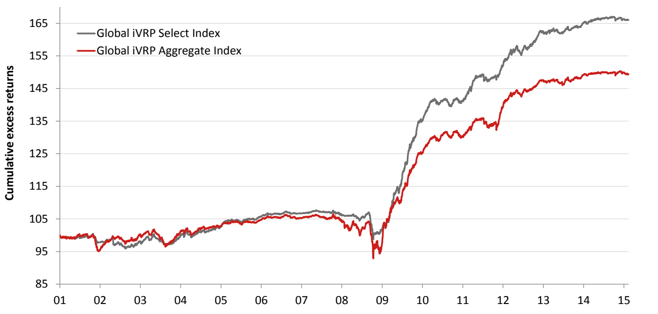
Source: Nomura research. Each expiry portfolio contains swaptions on 2y/5y/10y/20y/30y tails (equal notional). The sample period is January 1995 to April 2014 for USD; January 1999 to April 2014 for EUR; January 1997 to April 2014 for JPY.

Risk premia after crises have increased significantly. We believe this is attributable to a post-Basel 2.5 regulatory environment, where the use of Stressed-VAR has increased among investment banks. This framework penalises short gamma positions, making them extremely expensive in risk capital terms. Hedge funds have also reduced short gamma exposure, often owing to client pressure. So as suppliers of volatility have withdrawn, compensation has increased.

Volatility risk premia seem to have various kinds of quasi-predictability, in common with other asset classes. Using various tools to estimate expected returns across expiries and underlyings, we can outperform aggregate short-volatility strategies (i.e., those with equal risk weighting). This is true of rates and forex (Figures 21 and 22, respectively).

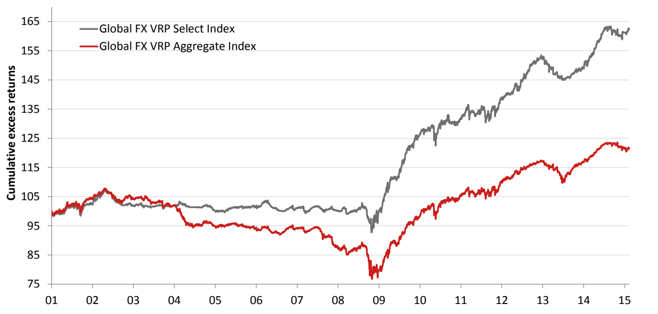
[9] Duyvesteyn, Johan G. and de Zwart, Gerben J., Riding the Swation Curve (April 4, 2013). Available at SSRN: http://ssrn.com/abstract=2008841

Fig. 21: VRP predictability helps improve the performance in rates



Source: Nomura research. The sample period is January 2001 to January 2015.

Fig. 22: VRP predictability helps improve the performance in forex



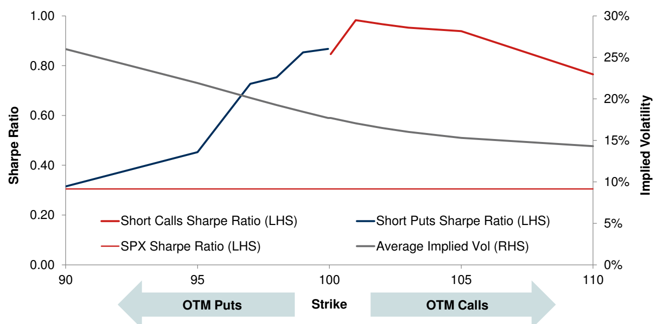
Source: Nomura research. The sample period is January 2001 to January 2015.

Myth 5: Sell options when implied volatility is high

Part 1: Sell options when implied volatility is high relative to other strikes
many participants believe low strike puts in equities should be more attractive to sell than high-strike calls owing to their relative 'richness' as measured through their higher levels of implied volatility for the low strike puts relative to the high strike calls. Nonetheless, the historical unconditional performance is not as many market participants would expect.

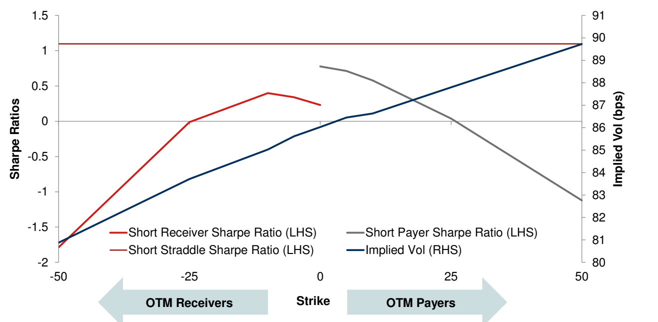
Lower strike puts do very poorly, almost as poorly as holding S&P 500 itself. Modestly high strike calls tend to outperform. Negative volatility skew in equities does not imply a higher risk premium in out-of-the-money (OTM) puts. Instead, OTM calls outperformed (see Fig. 23, December 1997-June 2013).

Fig. 23: S&P 500 OTM calls outperform



Source: Nomura research. The sample period is1998 to 2015.

Fig. 24: USD 1m10y ATM straddle swaptions outperform



Source: Nomura research. The sample period is 2010 to 2015.

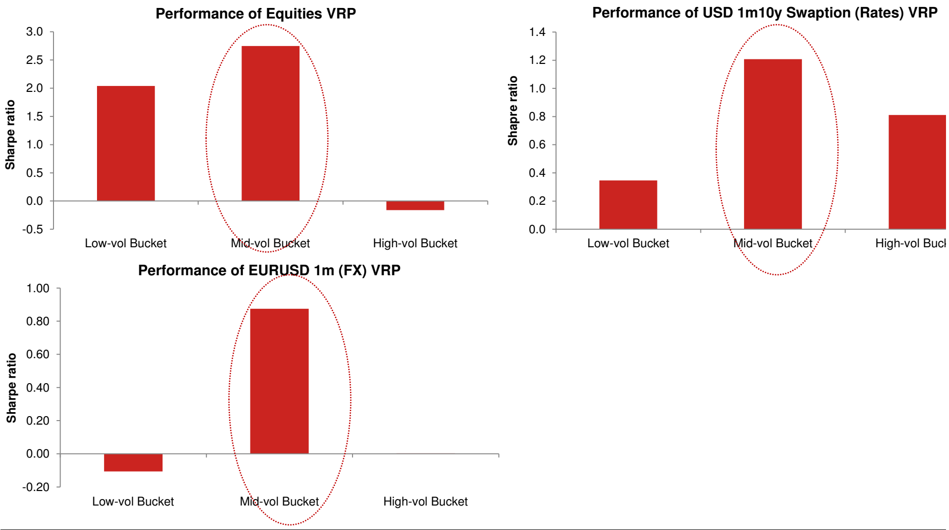
For rates, as is true of forex, the picture is less decisive, and probably depends more on specific market conditions. In general in rates, modestly OTM payers did better, although low strike receivers did better than ATM receivers. There is further work to be done on other expiries and tenors and changing market conditions. Shorting straddles outperforms any single payer or receiver owing to lower transaction costs. In forex, we have noted that shorting strangles does better for shorter expiries, while shorting straddles does better for longer expiries.

In equity, a rationale for the low strike put underperformance is largely to do with the correlation of S&P 500 and realised volatility. Sharp falls in equities are typically related to spikes in volatility. In other words, equities tend to grind higher and spike lower. The issue with selling lower strike puts is that after a sharp fall they may be at peak negative gamma and will likely not just lose on the fact that realised volatility can far exceed implied, but re-hedging costs will make the position continue to lose. By contrast, a high strike call may lose in a sharp down-spike in equities, but owing to its low gamma, there are lower re-hedging costs, and consequently, it is likely to do better.

Part 2: Sell options when implied volatility is high relative to history
In a similar fashion, most participants believe selling volatility can be profitable only when volatility is considered rich or equivalently high relative to its own history. However, the actual data do not fit this general belief. To test this, we divide the volatility level for equities volatility, swaption volatility and EURUSD volatility into three equal-sized buckets. It turns out that short-gamma strategies usually outperform in low- and mid-

volatility buckets, with higher-volatility buckets including possible periods of significant market distress, often underperforming.

Fig. 25: Short gamma in steady markets tends to outperform

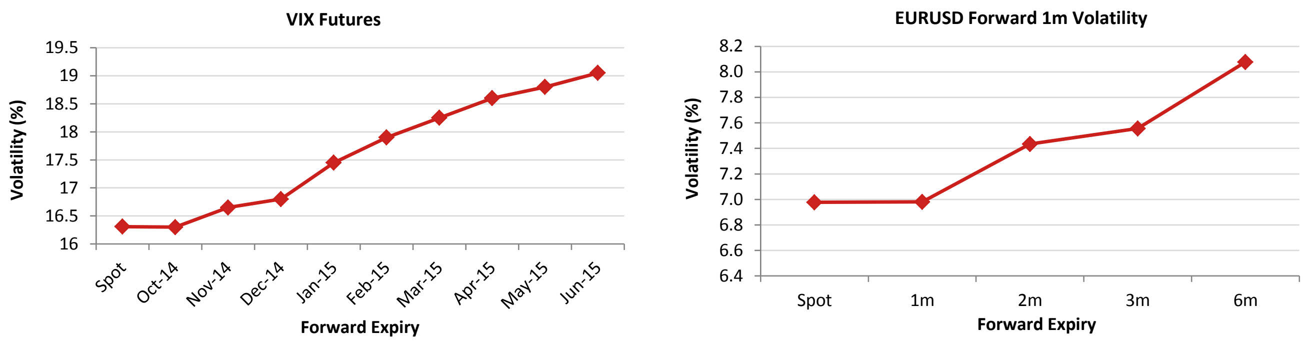


Source: Bloomberg, Nomura research. The sample period is January 2006 to January 2015 across equities, rates and forex. Sharpe ratio is calculated by monthly data.

Myth 6: crisis hedges nearly always cost carry

Crisis hedges, being insurance, typically are costly. One form of insurance is forward volatility, which will pay based on the difference between the forward volatility strike and implied volatility at the end of the forward period. If one goes long forward volatility, one benefits from periods of large distress when implied volatility spikes. As one should expect, forward volatility usually has costly negative carry.

Fig. 26: Typically going long forward volatility induces negative carry in equities and forex

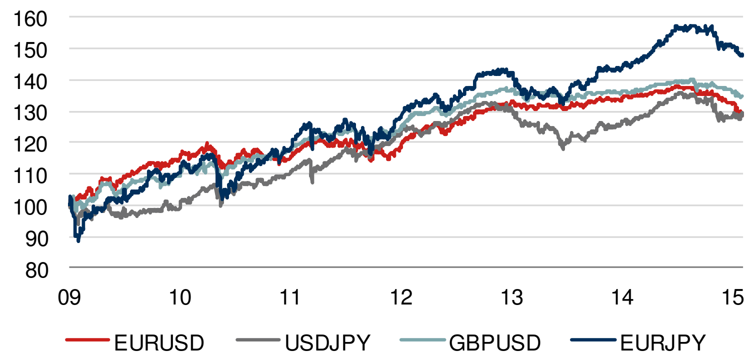


Source: Nomura research. Volatility level observed on 30-Sep-2014.

We can see the negative carry in forward volatility in VIX and in forex (here showing EURUSD forward volatility) in Fig. 26.

We can even systematically sell forward volatility agreement (FVAs) in forex to capture the negative carry. This is also a form of insurance selling, and also tends to perform well in the long run (as well as having low correlation to underlying forex strategies), with underperformance in stressed markets.

Fig. 27: Systematically going short FVA (selling insurance) in forex outperforms

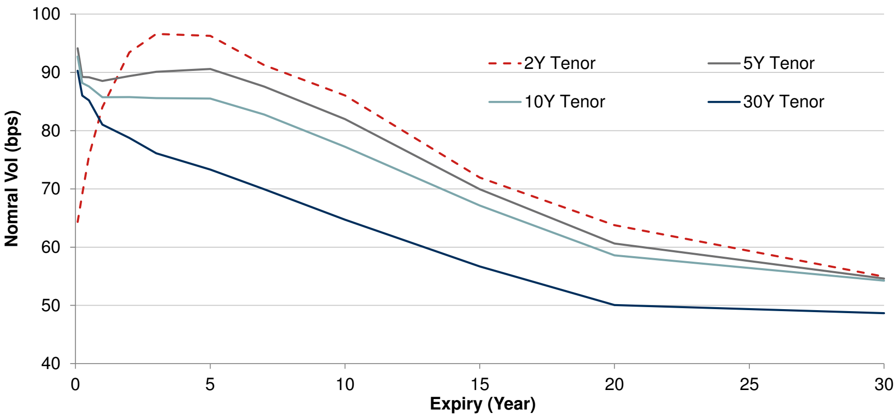


since 2009	EURUSD	USDJPY	GBPUSD	EURJPY
Return	4.1%	4.2%	4.8%	6.5%
Volatility	4.9%	6.1%	4.1%	7.8%
Sharpe	0.84	0.69	1.18	0.83
Max Drawdown	7.3%	11.4%	4.9%	13.8%
Calmar	0.56	0.37	0.98	0.47

Source: Nomura research. EURUSD Forward Volatility Aggregative Index sells EURUSD FVA 1m1m, 2m1m, 3m3m and 6m6m (equal notional) on a daily basis and keeps short position till expiry. The sample period is January 2010 to January 2015.

In rates, by contrast, volatility for individual swap tenors may be upward sloping for a while, but are generally downwards sloping at far longer expiries (see Fig. 28).

Fig. 28: Spot volatility 'tails'

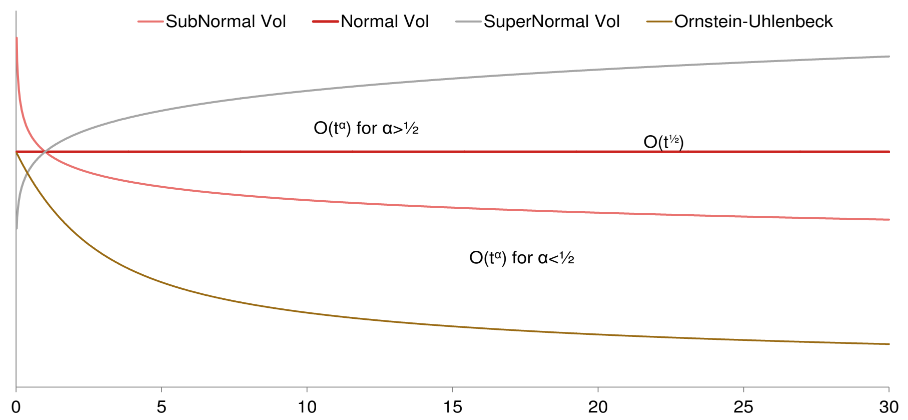


Source: Nomura research. Volatility level observed on 30-Sep-2014.

This plot from 30 September 2014 is not entirely representative, except that it captures the typical downwards slope in rates volatility for expires longer than one to two years.

If we compare with theoretical annualised volatility for various different diffusion processes, we see that if term volatility was normally distributed (with volatility to horizon T spreading out like $T^{1/2}$, annualised volatility should be constant. If annualised volatility is upward sloping, this corresponds to supernormal (highly dispersive) distributions, akin to explosive diffusions, while if the volatility is downward sloping, it corresponds to subnormal (less dispersive) distributions. Subnormal diffusion is less extreme than mean reversion, as we can see annualised term volatility for an Ornstein-Uhlenbeck process converges to zero. One of the popular sets of models for pricing rates derivatives were Affine models, including Vasicek, Cox-Ingersoll-Ross, and others, each having some form of mean-reversion in them and fitting volatility surfaces reasonably well. Irrespective, markets price rates distributions as more similar to mean-reverting while Equities and forex are more akin to explosive processes.

Fig. 29: Simulated volatility, annualised

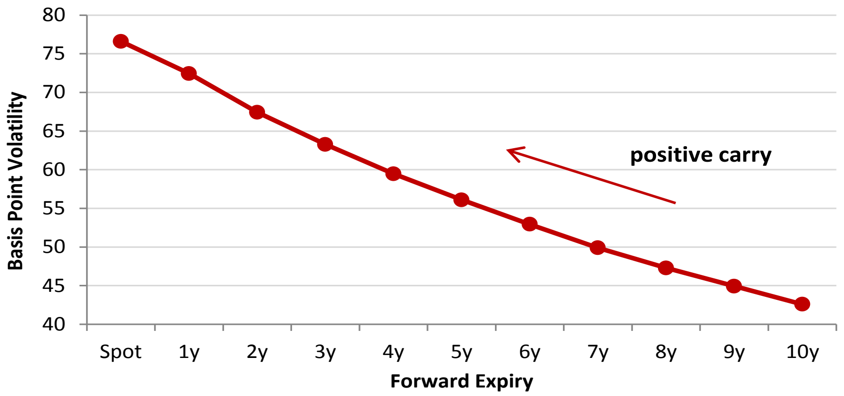


Source: Nomura research. Volatility level observed on 30-Sep-2014.

When calculating forward volatility, we see that, in rates, many longer tenor forward volatility positions have positive carry. For instance, as shown in Fig. 30, 5y20y rates with various forward expiries have positive carry. In general, longer tenor forward vols have positive carry while short expiry short tenor volatilities have negative carry, (i.e., corresponding to rates at the very front end of the yield curve).

Fig. 30: USD forward 5y20y volatility

The downward sloping term-structure of forward interest rate volatility offers positive roll carry



Source: Nomura research. Volatility level observed on 26-Feb-2015.

The market rightly prices in momentum in short rates – when the Fed hikes and takes short rates with it, it continues to hike for some time. But during this hiking process, the 30y swap mostly shrugs this all off. Rightly or wrongly, the market prices in a sort of mean reversion for longer rates and a momentum for short rates.

In terms of the efficacy of the insurance, long rates, however, are not generally reactive to bad news in equities, while short rates are typically the most reactive. Essentially those forward volatilities with the most positive carry are not particularly effective insurance, while those which are the most reactive have negative carry, just as in forex and equities. Nonetheless, we can strike a balance and find forward volatilities that are both reactive to bad news and have positive carry.

In rates, we have a number of ways of putting on a synthetic long forward volatility position, and we present two – 5y5y20y mid-curve calendar spreads (selling a 5y5y20y mid-curve option, and buying a 10y20y swaption with the same strike) and swaption triangles (buying a 10y20y straddle, buying a 5y5y and selling a 5y25y straddle). Given that these are synthetic forward volatility strategies and there is some level dependence, we hedge with the respective underlyings (the 10y20y rate in the case of the mid-curve calendar spreads and the three separate underlyings for the triangle) daily. In both cases, we have a proxy for 5y20y volatility, 5y forward.

The resulting strategies perform well, showing the gains of positive carry over long horizons, but do even better when the equities market does poorly. In Fig. 31, we see the Sharpe ratios below for both unconditional hedged forward volatility strategies, and also for the same strategies during down equities markets, where we show periods when equities returns were in their lowest 40th percentile (with resulting S&P 500 Sharpe ratio is of -6.65) down to the lowest 10th percentile (with resulting S&P 500 Sharpe ratio of -15.52). During these same periods, the MCCS (Mid-Curve Calendar Spread trade) has a Sharpe of 1.77 up to 3.18, while the Volatility Triangle has a Sharpe of 1.63 up to 2.82, respectively.

Consequently, and somewhat surprisingly, we can actually get 'paid' to put on insurance.

Fig. 31: Some rates forward volatility strategies perform in equities down markets

Sharpe Ratio	MCCS 5y5y20y ATM hedged	Triangle 5y5y20y ATM hedged	S&P 500
Past 5 Years			
All sample	0.63	0.56	0.72
upper 10 percentile	-2.42	-2.65	19.32
upper 20 percentile	-1.36	-1.26	16.04
upper 30 percentile	-0.09	-0.09	13.71
upper 40 percentile	-0.04	-0.03	11.67
lower 40 percentile	1.77	1.63	-6.65
lower 30 percentile	2.02	1.83	-8.59
lower 20 percentile	2.50	2.19	-11.63
lower 10 percentile	3.18	2.82	-15.52
Past 10 Years			
All sample	0.71	0.36	0.35
upper 10 percentile	0.76	-0.86	16.88
upper 20 percentile	0.98	-0.75	14.09
upper 30 percentile	0.99	-0.43	11.94
upper 40 percentile	1.01	-0.15	10.20
lower 40 percentile	0.92	1.39	-6.60
lower 30 percentile	1.09	1.56	-8.18
lower 20 percentile	1.11	1.70	-10.33
lower 10 percentile	1.79	2.43	-13.41

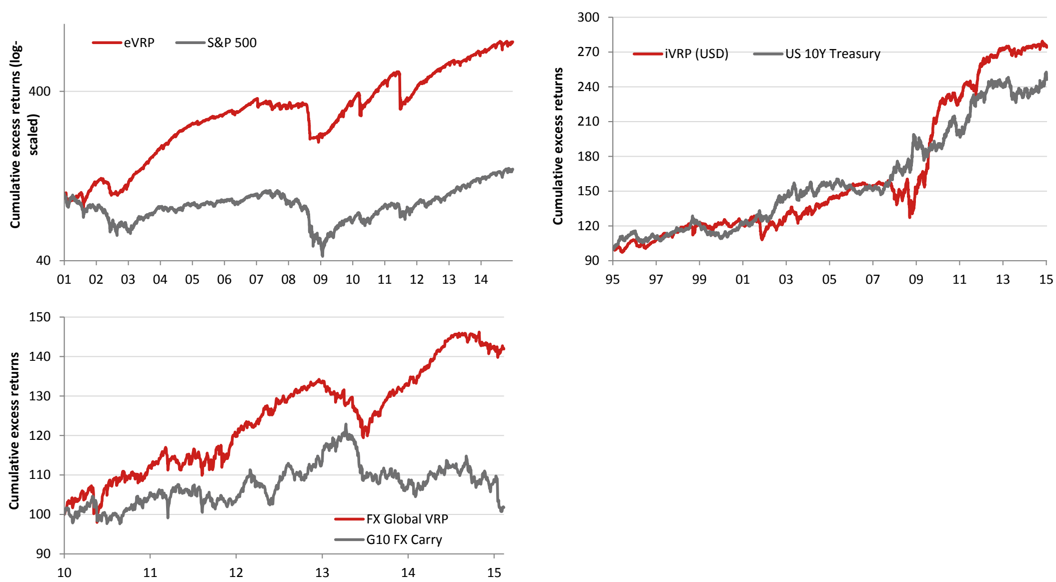
Source: Nomura research. Data are as of October 2014.

Volatility is an asset class you should not ignore

Volatility risk premia are a relatively steady source of income. As we can see in Fig. 32, they tend to outperform their respective underlyings:

- S&P 500 appears to be a de-trended version of the equities volatility risk premium (eVRP),
- FX Global VRP significantly outperforms G10 FX Carry, which has done poorly post-crisis
- Interest rate volatility risk premium (iVRP) manages to keep up with 10y treasuries, which have experienced a 20y bull market.

Fig. 32: Volatility Risk Premia — performance and diversification



Source: Nomura research. G10 FX Carry is the Nomura G10 FX Carry Index.

And while volatility may appear to be the same across asset classes, it actually offers significant diversification, both in relation to other volatility strategies as well as underlying asset classes.

Fig. 33: Correlations between VRP strategies are low

Correlation	iVRP (USD)	eVRP	FX VRP	S&P 500	US Tsy	FX Carry
iVRP (USD)	100%					
eVRP	16%	100%				
FX VRP	20%	12%	100%			
S&P 500	16%	52%	8%	100%		
US Tsy	3%	-20%	-3%	-35%	100%	
FX Carry	9%	21%	9%	23%	-18%	100%

Source: Nomura research. Correlation is calculated based on January 2001 to January 2015.

Conclusion

LSD (leverage, shorting and derivatives) is much more reasonable than assumed. By using LSD, investors are compensated for selling insurance and, in doing so, they are ‘obtaining a premium that is commensurate with the risk’. As with insurance products, VRP products offer decent gains in the long run.

We have established this premise on the back of dispelling many volatility-related myths:

- Most investors are short volatility, and have no choice in the matter — but there are often much better ways of being short.
- In the long run, selling volatility should make money.
- Derivative market participants may have key misconceptions about volatility, in particular about when to buy or sell gamma.

Lastly, it should be clear to those who look at hedge fund track records that volatility traders’ performance is not terribly smooth. This alone should indicate that there is a great deal of room for systematic approaches to volatility. Volatility risk premia are everywhere, but few use them to their potential.

Appendix A-1

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We, Nick Firoozye, Xiaowei Zheng, Qilong Zhang, Chien-Hua Chen and Anthony Morris, hereby certify (1) that the views expressed in this Research report accurately reflect our personal views about any or all of the subject securities or issuers referred to in this Research report, (2) no part of our compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this Research report and (3) no part of our compensation is tied to any specific investment banking transactions performed by Nomura Securities International, Inc., Nomura International plc or any other Nomura Group company.

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Analyst Name	Disclosures
Anthony Morris	B29

B29 An analyst who was involved in preparing the contents of this report, a member of the analyst's household or other associate of the analyst, holds a personal investment in gold.

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