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Optimizing an Asset Allocation with Convertible Securities

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Executive Summary

Allocators use a wide array of models and procedures to determine how to diversify across asset classes and investment managers. Optimizers, Monte-Carlo simulations, scenario stress tests and various return ratios are all useful tools to evaluate the benefits or considerations associated with any asset class. When reviewed closely through various forms of analysis, it is clear that convertibles are an attractive asset class for use in nearly all optimized asset allocation models and have definitively added value in all conventional scenarios.

- Since 1973, convertibles have delivered a 0.73 beta to the S&P 500 and **261 basis points per year of alpha** which produced a **Sharpe ratio 12% higher** than the S&P 500.
- Convertibles have demonstrated positive asymmetry by participating in only **49% of the downside** versus the S&P 500, while participating in **86% of the upside.**
- Over the last 20 years, **convertibles outperformed a typical 60/40 blend of stocks and bonds by 194 basis points per year.**
- Several Markowitz mean-variance optimization tests, spanning periods of up to 47 years and 32 asset class categories, each called for significant allocations to convertible bonds which resulted in improved returns, risk metrics, and Sharpe ratios.
- Monte-Carlo modeling, which is able to account for the **positively asymmetric return profile of convertibles**, also recommended significant allocations to convertibles, due to a higher expected return relative to other asset classes.
- Black-Litterman asset allocation modeling, which accommodates investor views of absolute or relative returns, recommended a **15.1% allocation to convertibles. Six back-tests show that this would have improved return, alpha, Sharpe ratios and Sortino ratios.**

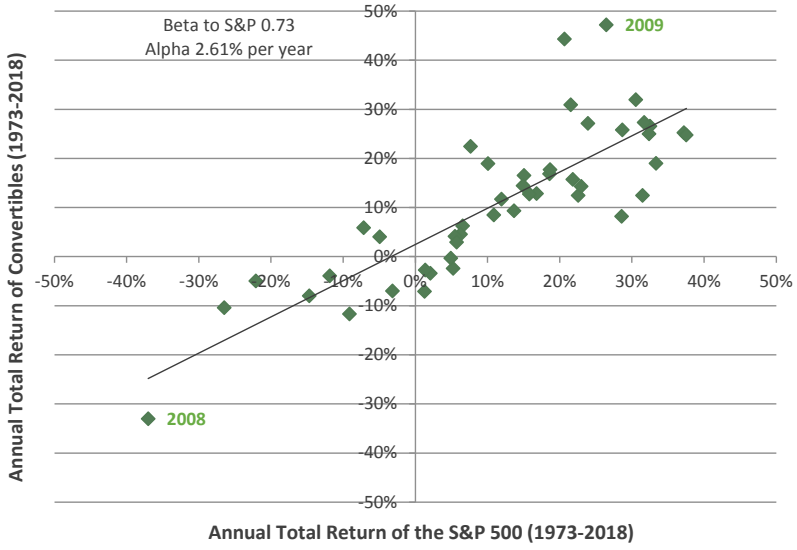
Convertibles Generate Significant Alpha with Positive Asymmetry

Positive Alpha is the return of an asset class over and above what would be expected given a move in a broad equity index and the long term sensitivity of the asset class to the index.

Figure 1 illustrates the return of convertibles[1] and the S&P 500 by year, from 1973 through 2018. While past performance is no guarantee of future success, it is beyond dispute that convertibles have provided **long-term structural alpha.**

Since comprehensive convertible return tracking began in 1973, convertibles have exhibited a beta of 0.73, and an alpha of 2.61% versus the S&P 500. However, the beta is higher in up years and lower in down years. This positive asymmetry means that in up years, convertibles participated in 86% of the upside versus the S&P 500. Yet, in all but one down year (2008), convertible "bond floors" held up fairly well and the asset class demonstrated low downside participation. Including 2008, convertibles participated in 49% of the downside of the S&P 500, while excluding that year, the **downside participation was only 36%.** By excluding both 2008, and the ensuing credit rally of 2009, we get a better feel for the "normal" relationship between convertibles and the S&P 500 over the past 45 years. During this period, we see that convertibles delivered an even **lower beta of 0.66, and a higher alpha of 3.08% per year.**

Figure 1. Convertibles Provide 2.61% of Alpha Versus the S&P 500 (per annum), with 0.73 of Beta



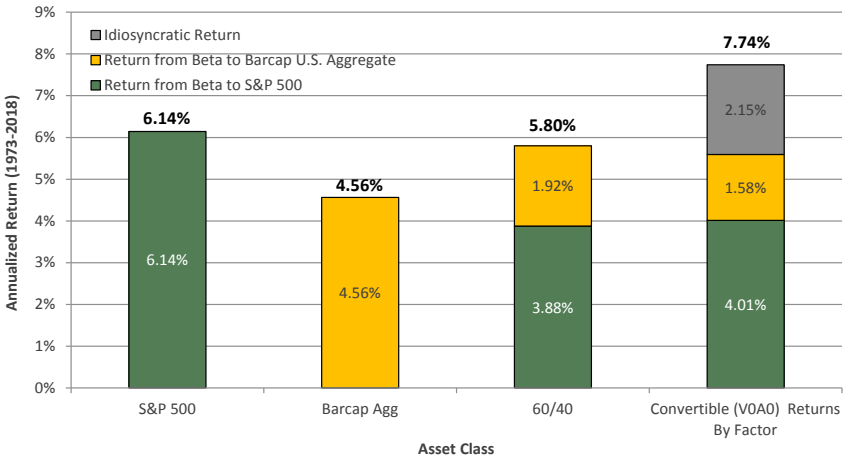
Source: Advent Capital and Bloomberg.[1]

Convertibles Outperformed a 60/40 Balanced Portfolio

The figures below dispute the idea that the positively asymmetric return profile of convertibles can be matched by combining stocks and bonds. Our research proves that the **asymmetry arises from the embedded optionality in convertibles.**

- By regressing convertible returns versus the S&P 500 and the Bloomberg Barclays Aggregate U.S. Bond Index (BarCap Aggregate), and using the betas to create a blended portfolio, the return of that portfolio falls 215 basis points short of the return of convertibles, as shown in Figure 2.
- Since 1999, the total return of the S&P 500 is +6.14%, the BarCap Aggregate is +4.56%, and a 60/40 blend of the two is +5.80%. Convertibles exceeded this by 194 basis points to return +7.74%.

Figure 2. Convertibles Outperform 60/40 Blend by 194 basis points per year



Source: Advent Capital, Bloomberg and Ibbotson.[2]

- When extending the analysis to include high yield, the blended portfolio (47% S&P 500 / 50% High Yield / 3% BarCap Aggregate) still fell 138 basis points short of the return of convertibles.

This demonstrates the fact that **customary blends of stocks and bonds have not been able to match the return of convertibles over the long run.** The data is clear and indisputable.

Classic Mean-Variance Optimization Allocates a High Percentage to Convertibles and Achieves Significant Improvement in Risk Adjusted Returns and Sharpe Ratios

The classic one-step mean variance optimization methodology was introduced by Harry Markowitz, the Nobel Prize winning economist, in 1952 as a part of his Modern Portfolio Theory (MPT) framework. The method is inherently backward (ex-post) looking and relies on average historical asset class returns, their standard deviations, and the covariance of asset class returns. We performed the optimization process across a wide variety of target risk levels (ranging from highly risk averse to highly risk tolerant), time frames, and a range of asset classes and asset class categories – both with and without convertibles in the analysis. As illustrated in Table 1, in all cases, **convertibles were included in the most optimal portfolios, leading to reduced risk and significantly higher returns and Sharpe ratios**.

Table 1. All Mean-Variance Optimization Trials Resulted in Significant Convertible Allocations, and Enhanced Risk, Return, and Sharpe Ratio Metrics Relative to a 60/40 Blended Portfolio

	Moderately High Risk Tolerance Optimized Portfolio				
Time Frame - Model	**Convertible Weight**	**Return Diff. vs. 60/40 Blend**	**St. Dev. Diff vs. 60/40 Blend**	**Risk Adjusted Return Diff vs. 60/40 Blend**	**Sharpe Ratio Increase vs. 60/40 Blend**
1973 - 2018 Mean-Variance Unconstrained[1]	43%	0.16%	-1.15%	1.30%	0.07
1988 - 2019 Mean-Variance Unconstrained[3]	14%	0.22%	-0.72%	1.08%	0.09
1999 - 2019 10% Constrained Mean-Variance[4]	10% (Max)	1.79%	-2.28%	4.64%	0.46
1999 - 2019 25% Constrained Mean-Variance (2 Step)[4]	24%	2.67%	2.26%	0.84%	0.14
2009 - 2019 Mean-Variance Unconstrained[5]	33%	4.01%	1.71%	1.46%	0.19
Ex-Ante 3 Years Monte-Carlo & 5% Constrained Mean-VaR[6]	5% (Max)	2.12%	-1.83%	4.00%	0.35
Ex-Ante 3 Years Monte-Carlo & Black-Litterman[6,7]	15%	0.56%	-0.01%	0.56%	0.06

1973 to 2018: Using annual data since 1973 without a constraint on the weight of convertibles, the optimizer **assigns a 43% allocation to convertibles at a moderately high risk tolerance level resulting in a Sharpe Ratio 15% higher than the 60/40 blend of stocks and bonds.** We recognize that plans may not allocate as much as 43% to convertibles, however, this allocation produces optimal results under mean-variance simulations.

1988-2019: Using monthly data since 1988, including high yield and investment grade corporates, the BarCap Aggregate, and two convertible indices (with and without mandatory convertibles), we found a 14% allocation to convertibles for the moderately high risk tolerance optimal portfolio. **The Sharpe ratio was increased by 12% in the moderately high risk tolerance portfolio** driven by a 72 basis points lower standard deviation and 22 basis points higher return than the 60/40 portfolio.

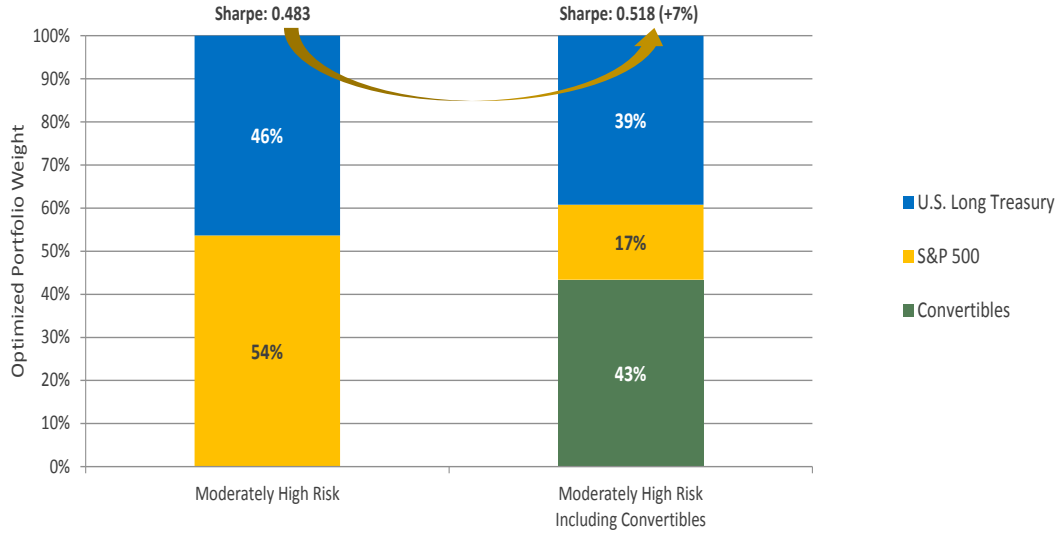
1999-2019: Using monthly data since 1999, including 32 asset class indices and category level sub-indices *(growth/value, small/mid/large cap, high yield/investment grade),* we found that convertibles were included in every allocation model regardless of the constraints applied against convertibles.

For moderately high risk optimized portfolios, **the Sharpe ratio was increased 92% relative to the 60/40 blend** due to a reduction of standard deviation of over 200 basis points, and increased return of over 170 basis points.

- A two-step process which optimized equity and fixed income separately and then blended the two portfolios also resulted in significant allocation of 24% to convertibles and a significant improvement of 29% in the Sharpe ratio.

2009 to 2019: Using quarterly data since 2009 without a constraint on the weight of convertibles, the optimizer **assigns a 33% allocation to convertibles at a moderately high risk tolerance level resulting in a Sharpe Ratio 15% higher** than the 60/40 blend of stocks and bonds.

Figure 3. Replacing Equities and Treasuries with a Convertible Allocation = 7% Higher Sharpe Ratios (1973 – 2018)



Source: Advent Capital and Bloomberg.[1]

Figure 4. Convertibles Reduce Volatility and Enhance Returns of Optimal Portfolios, Improving Sharpe Ratios by 7%

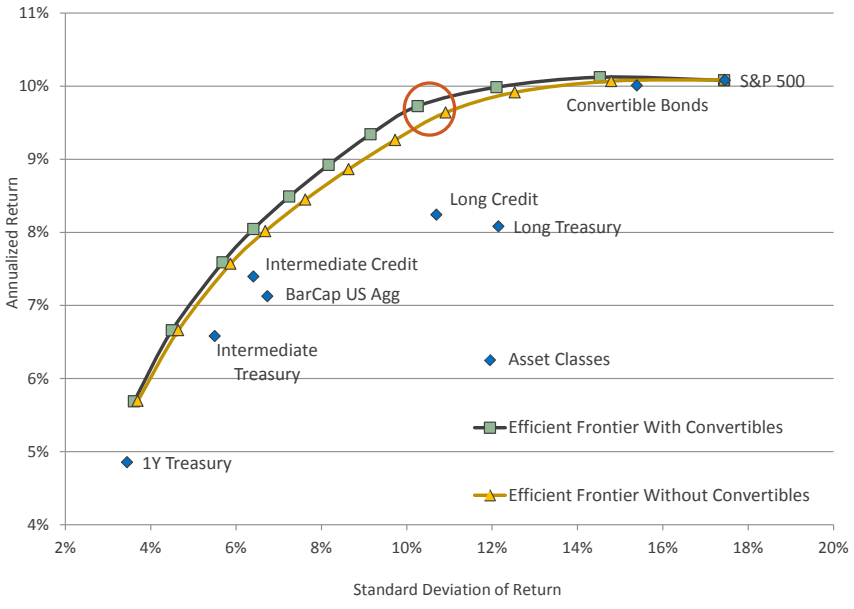


Figure 4 demonstrates that the efficient frontier shifts upwards **(higher return)** and to the left **(less risk)** when convertibles are included in a model portfolio. For example, at the circled point in Figure 4, the optimal portfolio included convertibles and **reduced standard deviation by 53 basis points and increased return by 4 basis points**.

Source: Advent Capital and Bloomberg.[1]

Table 2. Separate Mean-Variance Optimization of Equity Portfolios and Fixed Income Portfolios Results in Significant Convertible Allocations, and Improved Risk, Return, and Sharpe Ratios

1999 - 2019 Monthly		Moderately High Risk Tolerance Optimized Portfolio				
Fixed Income Portfolio Optimizations		**Convertible Weight**	**Return Diff.**	**St. Dev. Diff**	**Risk Adj. Diff**	**Sharpe Ratio Diff**
Vs. BarCap Aggregate	25% Constrained Mean-Variance	20%	1.38%	0.42%	0.73%	0.27
Equity Portfolio Optimizations		**Convertible Weight**	**Return Diff.**	**St. Dev. Diff**	**Risk Adj. Diff**	**Sharpe Ratio Diff**
Vs. S&P 500	25% Constrained Mean-Variance	25% (Max)	2.73%	-0.81%	3.32%	0.22

Source: Advent Capital and Bloomberg.[4]

Considering the effect of convertibles in optimized fixed income portfolios, we see that the optimizer included a 20% allocation in moderately high risk tolerance portfolios. The increase in the Sharpe Ratio was 35%.

Considering the effect of convertibles in optimized equity portfolios, we see that the optimizer included a 25% allocation (the maximum constrained level) in moderately high risk tolerance portfolios. The increase in the Sharpe Ratio was 60%.

Forward Looking Monte-Carlo Process Anticipates Convertible Outperformance

Unlike Mean-Variance models, which do not capture the non-linear profile of convertibles properly and are backward looking, Monte-Carlo models can capture every aspect of asset class valuation, and reflect current and potential future conditions. A Monte-Carlo optimization process generates a large number of scenarios for a given number of market inputs. The factors are then mapped to asset class exposures using valuation models to simulate ex-ante returns. The set of return vectors can then be analyzed for properties such as standard deviation, Value at Risk, expected return and asset covariance. The Monte-Carlo optimization presented below models ex-ante the risk and return profile for the following 12 quarters.

Table 3. Convertibles Outperform Other Asset Classes in Monte-Carlo (Ex-Ante) Simulations

	S&P 500	VXA0	V0A0	H0A0	C0A0	BarCap Agg.
Return	9.31%	10.03%	9.82%	5.35%	3.80%	2.80%
Std. Deviation	15.56%	11.03%	10.82%	5.34%	1.10%	1.02%
VaR 3 Year	-5.90%	-1.47%	-1.52%	-0.52%	1.16%	0.37%
VaR 1 Quarter	-10.2%	-5.7%	-5.6%	-3.4%	0.16%	-0.03%
CVaR 3 Year	-9.07%	-3.64%	-3.61%	-2.17%	-0.13%	-0.83%
95% Upside 1 Quarter	14.22	11.60	11.41	5.69	1.61	1.32
Sharpe Ratio	0.44	0.69	0.68	0.55	1.25	0.37

As of: February 28, 2019. Source: Advent Capital and Bloomberg.[6]

Convertibles also compared favorably to other asset classes when employing multiple risk metrics, including:

- Convertibles model **a higher return than the S&P 500 with a 30% lower standard deviation.**
- Convertibles model **a higher Sharpe Ratio than high yield, equities or core fixed income.**
- Convertibles model **average returns 2.6 times that of investment grade corporate bonds.**

Using the optimizer to allocate to these asset classes, convertibles tend to maximize their allocation at all constraint levels. Setting the constraint at 5%, 15%, and 25% we see the following.

- Allocating 5% to convertibles **reduces value at risk (VaR*) by 30 basis points and standard deviation of return by 31 basis points** at a constant return level.
- Allocating 15% to convertibles **reduces value at risk (VaR*) by 89 basis points and standard deviation of return by 94 basis points at a constant return level.** See Table 4 below.
- Allocating 25% to convertibles **reduces value at risk (VaR*) by 147 basis points and standard deviation of return by 156 basis points** at a constant return level.

Black-Litterman Model Assigns 15% Allocation to Convertibles - Boosting Alpha by 54%

The Black-Litterman asset allocation model incorporates investor return expectations. Using the expected returns obtained from the Monte-Carlo analysis, the model recommended a 15.1% allocation to convertibles, as shown in Table 4.

- The optimized portfolio generated ex-ante returns that were **56 basis points per year higher than the 60/40 blend, Sharpe and Sortino ratios that were 18% higher,** and 54% more alpha using ex-ante Monte-Carlo data.
- Backtesting the optimized portfolio versus the 60/40 blend since the end of 2017, 2015, 2008, 1999, and 1987, **generated higher returns, Sharpe ratios, Sortino ratios, and Alpha in each of those timeframes for the optimized portfolio.****

Table 4. 15% Convertible Allocation Improves the Risk and Return Profile of a 60/40 Portfolio

Ex-Ante and Ex-Post Backtest of Monte-Carlo/Black-Litterman Optimization Recommendation

	Ex-Ante (Monte Carlo)	Ex-Post Backtest (Using Portfolio Optimizer)					
Value Added vs 60/40 Blend p.a.	3Y Fwd***	Since 12/31/17	Since 12/31/15	Since 12/31/11	Since 12/31/08	Since 12/31/99	Since 12/31/87
Return (bp difference)	0.56%	0.48%	0.34%	0.18%	0.38%	0.26%	0.07%
Standard Deviation (bp difference)	-0.01%	-0.08%	0.03%	0.03%	-0.11%	0.14%	0.01%
Sharpe Ratio (% difference)	17.62%	14.29%	3.70%	1.54%	4.35%	6.00%	1.49%
Sortino Ratio (% difference)	18.06%	15.69%	4.24%	1.83%	7.65%	4.11%	1.00%
Alpha (% difference)	53.63%	54.95%	22.95%	14.56%	30.87%	11.60%	3.13%

Source: Advent Capital and Bloomberg.[7]

* The VaR metric denotes the maximum cumulative loss over 3 months that a portfolio may experience with a probability of 5%.
** The period starting in 2018 captures a Fed hiking cycle as well as one of sustained market volatility. The period since the end of 2016 captures the market weakness seen in early 2016. The period since the end of 2011 captures the 2012 brief relapse into negative growth in the US. The period since the end of 2008 captures the great recession. The period since the end of 1999 captures the tech bubble. The period since the end of 1988 encompasses all the data available.
*** Ex-ante annualized figures for the three years starting in March 2019.
The shades of green in the table above indicate the improvement in the optimized portfolio's risk and return characteristics. Whilst the optimized portfolio benefits, across all time periods, from allocating to convertibles, the metrics shaded in yellow do not improve versus the 60/40 blend.

The Convertible Asset Class is Ripe for Active Management

Another goal of certain portfolio allocation models is to identify the potential for managers to generate alpha versus their benchmarks. In some asset classes, the opportunity to add alpha is limited. The convertible asset class, however, lends itself to active management in a way that other asset classes do not. The following factors provide ample opportunity for experienced managers to add alpha.

- Convertible properties vary dramatically, because those with higher deltas provide equity like exposure and those with lower deltas provide bond-like exposure.
- Varying amounts of "gamma" and "vega" in convertibles help shape their attractive asymmetric profile.
- Equities underlying convertibles are often quite volatile, which leads to dramatic dispersion of returns.
- Most underlying convertible equity issuers have high expected growth rates, but not all deliver.

Conclusion

Convertibles generate structural alpha due to their valuable asymmetric properties, such as:

- 0.73 beta to the S&P 500 and 261 basis points per year of alpha since 1973;
- Higher participation on the upside (89%) and lower participation on the downside (36%); and
- The combination of alpha and downside protection provides returns that have not been matched by any common blend of stocks and bonds. Convertibles outperformed a 60/40 allocation by 194 basis points per year.

Though there are many approaches to determe the best asset allocation, all of those studied in this paper suggest that **a significant allocation to convertibles is required to generate an 'optimal' portfolio**.

- Mean-Variance Optimization over the four time periods detailed in this paper, and spanning across as many as 32 asset class categories, illustrates that **adding convertibles increases a portfolio's Sharpe Ratio.**
- Alternative optimization approaches, including a two-step mean variance optimization through the use of alternative risk measures such as average downside and CVaR, also include convertibles in optimal portfolios.
- The Monte-Carlo process, using current market conditions, **projects outperformance of convertibles compared to customary equity and fixed income benchmarks.**

The Monte-Carlo process shows that given all of these considerations, convertibles can be especially beneficial in enhancing return and lowering risk in optimal portfolios. Convertibles can play the role of a defensive equity alternative or an enhanced fixed income strategy that performs better than other fixed income assets over the long run.

Though there are many reasons convertibles are usually overlooked by asset allocators, this paper illustrates there is a compelling justification/need for their use in optimizing conventional portfolios. Convertibles' past performance, which includes equity-like returns on the upside and bond-like returns on the downside, provides ample evidence to warrant greater consideration of the potential benefits of this asset class. The absolute and risk adjusted performance is undeniable for investors willing to consider "outside of the box" investment options.

End Notes

[1] B0A0 represents the ICE BofA ML Corporate and Government Master Index. H0A0 represents the ICE BofA ML U.S. High Yield Index. V0A0 represents the ICE BofA ML All U.S. Convertibles Index Excluding Mandatories. From 1973 to 1981, the convertible proxy for these years, referenced in an Ibbotson Associates study, is based on returns of convertible bond mutual funds. From 1982 to 1987, the Ibbotson proxy for convertible performance is the First Boston Convertible Bond Index. From 1988 to present, we reference returns from the V0A0 index, as that benchmark's inception date was 12/31/87. Past performance is not a guarantee of future results.

[2] The two factor regression of the V0A0 to the S&P 500 and Barcap Aggregate suggested weights of 65.29% S&P 500 and 34.71% BarCap Aggregate. The three factor regression of the V0A0 to the S&P 500, BarCap Aggregate, and ICE BofA High Yield Index suggested weights of 46.71% S&P 500, 3.35% BarCap Aggregate, and 49.94% High Yield. Outperformance is based on a comparison of the return of the V0A0 to a blended portfolio using these 2-factor and 3-factor weights. Data is from 1999 to present (12/31/98 to 2/28/19). Past performance is not a guarantee of future results.

[3] H0A0 represents the ICE BofA ML U.S. High Yield Index. V0A0 represents the ICE BofA ML All U.S. Convertibles Index Excluding Mandatories. VXA0 represents the ICE BofA ML All U.S. Convertibles Index. Data is from 1988 to present (12/31/87 to 2/28/19). Past performance is not a guarantee of future results.

[4] H0A0 represents the ICE BofA ML US High Yield Index. V0A0 represents the ICE BofA ML All U.S. Convertibles Index Excluding Mandatories. VXA0 represents the ICE BofA ML All U.S. Convertibles Index. VVAL represents the ICE BofA ML All U.S. Value Convertibles Index. VGRO represents the ICE BofA ML All U.S. Growth Convertibles Index. VMID represents the ICE BofA ML Mid Cap U.S. Convertibles Index. VLRG represents the ICE BofA ML Large Cap US Convertibles Index. VSML represents the ICE BofA ML Small Cap U.S. Convertibles Index. VEQU represents the ICE BofA ML Equity Alternatives U.S. Convertibles Index. VTOT represents the ICE BofA ML Total Return U.S. Convertibles Index. VYLD represents the ICE BofA ML Yield Alternative U.S. Convertibles Index. Russell 2000 Total Return Growth Index, Russell 2000 Total Return Value Index, Russell 1000 Growth Index, Russell 1000 Value Index, Russell 2000 Total Return Index, NASDAQ Total Return, S&P 500 Total Return. R0A0 represents the ICE BofA ML U.S. Fixed Rate Asset backed Securities Index. M0A0 represents the ICE BofA ML U.S. Mortgage Backed Securities Index, U0A0 represents the ICE BofA ML U.S. Municipal Securities Index. Data is from 1999 to present (12/31/98 to 2/28/19). BarCap Aggregate Index. Past performance is not a guarantee of future results.

[5] V0A0 represents the ICE BofA ML All U.S. Convertibles Index Excluding Mandatories. SPX represents the S&P 500 Index. H0A0 represents the ICE BofAML US High Yield Index. C0A0 represents the ICE BofAML US Corporate Index. CSLL rerepsents the Credit Suisse Leveraged Loan Total Return. U0A0 represents the ICE BofA ML U.S. Municipal Securities Index. Data is from 2009 to present (5/17/09 to 5/17/19). Past performance is not a guarantee of future results.

[6] Models based on the following Index Characteristics: H0A0 represents the ICE BofA ML U.S. High Yield Index. V0A0 represents the ICE BofA ML All U.S. Convertibles Index Excluding Mandatories. VXA0 represents the ICE BofA ML All U.S. Convertibles Index. BarCap Aggregate Index represents Bloomberg Barclays U.S. Aggregate Bond Index. The Monte-Carlo process used is a 12 time step process (quarterly steps for 3 years) that generates 10,000 scenario sets at a time. We have modeled equity prices by calibrating to historic standard deviation of returns and an expected return of 2% per quarter. High yield prices were modeled using a polynomial regression to S&P 500 and BarCap Aggregate Index returns, while high yield total return was achieved by adding initial current yield to the price return. Investment grade spreads were modeled using a beta to equity prices, and rate change is modeled as a function of spread change (spreads are negatively correlated to rates). Investment grade total returns were then calculated as the decline in total yield multiplied by duration plus an adjustment for convexity, plus initial current yield. BarCap Aggregate Index and Treasury total return was modeled purely as a function of the decline in rates times average duration plus and adjustment for convexity, plus initial current yield. Convertibles have significantly more 'moving parts' than most other asset classes, and as such they have been using sensitivity factors to equity prices, interest rates, credit spreads, volatility, as well as current yield and returns derived from equity gamma.

[7] Return assumptions taken from the Monte-Carlo process, V0A0 monthly returns 1/88 – 3/19. PortfolioVisualizer.com Black-Litterman optimizer as of 4/22 using Total U.S. Equity, Total U.S. Bond, High Yield Corporate, and the ICE BofA ML V0A0 as the four candidate asset classes. Permission was obtained from PortfolioVisualizer.com. The Black Litterman results were backtested using the PortfolioVisualizer backtesting module from 6 dates (12/31/87, 12/31/99, 12/31/08, 12/31/11, 12/31/15, and 12/31/17) through 4/30/2019.

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