



Sources of CBOE *PutWrite* Index Returns

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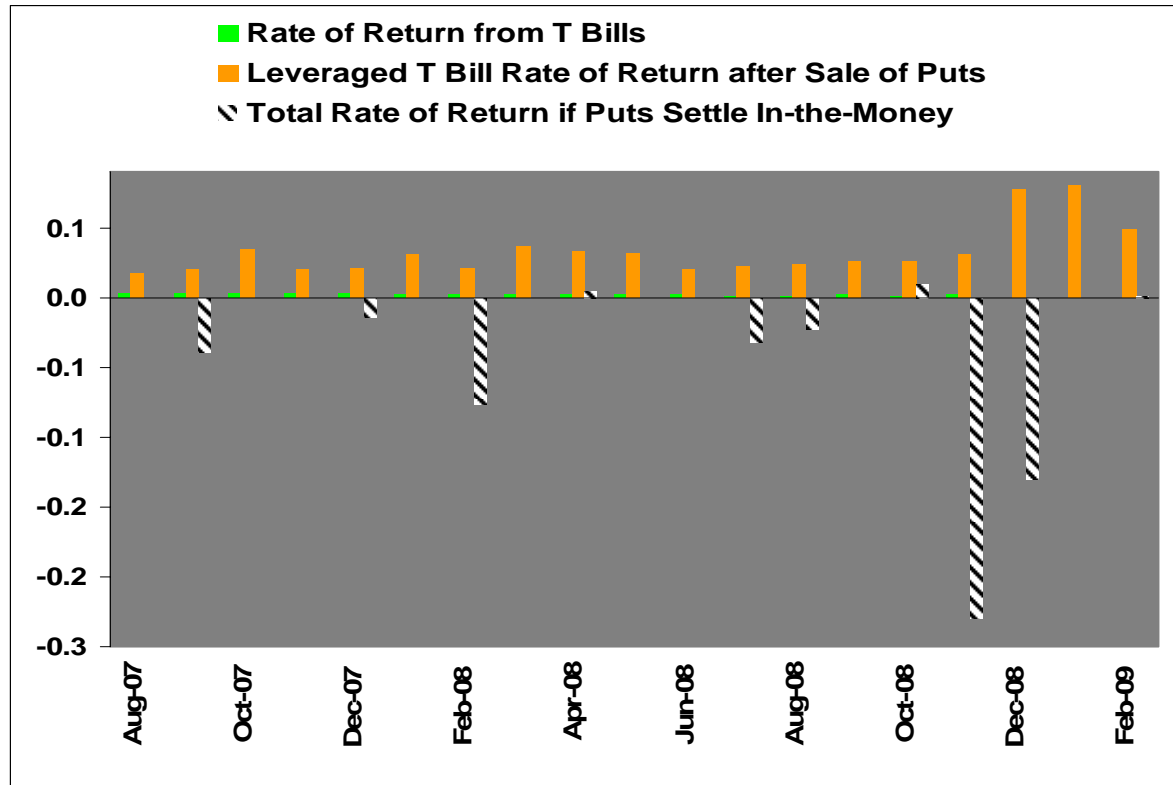
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I. Introduction

- CBOE's PutWrite Index applies a collateralized short-put strategy to the S&P 500. The PutWrite portfolio overlays short at-the-money S&P 500 one-month puts (ATM SPX puts) on an investment in Treasury bills.
- The puts lever up the return on Treasury bills. The tradeoff is a lower return when the S&P 500 index drops and the puts settle in-the-money.
- This document outlines the construction of the CBOE PutWrite Index and decomposes its return from roll date to roll date.
- The components of PutWrite cycle returns are posted monthly at <http://www.cboe.com/micro/put/>

I. Introduction: The Big Picture



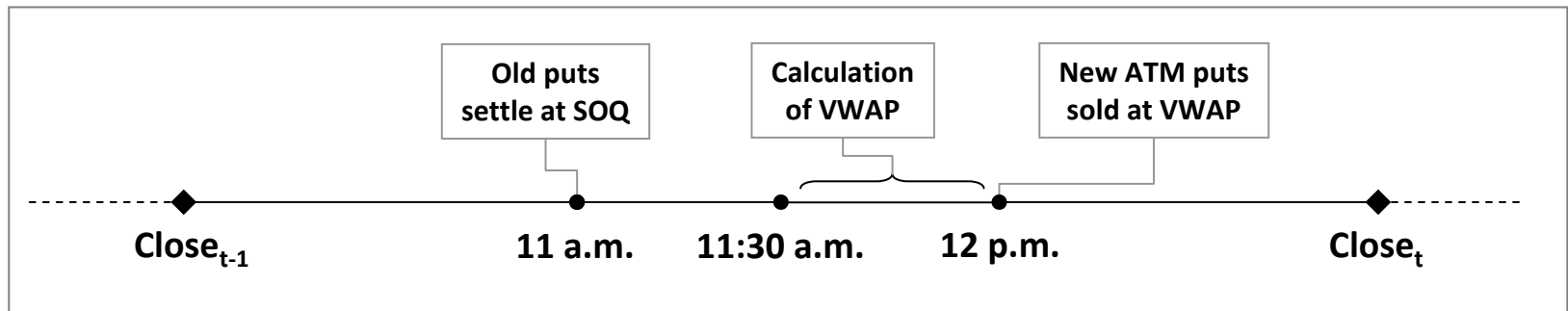
Sources: Bloomberg, CBOE Research

I. Overview of PutWrite Index Construction

- The value of the PutWrite Index is equal to the value of the PutWrite portfolio, which is long Treasury bills and short ATM SPX puts. Unlike the BXM, the portfolio is not rebalanced between roll dates.
- Three-month Treasury bills are held to obtain a higher yield, and one-month Treasury bills are held to finance interim roll date cash flows. On months in the February quarterly cycle, only 3-month T-bills are held. On other months both one and three-month T-bills are held.
- The puts are sold monthly on the 3rd Friday of the month and held to the next 3rd Friday.
- An important feature of the PutWrite portfolio is that it is collateralized: this means that the number of puts sold monthly is set to ensure that the value of the portfolio at the expiration of the puts cannot fall below zero.

II. What Happens on a Roll Date?

- At 11:00 a.m. ET on every roll date, a number N of expiring puts are settled to a Special Opening Quotation (SOQ) of the S&P 500 index
- If the puts settle in-the-money, the settlement amount is financed by liquidating some Treasury Bills. The values of 1 and 3-month Treasury bills held post-settlement are denoted by M_1 and M_3 .
- At 12 p.m. new ATM puts at strike K are sold at the volume-weighted-average price (P_{VWAP}). The VWAP covers the period from 11:30 a.m. to 12:00 p.m.



II. What Happens on a Roll Date? continued

- The number N of puts sold is set such that the PutWrite portfolio always has a non-negative value after the next settlement.
- On months in the February quarterly cycle:

$$(M_3 + N_{new} P_{vwap}) (1 + r_3) \leq N_{new} K_{new} \Rightarrow$$

$$N_{new} = \frac{M_3 (1 + r_3)}{K_{new} - P_{vwap} (1 + r_3)}$$

where r_3 is the effective rate of return from holding 3-month T-bills to the next roll date.

II. What Happens on a Roll Date? continued

- On months not in the February quarterly cycle,

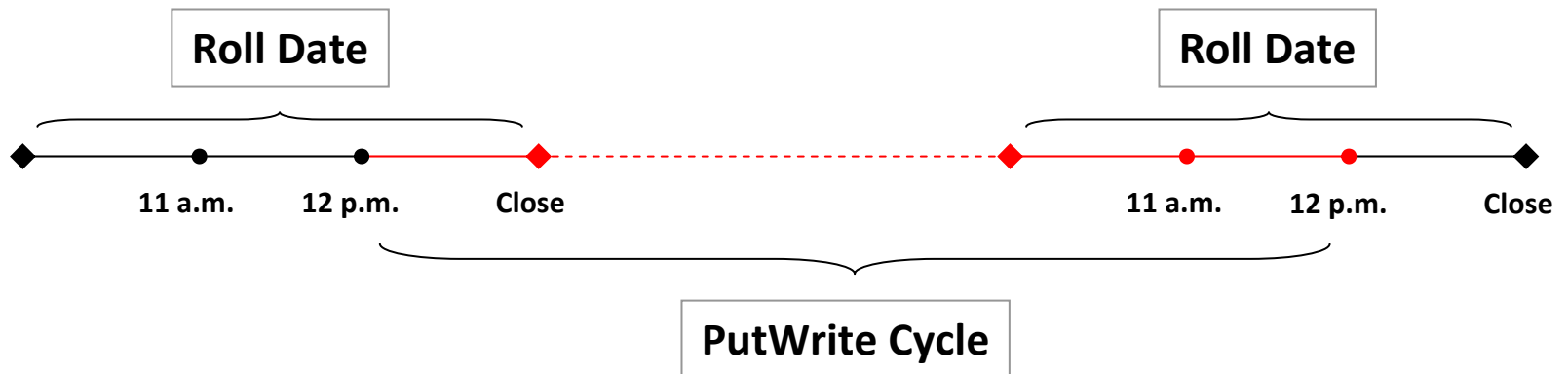
$$(M_3(1+r_3) + (M_1 + N_{new}P_{vwap})(1+r_1)) \leq N_{new}K_{new} \Rightarrow$$

$$N_{new} = \frac{M(1+r)}{K_{new} - P_{vwap}(1+r_1)}$$

where r_1 is the effective rate of return from holding 1-month T-bills to the next roll date. $M = M_1 + M_3$, and $r = wr_3 + (1-w)r_1$, with w the share of the total T-bill balance invested in 3-month T-bills.

III. The Roll Cycle

- The roll cycle of the PutWrite Index begins when new puts are sold and ends just before the next puts are sold, i.e. from 12 p.m. on a roll date to 12 p.m. on the next roll date.



III. Cycle Return of PutWrite Index

- On roll dates in the February quarterly cycle, the PUT portfolio is long 3-month bills and short SPX puts. Its rate of return is a weighted average of the 3-month T-bill rate and of the rate of return of SPX puts:

$$R_{PUT} = L r_3 + (1-L) R_p, \quad L = \frac{1}{1 - \frac{P_{VWAP}}{K}(1+r_3)}, \quad L > 1$$

where L, the weight applied to the three-month Treasury bill rate is the leverage from selling SPX puts, R_p is the unweighted rate of return of SPX puts, and (1-L) is their negative weight in the portfolio.

- When the puts settle out-of-the-money, $R_p = -1$. The gross rate of return of the PUT is then equal to the leveraged gross 3-month T-bill rate:

$$1 + R_{PUT} = L (1 + r_3)$$

III. Cycle Return of PutWrite Index ctd.

- On roll dates not in the February quarterly cycle, the PUT portfolio holds both one- and three- month Treasury bills and SPX puts. In this case, its rate of return over the cycle is a weighted average of the two T-bill rates and of the rate of return of SPX puts:

$$R_{PUT} = wr_3 + \{(1 - w) + l\}r_1 - lr_p,$$
$$l = \frac{(1 + r) P_{VWAP}}{K - P_{VWAP} (1 + r_1)}$$

where w is the percentage invested at the 3-month T-Bill rate, l is the extra weight invested at the one month-T-bill rate and funded by selling puts.

- When the puts settle out-of-the-money, the rate of return of the PUT is equal to the average T-Bill rate plus the levered gross one-month T-bill rate

$$R_{PUT} = r + l(1 + r_1)$$

IV PUT Cycle Returns since 2007

- In summary, the overlay of SPX puts on Treasury bills levers up the T-bill rate of return, in exchange for a loss when the puts settle-in-the-money.
- These two effects are illustrated in the next two slides which show the decomposition of the rate of return of the PUT into its T-bill and put components from 2007 to 2009, preceded by underlying data.

IV PUT Cycle Returns since 2007

Roll Date	Roll Date Information									
Monthly "Roll" Dates	Roll Indicator 1 for 3rd Roll, 0 for Other Rolls	Settlement SOQ	New ATM Put Strike Price	New Put VWAP	Number of New Puts Sold	Effective 1 Month T-Bill Rate	Effective 3 Month T-Bill Rate	1-Month Money Market Account	3 Month Money Market Account	
15-Jun-07	0	1534.09	1535	19.4381	0.64159015	0.43%	0.46%	12.47	967.86	
20-Jul-07	0	1551.46	1540	24.69438	0.65236179	0.36%	0.37%	28.63	972.32	
17-Aug-07	1	1450.11	1425	42	0.68656277	0.30%	0.36%	0.00	974.83	
21-Sep-07	0	1533.38	1525	24.59848	0.65397126	0.26%	0.29%	16.09	978.35	
19-Oct-07	0	1531.12	1515	26.05048	0.67176304	0.24%	0.29%	33.63	981.18	
16-Nov-07	1	1462.47	1445	37.5	0.70033257	0.37%	0.33%	0.00	1008.70	
21-Dec-07	0	1474.95	1475	26.16667	0.70032178	0.18%	0.26%	18.33	1011.98	
18-Jan-08	0	1333.94	1335	44.125	0.72562404	0.22%	0.26%	32.02	934.19	
15-Feb-08	1	1347.2	1340	39.99769	0.74686692	0.21%	0.22%	0.00	998.58	
20-Mar-08	0	1302.64	1310	38.41404	0.76657703	0.08%	0.19%	29.45	972.90	
18-Apr-08	0	1391.12	1385	25.00739	0.73973495	0.07%	0.18%	47.97	974.74	
16-May-08	1	1425.7	1415	28.29126	0.74014328	0.16%	0.18%	0.00	1045.47	
20-Jun-08	0	1339.28	1325	29.12366	0.76602898	0.14%	0.14%	22.31	991.26	
18-Jul-08	0	1264.17	1255	29.71429	0.7914641	0.10%	0.14%	23.52	968.39	
15-Aug-08	1	1294.49	1300	30.73065	0.78396955	0.17%	0.18%	0.00	1017.38	
19-Sep-08	0	1279.31	1235	35.58039	0.83736654	0.03%	0.14%	29.79	1002.94	
17-Oct-08	0	922.51	945	66.3	0.88065896	0.01%	0.18%	58.39	772.48	
21-Nov-08	1	763.45	745	55.77228	0.975525	0.00%	0.00%	0.00	726.75	
19-Dec-08	0	889.74	900	41.19333	0.84627544	0.00%	0.00%	34.86	726.77	
16-Jan-09	0	859.37	845	45	0.90911183	0.00%	0.00%	41.39	726.79	
20-Feb-09	1	768.2	765	38.1	0.96097929	0.01%	0.02%	0.00	734.99	
20-Mar-09	0	789.4	785	35.2	0.98067151	0.01%	0.02%	34.52	735.15	
17-Apr-09	0	870.59	860	28.3802	0.92588611	0.00%	0.02%	60.80	735.31	
15-May-09	1	891.06	890	32.26154	0.92847628	0.01%	0.02%	0.00	826.22	
19-Jun-09	0	926.15	925	25.53534	0.91882203	0.01%	0.01%	23.46	826.34	
17-Jul-09	0	940.03	935	26.5	0.93565765	0.01%	0.02%	48.26	826.45	
21-Aug-09	1	1020.85	1020	22	0.8767067	0.01%	0.01%	0.00	894.13	
18-Sep-09	0	1071.57	1065	25.2	0.86012181	0.00%	0.01%	21.68	894.24	
16-Oct-09	0	1087.5	1080	26.2	0.8693999	0.00%	0.02%	44.45	894.35	

Components of Rate of Return of PUT Since 2007

Components of Put Returns Reference Document: Sources of Put Returns							
Weight of 1-Month Money Market Account	Weight of 3-Month Money Market Account	Average Weighted Rate of Return from T-Bills	Weight of Puts	Rate of return of puts	Weighted Rate of Return of Puts	Rate of Return of PUT Index	
2.54%	98.73%		-1.27%				15-Jun-07
4.47%	97.14%	0.47%	-1.61%	-100.00%	1.27%	1.74%	20-Jul-07
0.00%	103.05%	0.37%	-3.05%	264.01%	-4.25%	-3.87%	17-Aug-07
3.24%	98.38%	0.37%	-1.62%	-100.00%	3.05%	3.42%	21-Sep-07
5.04%	96.69%	0.29%	-1.72%	-100.00%	1.62%	1.91%	19-Oct-07
0.00%	102.67%	0.29%	-2.67%	101.65%	-1.75%	-1.46%	16-Nov-07
3.56%	98.22%	0.33%	-1.78%	-100.00%	2.67%	3.01%	21-Dec-07
6.63%	96.69%	0.26%	-3.31%	439.08%	-7.81%	-7.55%	18-Jan-08
0.00%	103.08%	0.27%	-3.08%	-100.00%	3.31%	3.58%	15-Feb-08
5.88%	97.06%	0.23%	-2.94%	-6.59%	0.20%	0.43%	20-Mar-08
6.50%	95.31%	0.19%	-1.81%	-100.00%	2.94%	3.13%	18-Apr-08
0.00%	102.04%	0.18%	-2.04%	-100.00%	1.81%	1.99%	16-May-08
4.40%	97.80%	0.18%	-2.20%	167.64%	-3.43%	-3.25%	20-Jun-08
4.74%	97.63%	0.14%	-2.37%	108.87%	-2.40%	-2.25%	18-Jul-08
0.00%	102.43%	0.14%	-2.43%	-100.00%	2.37%	2.51%	15-Aug-08
5.77%	97.12%	0.18%	-2.88%	-32.67%	0.79%	0.97%	19-Sep-08
14.05%	92.97%	0.14%	-7.03%	778.26%	-22.45%	-22.31%	17-Oct-08
0.00%	108.09%	0.16%	-8.09%	173.83%	-12.22%	-12.05%	21-Nov-08
9.15%	95.42%	0.00%	-4.58%	-100.00%	8.09%	8.10%	19-Dec-08
10.71%	94.61%	0.00%	-5.33%	-1.37%	0.06%	0.07%	16-Jan-09
0.00%	105.24%	0.00%	-5.24%	70.67%	-3.76%	-3.76%	20-Feb-09
8.97%	95.52%	0.02%	-4.48%	-100.00%	5.24%	5.26%	20-Mar-09
10.94%	92.36%	0.02%	-3.30%	-100.00%	4.48%	4.51%	17-Apr-09
0.00%	103.76%	0.02%	-3.76%	-100.00%	3.30%	3.32%	15-May-09
5.52%	97.24%	0.02%	-2.76%	-100.00%	3.76%	3.78%	19-Jun-09
8.35%	94.48%	0.01%	-2.83%	-100.00%	2.76%	2.77%	17-Jul-09
0.00%	102.20%	0.02%	-2.20%	-100.00%	2.83%	2.85%	21-Aug-09
4.73%	97.63%	0.01%	-2.37%	-100.00%	2.20%	2.22%	18-Sep-09
7.16%	95.26%	0.01%	-2.43%	-100.00%	2.37%	2.38%	16-Oct-09

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