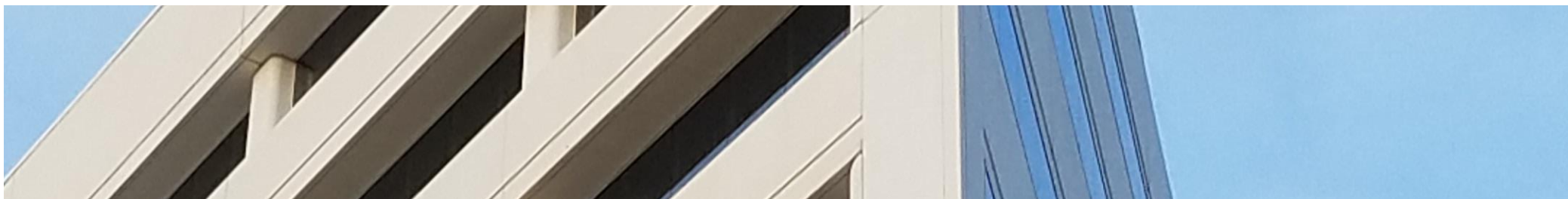




Options-Based Benchmark Indexes: Performance, Risk and Premium Capture (June 1986-Dec. 2018): *An Update*



Wilshire Analytics

March 2019



KEY HIGHLIGHTS (PART 1)

This study analyzes performance of five option-based indexes over 32 ½ years, June 30, 1986 – Dec. 31, 2018, with comparisons to the risk and return profiles of asset classes typically found in investment portfolios of institutional and individual investors. Highlights of our findings include the following:

- **Total Return:** Cumulative returns for two option-writing indexes (BXMDSM and PUTSM) exceeded those of a wide variety of asset classes over most of the 32-year period, outperforming U.S. equities in both up and down markets. (*Exhibit 2*)
- **Returns and Risk in Sub-periods:** Across various market regimes (dot-com era, Financial Crisis, low volatility bull market), option-based indexes were among the top three performing asset classes 21 times, versus 9 times for the S&P 500[®] Index. (*Exhibits 3, 11*)
- **Volatility:** Volatility of all five option indexes was lower than for all other asset classes studied except fixed income, while delivering competitive returns. The PUT index's annualized volatility was 9.9% vs. 14.9% for the S&P 500. (*Exhibit 4*)
- **Risk-adjusted Return:** The BXMD index was highest on the mean/variance Efficient Frontier across all asset classes, with a higher return *and* lower volatility than the S&P 500. Compared to the S&P 500, all option-writing strategies had superior Sharpe ratios; the PUT index's Sharpe ratio was 46% greater than S&P 500's. (*Exh. 4, 5*)
- **Positive Alpha:** Option-writing index strategies delivered positive alpha in most years, with high correlations to the S&P 500. The BXMD tracked the S&P 500 closely, with an overall correlation of 0.95 and an average 0.25% of alpha annually. (*Exhibits 7, 8*)
- **Liquidity:** Average Daily Volume (notional) for S&P 500 options has more than quadrupled over the decade since the Financial Crisis, with sustained liquidity regardless of the level of market volatility levels. (*Exhibit 11*)

KEY HIGHLIGHTS (PART 2)

- **Implied Volatility Risk Premium (IVRP):** Implied volatility, as measured by the Cboe Volatility Index® (VIX®) exceeded realized volatility by at least 1% and as much as 54% in all but one of the past 21 years, rewarding option sellers. Average monthly gross premiums from writing options were fairly constant, with a small upward trend over the study period. (*Exhibits 9a-9d*)
- **IVRP and Higher Returns:** The IVRP delivered higher returns for options-selling indexes across the time horizon of this study as compared to both the option-buying index and key size- and style-based indexes.
- **Drawdowns and Tail Risk:** Income captured by option-selling strategies aims to enhance returns and cushion downside risk. Over the 32 years covered in this study, the option indexes' maximum drawdowns ranged from 16% to 30% less than the S&P 500 Index's maximum drawdown. (*Exhibit 6*) Option-selling indexes had fatter tails (i.e., higher kurtosis and negative skew). The options-based strategies analyzed in this study demonstrated more positive monthly returns (and fewer negative) than the S&P 500 over time. Additionally, both Sortino ratios and Stutzer index values were on par with, if not better than for the S&P 500 (*Exhibit 8*) as well, indicating positive risk-adjusted returns.
- **Performance in Different Regimes:** The 32-year period covered various "regimes" characterized by high or low returns, and high or low volatility. Except for the lengthy bull market of 2010-Q3 2018, option-writing strategies produced superior Sharpe ratios compared to the S&P 500 in all sub-periods. (*Exhibit 12*)
- **Implications for Pension Plans:** Allocating a portion of U.S. equity exposure to option-writing strategies can benefit risk/return profiles. Replacing 15% of S&P 500 exposure with BXMD or a combination of BXMD & PUT exceeded S&P 500-only monthly returns more than 50% of the time. (*Exhibit 13*)
- **Fund Analysis:** Dozens of mutual funds/ETFs employ options-based strategies. Although differences in their strategies lead to a wide range of returns across funds, most use covered call-writing, which makes their average volatility lower than the S&P 500's. (*Exhibit 14*)

SPOTLIGHT ON VOLATILITY

- **Throughout this presentation, we'll investigate:**
 - Key risk/return metrics for options-based index strategies versus the broad market, each other and other widely accepted investment approaches over time
 - Critical relationship between implied and realized volatility
- **What is volatility?**
 - Synonymous with risk, volatility measures fluctuations – either expected (implied) or realized (historical) - in price
- **Option overlay strategies commonly provide exposure to two risk premiums**
 - Equity risk and (implied) volatility
- **IVRP (Implied Volatility Risk Premium)**
 - The notion that historically, implied volatility for index options often exceeds subsequent realized volatility; and, as a result, sellers hope to secure strong risk-adjusted returns by capitalizing on the discrepancy
 - Is well documented in the institutional investment community
 - Transfers risk from options buyers to sellers and is a potential source of portfolio diversification
 - Is driven primarily by diverging investor bias and supply/demand imbalances
- **Traditional volatility risk factor for stocks** (more accurately refers to 'low volatility', i.e., an equity risk factor which aims to capture excess returns from stocks with lower than average volatility) **is different than the IVRP covered in this presentation**
- **Selling volatility can be a fruitful investment strategy**, is similar to selling insurance and susceptible to underperformance in rising markets; use should be sized thoughtfully, with investment goals in mind

INDEX DESCRIPTIONS

Exhibit 1a

TICKER*	DESCRIPTION
BXM SM	Cboe S&P 500 BuyWrite Index. Strategy that purchases stocks in the S&P 500 index and each month sells at-the-money SPX index call options.
BXMD	Cboe S&P 500 30-Delta BuyWrite Index. Covered call strategy that holds a long position indexed to the S&P 500 Index and sells monthly 30-delta out-of-the-money SPX index call options.
CMBO SM	Cboe S&P 500 Covered Combo Index. Strategy sells a monthly at-the-money (ATM) SPX put option and a monthly 2% out-of-the-money (OTM) SPX call option. The short SPX put position is collateralized by a money market account invested in Treasury bills and the 2% OTM SPX call is collateralized by the long SPX Index position.
PPUT SM	Cboe S&P 500 5% Put Protection Index. Strategy that holds a long position indexed to the S&P 500 Index and buys a monthly 5% out-of-the-money SPX put option as a hedge.
PUT	Cboe S&P 500 PutWrite Index. Strategy that purchases Treasury bills and sells cash-secured at-the-money put options on the S&P 500 Index.

**Unless otherwise noted, all indexes used in this presentation are Total Return indexes (return includes price change + dividends/interest).*

Visit www.cboe.com/benchmarks to see full descriptions of methodologies of these indexes.

» » » Since 2002, dozens of benchmark indexes that use index options have been introduced. This study analyzes the performance of five indexes above. The BXM Index was the first major options-based benchmark index offered, and is probably the best known of all options-based benchmark indexes.

MARKET INDEXES

Exhibit 1b

INDEX NAME*	DESCRIPTION
Wilshire 5000® Index	Measures the performance of all U.S. equity securities with readily available price data (including large-cap, mid-cap, small-cap and some micro-cap stocks).
MSCI EAFE® (US\$) Index	Represents the performance in USD of large- and mid-cap stocks across 21 developed markets covering countries in Europe, Australasia and the Far East, excluding the U.S. and Canada.
Bloomberg Barclays U.S. Aggregate Bond Index	Tracks the performance of USD-denominated, fixed-rate U.S. Treasury securities, U.S. Agency securities, investment grade MBS and ABS, and investment grade corporate bonds and taxable municipal bonds with maturities > 1 year.
Bloomberg Barclays U.S. Treasury Index	Tracks the performance of USD-denominated, fixed-rate U.S. Treasury securities (excluding TIPS) - a component of the Aggregate index.
S&P GSCI®	A broad-based, production-weighted index representing the global commodity markets, constructed from the most liquid commodity futures.

**Unless otherwise noted, all indexes used in this presentation are Total Return indexes.*

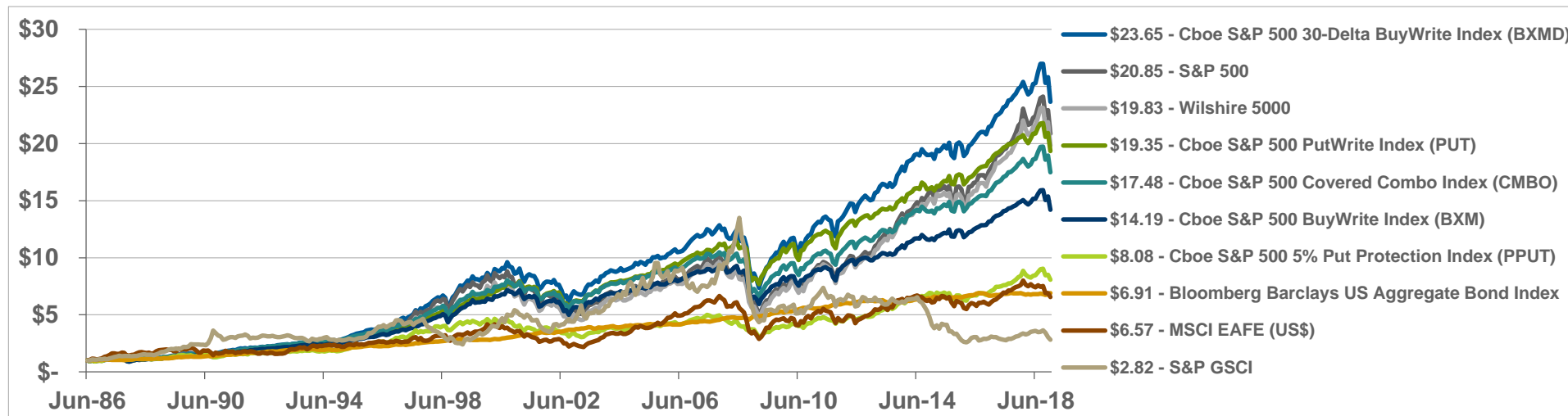
» » » In addition to the S&P 500® index, which represents the performance of Large-Cap U.S. equities, the analysis includes the above indexes. These reflect other key asset classes that form a typical investor's opportunity set.



INDEX RETURNS OVER 32 YEARS

Exhibit 2

Cumulative Total Returns
June 30, 1986 – December 31, 2018



Returns Across Various Market Environments
Select Years from 1998 – 2018

1998	2000	2001	2002	2007	2008	2009	2012	2016	2018	
22.4%	0.1%	-8.9%	-13.2%	6.2%	-31.3%	43.4%	11.0%	12.4%	-5.4%	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)
18.5%	13.1%	-10.6%	-8.6%	9.5%	-26.8%	31.5%	8.1%	7.8%	-5.9%	Cboe S&P 500 PutWrite Index (PUT)
28.6%	-9.1%	-11.9%	-22.1%	5.5%	-37.0%	26.5%	16.0%	12.0%	-4.4%	S&P 500 Index

» » » Over much of the past 32 years, in both up and down markets, two option-based indexes that **sell** options (BXMD and PUT) achieved higher returns than the US Equity market (large cap and total market), and higher than the option index that **buys** options (PPUT). The BXMD and PUT indexes outperformed in bear markets.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



ASSET CLASS RELATIVE PERFORMANCE

Exhibit 3

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cboe S&P 500 BuyWrite Index (BXM)	-10.9%	-7.6%	19.4%	8.3%	4.2%	13.3%	6.6%	-28.7%	25.9%	5.9%	5.7%	5.2%	13.3%	5.6%	5.2%	7.1%	13.0%	-4.8%
Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	-8.9%	-13.2%	25.9%	10.4%	5.0%	17.8%	6.2%	-31.3%	32.1%	11.2%	7.3%	11.0%	19.1%	6.2%	4.0%	8.4%	16.1%	-5.4%
Cboe S&P 500 PutWrite Index (PUT)	-10.6%	-8.6%	21.8%	9.5%	6.7%	15.2%	9.5%	-26.8%	31.5%	9.0%	6.2%	8.1%	12.3%	6.4%	6.4%	7.8%	10.8%	-5.9%
Cboe S&P 500 Covered Combo Index (CMBO)	-10.7%	-8.8%	22.4%	9.5%	4.4%	14.1%	5.5%	-30.2%	28.5%	7.7%	6.4%	7.5%	16.4%	5.5%	4.3%	7.9%	15.4%	-4.9%
Cboe S&P 500 5% Put Protection Index (PPUT)	-2.1%	-17.6%	19.3%	6.0%	2.3%	12.3%	-0.5%	-20.1%	8.7%	11.7%	-1.4%	10.0%	27.1%	11.2%	-5.1%	8.3%	18.6%	-3.7%
S&P 500 Index	-11.9%	-22.1%	28.7%	10.9%	4.9%	15.8%	5.5%	-37.0%	26.5%	15.1%	2.1%	16.0%	32.4%	13.7%	1.4%	12.0%	21.8%	-4.4%
MSCI EAFE (US\$)	-21.4%	-15.9%	38.6%	20.2%	13.5%	26.3%	11.2%	-43.4%	31.8%	7.8%	-12.1%	17.3%	22.8%	-4.9%	-0.8%	1.0%	25.0%	-13.8%
Bloomberg Barclays US Aggregate Bond Index	8.4%	10.3%	4.1%	4.3%	2.4%	4.3%	7.0%	5.2%	5.9%	6.5%	7.8%	4.2%	-2.0%	6.0%	0.5%	2.6%	3.5%	0.0%
Bloomberg Barclays US Treasury Index	6.7%	11.8%	2.2%	3.5%	2.8%	3.1%	9.0%	13.7%	-3.6%	5.9%	9.8%	2.0%	-2.7%	5.1%	0.8%	1.0%	2.3%	0.9%
S&P GSCI Index	-31.9%	32.1%	20.7%	17.3%	25.6%	-15.1%	32.7%	-46.5%	13.5%	9.0%	-1.2%	0.1%	-1.2%	-33.1%	-32.9%	11.4%	5.8%	-13.8%
	Lowest Return				1	2	3	4	5	6	7	8	9	10			Highest Return	

» » » Colors in this heat map rank returns across asset class, by year (within each column). Across market environments (strongly positive, negative and moderate), option-writing strategies, particularly BXMD and PUT strategies, typically had above-average returns and were rarely among lower-performing asset classes. BXMD and PUT strategies frequently offered one of the highest returns of the ten asset classes studied and were never among the bottom three.

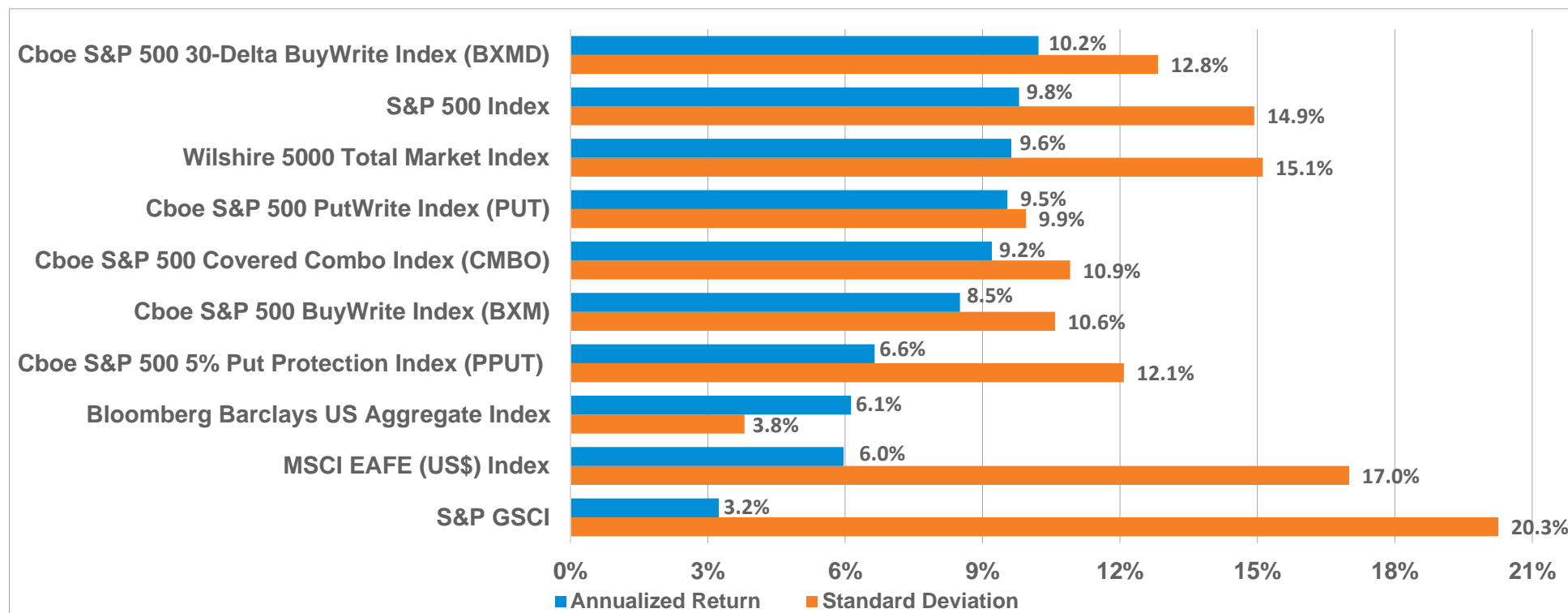
Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

RETURNS AND VOLATILITY

Exhibit 4

Annualized Returns and Standard Deviations

June 30, 1986 - December 31, 2018



» » » Over 32 years, the volatility of all five option-based indexes was lower than for the equity and commodity indexes; only bond market index volatility was lower. The PUT, BXM and CMBO Indexes, which write at-the-money (ATM) options, were the least volatile of the equity-based indexes.

Even with their relatively low volatilities, option-writing strategies delivered strong returns over this period. The BXMD had the highest annualized returns across all indexes, which represent a wide spectrum of asset classes.

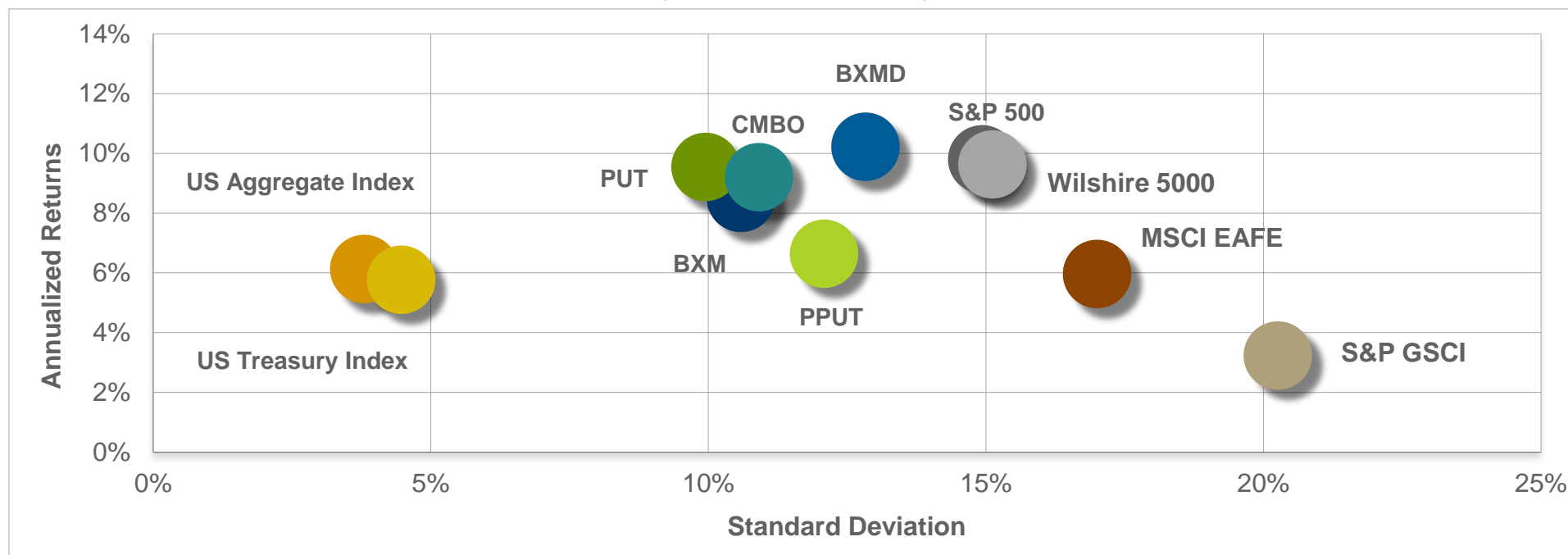
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EFFICIENT FRONTIER

Exhibit 5

Efficient Frontier

June 30, 1986 – December 31, 2018



BXMD - Cboe S&P 500 30-Delta BuyWrite Index

BXM - Cboe S&P 500 BuyWrite Index

PUT - Cboe S&P 500 PutWrite Index

CMBO - Cboe S&P 500 Covered Combo Index

PPUT - Cboe S&P 500 5% Put Protection Index

» » » The BXMD index is highest on the efficient frontier, showing risk/return trade-offs between all indexes in this study.

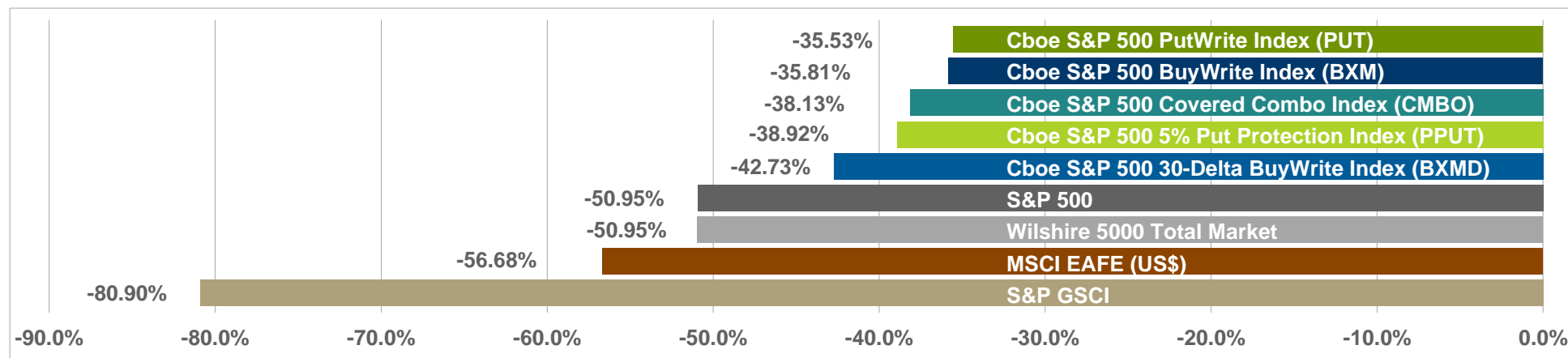
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MAXIMUM DRAWDOWNS

Exhibit 6

Maximum Drawdowns
June 30, 1986 - December 31, 2018



	Cboe S&P 500 BuyWrite Index (BXM)	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	Cboe S&P 500 PutWrite Index (PUT)	Cboe S&P 500 Covered Combo Index (CMBO)	Cboe S&P 500 5% Put Protection Index (PPUT)	S&P 500	Wilshire 5000 Total Market Index	MSCI EAFE (US\$) Index	S&P GSCI Index
Max. Drawdown	-35.81%	-42.73%	-35.53%	-38.13%	-38.92%	-50.95%	-50.95%	-56.68%	-80.90%
Max. Drawdown Begin Date	Jun-08	Nov-07	Jun-08	Nov-07	Jun-07	Nov-07	Nov-07	Nov-07	Jul-08
Max. Drawdown End Date	Feb-09	Feb-09	Feb-09	Feb-09	Feb-09	Feb-09	Feb-09	Feb-09	Feb-16
Max. Drawdown Length	9	16	9	16	21	16	16	16	92
Max. Drawdown Recovery Date	Dec-11	Jan-11	Nov-10	Apr-11	Jan-13	Mar-12	Mar-12	Jun-14	N/A

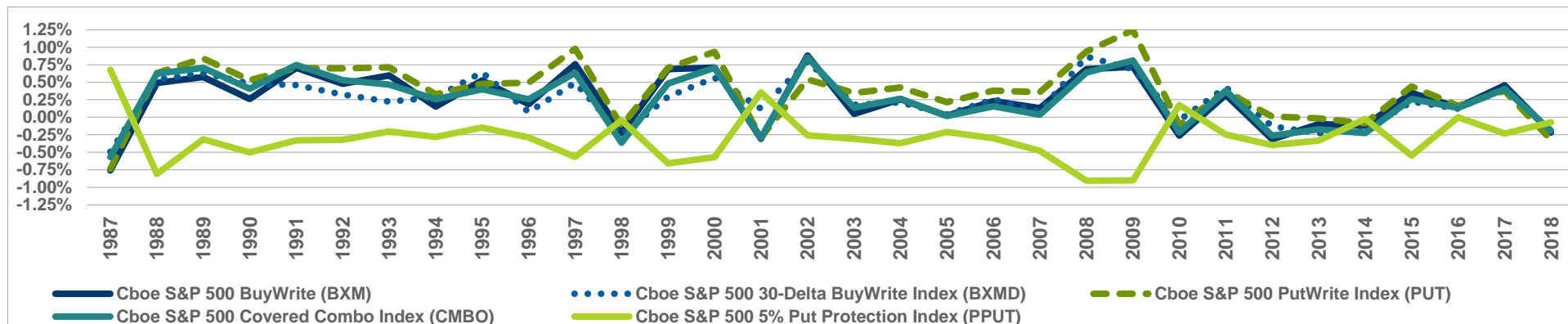
» » » Over 32 years, the worst peak-to-trough drawdowns were considerably smaller for option-based indexes than for equity market indexes. PUT and BXM index max drawdown periods were short-lived.

ANNUAL ALPHA

Exhibit 7

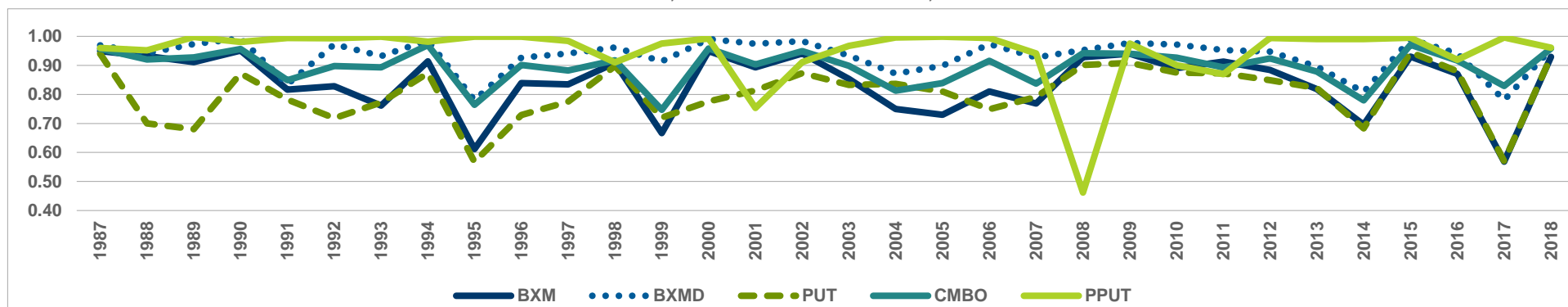
Annual Alpha Versus S&P 500

June 30, 1986 – December 31, 2018



12-month Correlations Versus S&P 500

June 30, 1986 – December 31, 2018



» » » Option-writing strategies included in the analysis delivered positive alpha in most of the 32 years covered by the study, while offering exposure strongly linked to the S&P 500® and correlations averaging > 0.89 across strategies.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



RISK RETURN METRICS

Exhibit 8

June 30, 1986 - December 31, 2018

	Cboe S&P 500 BuyWrite Index (BXM)	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	Cboe S&P 500 PutWrite Index (PUT)	Cboe S&P 500 Covered Combo Index (CMBO)	Cboe S&P 500 5% Put Protection Index (PPUT)	S&P 500 Index	Wilshire 5000 Total Market Index	MSCI EAFE (USD) Index	S&P GSCI Index	Bloomberg Barclays US Aggregate Bond Index
Annualized Return	8.50%	10.22%	9.54%	9.20%	6.64%	9.80%	9.63%	5.96%	3.24%	6.13%
Annualized Std. Dev.	10.6%	12.8%	9.9%	10.9%	12.1%	14.9%	15.1%	17.0%	20.3%	3.8%
Auto-correlation	0.08	0.04	0.13	0.05	-0.04	0.04	0.07	0.07	0.19	0.08
Maximum Drawdown	-35.8%	-42.7%	-35.5%	-38.1%	-38.9%	-50.9%	-51.0%	-56.7%	-80.9%	-5.1%
Skew	-1.56	-1.11	-2.10	-1.53	-0.28	-0.81	-0.94	-0.40	-0.21	-0.11
Kurtosis	6.40	3.91	9.72	5.87	0.54	2.53	2.94	1.03	2.00	0.62
Annual Alpha	0.25%	0.25%	0.38%	0.25%	-0.29%	0.00%	0.01%	-0.09%	0.10%	0.18%
Beta	0.55	0.77	0.47	0.61	0.84	1.00	1.00	0.82	0.17	0.05
Sharpe Ratio (Annual)	0.51	0.55	0.64	0.55	0.29	0.45	0.43	0.17	0.00	0.78
Sortino Ratio (Annual)*	0.40	0.49	0.43	0.44	0.32	0.42	0.41	0.23	0.10	0.77
Stutzer Index	0.22	0.19	0.20	0.19	0.14	0.17	0.17	0.12	0.11	0.20
Correlation vs. S&P 500	0.89	0.95	0.84	0.91	0.92	1.00	0.99	0.70	0.17	0.11
# of Up months	278	262	297	277	236	257	226	218	267	249
# of Down months	112	128	93	113	154	133	164	172	123	141

* MAR = prevailing 3-month T-bill rate

» » » All three option-writing strategies (BXM, BXMD and PUT) provided a superior risk/return profile versus the S&P 500® over the past 32+ years, measured by their Sharpe ratios. Capturing premiums from call option writing dampened return volatility versus the S&P 500, although the lower upside from writing ATM calls reduced returns for the BXM. The BXMD had a higher return **and** lower volatility than the S&P 500 over the period. The PUT strategy's return was close to the S&P 500's, with significantly lower volatility. Although returns for the option-based strategies are more negatively skewed with fatter tails (higher kurtosis) than S&P 500 returns, Stutzer index values (which penalize both negative skew and excess kurtosis), and Sortino ratios calculated from downside returns are favorable for option-writing strategies. All option-writing strategies also have more 'Up' and fewer 'Down' monthly returns than the S&P 500.

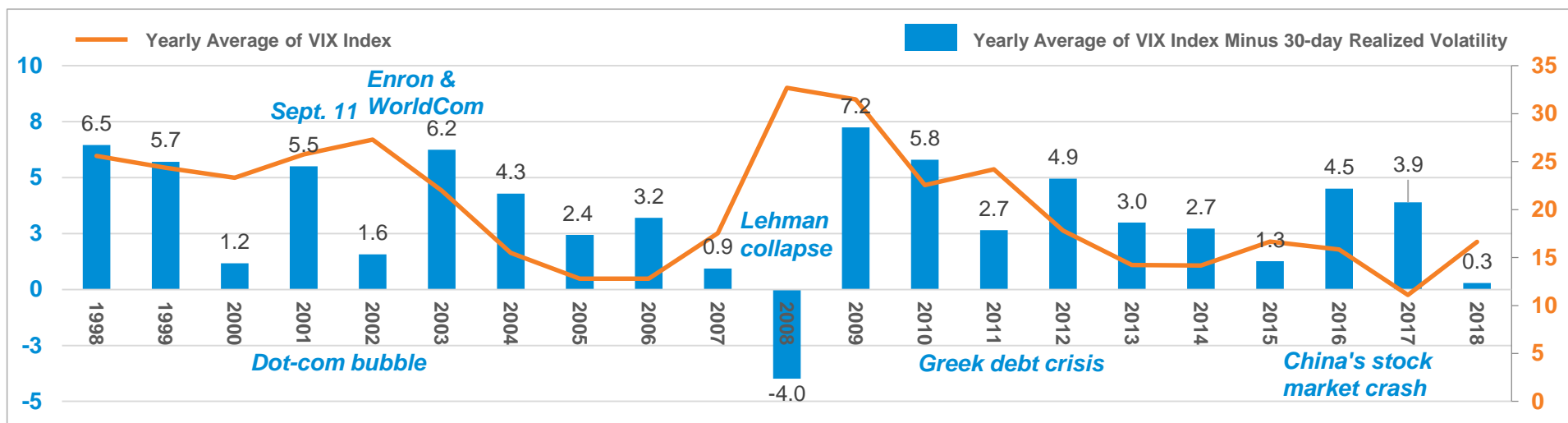
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IMPLIED VOLATILITY RISK PREMIUM (IVRP)

Exhibit 9a

Average Implied Volatility (VIX) Minus 30-day S&P 500 Realized Volatility



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Average VIX	23.0	18.4	15.5	12.7	13.9	12.4	16.4	22.4	25.6	24.4	23.3	25.7	27.3	22.0	15.5
30-day Realized	16.1	13.7	9.6	8.7	9.8	8.3	11.7	18.2	19.1	18.7	22.1	20.2	25.7	15.7	11.2
Implied/Realized	143%	135%	161%	147%	143%	150%	140%	123%	134%	131%	105%	127%	106%	140%	138%

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
Average VIX	12.8	12.8	17.5	32.7	31.5	22.5	24.2	17.8	14.2	14.2	16.7	15.8	11.1	16.6	19.3
30-day Realized	10.4	9.6	16.6	36.7	24.2	16.7	21.6	12.9	11.2	11.5	15.4	11.3	7.2	16.3	15.5
Implied/Realized	123%	133%	106%	89%	130%	135%	112%	139%	127%	124%	108%	140%	154%	102%	129%

» » » Implied volatility (measured by the VIX) usually exceeds realized volatility for the S&P 500. This suggests writing covered calls will often be profitable, as option premiums increase with implied volatility but the likelihood of call exercise is a function of realized volatility. Whether implied volatility (VIX) is above or below average, it exceeds realized volatility almost all of the time.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



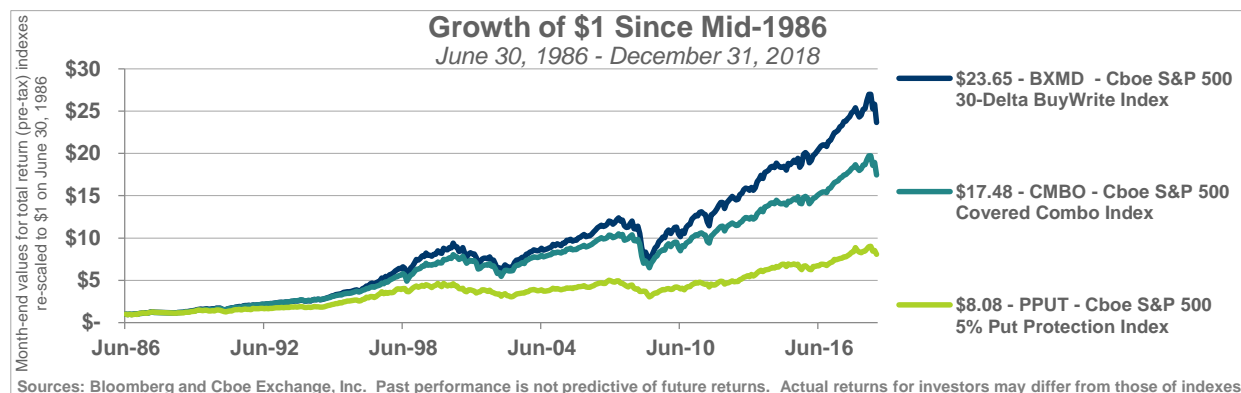
IVRP – OPTION-SELLING INDEXES OUTPERFORMED OPTION-BUYING INDEX

Exhibit 9b

» » » The implied volatility risk premium (IVRP) facilitated strong performance for two option-selling indexes (BXMD and CMBO) when compared to the PPUT option-buying index.

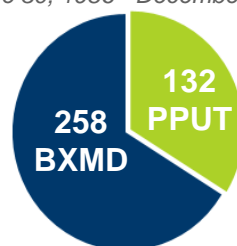
Higher Returns: Since mid-1986, the returns the BXMD and CMBO indexes were higher than the PPUT Index in aggregate by more than twice as much (see top chart). While CMBO outperformed PPUT 59% of the time, BXMD outperformed PPUT in 66% of all instances (see pie charts).

Strong Outperformance: Since mid-1986, the CMBO and BXMD indexes had higher risk-adjusted returns than the PPUT and S&P indexes (see Columns 3-5, Table below).



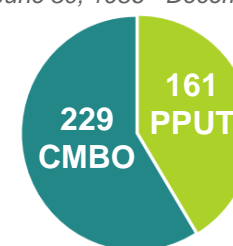
390-Month Analysis of 2 Indexes

Months Each Had Higher Return
June 30, 1986 - December 31, 2018



390-Month Analysis of 2 Indexes

Months Each Had Higher Return
June 30, 1986 - December 31, 2018



Metrics for 6 Benchmark Indexes

June 30, 1986 - December 31, 2018

	Annualized Return	Standard Deviation	Sharpe Ratio	Sortino Ratio	Stutzer Index	Maximum Drawdown	Correlation vs. S&P 500	Beta vs. S&P 500	Skewness
Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	10.2%	12.8%	0.80	0.40	0.19	-42.73%	0.95	0.82	-1.11
Cboe S&P 500 Covered Combo Index (CMBO)	9.2%	10.9%	0.84	0.44	0.19	-38.13%	0.91	0.67	-1.53
Cboe S&P 500 5% Put Protection Index (PPUT)	6.6%	12.1%	0.55	0.32	0.14	-38.92%	0.92	0.75	-0.28
S&P 500 Index	9.8%	14.9%	0.66	0.42	0.17	-50.95%	1.00	1.00	-0.81

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



IVRP – OPTION-SELLING INDEXES ALSO OUTPERFORMED SIZE & STYLE INDEXES

Exhibit 9c

» » » IVRP had strong risk-adjusted performance for two option-selling indexes (BXMD and CMBO) when compared with key size- and style-based indexes.

Higher Returns: Since mid-1986, aggregate returns for BXMD has outperformed not only broad market indexes, but also size and style benchmarks including growth, value and small-cap.

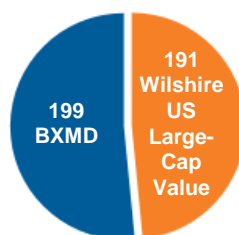
Lower Volatility: Since mid-1986, CMBO had lower volatility than broad market indexes and each of the same size and style benchmarks for growth, value and small-cap.

Higher Risk-Adjusted Returns: Since mid-1986, both CMBO and BXMD had higher Sharpe Ratios than broad market indexes and each of the size and style benchmarks noted (see Column 3, Table below.).



390-Month Analysis of 2 Indexes

Months Each Had Higher Return
June 30, 1986 - December 31, 2018



Sharpe Ratios

Cboe S&P 500 Covered Combo Index (CMBO)	0.55
Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	0.54
Wilshire US Large-Cap Value	0.52
S&P 500 Index	0.44
Wilshire US Large-Cap Growth	0.44
Wilshire US Small-Cap	0.42

Metrics for 6 Benchmark Indexes

June 30, 1986 - December 31, 2018

	Annualized Return	Standard Deviation	Sharpe Ratio	Sortino Ratio	Stutzer Ratio	Max Drawdown	Correlation vs. S&P 500	Beta vs. Market	Skewness
Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	10.22%	12.83%	0.54	1.17	0.19	-42.73%	0.95	0.82	-1.11
Cboe S&P 500 Covered Combo Index (CMBO)	9.20%	10.91%	0.55	1.18	0.19	-38.13%	0.91	0.67	-1.53
S&P 500 Index	9.80%	14.90%	0.44	0.98	0.17	-50.95%	1.00	1.00	-0.81
Wilshire US Small-Cap	9.66%	18.93%	0.42	0.69	0.16	-54.35%	0.85	1.08	-0.78
Wilshire US Large-Cap Growth	9.56%	17.19%	0.44	0.72	0.16	-61.39%	0.96	1.11	-0.73
Wilshire US Large-Cap Value	9.61%	13.75%	0.52	0.85	0.17	-53.90%	0.95	0.88	-0.90

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



IVRP – OPTION-SELLING INDEXES VS. SIZE & STYLE INDEXES ACROSS REGIMES

Exhibit 9d

Index Returns (Annualized) During Up and Down Market Regimes
July 1986 - December 2018

	Up Period Jul. 1986 – Mar. 2000 165	Down Period Apr. 2000 - Sep. 2002 30	Up Period Oct. 2002 - Oct. 2007 61	Down Period Nov. 2007 - Feb. 2009 16	Up Period Mar. 2009 - Jan. 2018 107	Choppy Feb. 2018 - Dec. 2018 11	All Months Jul. 1986 – Dec. 2018 390
Total Months per Period							
Broad Stock Market Indexes							
S&P 500 Index	17.0%	-20.6%	15.5%	-41.4%	18.8%	-10.4%	9.8%
Wilshire 5000 Index	16.2%	-20.6%	16.7%	-41.1%	18.8%	-11.0%	9.6%
MSCI EAFE Index (US\$)	10.9%	-22.3%	24.1%	-46.6%	12.1%	-19.4%	6.0%
Options-selling Indexes							
Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	17.3%	-14.6%	15.8%	-34.2%	14.9%	-7.5%	10.2%
CMBO - Cboe S&P 500 Covered Combo Index (CMBO)	15.7%	-11.8%	13.7%	-30.2%	12.6%	-6.9%	9.2%
Options-buying Index							
PPUT - Cboe S&P 500 5% Put Protection Index (PPUT)	11.8%	-14.9%	9.6%	-30.3%	12.7%	-9.4%	6.6%
Small-cap Index							
Wilshire Small-Cap	13.0%	-14.6%	20.9%	-43.9%	20.5%	-14.0%	9.7%
Value Indexes							
Wilshire Large-Cap Value	14.3%	-9.0%	17.0%	-43.6%	17.6%	-10.3%	9.6%
Wilshire Small Cap-Value	11.6%	3.4%	19.0%	-43.1%	19.8%	-13.9%	10.4%
Growth Indexes							
Wilshire Large-Cap Growth	18.6%	-31.4%	15.0%	-38.4%	19.7%	-10.9%	9.6%
Wilshire Small Cap-Growth	13.8%	-30.1%	22.6%	-44.5%	20.9%	-14.2%	8.6%

» » » BXMD outperformed the S&P 500 in 5 out of 6 of the displayed market regimes and the total broad U.S. stock market (measured by the Wilshire 5000) in 4 of the last 6 (all 3 down markets, and 1 of 3 up markets). Option-selling and option-buying indexes outperformed growth indexes in all down periods, and also outperformed value indexes in all down periods, with the exception of April 2000-Sept 2002. Across the full history of the study (mid 1986 – Dec. 2018), BXMD outperformed all size and style indexes, with the exception of small-cap value.

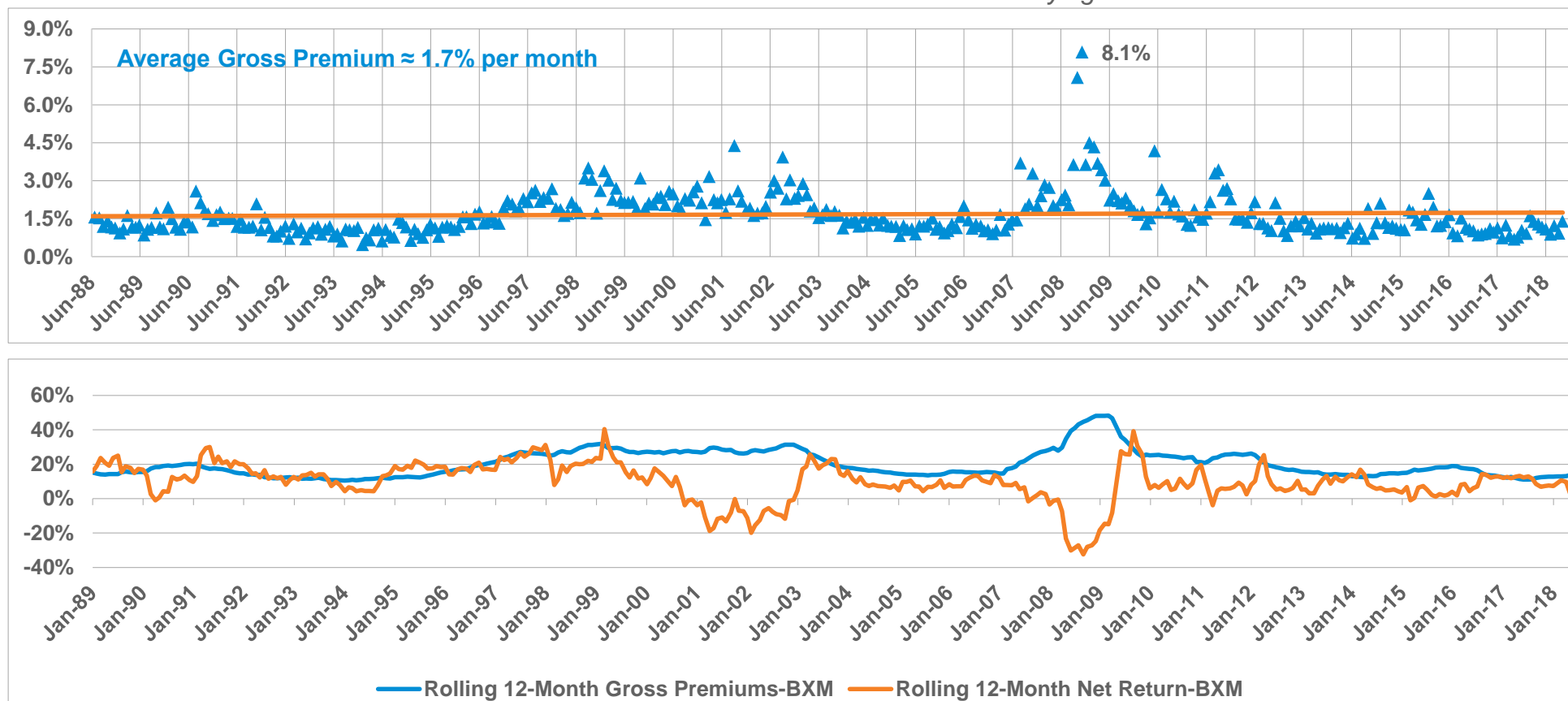
Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

MONTHLY GROSS PREMIUMS RECEIVED

Exhibit 10

Monthly Gross Premiums - BXM Index

Gross amount* received as a % of the underlying



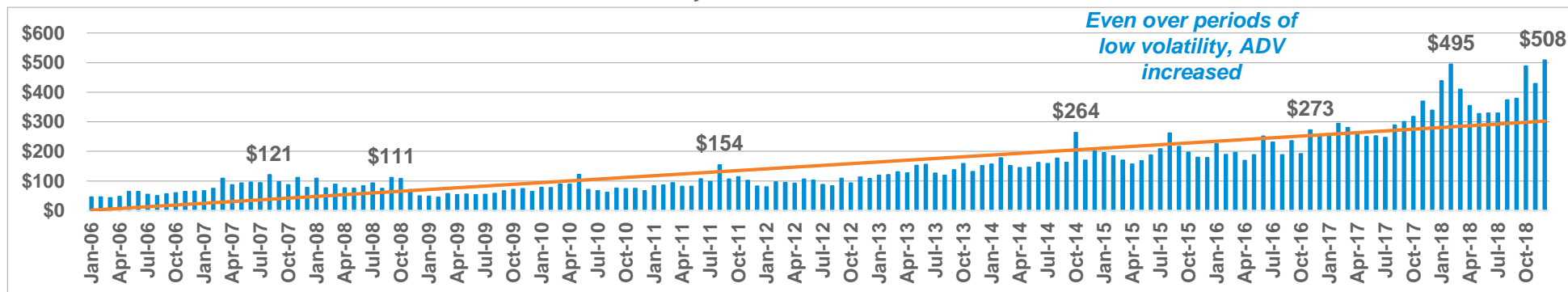
» » » Monthly gross premiums as a % of the underlying increase during periods of high market volatility, but soon return to normal levels. The long-term trend line shows the monthly premium has been fairly constant over 32 years. While option writers capture option premiums, the total return from option strategies depends on many variables.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

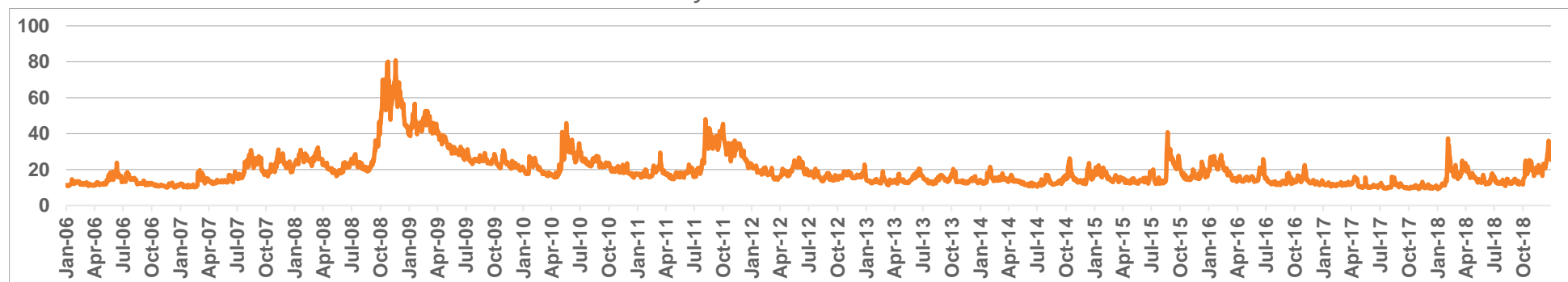
MARKET CAPACITY AND TRADING VOLUME

Exhibit 11

Notional Value of Average Daily Volume
S&P 500 (SPX) Options (\$Billions)
January 2006 - December 2018



Cboe Volatility Index (VIX)
Daily Closing Values for Price Return Index
January 2006 - December 2018



» » » Notional value of average monthly trading volume in SPX Options has grown significantly over the past 12 years; it was 17.2x greater in Q4 2018 versus Q1 2006. Trading volume shows SPX option liquidity is strong regardless of the level of the VIX, indicating market depth is sustained regardless of volatility spikes or lulls.

Past performance is not predictive of future returns. Source[s]: Source[s]: Bloomberg, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



PERFORMANCE - VARIOUS MARKET REGIMES

Exhibit 12

January 31, 1995 – December 30, 2018 (Monthly Returns)

	Cboe S&P 500 BuyWrite Index (BXM)	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	Cboe S&P 500 PutWrite Index (PUT)	Cboe S&P 500 Covered Combo Index (CMBO)	Cboe S&P 500 5% Put Protection Index (PPUT)	S&P 500 Index	Wilshire 5000 Total Market Index
High Returns/Moderate Vol: 1995-1999							
Annualized Monthly Return	21.13%	26.61%	20.44%	21.57%	21.12%	29.79%	28.34%
Annualized Standard Dev.	9.48%	12.11%	8.32%	9.93%	11.50%	13.95%	14.30%
Sharpe Ratio	2.23	2.20	2.46	2.17	1.84	2.13	1.98
Skew	-1.86	-1.47	-1.82	-1.95	-0.82	-1.38	-1.49
Low Returns (dot-com)/Moderate Vol: 2000-2006							
Annualized Monthly Return	4.93%	5.36%	6.63%	5.27%	0.81%	2.16%	3.06%
Annualized Standard Dev.	10.28%	12.76%	9.93%	10.71%	12.03%	14.32%	14.68%
Sharpe Ratio	0.48	0.42	0.67	0.49	0.07	0.15	0.21
Skew	-0.99	-0.39	-1.90	-0.83	-0.20	-0.27	-0.45
Financial Crisis Era: 2007-2009							
Annualized Monthly Return	-0.16%	0.59%	3.12%	-0.45%	-3.82%	-3.72%	-3.23%
Annualized Standard Dev.	15.90%	18.81%	15.85%	16.62%	13.92%	19.91%	20.43%
Sharpe Ratio	-0.01	0.03	0.20	-0.03	-0.27	-0.19	-0.16
Skew	-1.38	-0.97	-1.98	-1.25	-0.60	-0.75	-0.78
Bull market (excl. Q4 2018)/Low Vol: 2010-2018							
Annualized Monthly Return	6.53%	9.01%	7.09%	7.66%	8.62%	12.59%	12.53%
Annualized Standard Dev.	8.72%	10.20%	8.98%	9.17%	10.29%	12.52%	12.67%
Sharpe Ratio	0.75	0.88	0.79	0.83	0.84	1.01	0.99
Skew	-0.48	-0.30	-0.82	-0.68	-0.28	-0.38	-0.34

» » » During the recent lengthy bull market the S&P 500 dominated. However, in other market regimes, on an absolute and/or risk-adjusted basis, option-based indexes have offered superior return profiles.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

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PENSION ALLOCATIONS & OPTION INDEXES

Exhibit 13

June 30, 1986 – December 31, 2018 (Monthly Returns)

» » » Compare the impact of replacing a percentage of a pension plan's U.S. equity allocation with an allocation to one or more option-writing strategies.

» » » Replacing a portion of S&P 500 exposure with an option index can benefit performance while retaining ultra-high correlation to the S&P 500. For example, replacing 15% with BXMD or a combination of BXMD & PUT exceeded S&P 500-only monthly returns more than 50% of the time.

» » » Modifying a traditional pension plan's U.S. equity allocation by writing OTM calls (BXMD) and/or ATM puts (PUT) can result in improved returns, upside/downside risk, and/or Sharpe ratios.

S&P 500	= 100% S&P500	} Replaces 15% of S&P 500 allocation with option indexes.
+ BXM	= 85% S&P500 + 15% BXM	
+ BXMD	= 85% S&P500 + 15% BXMD	
+ PUT	= 85% S&P500 + 15% PUT	
+ BXMD/PUT	= 85% S&P500 + 10% BXMD + 5% PUT	

Performance Metrics – S&P 500 + Optional Index Allocation

	S&P 500	+ BXM	+ BXMD	+ PUT	+BXMD/PUT
Avg Return	11.0%	10.7%	11.1%	10.9%	11.0%
Std. Deviation	14.9%	14.1%	14.5%	14.0%	14.3%
Sharpe Ratio	0.74	0.76	0.76	0.78	0.77
Skew	-0.81	-0.92	-0.88	-0.95	-0.90
Kurtosis	2.53	2.94	2.72	3.05	2.82

Allocation	# of Months > S&P 500	# of Up Months	# of Down Months	Correl. with S&P 500
S&P 500	-	257	133	-
+ BXM	188	257	133	0.999
+ BXMD	238	256	134	0.999
+ PUT	187	258	132	0.998
+BXMD/PUT	216	257	133	0.999

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

OPTION-BASED FUNDS WITH 5-YEAR HISTORY

Exhibit 14

Results from 19 Mutual Funds & ETFs Using Option-based Strategies with 5-Year Return History
5-Year Performance Analysis (2014 - 2018)

19 Options-based Funds	--- 5 Year Performance Metrics ---			--- Calendar Year Returns ---				
	Annualized Returns	Standard Deviations	Sharpe Ratios	2014	2015	2016	2017	2018
Average	2.4%	5.9%	0.27	3.9%	0.6%	4.1%	7.7%	-4.1%
Maximum	5.7%	9.6%	0.79	9.4%	7.1%	9.3%	13.3%	2.0%
Minimum	-0.7%	2.6%	-0.57	-4.3%	-5.0%	-0.2%	-1.3%	-10.0%
Three Benchmark Indexes								
CBOE S&P 500 BuyWrite Index (BXM)	5.5%	7.3%	0.63	5.6%	5.2%	7.1%	13.0%	-4.8%
CBOE S&P 500 30-Delta BuyWrite Index (BXMD)	6.1%	8.7%	0.61	6.2%	4.0%	8.4%	16.1%	-5.4%
S&P 500 Index	9.3%	11.2%	0.75	13.7%	1.4%	12.0%	21.8%	-4.4%

Sources: Bloomberg and Cboe Exchange, Inc.

» » » Dozens of Mutual Funds and ETFs use options as a key feature of their investment strategies. Typically, the stated objective of these funds is to capture the majority of equity market returns while taking less risk and/or generating additional income versus other equity investments, typically by writing covered calls. These statistics are based on 19 funds in this category with a five-year track record.

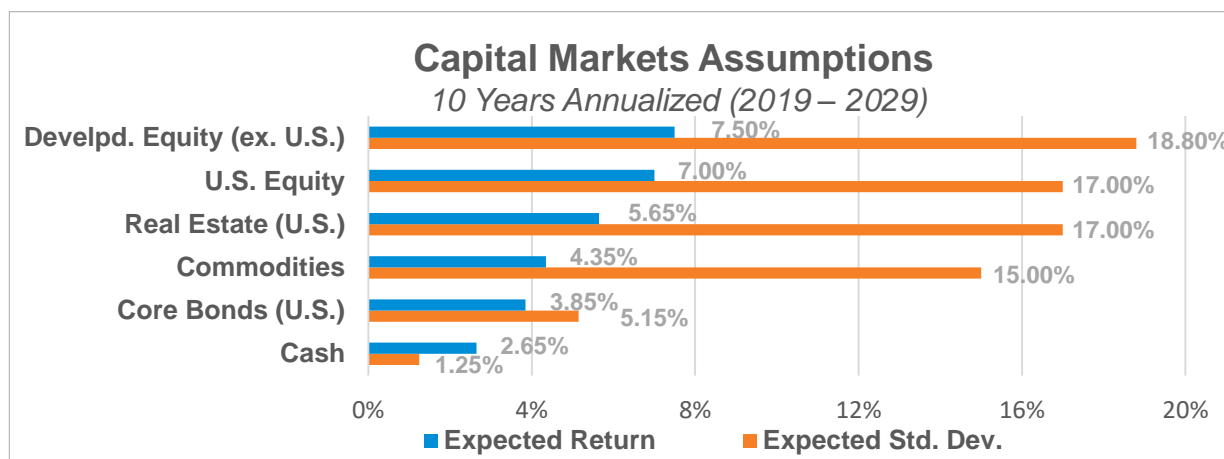
Fund strategies in this category vary (i.e., some buy and/or write index options only, others use individual stock options; some write covered calls, others buy and/or write both puts and calls; some focus on large cap stocks, others on mid-cap; some employ a degree of active management, others include some leverage, etc.). Given this, their returns also vary. Annualized returns for these funds averaged 2.4% over the past 5 years, but ranged from -0.7% to +5.7%. Notably, over the same 5 year time period, the average of the standard deviations for the 19 ETFs or mutual funds that used options was 5.9%, 47% lower than the 11.2% standard deviation for the S&P 500 Index.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

LOOKING FORWARD

Capital Markets forecasts for traditional asset classes and historical relationships between equity markets and options-based strategies are used to project plausible future return and risk measures for option-based indexes.

	Cboe S&P 500 BuyWrite Index (BXM)	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	Cboe S&P 500 PutWrite Index (PUT)	Cboe S&P 500 Covered Combo Index (CMBO)	Cboe S&P 500 5% Put Protection Index (PPUT)	S&P 500 Index	MSCI EAFE Index (US\$)	S&P GSCI Index
Forecasts (2019-2029)*								
Annualized Return	6.08%	7.30%	6.82%	6.57%	4.75%	7.00%	7.50%	4.35%
Standard Deviation	11.7%	14.1%	11.8%	12.3%	13.9%	17.0%	18.8%	15.0%
Sharpe Ratio	0.29	0.33	0.35	0.32	0.15	0.26	0.26	0.11
Historical measures								
Annualized Return	8.50%	10.22%	9.54%	9.20%	6.64%	9.80%	5.96%	3.24%
Beta (past 32 years)	0.55	0.77	0.47	0.61	0.84	1.00	0.82	0.17
Beta (past 10 years)	0.56	0.73	0.54	0.64	0.83	1.00	0.92	0.73
Std. Dev. (32 years)	10.58%	12.83%	9.95%	10.91%	12.08%	14.93%	17.00%	20.26%
Std. Dev. (10 years)	9.44%	11.40%	9.53%	9.97%	11.22%	13.73%	16.27%	19.33%



» » » Although equity market returns are expected to be significantly lower over the next ten years versus historical returns, these projections show that option-writing strategies may offer superior risk/return profiles over the next decade, with lower standard deviations and higher Sharpe ratios than projected for the U.S. equity market.

* Capital markets forecasts (2019-2029) for expected return and standard deviation provided by Wilshire Associates.

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



APPENDIX A - ANNUAL INDEX RETURNS

Year	Cboe S&P 500 BuyWrite Index (BXM)	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	Cboe S&P 500 PutWrite Index (PUT)	Cboe S&P 500 Covered Combo Index (CMBO)	Cboe S&P 500 5% Put Protection Index (PPUT)	S&P 500 Index	MSCI EAFE Index (US\$)	Wilshire 5000 Index	S&P GSCI Index	Bloomberg Barclays US Aggregate Bond Index	Bloomberg Barclays US Treasury Index
1987	-3.0%	-0.2%	-2.6%	-0.7%	15.6%	5.3%	24.6%	2.3%	23.8%	2.8%	2.0%
1988	21.0%	22.8%	19.7%	22.1%	4.9%	16.6%	28.3%	17.9%	27.9%	7.9%	7.0%
1989	25.0%	32.7%	24.6%	27.9%	26.4%	31.7%	10.5%	29.2%	38.3%	14.5%	14.4%
1990	4.0%	3.9%	8.9%	5.8%	-7.2%	-3.1%	-23.4%	-6.2%	29.1%	9.0%	8.5%
1991	24.4%	23.5%	21.3%	24.0%	23.3%	30.5%	12.1%	34.2%	-6.1%	16.0%	15.3%
1992	11.5%	10.8%	13.8%	12.4%	3.4%	7.6%	-12.2%	9.0%	4.4%	7.4%	7.2%
1993	14.1%	11.1%	14.1%	12.9%	7.3%	10.1%	32.6%	11.3%	-12.3%	9.7%	10.7%
1994	4.5%	5.5%	7.1%	5.6%	-1.7%	1.3%	7.8%	-0.1%	5.3%	-2.9%	-3.4%
1995	21.0%	32.9%	16.9%	23.3%	34.7%	37.6%	11.2%	36.4%	20.3%	18.5%	18.4%
1996	15.5%	19.2%	16.4%	17.7%	18.3%	23.0%	6.0%	21.2%	33.9%	3.6%	2.7%
1997	26.6%	33.7%	27.7%	27.2%	21.4%	33.4%	1.8%	31.3%	-14.1%	9.7%	9.6%
1998	18.9%	22.4%	18.5%	17.9%	19.1%	28.6%	20.0%	23.4%	-35.7%	8.7%	10.0%
1999	21.2%	21.2%	21.0%	19.1%	9.5%	21.0%	27.0%	23.6%	40.9%	-0.8%	-2.6%
2000	7.4%	0.1%	13.1%	6.0%	-14.2%	-9.1%	-14.2%	-10.9%	49.7%	11.6%	13.5%
2001	-10.9%	-8.9%	-10.6%	-10.7%	-2.1%	-11.9%	-21.4%	-11.0%	-31.9%	8.4%	6.7%
2002	-7.6%	-13.2%	-8.6%	-8.8%	-17.6%	-22.1%	-15.9%	-20.9%	32.1%	10.3%	11.8%

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.



APPENDIX A - ANNUAL INDEX RETURNS (CONT'D)

Year	Cboe S&P 500 BuyWrite Index (BXM)	Cboe S&P 500 30-Delta BuyWrite Index (BXMD)	Cboe S&P 500 PutWrite Index (PUT)	Cboe S&P 500 Covered Combo Index (CMBO)	Cboe S&P 500 5% Put Protection Index (PPUT)	S&P 500 Index	MSCI EAFE Index (US\$)	Wilshire 5000 Index	S&P GSCI Index	Bloomberg Barclays US Aggregate Bond Index	Bloomberg Barclays US Treasury Index
2003	19.4%	25.9%	21.8%	22.4%	19.3%	28.7%	38.6%	31.6%	20.7%	4.1%	2.2%
2004	8.3%	10.4%	9.5%	9.5%	6.0%	10.9%	20.2%	12.6%	17.3%	4.3%	3.5%
2005	4.2%	5.0%	6.7%	4.4%	2.3%	4.9%	13.5%	6.3%	25.6%	2.4%	2.8%
2006	13.3%	17.8%	15.2%	14.1%	12.3%	15.8%	26.3%	15.9%	-15.1%	4.3%	3.1%
2007	6.6%	6.2%	9.5%	5.5%	-0.5%	5.5%	11.2%	5.7%	32.7%	7.0%	9.0%
2008	-28.7%	-31.3%	-26.8%	-30.2%	-20.1%	-37.0%	-43.4%	-37.3%	-46.5%	5.2%	13.7%
2009	25.9%	32.1%	31.5%	28.5%	8.7%	26.5%	31.8%	29.4%	13.5%	5.9%	-3.6%
2010	5.9%	11.2%	9.0%	7.7%	11.7%	15.1%	7.8%	17.9%	9.0%	6.5%	5.9%
2011	5.7%	7.3%	6.2%	6.4%	-1.4%	2.1%	-12.1%	0.6%	-1.2%	7.8%	9.8%
2012	5.2%	11.0%	8.1%	7.5%	10.0%	16.0%	17.3%	16.1%	0.1%	4.2%	2.0%
2013	13.3%	19.1%	12.3%	16.4%	27.1%	32.4%	22.8%	34.0%	-1.2%	-2.0%	-2.7%
2014	5.6%	6.2%	6.4%	5.5%	11.2%	13.7%	-4.9%	12.1%	-33.1%	6.0%	5.1%
2015	5.2%	4.0%	6.4%	4.3%	-5.1%	1.4%	-0.8%	-0.2%	-32.9%	0.5%	0.8%
2016	7.1%	8.4%	7.8%	7.9%	8.3%	12.0%	1.0%	13.0%	11.4%	2.6%	1.0%
2017	13.0%	16.1%	10.8%	15.4%	18.6%	21.8%	25.0%	21.0%	5.8%	3.5%	2.3%
2018	-4.8%	-5.4%	-5.9%	-4.9%	-3.7%	-4.4%	-13.8%	-5.3%	-13.8%	0.0%	0.9%

Past performance is not predictive of future returns. Source[s]: Bloomberg, Cboe, St. Louis Federal Reserve Bank and Wilshire Associates. Please read important disclosures on Slide 28 and at www.cboe.com/benchmarks.

APPENDIX B - OPTION OVERLAY CONCEPTS: EQUITY OPTION & RISK PREMIUM

- **What is an option?:** An instrument whose returns are dependent on the returns of some other, underlying security; and, a contract which provides the right, but not the obligation, to buy or sell the underlying security at a specified price, on or before a certain expiration date
- There are a **number of options for implementation** ranging from rules-based strategies to more active strategies
- **What influences the value of an option?:** Price of the underlying security, the option's time to expiration and expected (implied) volatility
 - Option buyers pay a premium to the seller (or writer) of the option as compensation for underwriting financial risk
- **Option overlay strategies provide exposure to two risk premiums**
 - Equity risk premium
 - » Similar to the exposure provided by long-only public equity, albeit with a lower beta
 - Volatility risk premium
 - » Transfers risk from options buyers to sellers, with insurance that tends to be richly priced
 - » Potential source of diversification within the portfolio
 - » Sources of volatility risk premium
 - » Biases
 - » Aversion to risk and a preference for more certainty the stock price falls, albeit a smaller loss than without the premium from the option overlay
 - » Buying options limits the downside, and provides unlimited upside participation
 - » Economic
 - » Supply/demand imbalance as more investors are interested in buying, rather than selling options
 - » Asymmetric payout profiles can make option selling less attractive to some investors; strategies will lag the broad market during extended rallies

APPENDIX B - OPTION OVERLAY CONCEPTS: BENEFITS, IMPLEMENTATION & PERFORMANCE

- **Option overlay strategies have an attractive risk/return profile over time** and can act as a strong complement to traditional long-only equity portfolios
- **There are many implementation options, ranging from rules-based strategies to more active strategies**
 - Rules-based strategies follow a repeatable, well-defined process with no subjective positioning
 - Active strategies can also follow a rules-based process, but may use additional subjective elements based on sophisticated modeling techniques which attempt to optimize the payoff structure of the overlay positions
 - Both implementations are dynamic, rather than static, because old contracts expire and new ones initiated, which provides some protection against poor market timing decisions
- **General performance experience includes the following:**
 - Outperforms a long-only position during periods where the security prices remain flat or fall in value, since the option will expire worthless
 - Faces a loss as the stock price falls, albeit a smaller loss than without the premium from the option overlay
 - Enjoys some of the upside until the stock prices passes the strike price of the option
 - Option strategies will lag the broad market during extended rallies



IMPORTANT INFORMATION

Cboe Exchange, Inc. (Cboe) provided financial support for the research of this paper.

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