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European Derivatives
11 April 2013

Derivatives in Perspective

Comparing V2X and SX5E options

Evaluating the historical behaviour of V2X options vs. vanilla SX5E options

- Given the relatively new market for VSTOXX options, investors often wonder about the relative value of setting up a bullish or bearish position using VSTOXX or SX5E options. In this report we shed some light on the dynamics in the two markets. This is not to define arbitrage rules, but rather to provide practitioners with a framework to understand how those instruments performed and how to choose between them.

- As VSTOXX options are a relatively new market which only started trading at the beginning of 2010, we will use the framework developed in our recent report *Derivatives in Perspective: Understanding the VSTOXX volatility surface*, 6 March 2013, to extend the time series of VSTOXX option data back to 2001 by using our proxies. This will enable us to comment on the general behaviour of volatility options vs. vanilla options, not restricting ourselves to the regime dominated by the eurozone crisis. We standardize the premium at inception to take into consideration the difference in V2X and SX5E implied volatilities in order to make the strategies comparable.

Bullish trades – 1 mth ATM VSTOXX puts vs. SX5E calls

- The historical analysis indicates that the maximum leverage from buying SX5E calls exceeds the maximum leverage from buying V2X puts. This is because the convex relationship between the movements in volatility futures vs. the SX5E market flattens out considerably for larger upside moves of more than 5% per month.

- However, the hit ratio of V2X puts has been higher since their inception, which leads to the fact that buying VSTOXX puts while selling SX5E calls generated a consistent return since March 2010. However, from 2004 to 2007, vol puts underperformed SX5E calls due to a higher number and larger magnitude of positive spot moves relative to negative vol futures moves. This, in combination with a rising vol of vol vs. the SX5E implied vol lead to the underperformance of vol puts vs. equity market calls. But we believe that in lower return, low vol bull markets, puts on vol can still be an attractive alternative to SX5E calls as they tend to outperform for smaller moves.

Bearish trades – 1mth ATM VSTOXX calls vs. SX5E puts

- As volatility returns unfold a large convexity vs. equity market returns for large downside moves, it is not surprising to find that the maximum leverage of volatility call options is much higher than vanilla put options. The median leverage is comparable, which shows that those large leverage statistics are not accomplished very often but can be an efficient tail risk hedge.

- Over the past years the hit ratio of SX5E put was higher than for V2X calls, while over the long term they were comparable. The higher hit ratio did not lead to a much better performance for SX5E put though, apart from 2012 where the realised volatility in the SX5E sell-off was rather contained and hence the vanilla put was able to capture the downwards drift better than the volatility option. The vanilla option tends to do slightly better for sell-offs in the region of -3% to -9% per month.

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DERIVATIVES IN PERSPECTIVE: COMPARING VSTOXX OPTIONS TO SX5E OPTIONS

Evaluating the economics of V2X options vs. SX5E options

As volatility options are a relatively new instrument, investors often ask us how to think about the relative value of VSTOXX options vs. vanilla SX5E options. Essentially, investors who are bearish have two choices: they can either buy a put on the SX5E or a call on the VSTOXX, as volatility is negatively correlated with the equity market. Equally, if they are bullish they can either buy a call on the SX5E, or a put on the VSTOXX. The underlying question is: how those choices performed in the past and can we say which one is better?

In order to compare the two underlyings we need to first standardize the allocation so that we take into account the different levels of implied volatility. Once the allocation is standardized, we proceed to calculate the historical payoffs of VSTOXX and SX5E options.

Because the options market on the VSTOXX is relatively young, we will use the framework we developed in our recent report *Derivatives in Perspective: Understanding the VSTOXX volatility surface* to extend the calculation of VSTOXX implied volatilities back in time in order to calculate the payoff for VSTOXX options. This will aid our assessment of what to expect from the two instruments in different market regimes.

The purpose of the analysis below is not to define some arbitrage rules between the two markets, but rather to give practitioners a framework to understand how those instruments have performed in the past and how to choose between them.

Methodology

- **Implied volatility calculation:** As we explained in our report *Derivatives in Perspective: Understanding the VSTOXX volatility surface*, we calculate the 2mth ATM VSTOXX option implied volatility in three stages. From Mar13 to Mar12 we use listed V2X option price data from Option Metrics. From Mar12-Mar10 we use our trader surfaces due to significant noise in the listed dataset. Before Mar10 we use an implied volatility surface that is derived from a two-factor regression model. The model uses as input factors the SX5E skew level and the historical realised volatility in VSTOXX futures.

  Once we calculate the 2mth ATM implied volatility, we match the precise duration of the option contract from the roll date to expiry using a term structure equation which relies on an exponential decay function. This function is also explained in the document above.

  As a result we have V2X 1mth ATM implied volatility going back till 2001. Please note that we have also incorporated the implied volatility metrics in our weekly *VIX Compass* to track them going forward.

- **Transaction cost**: We incorporate a transaction cost of 0.1 points in the VSTOXX options, while we incorporate a transaction cost of 2bps of notional into the SX5E option strategies.

- **Sizing of positions:** In the analysis below we price ATM options for the sake of simplicity. The calculation could in theory be extended to any strike but we would suggest to compare options with a similar delta, which should then also adjust the % strike and premium outlay for the probability of exercise. However, if we compare ATM options, it would not be instructive to compare the performance of the two underlyings for the same notional, in our view, as the two assets have very different volatilities.

Figure 1 highlights that the ratio of the implied volatilities can vary but the V2X implied volatilities are much higher. This reflects the higher propensity of large moves for volatility compared to the SX5E spot. Hence we reduce the V2X trade notional so that the overall trade is roughly zero cost at inception. If we use ATM options this boils down to the ratio of the implied volatilities (before transaction costs).

FIGURE 1

Ratio of 1mth ATMf SX5E implied vol to V2X implied vol

Note: * V2X implied volatility before Mar10 is based on proxies. Source: Barclays Research

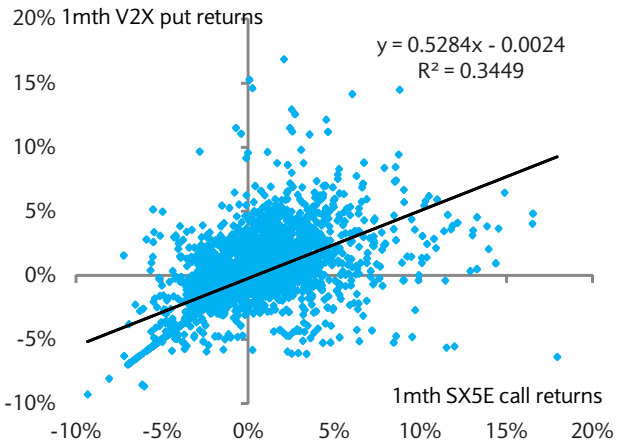
Using this framework, we will now proceed to highlight the historical payoffs of vanilla options vs. volatility options in Europe.

(A) Bullish trades – Long V2X Put vs. Long SX5E call

Figure 2 shows the payoffs of being long SX5E calls vs. V2X puts. As both are bullish trades, the regression line fitting their monthly returns is upward sloping. We price options daily in order to limit the effect of path dependency.

FIGURE 2

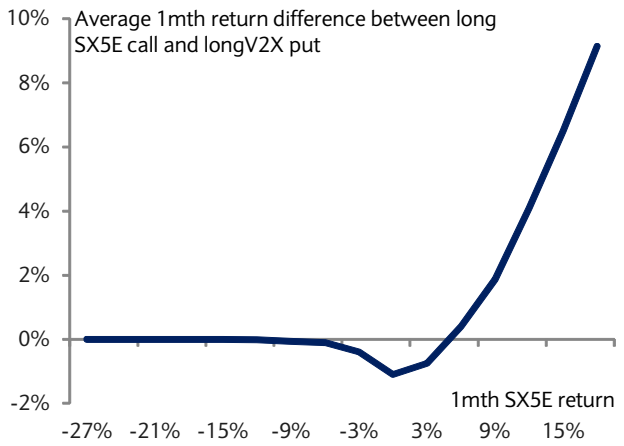
Bullish trades - long 1M ATM SX5E call vs. long VSTOXX put payoff*



Note: *we price both V2X and SX5E options OTC. Each day we put on a 1mth ATM option position and measure the subsequent return as % of notional. The notional of the V2X option position is reduced to make the premium outlay equal at inception. Source: Barclays Research

FIGURE 3

Average P&L of long SX5E call vs. long V2X put conditioned on SX5E market return bucket*



Note: *we price both V2X and SX5E options OTC. Each day we put on a 1mth ATM option position and measure the subsequent return as % of notional. The notional of the V2X option position is reduced to make the premium outlay equal at inception. Source: Barclays Research

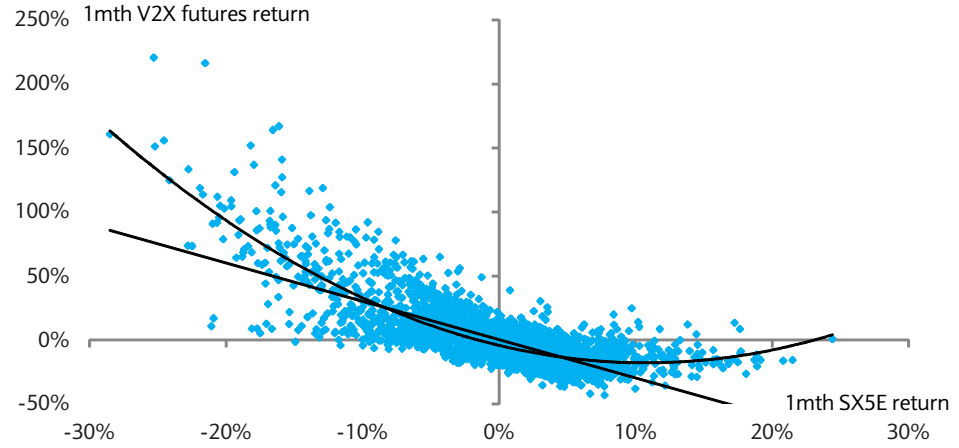
The R2 of the regression is not very high (around 34%). On the other hand the R2 for bearish trades is higher (56%) as we can see in Figure 9. This is largely because there are less extreme outliers in the bullish return series, while there is also more basis risk between volatility and equity returns in upward trending markets.

Figure 4 highlights this. For negative SX5E returns the movement in the V2X futures and the SX5E tends to be relatively strongly correlated, even though there have been a few observations where vol futures were falling and markets were also falling. However, in strongly rising markets the relationship flattens out considerably. That means that it does not hold that strongly rising markets need to be associated with a similar acceleration in the volatility decline. In fact the volatility decline for large upside moves is far less than what would be implied by a more linear relationship.

If that is the case, does that mean that buying puts in the V2X was a bad investment? Interestingly, Figure 3 shows that the payoff of the two bullish trades diverges for large upside market moves. During those moves the SX5E call will likely outperform the vol put as the decline in volatility does not keep pace. However, for smaller moves, say below +5% SX5E return per month, we are more indifferent or would maybe even slightly prefer the volatility put to the SX5E call based on the average return line. Interestingly, if the market says constant around the spot level at maturity, we find that the VSTOXX put outperforms the SX5E call by about 1.1% on average over the observation period.

FIGURE 4

V2X futures have different behaviour relative to SX5E returns depending on the market regime*



Note: *chart depicts V2X futures return vs. SX5E returns rolled daily since Feb 2001. Before the listing of V2X futures data is based on proxies. Source: Barclays Research

Another way of showing the dynamics between vol puts and vanilla calls is depicted in Figure 5. Here we look at the leverage from the two option positions, which measure intrinsic value at expiry vs. the premium outlay at inception. The average and the median leverage of the vol put and vanilla call are comparable both for the longer and shorter time period. However, while SX5E calls exhibit a higher maximum leverage for the reasons mentioned above. The hit ratio of vol options has been higher in recent years (in the period from March 2010 the hit ratio of vol puts was 66% vs. 55% for equity calls).

FIGURE 5

Comparison of ex post leverage for buying ATM VSTOXX vs. SX5E options*

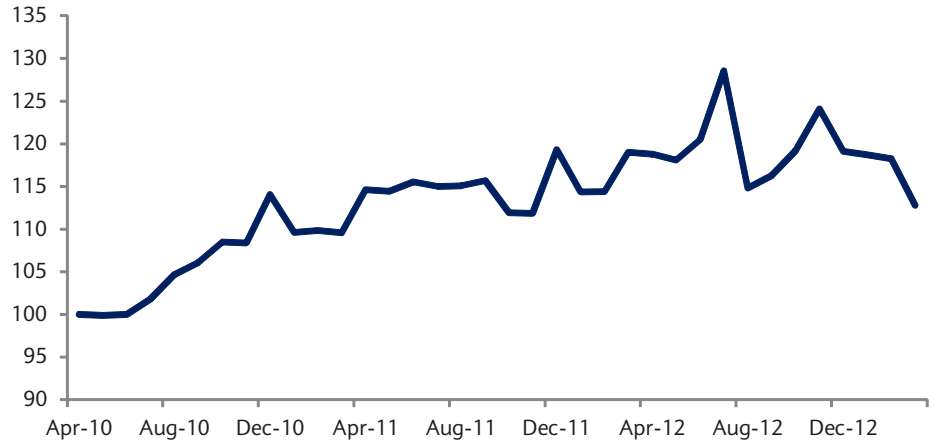
	Mar01-Mar10		Mar10-Mar13	
	V2X put	SX5E call	V2X put	SX5E call
Average leverage	1.3	1.6	1.5	1.5
Median leverage	1.2	1.4	1.5	1.4
25th percentile	0.6	0.8	0.8	0.8
75th percentile	1.8	2.2	2.0	2.1
Highest leverage	3.7	5.1	3.7	4.6
Hit rate	60%	56%	66%	55%

Note: *we price both V2X and SX5E options OTC. Each day we put on a 1mth ATM option position and measure the subsequent return as % of notional. The notional of the V2X option position is reduced to make the premium outlay equal at inception. Source: Barclays Research

Figure 6 shows the payoff of being long a VSTOXX put and short an SX5E call over the past few years. As the strategy was profitable in recent years and had a positive drift, it highlights that VSTOXX puts were better able to capture the bullish market environment than SX5E calls from the inception of the VSTOXX option market. The reason for this is the higher hit ratio of the V2X put over the past few years, which outweighed the higher maximum realised leverage for vanilla calls over this period.

FIGURE 6

Buying V2X puts and selling SX5E calls has been profitable in recent years

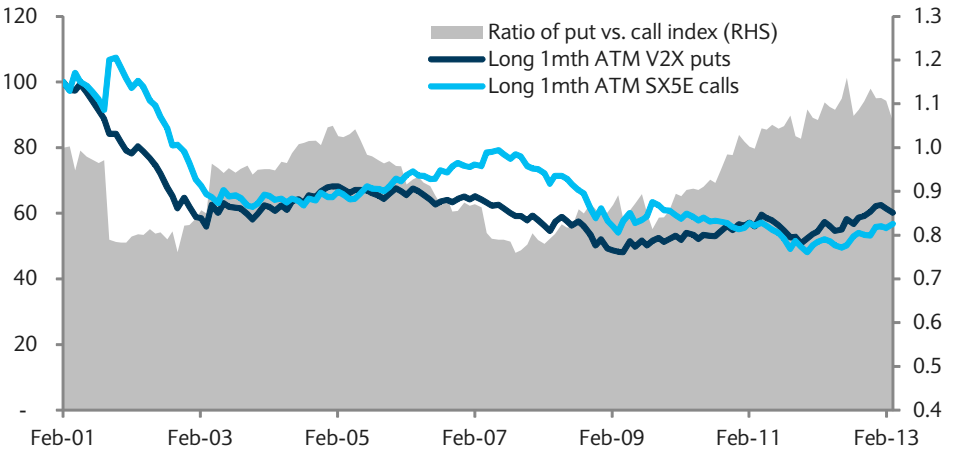


Note: * we measure the performance of buying 1mth ATM V2X options rolled at the V2X expiry. We compare this to the performance of 1mth SX5E options rolled at the SX5E expiry. The strategy notional is rebalanced at the V2X option expiry and the premium of the V2X option trade is reduced to make the premium outlay zero at inception.
Source: Barclays Research

However, Figure 7 demonstrates that over longer time periods the vol put had a more mixed performance and the relative value between the two underlyings is less clear cut. It did well in the period from 2003-2005 but underperformed the SX5E call up to the end of 2007. This was a period where the market grinded upwards with a low realised volatility.

FIGURE 7

The long-term performance of systematically buying 1mth V2X puts and SX5E calls is mixed*

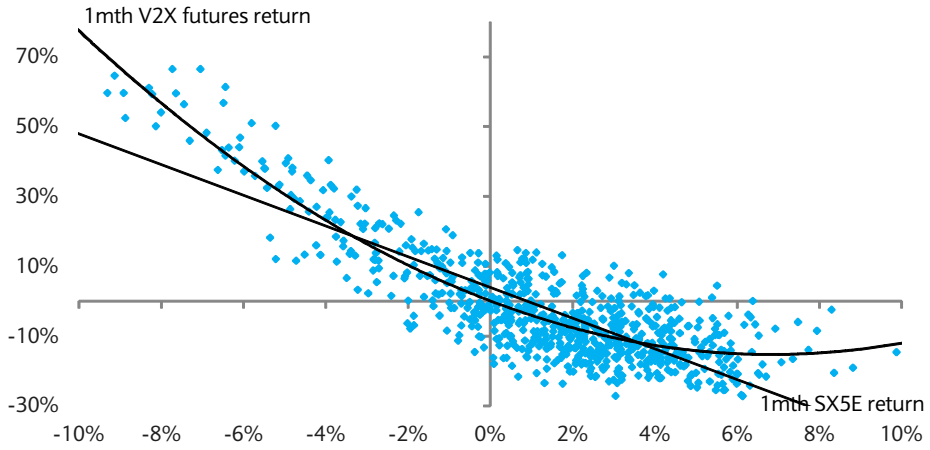


Note: * we measure the performance of buying 1mth ATM V2X options rolled at the V2X expiry. We compare this to the performance of 1mth SX5E options rolled at the SX5E expiry. The strategy notional is rebalanced at the V2X option expiry and the premium of the V2X option trade is reduced to make the premium outlay zero at inception.
Source: Barclays Research

Figure 8 highlights that during this period the equity market had a relatively strong drift upwards, while the returns from falling volatility levels were less consistent and less strong. On the other hand this was a period where the V2X vol increased marginally vs. the SX5E vol, as is evident in Figure 1. Both of those factors contributed to the underperformance of volatility puts vs. equity calls in this period. However, during lower return low vol bull markets volatility puts have a strong chance of doing well relative to equity calls in our view.

FIGURE 8

V2X futures returns vs. SX5E returns during low vol bull market from Sep04- Sep07*



Note: *chart depicts V2X futures return vs. SX5E returns rolled daily. Source: Barclays Research

(B) Bearish trades – Long V2X call vs. Long SX5E put

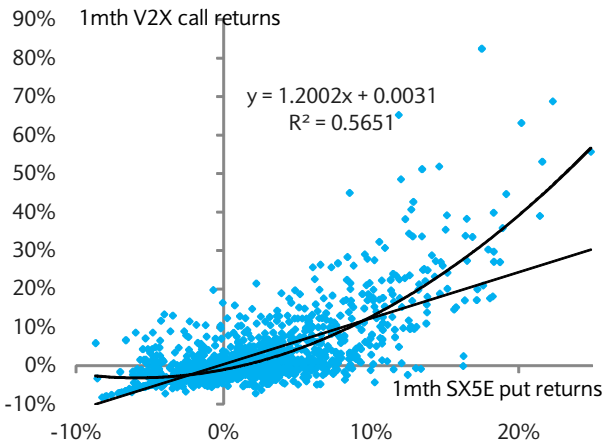
Now we turn our attention to bearish trades. Investors with a negative market view can either buy a put on the SX5E, or a call on the VSTOXX. As volatility returns unfold convexity vs. equity returns on the upside, buying volatility as an equity hedge is a popular defensive trade. This convexity on the upside is demonstrated in Figure 4, which shows that the polynomial regression line for negative monthly SX5E return observations increases more than implied by a linear fit. The opposite is true for rising markets, as we discussed earlier.

Figure 9 depicts the vol call returns vs. the vanilla put returns in Europe for the period since the listing but also for the longer time periods using the proxy data set.

The R2 for V2X call returns vs. SX5E put returns is 56% for the period from 2001-2013. The R2 is skewed upwards due to more extreme observations during bear markets compared to bull markets. The maximum return from vol option buying goes to about ~80% of notional, vs. a maximum return of only ~15% of notional for the VSTOXX puts in Figure 2. But those outliers are mostly realised during extreme market sell-offs and are hence rare. From 2001 there were 180 observations where return was more than 10% of notional. That's about 6% of the overall observations. If we were to remove those data points in our regression where the SX5E fall was more than 10% over a 1mth period, the R2 would fall to 36%, very close to the R2 observed in Figure 2.

FIGURE 9

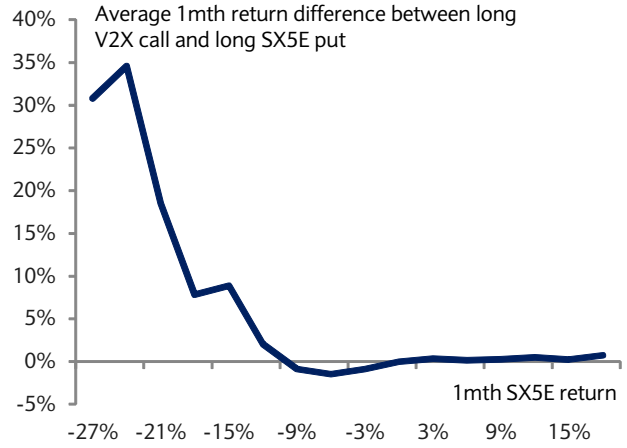
Bearish trades - long 1M ATM SX5E put vs. Long VSTOXX call payoff



Note: *we price both V2X and SX5E options OTC. Each day we put on a 1mth ATM option position and measure the subsequent return as % of notional. The notional of the V2X option position is reduced to make the premium outlay equal at inception. Source: Barclays Research

FIGURE 10

Average P&L of long SX5E put vs. long V2X call conditioned on SX5E market return bucket*



Note: *we price both V2X and SX5E options OTC. Each day we put on a 1mth ATM option position and measure the subsequent return as % of notional. The notional of the V2X option position is reduced to make the premium outlay equal at inception. Source: Barclays Research

Figure 10 depicts the average returns for buying VSTOXX calls vs. SX5E puts conditioned on certain SX5E return buckets. Please note that, like Figure 3, we size the strategies using the ratio of their premia, while we record the return here as the return on notional. Here we find that VSTOXX calls are very efficient tail risk hedges. The return from call buying can exceed the return from put buying by more than 30% during tail events. However, the return from volatility call buying can be slightly inferior to the outright vanilla puts for smaller sell-offs. We measure that historically that has been the case if the market sell-off was somewhere between -3% and -9% 1mth SX5E returns. But the underperformance was not dramatic, it is usually in the region of 1.5% on average for a market sell-off of -6%.

Turning to our leverage statistics in Figure 11, we can confirm this intuition. The average leverage of volatility options was higher; however, the median leverage of the volatility options over the full period was actually lower, while over the recent period the two were similar. This shows that the average leverage statistics were skewed upwards by large outliers. Indeed, the maximum leverage for volatility options was 24x vs. 8.6x in the earlier period where we use proxy data and 12.8x vs. 8.9x in the period since March 10. Please note that we price options daily here to limit the effect of path dependency. For listed options the leverage would have been lower than the leverage recorded in our backtest but still high on an absolute basis.

Interestingly, the hit ratio has now reversed with the SX5E puts showing a higher consistency vs. the vol calls. Even though vol calls have a lower hit rate over the past two years, over the long term the hit rate is more similar. However, the relative performance of buying SX5E puts vs. V2X calls is not as divergent compared to the bullish trades. Figure 11 shows that the relative performance (depicted by the grey area in the chart) is actually trending sideways rather than down over the last few years.

FIGURE 11

Comparison of ex-post leverage for buying ATM VSTOXX vs. SX5E options*

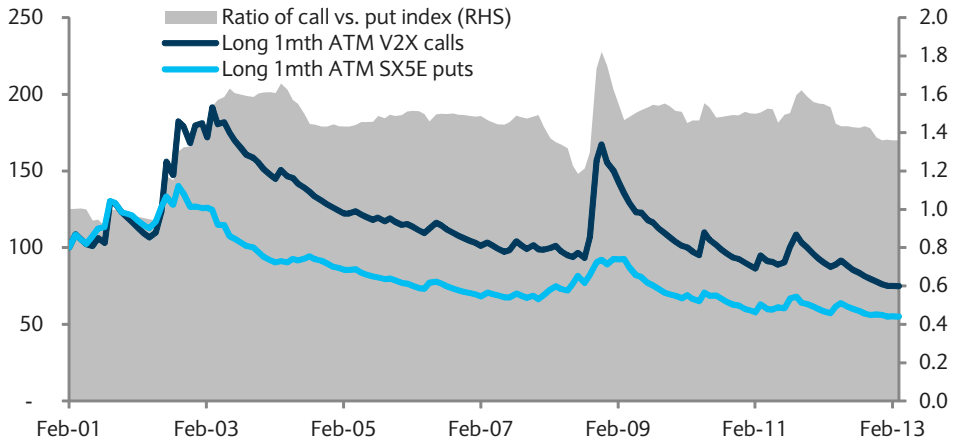
	Mar01-Mar10		Mar10-Mar13	
	V2X call	SX5E put	V2X call	SX5E put
Average leverage	2.4	2.0	2.3	2.0
Median leverage	1.3	1.7	1.4	1.4
25th percentile	0.6	0.7	0.6	0.7
75th percentile	2.9	3.0	2.8	2.6
Highest leverage	24.0	8.6	12.8	8.9
Hit rate	40%	44%	34%	45%

Note: *we price both V2X and SX5E options OTC. Each day we put on a 1mth ATM option position and measure the subsequent return as % of notional. The notional of the V2X option position is reduced to make the premium outlay equal at inception. Source: Barclays Research

Only in 2012 did vanilla puts outperform volatility calls as the realised volatility during the sell-offs was contained. We also commented on this phenomenon at the time in our report *Derivatives in Perspective – Trading the Performance Barbell*. The lack of a high vol sell-off in 2012 was probably caused by already bearish / under allocated positioning of the investor base, which lead to a lack of panic vol buying / index selling during the grind lower. As investors are now more invested compared to Q1 12, while many have resumed to sell volatility to generate carry, such a low vol sell-off is less likely going forward in our view if another risk should rattle the markets. Hence, volatility calls could be an attractive alternative again, especially for tail risk hedges.

FIGURE 12

Buying VSTOXX calls works better in large sell offs as the leverage tends to exceed vanilla



Note: * we measure the performance of buying 1mth ATM V2X options rolled at the V2X expiry. We compare this to the performance of 1mth SX5E options rolled at the SX5E expiry. The strategy notional is rebalanced at the V2X option expiry and the premium of the V2X option trade is reduced to make the premium outlay zero at inception.
Source: Barclays Research

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