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Revisiting 'Timing the Carry vs. Convexity Trade'

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Yield Curve Convexity – 13 Years Later

2006: To what extent positive convexity compensates the negative carry yield?

August 11, 2006

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Can Convexity Be Exploited?¹

We examine the extent to which investors can benefit from exposure to convexity in periods of high yield curve volatility. We find that the yield-curve dynamics are sufficiently different from those implied by a parallel shift to offset the payoff for convexity. In contrast, option strategies can be employed successfully to express views on expected volatility spikes.

INTRODUCTION

2007: What are the payoffs of a strategy that is delta-neutral instead of duration-neutral

Quantitative Portfolio Strategy

Convexity and Yield Curve Trades

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In a recent publication, we demonstrated that in all-cash portfolios, the anticipated benefits of a long-convexity portfolio are not necessarily realized.¹ We studied the performance of various duration-neutral bullet versus barbell trades, and showed that:

1. Despite the duration-neutral construction, the results of these trades are directional, tending to outperform under rising yields and to underperform when yields fall.
2. In a return attribution setting in which we separate parallel shift return from other yield curve return components, the volatilities of the twist and butterfly returns (which are the first-order returns of the bullet-barbell trade) are much greater than that of the convexity return which is a second-order exposure to parallel shift

2012: Is it possible to use curve-implied volatility signals to time the convexity trade?

CROSS ASSET RESEARCH

Quantitative Portfolio Strategy | 26 November 2012

CARRY VS. CONVEXITY

Butterfly strategies using curve-implied volatility signals

Butterfly positions have often been considered a way to express a long convexity view in an all-cash portfolio, at the cost of a give-up in yield. We review the performance of such positions over time, in the US and German Treasury bond markets, and seek to determine how and when they can be most advantageous. Our key findings are:

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Overview

- Many investors believe convexity can enhance portfolio performance
- Establishing a long-convexity position typically involves an up-front cost
- The extent to which yield curve dynamics have deviated from a pure parallel shift more than offset the payoff for convexity (Ben Dor, Chen, Dynkin and Hyman, 2006 and 2007)
- 'Break-even volatility' (the vol. that justifies the upfront cost of convexity in a butterfly trade in a pure parallel-shift world) can be used as a timing tool (Ben Dor, Dynkin, Eisenthal-Berkovitz and Hyman, 2012)

Questions

- Does convexity pay off - over the entire sample? During the zero-lower bound period?
- Can investors still exploit the breakeven volatility (compared to implied volatility) as a timing tool?

Results

- Yield curve dynamics remain different from a pure parallel shift
- A butterfly trade generates average negative returns
 - The concept of breakeven vol is an effective timing signal both in normal times and during the zero lower bound period
 - Selling convexity if breakeven vol is relatively high produces an information ratio of 0.5 (UST and Bunds 2/10-5) and about 0.6 (Bunds 5/30-10) for the period 2002-2019
 - Results hold across geographies and vintage

Methodology and Data

- We study the empirical performance of the following Butterfly (positive-convexity) trades:

Buy Short- and Long- & Sell Medium-term Treasury: $\underbrace{w_s y_{\text{short}} + w_l y_{\text{long}}}_{y_{\text{Barbell}}} - y_{\text{Bullet}}$

where w_s and w_l are such that the butterfly trade is:

- Self-financing: $w_s + w_l = 1$
 - Duration-neutral: $w_s D_{\text{short}} + w_l D_{\text{long}} = D_{\text{bullet}}$
- On different parts of the yield curve:
 - Butterfly 2/10-5: Long the 2/10 barbell, short the 5-year bullet
 - Butterfly 5/30-10: Long the 5/30 barbell, short the 10-year bullet
 - In two different currencies (USD and Euro)
 - Monthly data between 2000 and 2019 on:
 - US Treasury On-The-Run (OTR), Off-The-Run (OffTR) – maturities of 2, 5, 10 and 30 years
 - German Bunds – OTR maturities of 2, 5, 10 and 30 years

Does Convexity Pay Off?

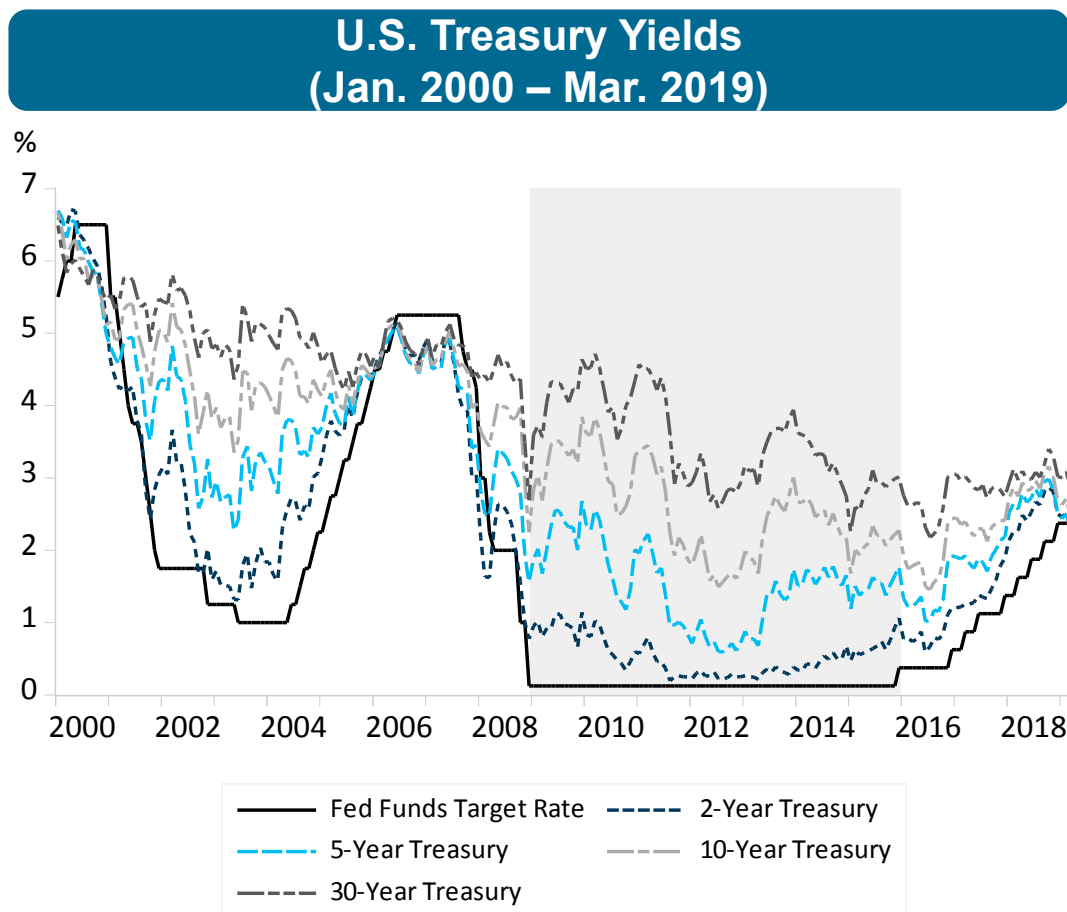
Summary Statistics for the Barbell-Bullet Trade				
	Full Sample (2000 - 2019)			
	2/10 - 5		30/5-10	
	U.S. OTR	German OTR Bunds	U.S. OTR	German OTR Bunds
Yield	-0.12	-0.03	-0.27	-0.27
Cvx	0.12	0.12	0.59	0.68
Ret Avg	-0.05	-0.02	0.02	-0.04
Ret Vol	0.32	0.24	0.37	0.37
Inf Ratio	-0.53	-0.33	0.22	-0.40
t-stat	-2.32	-1.46	0.94	-1.73

Source: Bloomberg, Barclays Research

- Negative carry across the board: 2bp/month in 5/30-10, 0-1bp/month in 2/10-5
- No performance advantage to the long-convexity trade
- On average, returns are flat to negative

Yield Curve Dynamics in the U.S.

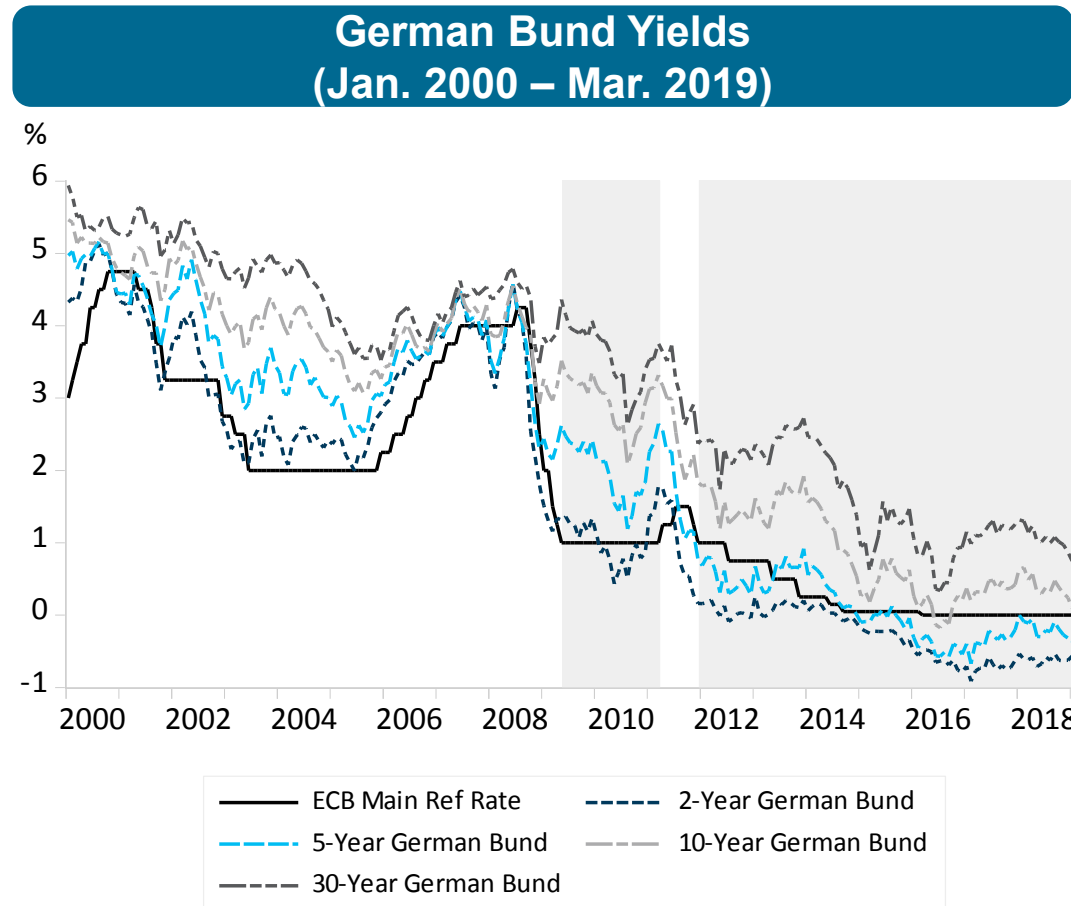
- 2-Year Treasury yield was somewhat constrained by the zero lower bound on the fed funds target rate



Note: The shaded area indicates the zero lower bound period between January 2009 and December 2015. Source: Bloomberg, Barclays Research

Yield Curve Dynamics in Germany Has Been Different Compared with the U.S.

- 2-, 5- and 10-Year German Bund yields have been constrained by the zero lower bound on the ECB policy rate



Note: The shaded area indicates the zero lower bound period between May 2009 and March 2011 and December 2011 and March 2019.

Source: Bloomberg, Barclays Research

Does Convexity Pay Off in Volatile Periods?

- We define a parallel shift as the average yield change of the corresponding maturities
- Assign months to quartiles by magnitude of change (1 = most neg., 4 = most positive)

Performance of Long Barbell / Short Bullet Strategy by Yield Change Quartile								
Treasury OTR								
Quartile	Normal Times: 2000-2008 and 2016-2019				Zero Lower Bound: 2009-2015			
	2/10 - 5		5/30 - 10		2/10 - 5		5/30 - 10	
	Avg. Yield Change	Avg. Ret. (%)	Avg. Yield Change	Avg. Ret. (%)	Avg. Yield Change	Avg. Ret. (%)	Avg. Yield Change	Avg. Ret. (%)
1 - Low	-0.36	-0.27	-0.32	-0.21	-0.23	-0.17	-0.28	-0.21
2	-0.09	-0.08	-0.09	0.03	-0.07	-0.14	-0.08	-0.09
3	0.05	0.03	0.03	0.15	0.06	-0.10	0.07	-0.08
4 - High	0.30	0.15	0.29	0.20	0.22	0.19	0.26	0.35

Note: Shift stands for the average yield change of the maturities included in the respective trade. Performance figures for each quartile reflect the mean returns across all monthly returns assigned to that quartile based on the contemporaneous changes in yield. Source: Bloomberg, Barclays Research

- Strategy returns are directional with yield shift. No U-shaped pattern
- During the ZLB period, the average shift is smaller and returns remain directional with yield shift

Yield Curve Dynamics Is Different From a Parallel Shift

- Yield curve dynamics are sufficiently different from those implied by a parallel shift to offset the payoff for convexity, both on average and conditional on monetary policy announcements

$$\Delta i_t = \alpha + \beta \text{ MonetaryPolicySurprise}_t + \varepsilon_t$$

The Response of Treasury Yields to Monetary Policy Surprises				
	2-y Tsy	5-y Tsy	10-y Tsy	30-y Tsy
Constant	0.00	0.00	0.00	0.00
Monetary Policy Surprise	0.59***	0.47**	0.38**	0.23*
R ²	0.148	0.063	0.046	0.026
Observations	154	154	154	154

Note: The sample period is Jan. 2000 – Mar. 2019 on FOMC meeting days. The monetary policy surprise corresponds to the daily change in the 3-month Treasury rate. The superscripts ***, **, and * indicate statistical significance at the 1%, 5% and 10% level, using robust standard errors. Source: Bloomberg, Barclays Research

- Short-term rates are more sensitive to monetary policy surprises compared to long-term rates \Rightarrow An upward (downward) shift in the level is accompanied by a flattening (steepening) of the yield curve

“Breakeven” Volatility

- Assuming parallel yield curve shifts, what yield volatility would “justify” the cost of convexity?
- Use 2nd order approximation of bond total return:

$$R \cong \underbrace{y \cdot \Delta t}_{\text{Carry Return}} \underbrace{-D \cdot \Delta y + \frac{1}{2} C \cdot \Delta y^2}_{\text{Price Return}}$$

- Given the trade duration neutrality, expected return is the sum of the carry (depends on yield) and convexity term (depends on volatility, assuming 0 expected yield change)
- We back out the “breakeven” volatility in terms of the butterfly yield and convexity:

$$\text{Var}(\Delta y_{\text{parallel_shift}}) = \frac{-2y_{\text{butterfly}}\Delta t}{C_{\text{butterfly}}}, \quad \text{BE_Vol} = \sqrt{\frac{-2y_{\text{butterfly}}\Delta t}{C_{\text{butterfly}}}}$$

- Note: “breakeven” volatility is defined only when butterfly yield is negative (barbell has lower yield than the bullet)

“Breakeven” vs. Implied Volatility

- 12-month B/E volatility is positively correlated with implied volatility
- The ratio between the two volatility measures oscillates around 1
- There is little difference between break-even volatility of OTR and 1st off-the-run strategy

Breakeven and Swaption-implied Vol. for 5/30-10 U.S. Treasuries

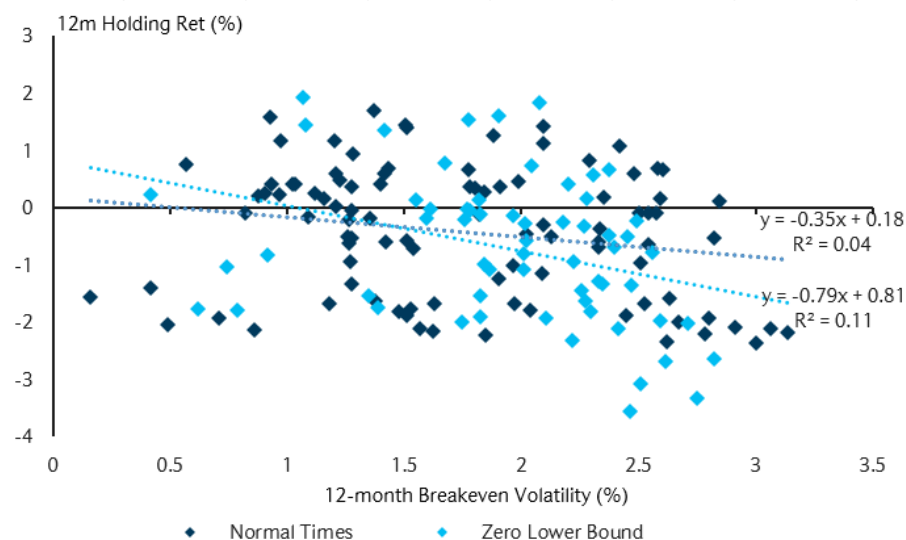


Note: The sample is January 2000-March 2019. The light blue line is the 1y forward 10y at-the-money swaption normalized implied volatility. The shaded gray area indicates periods for which the breakeven volatility was not defined because $y_{butterfly}$ was positive. Source: Bloomberg, Barclays Research

Yield Volatility and Strategy Returns

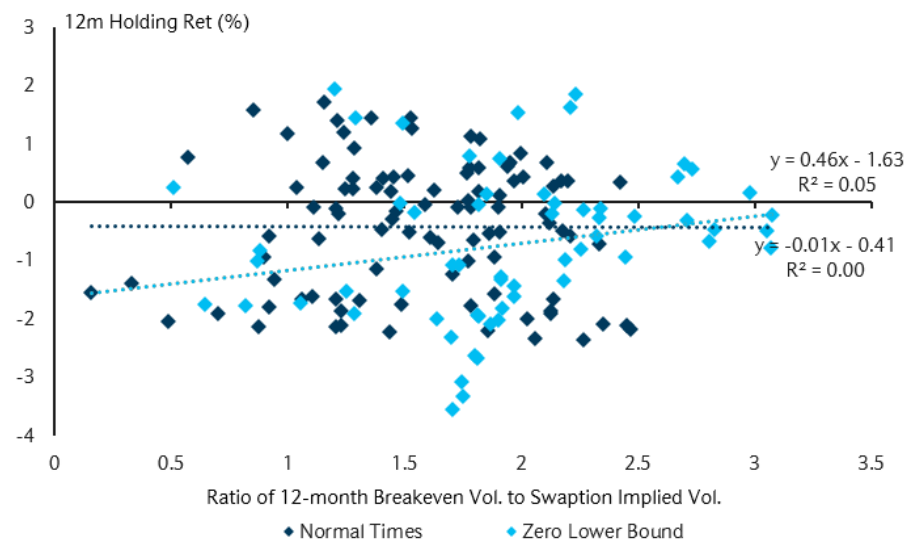
- Negative 12m cum. returns on the long-convexity position seem to be related to high B/E volatility signals:
 - Absolute high levels (left): both periods
 - High relative to implied vols (right) : only normal times

12-m Cum Ret (%) vs. 12m B/E Vol (%) for OTR UST 2/10-5



Note: The sample is January 2000-March 2019. The swaption implied vol stands for the 1y forward 5y at-the-money normalized implied volatility. Source: Bloomberg, Barclays Research

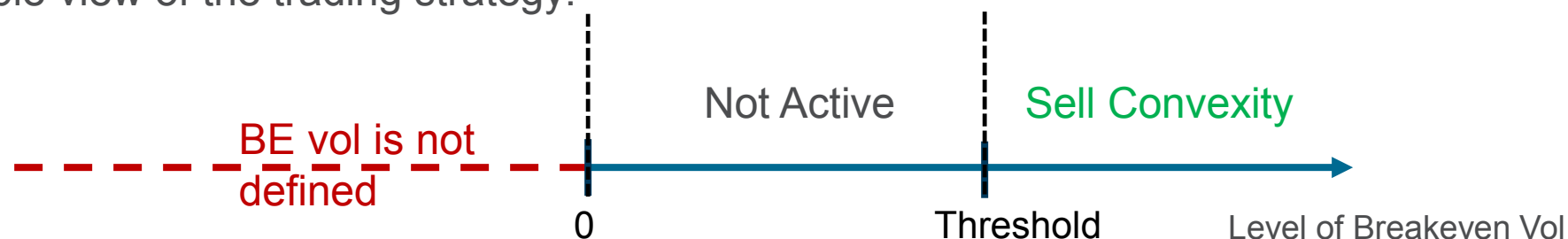
12-m Cum Ret (%) vs. Ratio of B/E to IV Vol (%) for OTR UST 2/10-5



Note: The sample is January 2000-March 2019. The swaption implied vol stands for the 1y forward 5y at-the-money normalized implied volatility. Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? (Continued)

- Simple view of the trading strategy:



- Threshold:

- 1) $Breakeven\ Vol > Historical\ Breakeven\ Vol$
- 2) $\frac{Breakeven\ Vol}{Swaption\ Implied\ Vol} > Historical\ Ratio$
- 3) *Either 1) or 2) is triggered*

Is Selling Convexity Profitable?

- Mostly yes. Summary of results:

		Geography	
		U.S.	Germany
Maturity: 2/10-5	Normal Times	✓	✓
	ZLB	✓	✓
Maturity: 5/30-10	Normal Times	✗	✓
	ZLB	✓	✓

Note: The sample is January 2000-March 2019. The median is computed for the sample period under consideration. The swaption implied vol stands for the 1y forward 5y or 1y forward 10y at-the-money normalized implied volatility.

Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? OTR US Treasury 2/10-5

- The concept of breakeven vol is an effective timing signal both in normal times and during the zero lower bound period
- Selling convexity if breakeven vol is relatively high produces an information ratio of about 0.5 for the US Treasury 2/10-5 strategy

2/10-5 OTR Treasury Strategy: Performance statistics for selling convexity by sample period and signal

Sell Criteria	% of Months with B/E Defined	% of B/E Months with Sell Signal	Average Return (%/m)	Return Volatility (%/m)	Inform. Ratio (ann.)	Min. Return (%/m)	Max Drawdown (%)	Hit Ratio (%)
Normal Times: 2000-2008 and 2016-2019								
Abs. Breakeven Vol. > Rolling Median	69%	52%	0.03	0.20	0.44	-0.70	-1.14	0.53
Ratio of Breakeven to Implied Vol. > Rolling Median	69%	50%	0.03	0.20	0.46	-0.70	-1.10	0.55
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	69%	55%	0.03	0.20	0.47	-0.70	-1.10	0.54
Zero Lower Bound: 2009-2015								
Abs. Breakeven Vol. > Rolling Median	73%	62%	0.03	0.23	0.47	-0.63	-2.39	0.58
Ratio of Breakeven to Implied Vol. > Rolling Median	73%	66%	0.04	0.24	0.56	-0.63	-2.39	0.58
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	73%	67%	0.04	0.24	0.58	-0.63	-2.39	0.59

Note: The sample is January 2000-March 2019. The rolling median is based on the most recent 24 months. When the sell signal is not active the strategy earns a zero return. The Hit Ratio measures the percentage of correct (up/down) predictions

Source: Bloomberg, Barclays Research

Summary

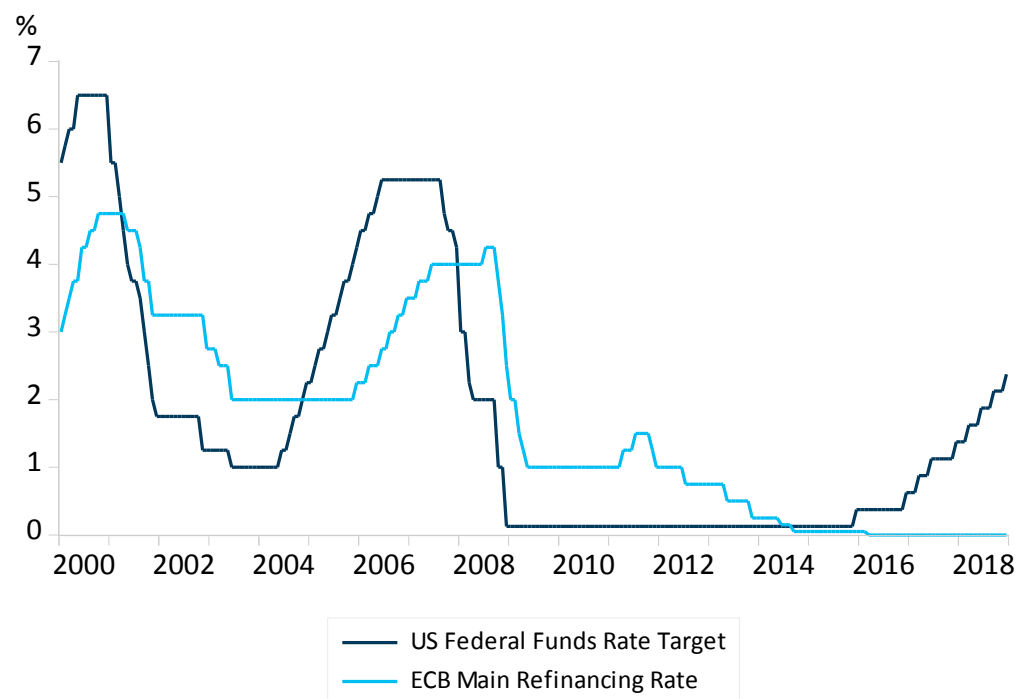
- Given the average negative returns to the butterfly trade, we study profitability for a seller of convexity
- Selling convexity performs best under relatively higher breakeven volatility, and it works both in normal times and zero lower bound periods

Appendix

Monetary Policy Rates in U.S. and Germany

- The effective zero lower bound may be greater than zero
- The zero lower bound is not a substantial constraint if longer-term interest rates continue to respond to monetary policy

**Monetary Policy Rates in U.S. and Euro-zone
(Jan. 2000 – Mar. 2019)**



Note: The sample is January 2000-March 2019, Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? OTR US Treasury 5/30-10

5/30-10 OTR Treasury Strategy: Performance statistics for selling convexity by sample period and signal

Sell Criteria	% of Months with B/E Defined	% of B/E Months with Sell Signal	Average Return (%/m)	Return Volatility (%/m)	Inform. Ratio (ann.)	Min. Return (%/m)	Max Drawdown (%)	Hit Ratio (%)
Normal Times: 2000-2008 and 2016-2019								
Abs. Breakeven Vol. > Rolling Median	84%	47%	-0.02	0.29	-0.19	-1.39	-3.72	0.55
Ratio of Breakeven to Implied Vol. > Rolling Median	84%	53%	-0.02	0.30	-0.28	-1.39	-3.89	0.53
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	84%	56%	-0.02	0.30	-0.18	-1.39	-3.11	0.55
Zero Lower Bound: 2009-2015								
Abs. Breakeven Vol. > Rolling Median	100%	46%	0.02	0.26	0.27	-0.90	-1.79	0.54
Ratio of Breakeven to Implied Vol. > Rolling Median	100%	62%	0.03	0.32	0.29	-1.30	-1.75	0.54
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	100%	70%	0.02	0.33	0.16	-1.30	-2.15	0.53

Note: The sample is January 2000-March 2019. The rolling median is based on the most recent 24 months. When the sell signal is not active the strategy earns a zero return. The Hit Ratio measures the percentage of correct (up/down) predictions. Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? OffTR US Treasury 2/10-5

2/10-5 OffTR Treasury Strategy: Performance statistics for selling convexity by sample period and signal

Sell Criteria	% of Months with B/E Defined	% of B/E Months with Sell Signal	Average Return (%/m)	Return Volatility (%/m)	Inform. Ratio (ann.)	Min. Return (%/m)	Max Drawdown (%)	Hit Ratio (%)
Normal Times: 2000-2008 and 2016-2019								
Abs. Breakeven Vol. > Rolling Median	68%	49%	0.02	0.18	0.39	-0.78	-1.49	0.53
Ratio of Breakeven to Implied Vol. > Rolling Median	68%	53%	0.01	0.17	0.28	-0.78	-1.27	0.51
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	68%	57%	0.02	0.18	0.45	-0.78	-1.27	0.54
Zero Lower Bound: 2009-2015								
Abs. Breakeven Vol. > Rolling Median	68%	67%	0.04	0.22	0.56	-0.61	-1.84	0.58
Ratio of Breakeven to Implied Vol. > Rolling Median	68%	75%	0.05	0.23	0.70	-0.61	-1.84	0.60
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	68%	75%	0.05	0.23	0.70	-0.61	-1.84	0.60

Note: The sample is January 2000-March 2019. The rolling median is based on the most recent 24 months. When the sell signal is not active the strategy earns a zero return. The Hit Ratio measures the percentage of correct (up/down) predictions

Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? OffTR US Treasury 5/30-10

5/30-10 OffTR Treasury Strategy: Performance statistics for selling convexity by sample period and signal

Sell Criteria	% of Months with B/E Defined	% of B/E Months with Sell Signal	Average Return (%/m)	Return Volatility (%/m)	Inform. Ratio (ann.)	Min. Return (%/m)	Max Drawdown (%)	Hit Ratio (%)
Normal Times: 2000-2008 and 2016-2019								
Abs. Breakeven Vol. > Rolling Median	82%	49%	-0.01	0.27	-0.09	-1.04	-3.60	0.51
Ratio of Breakeven to Implied Vol. > Rolling Median	82%	55%	-0.02	0.28	-0.18	-1.04	-3.80	0.50
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	82%	57%	-0.01	0.28	-0.12	-1.04	-3.66	0.51
Zero Lower Bound: 2009-2015								
Abs. Breakeven Vol. > Rolling Median	100%	45%	0.03	0.26	0.44	-0.77	-1.28	0.58
Ratio of Breakeven to Implied Vol. > Rolling Median	100%	58%	0.04	0.31	0.43	-1.18	-2.15	0.61
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	100%	69%	0.04	0.33	0.46	-1.18	-1.86	0.60

Note: The sample is January 2000-March 2019. The rolling median is based on the most recent 24 months. When the sell signal is not active the strategy earns a zero return. The Hit Ratio measures the percentage of correct (up/down) predictions. Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? OTR German Bund 2/10-5

2/10-5 OTR German Bund Strategy: Performance statistics for selling convexity by sample period and signal

Sell Criteria	% of Months with B/E Defined	% of B/E Months with Sell Signal	Average Return (%/m)	Return Volatility (%/m)	Inform. Ratio (ann.)	Min. Return (%/m)	Max Drawdown (%)	Hit Ratio (%)
Normal Times: 2002-2009 and 2011								
Abs. Breakeven Vol. > Rolling Median	78%	21%	0.02	0.08	0.70	-0.18	-0.29	0.71
Ratio of Breakeven to Implied Vol. > Rolling Median	78%	30%	0.02	0.11	0.59	-0.41	-0.41	0.70
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	78%	35%	0.02	0.12	0.66	-0.41	-0.41	0.70
Zero Lower Bound: 2009-2011 and 2011-2019								
Abs. Breakeven Vol. > Rolling Median	32%	34%	0.01	0.06	0.57	-0.22	-0.22	0.67
Ratio of Breakeven to Implied Vol. > Rolling Median	32%	40%	0.02	0.08	0.90	-0.22	-0.22	0.79
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	32%	43%	0.02	0.07	0.79	-0.22	-0.22	0.73

Note: The sample is December 2002-March 2019. The rolling median is based on the most recent 24 months. When the sell signal is not active the strategy earns a zero return. The Hit Ratio measures the percentage of correct (up/down) predictions.

Source: Bloomberg, Barclays Research

Is Selling Convexity Profitable? OTR German Bund 5/30-10

5/30-10 OTR German Bund Strategy: Performance statistics for selling convexity by sample period and signal

Sell Criteria	% of Months with B/E Defined	% of B/E Months with Sell Signal	Average Return (%/m)	Return Volatility (%/m)	Inform. Ratio (ann.)	Min. Return (%/m)	Max Drawdown (%)	Hit Ratio (%)
Normal Times: 2002-2009 and 2011								
Abs. Breakeven Vol. > Rolling Median	87%	50%	0.04	0.27	0.45	-0.84	-1.12	0.57
Ratio of Breakeven to Implied Vol. > Rolling Median	87%	39%	0.04	0.25	0.59	-0.84	-0.84	0.59
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	87%	54%	0.04	0.27	0.50	-0.84	-1.12	0.58
Zero Lower Bound: 2009-2011 and 2011-2019								
Abs. Breakeven Vol. > Rolling Median	100%	50%	0.05	0.25	0.70	-0.65	-1.55	0.64
Ratio of Breakeven to Implied Vol. > Rolling Median	100%	41%	0.07	0.35	0.71	-0.65	-1.72	0.61
Abs. Breakeven or Ratio to Imp. Vol. > Rolling Median	100%	60%	0.06	0.26	0.80	-0.65	-1.72	0.66

Note: The sample is December 2002-March 2019. The rolling median is based on the most recent 24 months. When the sell signal is not active the strategy earns a zero return. The Hit Ratio measures the percentage of correct (up/down) predictions.

Source: Bloomberg, Barclays Research

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