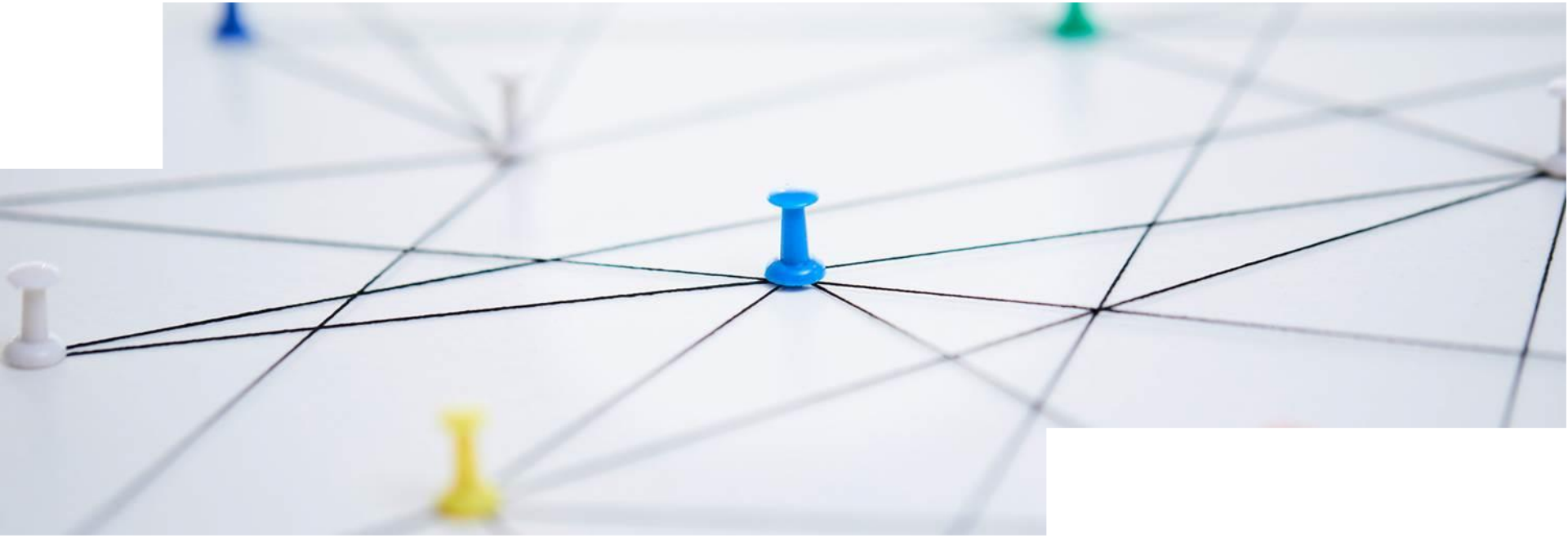
SX5E Tail Hedging Solutions
Term Structure + Fixed Strike FVA



Quantitative Investment Strategies
May 2021
Prepared Exclusively for UPS

CREDIT SUISSE

Important Information Relating to this Material

PLEASE CONSIDER THE FOLLOWING WHEN PAST PERFORMANCE IS SHOWN IN THIS PRESENTATION

Where past performance is shown, the following applies:
Past performance, whether actual or simulated, is not an indicator of future performance. If the currency in which the past performance is shown differs from the currency of the country in which you reside, then you should be aware that due to exchange rate fluctuations, the performance shown may vary if converted into your local currency.

Proforma performance is shown: Proforma refers to performance data for the full time period of past performance of the Index which includes both actual and simulated performance. The Proforma start date will be equal to the start date on which all of the figures detailed on the slide are based.

The Live Date for each index is highlighted in the footnote. Any data shown prior to the Live Date is simulated.

Non-live Indices
When showing backtested performance linked to an index that is not yet live, Credit Suisse will take the following into account:

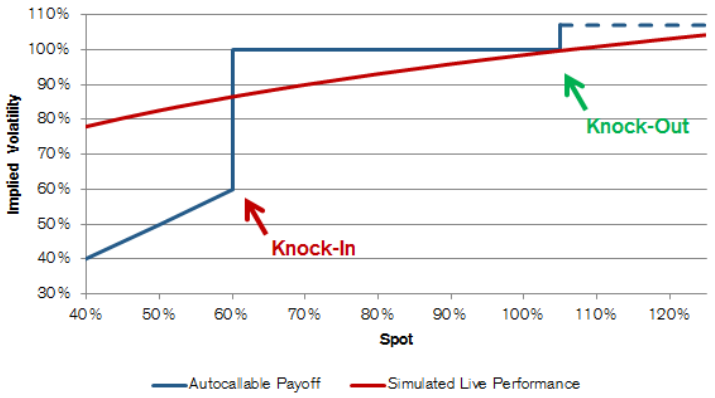
- Index set-up (Administrator, Calculation Agent, BMR status, involvement of third parties)
- Index methodology
- Client/ regional focus
- Complexity assessment subject to the client and region
- Backtest assumptions and checks

Fixed Strike FVA – Investment Rationale

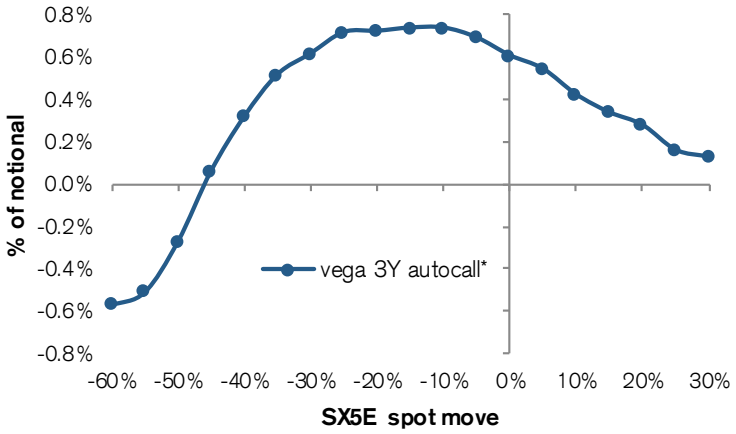
Autocallables: Product Overview

- Autocallable products are structured derivatives widely sold in the retail market globally, particularly linked to index underlyings.
- **What are they?** Autocallables are relatively long-term products where investors are:
  - Long a stream of coupons with potential early termination ("Knock-Out") occurring if index spot is above a certain upside barrier (usually close to spot) on the following observation date.
  - Short an at-the-money "Knock-In" put to finance the coupons.
- **Market Impact:** Autocallable vega dynamics are driven by spot moves relative to barrier levels, as illustrated in the 2nd chart:
  - → Spot rallies: volatility exposure decreases as early redemption becomes more likely, forcing dealers to buy back vega
  - → Spot selloffs: volatility exposure increases initially (dealers need to sell vega) and then decreases to turn negative below the put's down & in barrier (dealers rush to buy back vega)

Illustrative Autocallable Payoff



Illustrative Change in Autocallable Vega vs. Spot



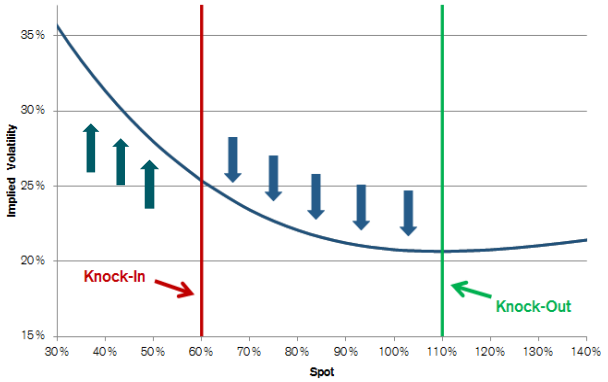
Source: Credit Suisse. *Based on 3Y autocall on SX5E with annual knockout at 100%, incremental coupons and European ATM put with a down-and-in barrier at 60%. Past performance (actual or simulated) is not an indicator of future performance.

Fixed Strike FVA – Investment Rationale
Autocallables: Market Dynamics

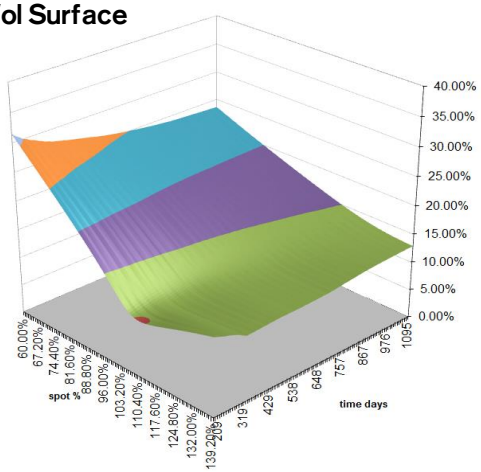
- Continuous & sizeable Autocallable flow, both in Asia and Europe, has significantly impacted the long-dated volatility surface of popular underlying indices (typically NKY, HSCEI, KOSPI2, SX5E)
- Specifically, vega hedging of Autocallable activity is known to have (i) depressed long-dated implied volatility and skew in the belly of the curve whilst (ii) keeping wings high → hence increasing overall convexity across skew.
- We illustrate such impact by comparing the implied vol surfaces of (i) the S&P 500 vs. (ii) the Eurostoxx 50, which generally exhibits a major market supply/demand imbalance from the autocallable market

→ **Long-dated SX5E skew is therefore typically depressed relative to SPX**

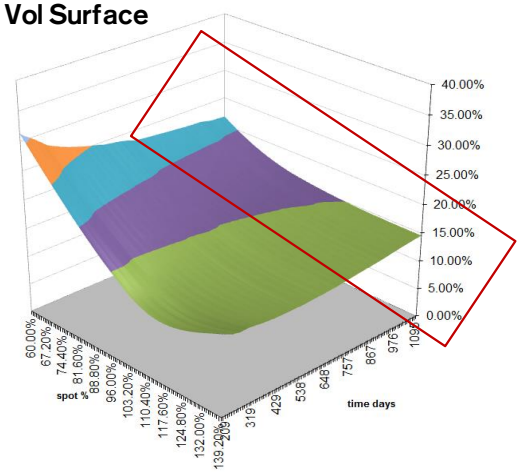
Illustrative Autocallable Impact on Skew



SPX Vol Surface



SX5E Vol Surface

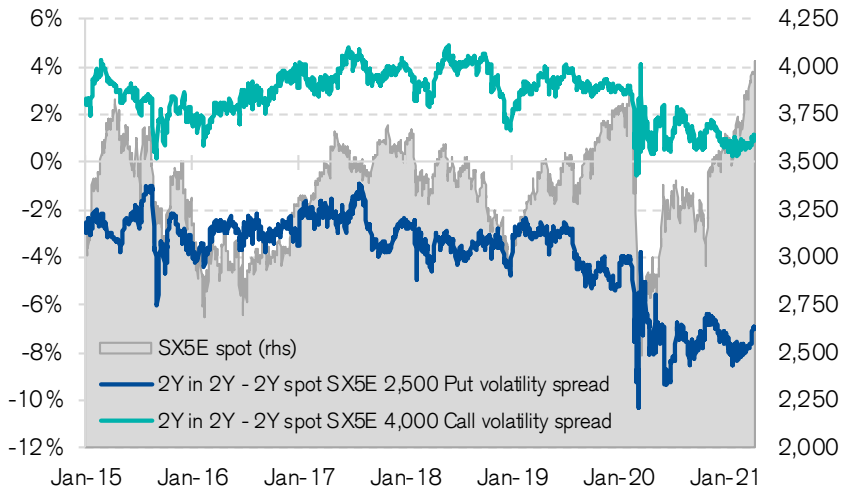


Source: Credit Suisse.

Fixed Strike FVA – Introduction
Benefitting from Autocallable Market Dislocation

- **Market Dislocation**: Autocall vega dynamics lead to inverted term structures of forward skew, with decreasing term structures of low-strike forward volatilities and increasing term structures of high-strike forward volatilities.

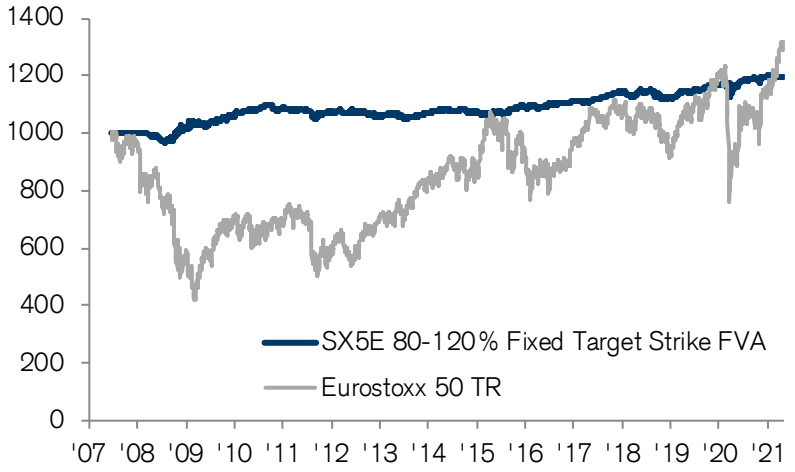
- **What are FVAs?** Fixed-strike forward volatility agreements (FSFVA) allow investors to capture forward volatility around a particular strike by replicating the economics of holding long or short positions in forward starting options: investors hold a long (resp. short) position in a vanilla option in exchange for paying (resp. receiving) a premium on a future date:
  - Premium determined via Black-Scholes formula on the premium payment date (inputting the prevailing spot level and option strike; maturity set as the difference between option expiry and the premium payment date.
  - Forward volatility is the volatility level that equates the present value of the Black-Scholes premium to the present value of the option.
- **Carry Application:** In relative-value strategies, FSFVA puts/collars are traded for carry & unwound by the start date to monetize volatility gains.
- **Hedging Application:** Alternatively FSFVA puts could be held to maturity as good-value protection in hedging strategies.



Source: Credit Suisse. Data from Jan-15 to Jan-21. Past performance (actual or simulated) is not an indicator of future performance.

Fixed Strike FVA – Systematic Implementation
Eurostoxx 50 FSFVA Strategy 80-120%

- The CS Fixed Strike FVA Strategy ('FSFVA') aims to capture the term-structure of skew roll yield by:
  - Purchasing forward starting fixed strike puts (whose implied vols typically roll-up), and
  - Selling forward starting fixed strike calls (whose implied vols typically roll-down)
- Each month, the strategy targets a 18m1y fixed strike FVA (achieved via a linear combination of 18m1y and 2y1y FVA) combination of:
  - Long T2 expiry puts vs. short T1 expiry replication
  - Short T2 expiry call vs. long T1 expiry replication
- Both legs sized based on equal notional with 3x leverage
- Strikes selected based on target **80%** put & **120%** call strikes



Full Period since Jun-07	FSFVA	SX5T
Ann. Return	1.3%	1.9%
Ann. Volatility	2.5%	23.2%
Worst 21bd Return	-3.5%	-37.8%
Max Drawdown	-4.4%	-58.6%
Sharpe Ratio	0.52	0.05
Calmar Ratio	0.30	0.03
Correl vs. Eurostoxx 50	-2%	
Last 5 Years		
Ann. Return	1.8%	8.3%
Ann. Volatility	2.2%	19.1%
Max Drawdown	-4.2%	-38.2%
Sharpe Ratio	0.81	0.37
Calmar Ratio	0.43	0.22
Correl vs. Eurostoxx 50	41%	

Source: Credit Suisse, Bloomberg. Data from 18-Jun-07 to 30-Apr-21. The CS Systematic Fixed Strike FVA indices are not yet live and all data is shown for indicative purposes only. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

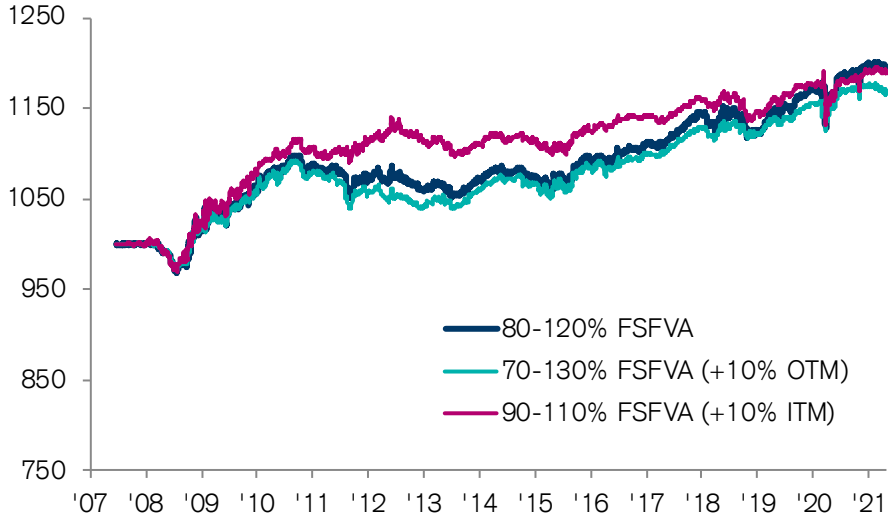
Eurostoxx 50 FSFVA Strategy 80-120%
Sensitivity Analysis: Strikes

We analyze the impact of varying put & call fixed strikes to test the robustness of parameters:

- We test shifting both fixed strikes based on +/-10% shifts in terms of moneyness
- The variations largely achieves similar profiles, although historically the 80-120% version:

  → **Generated the highest carry, both since 2007 and over the last 5 years**

  → **Generally achieves a superior risk-adjusted return profile**



Full Period since Jun-07	80-120%	70-130%	90-110%
Ann. Return	1.3%	1.1%	1.3%
Ann. Volatility	2.5%	2.3%	2.6%
Max Drawdown	-4.4%	-4.9%	-4.9%
Sharpe Ratio	0.52	0.50	0.48
Calmar Ratio	0.30	0.23	0.26
Correl vs. Eurostoxx 50	-2%	4%	-20%
Last 5 Years			
Ann. Return	1.8%	1.5%	1.0%
Ann. Volatility	2.2%	2.0%	2.0%
Max Drawdown	-4.2%	-3.0%	-4.9%
Sharpe Ratio	0.81	0.75	0.52
Calmar Ratio	0.43	0.49	0.21
Correl vs. Eurostoxx 50	41%	32%	31%

Source: Credit Suisse, Bloomberg. Data from 18-Jun-07 to 30-Apr-21. The CS Systematic Fixed Strike FVA indices are not yet live and all data is shown for indicative purposes only. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

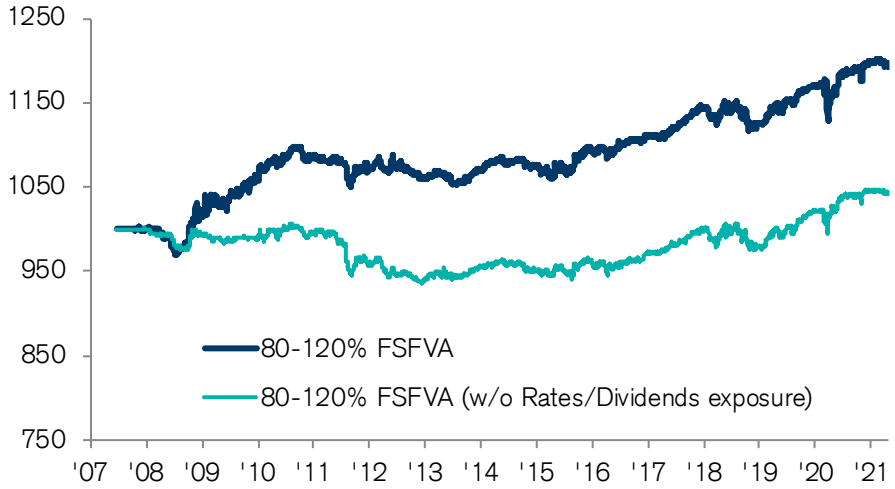
Eurostoxx 50 FSFVA Strategy 80-120%
Sensitivity Analysis: Rates/Dividends Exposure

Asymmetry in the option maturity leaves net duration & forward-forward exposure which are defensive in nature:

i. On the downside: long T2-put becomes ITM which increases short forward-forward exposure & long duration (historically benefitting from rate drops following equity selloffs via both increased forward exposure and premium asymmetry)

ii. On the upside, market rally results in the short T2-call being ITM, which increases short forward-forward exposure and long duration (partially offsetting the short premium duration & thus has more muted impact than (i)).

We analyze the PnL attribution to such asymmetry by comparing the FSFVA vs. a version without rates & dividends exposure, which shows the additional carry/alpha pickup in the strategy:



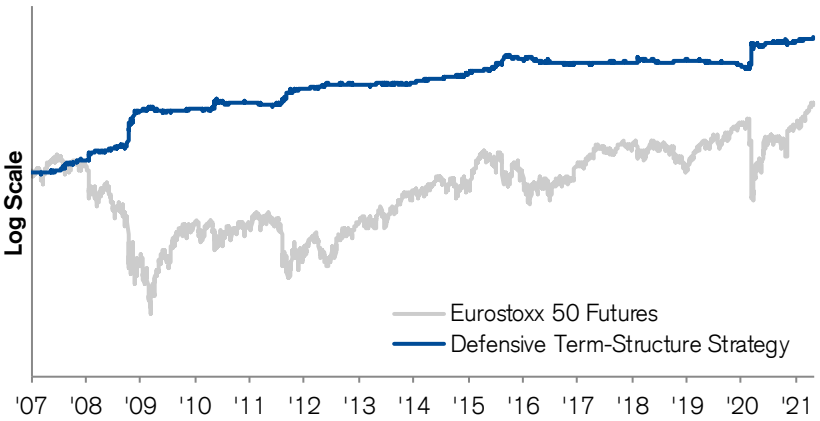
Full Period since Jun-07	FSFVA	W/O Rates/Divs*
Ann. Return	1.3%	0.3%
Ann. Volatility	2.5%	1.9%
Max Drawdown	-4.4%	-7.0%
Sharpe Ratio	0.52	0.16
Calmar Ratio	0.30	0.04
Correl vs. Eurostoxx 50	-2%	39%
Last 5 Years		
Ann. Return	1.8%	1.7%
Ann. Volatility	2.2%	2.2%
Max Drawdown	-4.2%	-3.1%
Sharpe Ratio	0.81	0.78
Calmar Ratio	0.43	0.55
Correl vs. Eurostoxx 50	41%	52%

*Rates/dividend exposure neutralized by (i) trading T1 & T2 options both deferred premium, (ii) striking a T1-T2 forward in the amount of the net delta, and (iii) restriking the T1-T2 forward and rebalancing the T1-option portfolio with fresh r and q when the underlying index moves has a large move, e.g. 10% - version without forward exposure is shown gross of forward & duration hedging costs.

Source: Credit Suisse, Bloomberg. Data from 18-Jun-07 to 30-Apr-21. The CS Systematic Fixed Strike FVA indices are not yet live and all data is shown for indicative purposes only. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

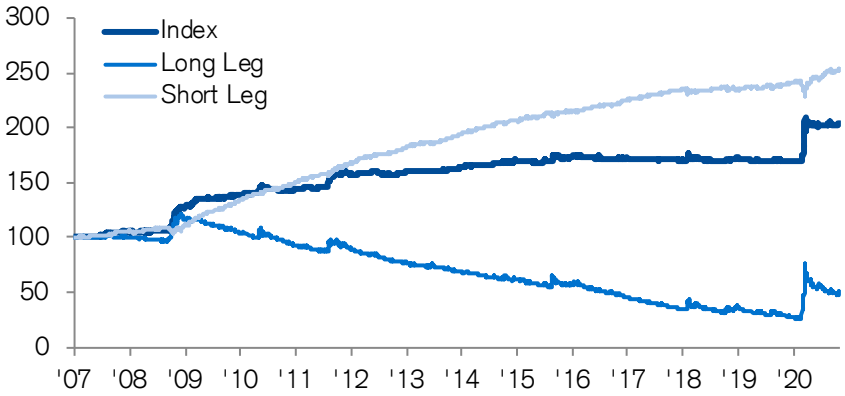
Defensive VRP Term Structure: Eurostoxx 50
Overview

- Defensive volatility term premium strategy combining short short-dated (1w) index vs. long longer-dated (5m) index variance replication
- Cost-effective way of owning volatility where the premium earned from selling short-dated vol (implied-realized) is used to subsidise cost of long implied vol (implied-implied)
- Defensive weighting between long/short legs results in a net long vega vs. short gamma exposure, with additional alpha by implementing differing delta-hedging mechanism across short & long volatility legs (intraday vs. close delta hedging)



Full Period	Defensive TS	ESTX50
Ann. Return	5.8%	2.9%
Ann. Volatility	4.5%	23.0%
Worst 21bd Return	-2.6%	-37.6%
Max Drawdown	-7.7%	-60.9%
Sharpe Ratio	1.28	0.12
Calmar Ratio	0.75	0.05
Correl vs. Eurostoxx 50	-54%	
Last 5 Years		
Ann. Return	2.8%	9.8%
Ann. Volatility	4.6%	19.3%
Max Drawdown	-6.8%	-38.1%
Sharpe Ratio	0.61	0.51
Calmar Ratio	0.42	0.26
Correl vs. Eurostoxx 50	-60%	

Performance Attribution by Leg



Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS VRP Term Structure Series methoddogy was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

Defensive VRP Term Structure: Eurostoxx 50

QIS Strategy Report

Key takeaways

VRP Decomposition: VRP can be split into two distinct but correlated premia:

- Implied vs realised ("gamma" premium or "gamma VRP")
- Implied-vs-implied ("vega"/term/ rolldown premium or "vega TRP")
- Both gamma-VRP & vega-TRP are tradable in practice (not a theoretical construct)
- We assume 1W VRP to be "pure" gamma premium, given liquidity considerations

Gamma-VRP vs Vega-TRP comparison: Based on the above decomposition, we note that:

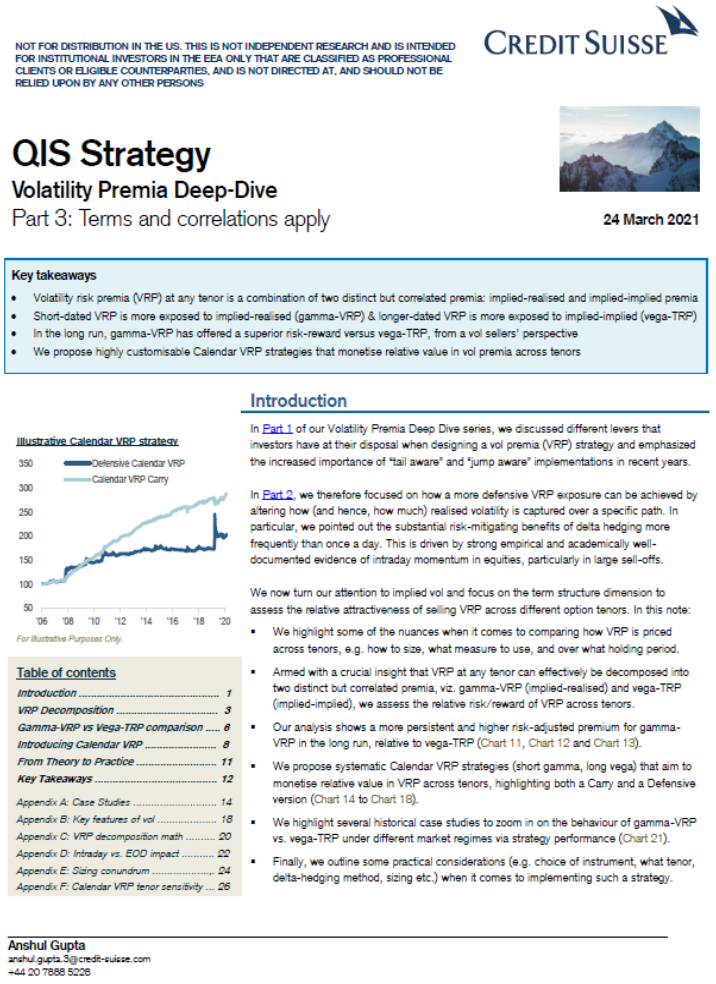
- In the long run, gamma-VRP has offered higher risk-adjusted premium vs. vega-TRP
- Short-dated VRP has greater exposure to gamma-VRP...
- ... while vega-TRP drives majority of the P&L variation for longer-dated VRP
- Gamma-VRP has also proved more resilient in large equity sell-offs than vega-TRP
- Moreover, gamma-VRP and vega-TRP are typically strongly positively correlated

Introducing Calendar VRP strategies that aim to monetise relative value in VRP across tenors:

- Calendar VRP Carry: monetising strong gamma-VRP, part-hedged by vega-TRP
- Defensive Calendar VRP: long vol bias via 'efficient' vega-TRP, funded by gamma-VRP
- Strategies screen quite favourably within our QIS/hedging framework

Practical considerations:

- We prefer variance-replication approach using listed options to fine-tune the risk exposure
- Intraday delta-hedging can bring an additional layer of risk-mitigation
- Choice of tenors is a function of relative permia, potential basis risk and liquidity
- In accounting for variability of relative beta, sizing prudently/conservatively is key



NOT FOR DISTRIBUTION IN THE US. THIS IS NOT INDEPENDENT RESEARCH AND IS INTENDED FOR INSTITUTIONAL INVESTORS IN THE EEA ONLY THAT ARE CLASSIFIED AS PROFESSIONAL CLIENTS OR ELIGIBLE COUNTERPARTIES, AND IS NOT DIRECTED AT, AND SHOULD NOT BE RELIED UPON BY ANY OTHER PERSONS

CREDIT SUISSE

QIS Strategy

Volatility Premia Deep-Dive

Part 3: Terms and correlations apply

24 March 2021

Key takeaways

- Volatility risk premia (VRP) at any tenor is a combination of two distinct but correlated premia: implied-realised and implied-implied premia
- Short-dated VRP is more exposed to implied-realised (gamma-VRP) & longer-dated VRP is more exposed to implied-implied (vega-TRP)
- In the long run, gamma-VRP has offered a superior risk-reward versus vega-TRP, from a vol sellers' perspective
- We propose highly customisable Calendar VRP strategies that monetise relative value in vol premia across tenors

Illustrative Calendar VRP strategy

Defensive Calendar VRP

Calendar VRP Carry

350 300 250 200 150 100 50

'06 '08 '10 '12 '14 '16 '18 '20

For Illustrative Purposes Only.

Table of contents

Introduction ... 1
VRP Decomposition ... 3
Gamma-VRP vs Vega-TRP comparison ... 6
Introducing Calendar VRP ... 8
From Theory to Practice ... 11
Key Takeaways ... 12
Appendix A: Case Studies ... 14
Appendix B: Key features of vol ... 18
Appendix C: VRP decomposition math ... 20
Appendix D: Intraday vs. EOD impact ... 22
Appendix E: Sizing conundrum ... 24
Appendix F: Calendar VRP tenor sensitivity ... 26

Introduction

In Part 1 of our Volatility Premia Deep Dive series, we discussed different levers that investors have at their disposal when designing a vol premia (VRP) strategy and emphasized the increased importance of "tail aware" and "jump aware" implementations in recent years.

In Part 2, we therefore focused on how a more defensive VRP exposure can be achieved by altering how (and hence, how much) realised volatility is captured over a specific path. In particular, we pointed out the substantial risk-mitigating benefits of delta hedging more frequently than once a day. This is driven by strong empirical and academically well-documented evidence of intraday momentum in equities, particularly in large sell-offs.

We now turn our attention to implied vol and focus on the term structure dimension to assess the relative attractiveness of selling VRP across different option tenors. In this note:

- We highlight some of the nuances when it comes to comparing how VRP is priced across tenors, e.g. how to size, what measure to use, and over what holding period.
- Armed with a crucial insight that VRP at any tenor can effectively be decomposed into two distinct but correlated premia, viz. gamma-VRP (implied-realised) and vega-TRP (implied-implied), we assess the relative risk/reward of VRP across tenors.
- Our analysis shows a more persistent and higher risk-adjusted premium for gamma-VRP in the long run, relative to vega-TRP (Chart 11, Chart 12 and Chart 13).
- We propose systematic Calendar VRP strategies (short gamma, long vega) that aim to monetise relative value in VRP across tenors, highlighting both a Carry and a Defensive version (Chart 14 to Chart 18).
- We highlight several historical case studies to zoom in on the behaviour of gamma-VRP vs. vega-TRP under different market regimes via strategy performance (Chart 21).
- Finally, we outline some practical considerations (e.g. choice of instrument, what tenor, delta-hedging method, sizing etc.) when it comes to implementing such a strategy.

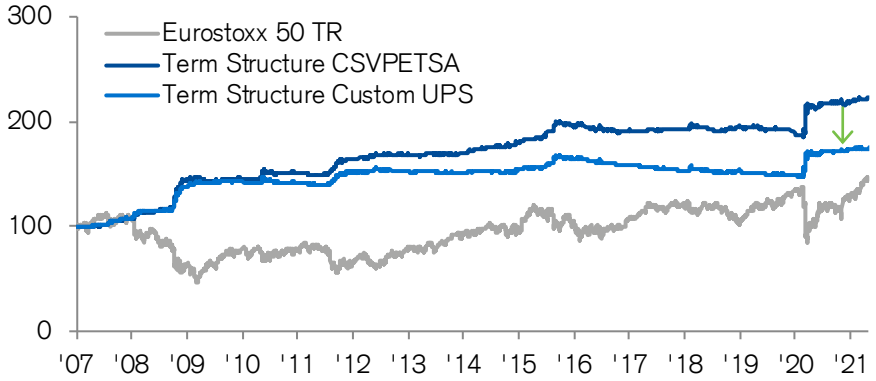
Anshul Gupta
anshul.gupta.5@credit-suisse.com
+44 20 7888 5228

Source: Credit Suisse, QIS Strategy 25/03/2021: "Terms and Correlations Apply", *Report Link:* https://plus.credit-suisse.com/r/V7qtzc2AF-ZjlG

Defensive VRP Term Structure: Eurostoxx 50
Introducing Customized UPS Strategy Version

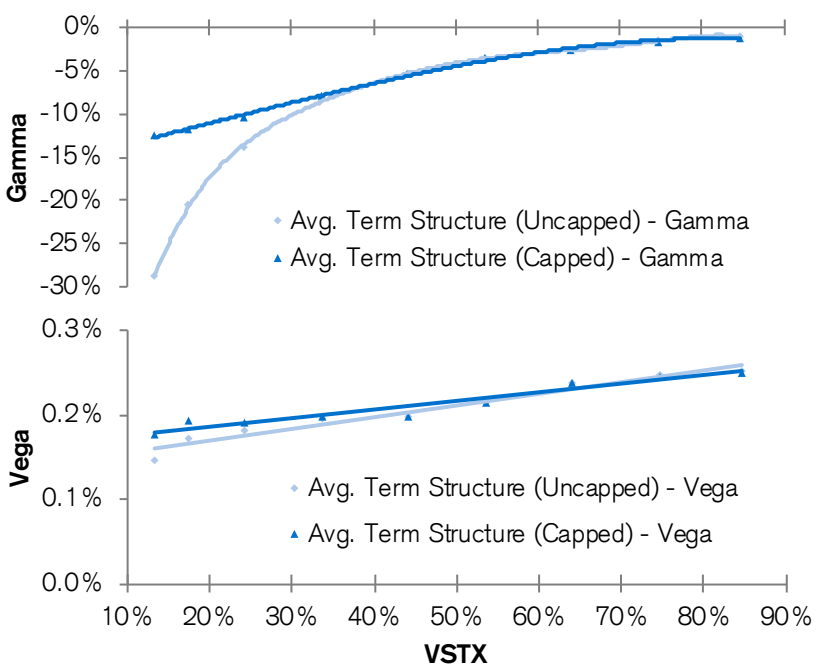
We customize the existing Defensive VRP Term Structure strategy (CSVPETSA) to suit UPS requirements:

- Short 1w volatility leg trades options daily (instead of only on Fri) to increase strategy capacity
- Introduction of a gamma cap to reduce short gamma exposure in low vol regimes – daily sold short leg target vega is capped so that strategy net target gamma does not exceed 10% gamma cap (i.e. the lower the vol regime, the lower the sold short leg target vega)



Full Period since Dec-06	CSVPETSA	Custom UPS	SX5T
Ann. Return	5.8%	4.0%	2.7%
Ann. Volatility	4.5%	4.1%	22.9%
Worst 21bd Return	-2.7%	-2.6%	-37.8%
Max Drawdown	-7.3%	-11.8%	-58.6%
Sharpe Ratio	1.28	0.97	0.12
Calmar Ratio	0.79	0.34	0.05
Correl vs. Eurostoxx 50	-54%	-57%	
Avg. Gamma	-21%	-11%	-
Avg. Vega	0.20%	0.19%	-

Vega & Gamma Profile Comparison



Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS VRP Term Structure Series methoddogy was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

Defensive VRP Term Structure: Eurostoxx 50
Overnight Gap-Risk Stress Test Scenarios

Term Structure Avg. Return in Overnight Gap-Risk Stress-Test Scenarios (No Delta-Hedging Adjustment)

- We first analyze the historical frequency of daily SX5E shocks, grouped into 5 scenarios (by magnitude) and 4 volatility regimes
- We then implement a stress test on the option portfolio (comprising both instantaneous Spot & Vol shocks), assuming no delta-hedging adjustment – and calculate the average strategy return within each scenario – vol regime bucket:

 # Historical Observations of Spot/Vol Regime Scenarios

		Vol Regime (VSTX=Vol)				
Scenario	Spot	Vol<15	15≤Vol<25	25≤Vol<50	Vol≥50	**Total**
A	-2%	149	533	452	22	1156
B	-4%	7	25	88	16	136
C	-6%		4	13	11	28
D	-8%	1	2	4	1	8
E	-10%				1	1
	Total	**157**	**564**	**557**	**51**	**1329**
Frequency %		11%	40%	34%	2%	87%
		1%	2%	7%	1%	10%
			0%	1%	1%	2%
		0%	0%	0%	0%	1%
					0%	0%
	Total	**12%**	**42%**	**42%**	**4%**	**100%**

→ **Historically large Eurostoxx 50 drawdowns mostly occurs in mid-to-high vol regimes**

Average Strategy Return across Spot/Vol Regime Scenarios

Term Structure Custom UPS				Vol Regime (VSTX=Vol)			
Scenario	**Spot**	**3mVol**	**1wVol**	**Vol<15**	**15≤Vol<25**	**25≤Vol<50**	**Vol≥50**
A	-2%	2%	4%	0.1%	0.2%	0.3%	0.5%
B	-4%	4%	9%	0.1%	0.2%	0.3%	0.8%
C	-6%	7%	15%	-0.1%	0.0%	0.2%	1.1%
D	-8%	11%	21%	-0.3%	-0.3%	-0.1%	1.2%
E	-10%	14%	27%	-0.1%	-0.5%	-0.4%	1.3%

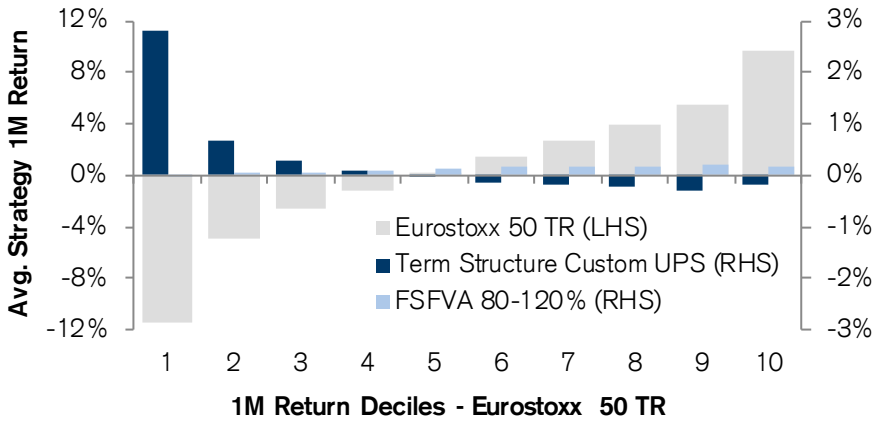
→ **On average, gamma-capped Custom UPS version gains in majority of scenarios across mid-to-high vol regimes, with minor positive stress values in less severe scenarios (A/B) across low vol regimes**

→ **Losses in severe scenarios (C/D/E) in low vol regimes are relatively limited, driven by the gamma cap – which can mitigate potential future moves in the low vol regime**

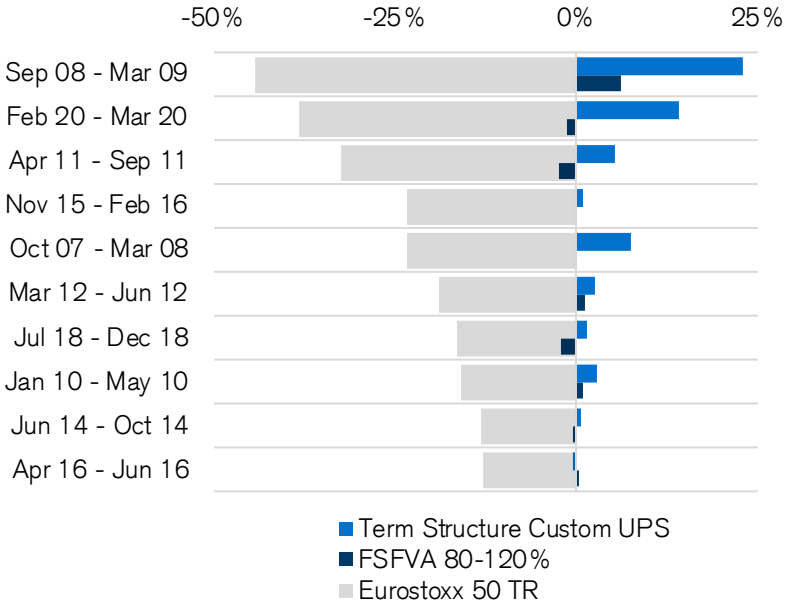
Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS VRP Term Structure Series methoddogy was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

Defensive VRP Term Structure: Eurostoxx 50
Complementarity vs. Fixed Strike FVA

1M Return Decile Comparison vs. Eurostoxx 50



Return Comparison: Top 10 SX5E Drawdowns



- FSFVA, which captures the term-structure of skew roll-down/up from 18m to spot for 1y options, is relatively orthogonal to the shorter-dated tenors in the Term Structure strategy
- As a result, positive FSFVA carry can be used to diversify financing of Term Structure long volatility exposure – complementing the reduced carry profile of the gamma-capped Term Structure strategy

→ **FSFVA provides an uncorrelated source of carry (low historical correlation vs. Eurostoxx 50 & Term Structure since '07)**

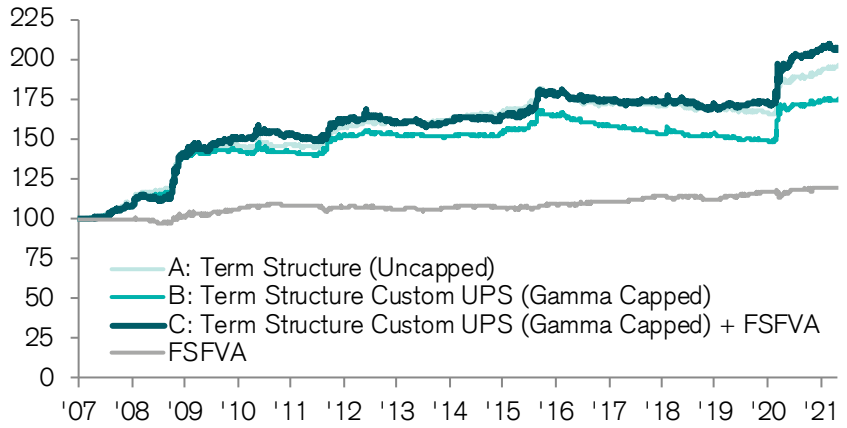
→ **In fact, FSFVA has not only historically shown capital preservation in equity crises, but has also at times also provided additional gains in major drawdowns**

Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS Systematic Fixed Strike FVA indices are not yet live and all data is shown for indicative purposes only. The CS VRP Term Structure Series methodology was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

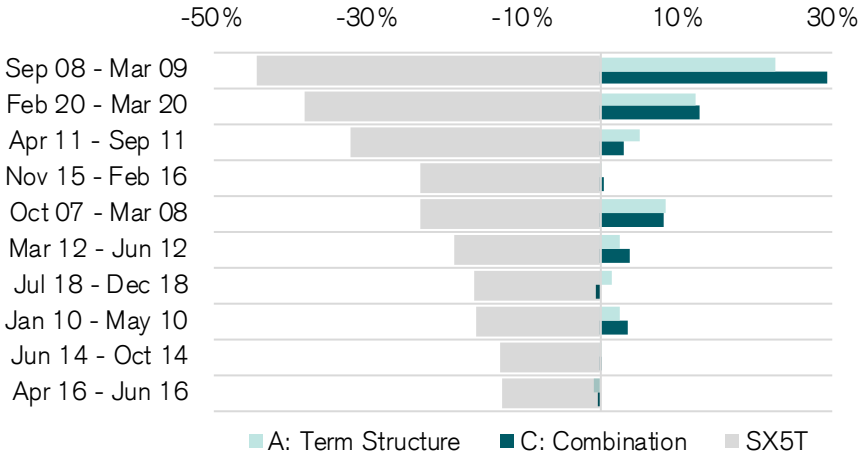
FSFVA Combination with Defensive VRP Term Structure
Combination Overlay Proposal

Capping Term Structure short leg gamma whilst adding FSFVA overlay to diversify financing of long volatility exposure:

- FSFVA exposure on top of gamma-capped Term Structure (equal notional, which translates into flat raw vega & positive vega on a root-time basis)
- Resulting combination **(C)** delivers similar profile to non-capped Term Structure (A), however with a more diversified source of carry (both FSFVA & short gamma) – aiming to create a more robust relative value, long vol biased strategy



(A) v (C) Return Comparison: Top 10 SX5E Drawdowns



Full Period since Dec-06	A	B	FSFVA	C
Ann. Return	4.8%	4.0%	1.2%	5.2%
Ann. Volatility	4.1%	4.1%	2.5%	4.9%
Worst 21bd Return	-2.7%	-2.6%	-3.5%	-2.7%
Max Drawdown	-9.2%	-11.8%	-4.4%	-6.6%
Sharpe Ratio	1.17	0.97	0.51	1.07
Calmar Ratio	0.52	0.34	0.29	0.79
Correl vs. Eurostoxx 50	-52%	-57%	-2%	-50%
Last 5 Years				
Ann. Return	2.3%	1.5%	1.8%	3.3%
Ann. Volatility	4.2%	4.2%	2.2%	4.7%
Max Drawdown	-6.3%	-9.5%	-4.2%	-6.2%
Sharpe Ratio	0.55	0.35	0.81	0.72
Calmar Ratio	0.36	0.15	0.43	0.53
Correl vs. Eurostoxx 50	-55%	-62%	41%	-39%

Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS Systematic Fixed Strike FVA indices are not yet live and all data is shown for indicative purposes only. The CS VRP Term Structure Series methodology was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

FSFVA Combination with Defensive VRP Term Structure

Simulated Historical Monthly Returns

SX5E 80-120% Fixed Target Strike FVA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2007	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2008	0.0%	0.1%	-0.5%	-0.5%	-0.1%	-1.6%	0.2%	0.2%	0.8%	2.3%	0.7%	0.3%	1.8%
2009	0.5%	1.7%	-0.1%	-1.0%	-0.1%	0.8%	0.6%	-0.1%	0.8%	0.8%	0.3%	-0.1%	4.1%
2010	1.0%	0.3%	0.6%	0.2%	-0.1%	0.4%	0.4%	0.7%	-0.2%	-1.1%	-0.1%	0.5%	2.7%
2011	-0.4%	0.1%	-0.4%	0.4%	0.1%	-0.6%	-0.3%	-2.3%	1.5%	0.1%	0.6%	-0.3%	-1.4%
2012	0.3%	0.3%	-0.6%	-0.1%	1.4%	-1.3%	0.3%	-0.3%	-0.2%	-0.4%	-0.5%	-0.1%	-1.2%
2013	0.2%	0.4%	0.0%	-0.1%	-0.3%	-0.9%	0.2%	0.3%	0.2%	0.3%	0.3%	0.4%	1.2%
2014	0.5%	0.1%	0.1%	0.3%	-0.3%	-0.2%	0.3%	0.0%	0.1%	-0.3%	-0.4%	-0.1%	0.1%
2015	-0.4%	0.1%	-0.4%	0.5%	0.3%	-0.1%	-0.5%	0.4%	1.2%	0.4%	0.4%	0.0%	1.9%
2016	0.2%	0.2%	-0.7%	0.4%	0.1%	0.3%	0.4%	0.1%	0.2%	0.1%	-0.1%	0.4%	1.6%
2017	0.1%	-0.2%	0.2%	0.1%	0.3%	0.3%	0.4%	0.2%	0.6%	0.4%	0.3%	0.0%	2.9%
2018	-0.1%	-0.6%	-0.5%	1.0%	-0.4%	0.3%	0.9%	-0.9%	-0.1%	-1.2%	-0.2%	0.2%	-1.5%
2019	0.0%	0.7%	0.4%	0.9%	-1.0%	1.1%	0.2%	0.3%	0.6%	0.1%	0.4%	0.1%	4.0%
2020	0.0%	-1.0%	-1.2%	1.5%	0.9%	1.0%	-0.1%	0.3%	0.1%	-1.1%	1.8%	0.2%	2.4%
2021	0.1%	0.2%	-0.6%	0.1%									-0.3%

Term Structure (Gamma Capped)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2007	-0.1%	0.2%	0.7%	0.3%	0.1%	0.7%	1.6%	1.5%	0.9%	0.6%	1.6%	0.0%	8.2%
2008	3.8%	2.0%	0.5%	-0.5%	0.2%	0.2%	0.2%	0.6%	2.1%	11.4%	4.0%	1.2%	28.2%
2009	0.9%	0.9%	1.1%	-0.8%	-0.1%	0.7%	0.5%	0.4%	-0.3%	0.1%	0.4%	-0.7%	3.0%
2010	-0.6%	-0.3%	-0.1%	0.5%	1.5%	0.4%	-1.6%	0.1%	-0.6%	0.2%	0.7%	-0.4%	-0.2%
2011	-0.7%	-0.2%	-0.4%	0.0%	-0.8%	0.3%	0.4%	2.1%	4.4%	0.3%	0.6%	0.9%	7.0%
2012	-0.2%	-0.2%	0.0%	0.9%	1.5%	-1.0%	-0.1%	0.3%	-0.7%	0.3%	-0.5%	0.3%	0.5%
2013	-1.0%	0.7%	0.0%	-0.1%	0.0%	0.0%	-0.8%	0.6%	-0.6%	-0.1%	-0.2%	0.3%	-1.1%
2014	0.5%	-0.3%	0.5%	0.2%	-0.2%	-0.3%	0.5%	-0.3%	-0.4%	-0.3%	0.4%	1.5%	1.7%
2015	1.4%	-0.4%	0.2%	0.2%	0.0%	1.2%	1.1%	3.7%	0.9%	-1.2%	0.0%	-0.8%	6.5%
2016	0.4%	0.1%	-1.0%	-0.6%	-0.6%	-0.7%	0.2%	-0.2%	-0.8%	-0.2%	0.0%	0.2%	-3.0%
2017	-0.6%	0.0%	-0.8%	-0.1%	-0.1%	-0.3%	-0.6%	0.0%	-0.5%	-0.2%	-0.3%	-0.2%	-3.6%
2018	-0.3%	1.3%	-0.1%	-0.5%	0.1%	-0.8%	-0.6%	0.0%	-0.2%	0.5%	-0.3%	1.0%	0.1%
2019	-1.2%	-0.1%	0.0%	-0.4%	0.0%	-0.7%	-0.2%	0.3%	-0.4%	0.2%	-0.4%	-0.2%	-2.9%
2020	-0.2%	4.9%	8.4%	0.1%	0.0%	1.4%	0.0%	0.0%	-0.2%	1.5%	-0.8%	0.5%	16.4%
2021	1.0%	0.1%	-0.8%	0.3%									0.7%

Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS VRP Term Structure Series methoddogy was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

FSFVA Combination with Defensive VRP Term Structure

Simulated Historical Monthly Returns

Term Structure (Gamma Capped) + FSFVA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2007	-0.1%	0.2%	0.7%	0.3%	0.1%	0.5%	1.7%	1.5%	0.9%	0.5%	1.5%	0.0%	8.0%
2008	3.8%	2.0%	-0.1%	-1.1%	0.2%	-1.4%	0.4%	0.8%	2.9%	13.5%	4.5%	1.5%	29.6%
2009	1.5%	2.5%	1.0%	-1.8%	-0.3%	1.5%	1.1%	0.2%	0.4%	0.9%	0.7%	-0.7%	7.1%
2010	0.4%	0.0%	0.4%	0.8%	1.4%	0.8%	-1.2%	0.8%	-0.7%	-1.0%	0.6%	0.1%	2.4%
2011	-1.1%	-0.1%	-0.8%	0.4%	-0.7%	-0.3%	0.2%	-0.1%	6.0%	0.4%	1.2%	0.6%	5.6%
2012	0.1%	0.1%	-0.6%	0.8%	2.9%	-2.2%	0.2%	0.0%	-0.9%	-0.2%	-1.0%	0.2%	-0.7%
2013	-0.8%	1.2%	0.0%	-0.2%	-0.3%	-0.9%	-0.6%	0.9%	-0.3%	0.2%	0.2%	0.7%	0.0%
2014	1.0%	-0.2%	0.6%	0.5%	-0.5%	-0.4%	0.8%	-0.3%	-0.4%	-0.6%	0.0%	1.4%	1.9%
2015	0.9%	-0.3%	-0.2%	0.8%	0.4%	1.1%	0.6%	4.1%	2.0%	-0.8%	0.4%	-0.8%	8.4%
2016	0.6%	0.3%	-1.6%	-0.2%	-0.5%	-0.4%	0.6%	-0.1%	-0.6%	-0.1%	-0.1%	0.6%	-1.4%
2017	-0.5%	-0.2%	-0.6%	0.0%	0.2%	0.1%	-0.2%	0.2%	0.1%	0.2%	0.0%	-0.2%	-0.8%
2018	-0.4%	0.7%	-0.6%	0.5%	-0.3%	-0.5%	0.4%	-0.8%	-0.3%	-0.7%	-0.5%	1.2%	-1.4%
2019	-1.2%	0.6%	0.5%	0.6%	-1.0%	0.4%	0.0%	0.7%	0.2%	0.4%	0.1%	-0.1%	1.0%
2020	-0.2%	3.9%	7.3%	1.6%	0.9%	2.4%	-0.1%	0.2%	-0.1%	0.4%	0.9%	0.7%	19.3%
2021	1.1%	0.3%	-1.4%	0.4%									0.4%

Eurostoxx 50 TR

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2007	1.5%	-2.2%	2.3%	5.5%	4.0%	-0.3%	-3.8%	-0.4%	2.0%	2.5%	-1.9%	0.2%	9.7%
2008	-13.8%	-1.8%	-2.5%	6.1%	0.4%	-11.1%	0.5%	0.1%	-9.6%	-14.7%	-5.8%	0.9%	-42.4%
2009	-8.6%	-11.6%	4.9%	15.5%	4.9%	-1.8%	9.9%	5.3%	3.6%	-4.4%	2.3%	6.2%	25.5%
2010	-6.3%	-1.7%	7.5%	-3.7%	-5.7%	-1.2%	6.6%	-4.2%	4.8%	3.6%	-6.5%	5.9%	-2.4%
2011	5.4%	2.0%	-3.4%	3.9%	-3.3%	-0.3%	-6.2%	-13.7%	-5.1%	9.5%	-2.0%	-0.5%	-14.5%
2012	4.6%	4.0%	-1.3%	-6.2%	-6.7%	7.3%	2.9%	5.0%	0.8%	2.1%	2.9%	2.1%	17.6%
2013	3.2%	-2.5%	-0.3%	4.0%	3.3%	-5.8%	6.5%	-1.7%	6.5%	6.1%	0.8%	0.6%	21.6%
2014	-2.6%	4.5%	0.5%	1.5%	2.7%	-0.3%	-3.4%	1.9%	1.8%	-3.4%	4.5%	-3.4%	3.9%
2015	7.0%	7.4%	2.8%	-1.9%	-0.1%	-3.9%	5.2%	-9.1%	-5.1%	10.3%	2.7%	-6.2%	7.4%
2016	-7.2%	-3.2%	2.1%	1.3%	2.5%	-6.2%	4.5%	1.1%	-0.6%	1.9%	0.0%	7.9%	3.1%
2017	-1.7%	2.9%	5.6%	2.0%	1.0%	-3.0%	0.3%	-0.7%	5.2%	2.3%	-2.8%	-1.7%	9.2%
2018	3.1%	-4.6%	-2.2%	5.8%	-2.5%	-0.2%	3.9%	-3.7%	0.3%	-5.9%	-0.7%	-5.7%	-12.5%
2019	6.0%	4.4%	1.8%	5.3%	-5.5%	6.0%	-0.1%	-1.1%	4.3%	1.1%	2.8%	1.3%	29.0%
2020	-2.7%	-8.5%	-16.2%	5.3%	4.7%	6.4%	-1.6%	3.2%	-2.3%	-7.3%	18.1%	2.3%	-2.8%
2021	-2.4%	4.5%	7.9%	1.8%									12.1%

Source: Credit Suisse, Bloomberg. Data from 15-Dec-06 to 30-Apr-21. The CS VRP Term Structure Series methoddogy was finalized on 14-Oct-20, figures refer to simulated performance until such date and out-of-sample performance thereafter. Index performance is in EUR, excess return, gross of swap fees and net of embedded transaction cost. Past performance (actual or simulated) is not an indicator of future performance.

Risk Considerations

GENERAL RISKS

Historical Performance: The live historical or past simulated performance of each strategy is not a guarantee or an indication of future performance.

Use of leverage: Certain strategies may involve the use of leverage, via a leverage factor or volatility targeting, which may exacerbate losses and subsequent deleveraging may increase the time taken to recover from a drawdown event.

Use of signals: Certain strategies may utilize timing signals, which determines if the strategy is invested or uninvested at any given time. The impact of such signal inclusion on strategy performance may be positive or negative versus an equivalent strategy that is always invested at all times.

Limited operating history: Strategies may have limited operating history (if any), which may have no proven track record in achieving the stated investment objective.

Individual strategy cost structure: Certain costs have been embedded in the calculation of each strategy, and there may be additional costs in accessing / trading a particular strategy, which will have an impact on the return an investor may receive from a particular strategy investment.

Strategy complexity and suitability: Various strategies will have differing levels of complexity and hence certain complex strategies may be less suitable for certain investor types. Investors should make an assessment of the strategy's suitability before any investment.

Investment product: The Investor's risk-return profile is a function of the type of strategy-linked product invested. As such, capital may or may not be at risk depending on product type, and the product may or may not employ leverage. For example a capital protected product linked to a strategy will have reduced risk versus a leveraged product which will conversely have increased risk.

OPTION/VOLATILITY SPECIFIC RISKS

Options: Derivatives and options are complex instruments that are not suitable for every investor, may involve a high degree of risk, and may be appropriate investments only for sophisticated investors who are capable of understanding and assuming the risks involved.

Understanding Volatility: Volatility can be considered as a measure of risk for a given underlying asset, due to the uncertainty of the future price or value of such asset. Volatility as a measure of risk may be determined on either:

- An historical basis (known as "realised volatility"); or
- A future basis (known as "implied volatility").

Historical volatility can be calculated formulaically with reference to the magnitude of daily price movements (in either direction) for the relevant underlying asset. For example, an asset whose price moves by 5% (in any direction) each day has a higher volatility than an asset whose price moves by 1% (in any direction) each day.

Implied volatility can be inferred from the price of equity options and represents the market's expectation of future volatility.

Potential losses from unexpected increase in volatility: Short volatility exposure may result in a negative performance if the implied volatility of the underlying, generally, increases during any given day. The larger the increase, the higher the expected fall in the strategy value.

Important Legal Information

This material has been prepared by individual traders or sales personnel of Credit Suisse Securities (USA) LLC and its affiliates ("CSSU") and not by the CSSU research department. It is not investment research or a research recommendation, as it does not constitute substantive research or analysis. It is intended for institutional customers of CSSU only, is provided for informational purposes, is intended for your use only and does not constitute an invitation or offer to subscribe for or purchase any of the products or services mentioned. The information provided is not intended to provide a sufficient basis on which to make an investment decision. It is intended only to provide observations and views of individual traders or sales personnel, which may be different from, or inconsistent with, the observations and views of CSSU research department analysts, other CSSU traders or sales personnel, or the proprietary positions of CSSU. Observations and views expressed herein may be changed by the trader or sales personnel at any time without notice. Trade report information is preliminary and subject to our formal written confirmation. This material may have previously been communicated to the CSSU trading desk or other CSSU clients. You should assume that the trading desk makes markets and/or currently maintains positions in any of the securities mentioned above.

CSSU may, from time to time, participate or invest in transactions with issuers of securities that participate in the markets referred to herein, perform services for or solicit business from such issuers, and/or have a position or effect transactions in the securities or derivatives thereof. To obtain a copy of the most recent CSSU research on any company mentioned please contact your sales representative or go to Research & Analytics.

FOR IMPORTANT DISCLOSURES on companies covered in Credit Suisse Investment Banking Division research reports, please see www.credit-suisse.com/researchdisclosures

Past performance should not be taken as an indication or guarantee of future performance, and no representation or warranty, expressed or implied is made regarding future performance. The information set forth above has been obtained from or based upon sources believed by the trader or sales personnel to be reliable, but each of the trader or sales personnel and CSSU does not represent or warrant its accuracy or completeness and is not responsible for losses or damages arising out of errors, omissions or changes in market factors. This material does not purport to contain all of the information that an interested party may desire and, in fact, provides only a limited view of a particular market.

Unlike an actual performance record based on trading actual client portfolios, hypothetical, back-tested or simulated results are achieved by means of the retroactive application of a back-tested model itself designed with the benefit of hindsight. Hypothetical, back-tested or simulated performance does not reflect the impact that material economic or market factors might have on an adviser's decision making process if the adviser were actually managing a client's portfolio. The back-testing of performance differs from actual account performance because the investment strategy may be adjusted at any time, for any reason and can continue to be changed until desired or better performance results are achieved. The back-tested performance includes hypothetical results that do not reflect the reinvestment of dividends and other earnings or the deduction of advisory fees, brokerage or other commissions, and any other expenses that a client would have paid or actually paid. No representation is made that any account will or is likely to achieve profits or losses similar to those shown. Alternative modeling techniques or assumptions might produce significantly different results and prove to be more appropriate. Past hypothetical, back-test or simulated results are neither indicators nor guarantees of future returns. In fact, there are frequently sharp differences between hypothetical, back-tested and simulated performance results and the actual results subsequently achieved. As a sophisticated investor, you accept and agree to use such information only for the purpose of discussing with Credit Suisse your preliminary interest in investing in the strategy described herein.

Structured Products: Structured securities are complex instruments, typically involve a high degree of risk and are intended for sale only to sophisticated investors who are capable of understanding and assuming the risks involved. The market value of any structured security may be affected by changes in economic, financial and political factors (including, but not limited to, spot and forward interest and exchange rates), time to maturity, market conditions and volatility, and the credit quality of any issuer or reference issuer. Any investor interested in purchasing a structured product should conduct their own investigation and analysis of the product and consult with their own professional advisers as to the risks involved in making such a purchase.

Important Legal Information

Options Disclaimer: Structured securities, derivatives and options are complex instruments that are not suitable for every investor, may involve a high degree of risk, and may be appropriate investments only for sophisticated investors who are capable of understanding and assuming the risks involved. Supporting documentation for any claims, comparisons, recommendations, statistics or other technical data will be supplied upon request. Any trade information is preliminary and not intended as an official transaction confirmation. Read the Options Clearing Corporation's disclosure document. Because of the importance of tax considerations to many option transactions, the investor considering options should consult with his/her tax advisor as to how taxes affect the outcome of contemplated options transactions.

Risks associated with options:

- **Call or Put Purchasing**: The risk of purchasing a call/put is that you may lose the entire premium paid.
- **Uncovered Call Writing**: The risk of selling an uncovered call is unlimited and may result in losses significantly greater than the premium received.
- **Uncovered Put Writing**: The risk of selling an uncovered put is significant and may result in losses significantly greater than the premium received.
- **Call or Put Vertical Spread Purchasing** (same expiration month for both options): The basic risk of effecting a long spread transaction is limited to the premium paid when the position is established.
- **Call or Put Vertical Spread Writing** (same expiration month for both options): The basic risk of effecting a short spread transaction is limited to the difference between the strike prices less the amount received in premiums.
- **Call or Put Calendar Spread Purchasing** (different expiration months & short must expire prior to the long): The basic risk of effecting a long calendar spread transaction is limited to the premium paid when the position is established.
- **Call or Put Calendar Spread Writing** (different expiration months & long must expire prior to the short): The risk of a short call (resp. short put) calendar spread may be unlimited in the situation where the long call (resp. long put) expires worthless and the short call (resp. short put), with a longer maturity, remains open.

Equity Derivatives Tax Disclaimer: CSSU does not provide any tax advice. Any tax statement herein regarding any US federal tax is not intended or written to be used, and cannot be used, by any taxpayer for the purpose of avoiding any penalties. Any such statement herein was written to support the marketing or promotion of the transaction(s) or matter(s) to which the statement relates. Each taxpayer should seek advice based on the taxpayer's particular circumstances from an independent tax advisor. Notwithstanding anything to the contrary herein, each party (and each of their employees, representatives, or other agents) may disclose to any and all persons, without limitation of any kind, the U.S. tax treatment and U.S. tax structure of any transaction that may described or included within the information contained herein relating to such U.S. tax treatment and U.S. tax structure. For this purpose, the tax treatment of a transaction is the purported or claimed U.S. federal income tax treatment of the transaction, and the tax structure of a transaction is any fact that may be relevant to understanding the purported or claimed U.S. federal income tax treatment of any transaction.

ERISA: You understand that (i) neither CS nor any of its affiliates has or exercises investment discretion with respect to any assets on behalf of any employee benefit plans or individual retirement accounts (collectively, "Plans") that may be involved with the purchase, holding, or redemption of a security, (ii) CS is not undertaking to provide impartial investment advice or give advice in a fiduciary capacity on behalf of such Plans within the meaning of the U.S. Department of Labor's final regulation defining "investment advice" for purposes of the Employee Retirement Income Security Act of 1974, as amended and Section 4975 of the Internal Revenue Code of 1986, as amended, and (iii) the information or communication provided herein or otherwise to the Plans or a fiduciary on behalf of any of the Plans is intended to be, and should be construed as, general information, and it does not and will not take into account your legal, regulatory, tax, business, investment, financial, accounting or other needs or priorities with respect to any Plans.

Municipalities: CSSU may provide various services to municipal entities or obligated persons ("municipalities"), including suggesting individual transactions or trades and entering into such transactions. Any services CSSU provides to municipalities are not viewed as "advice" within the meaning of Section 975 of the Dodd-Frank Wall Street Reform and Consumer Protection Act. CSSU is providing any such services and related information solely as an arm's length basis and not as an advisor or fiduciary to the municipality. In connection with the provision of the any such services, there is no agreement, direct or indirect, between any municipality (including the officials, management, employees or agents thereof) and CSSU for CSSU to provide advice to the municipality. Municipalities should consult with their financial, accounting and legal advisors regarding any such services provided by CSSU. In addition, CSSU is not acting for direct or indirect compensation to solicit the municipality on behalf of an unaffiliated broker, dealer, municipal securities dealer, municipal advisor, or investment adviser for the purpose of obtaining or retaining an engagement by the municipality for or in connection with Municipal Financial Products, the issuance of municipal securities, or of an investment adviser to provide investment advisory services to or on behalf of the municipality.