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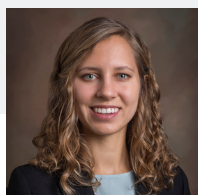
Multi-asset Investing

THE IMPACT OF YIELD CONSTRAINTS ON PORTFOLIO OPTIMIZATION



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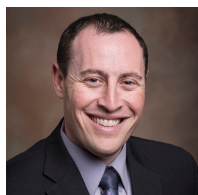

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KEY POINTS

- Global demographic trends have caused retirement plan sponsors and investment managers to think more about portfolio construction with specific income and yield objectives in mind.
- Our analysis examines the impact of single and layered constraints on an efficient frontier composed of multi-asset portfolios, with a focus on strategies involving a targeted yield.
- Given a set of assumptions, we found that adding multiple conflicting constraints, such as imposing both a yield minimum and a credit quality minimum, had the greatest impact on the efficient frontier and could lead to portfolios with lower Sharpe ratios.
- Using optimization as one input to a portfolio construction process is a common practice. However, investors often settle for portfolios that are below an efficient frontier due to constraints that are imposed by themselves (e.g., a home-country bias) or by a regulatory body (e.g., a maximum allocation to "risky" assets) or that are consistent with prevailing portfolio theory (e.g., a diversification requirement).

For this analysis, we calculated efficient frontiers with different combinations of yield constraints to examine the effects they could have on the resulting portfolios, including their expected risk and return characteristics and expected yields. We focused on yield target constraints, alone and in combination with a cap on exposure to fixed income assets rated below investment grade (IG). The specific efficient frontiers calculated were based on:

1. an unconstrained portfolio,
2. an imposed 4% yield target,
3. an imposed 5% yield target, and
4. an imposed 4% yield target combined with a 30% cap on exposure to below-IG fixed income assets.

RESULTS

While the results of any efficient frontier analysis will depend heavily on the asset classes included and the return, volatility, and correlation assumptions used, Figure 1 clearly shows that imposing single and multilayered yield constraints can significantly alter the shape of an efficient frontier. The 4% yield target frontier and the 5% yield target frontier both follow the unconstrained frontier until they are forced into staggered parallel dips. The layered frontier never follows the unconstrained frontier; at lower levels of volatility, it is actively constrained by the below-IG cap, and at volatility levels greater than 8.5% it is limited by the 4% yield target.

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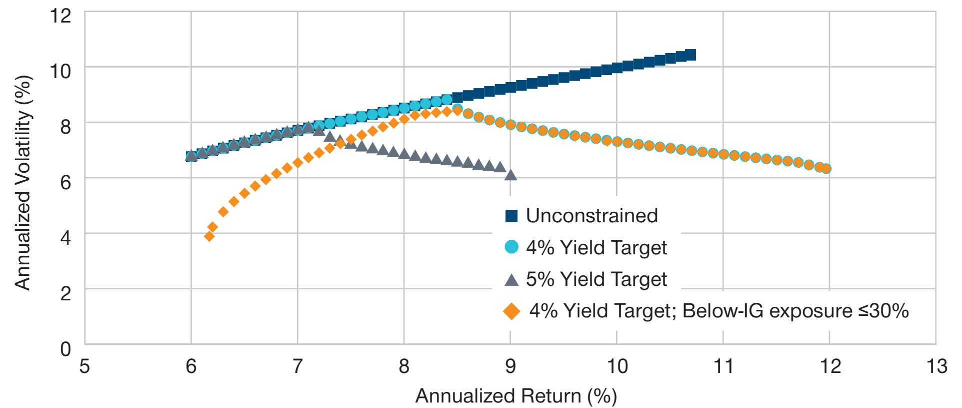
When a constraint becomes "active," the asset allocation in the resulting portfolio can change, potentially drawing in asset classes that were not included in the unconstrained allocations. Figure 2 summarizes the impact that different constraints may have on expected returns, Sharpe ratios, and portfolio concentrations at different volatility tolerances.

With an 8.5% volatility tolerance, the frontier for a 5% yield target is forced to underweight global equities and overweight real estate compared with an unconstrained frontier. Similarly, for volatility tolerances of less than 8.5%, the layered constraint frontier is forced to underweight global high yield and overweight real estate, global aggregate bonds, and emerging market (EM) bonds.

These constraints not only affect allocations and concentrations, they can also impact expected returns and Sharpe ratios. For example, with a 10% volatility tolerance, the addition of either of the yield target constraints reduces the expected Sharpe ratio. In some instances, constraints significantly limit the range of the efficient frontier; Figures 1 and 2 both show that the 5% yield target frontier does not extend to volatilities greater than 9%.

FIGURE 1: **Efficient Frontiers for Unconstrained and Yield-Constrained Multi-asset Portfolios**



Source: T. Rowe Price.
See appendix for important information regarding this analysis.

FIGURE 2: **Key Portfolio Metrics**

Volatility Tolerance	Conditions	Expected Return	Sharpe Ratio	Below-IG Exposure	Expected Yield	Allocations: Global Equity	Real Estate	Global Aggregate Bonds	Global High Yield	EM Bonds
7% Volatility Tolerance	Unconstrained	7.70%	0.67	63%	5.20%	33%	0%	0%	67%	0%
	4% Yield Target	7.70	0.67	63	5.20	33	0	0	67	0
	5% Yield Target	7.70	0.67	63	5.20	33	0	0	67	0
	4% Yield Target, Below-IG Exposure ≤30%	6.50	0.52	30	4.00	34	13	17	0	36
8.5% Volatility Tolerance	Unconstrained	8.90	0.80	36	4.00	62	0	0	38	0
	4% Yield Target	8.50	0.75	31	4.00	52	15	0	33	0
	5% Yield Target	6.60	0.52	39	5.00	5	54	0	41	0
	4% Yield Target Below-IG Exposure ≤30%	8.40	0.74	30	4.00	51	17	0	30	2
10% Volatility Tolerance	Unconstrained	9.90	0.78	11	2.90	88	0	0	12	0
	4% Yield Target	7.30	0.52	12	4.00	24	64	0	12	0
	5% Yield Target	—	—	—	—	—	—	—	—	—
	4% Yield Target Below-IG Exposure ≤30%	7.30	0.52	12	4.00	24	64	0	12	0

Source: T. Rowe Price.
See appendix for methodology and assumptions.

CONCLUSIONS

- Portfolios designed to deliver specified levels of yield and natural income have become increasingly common as population trends in the developed markets have brought asset decumulation into focus. However, focusing on optimizing portfolios with specific income considerations can change the shape of an efficient frontier.
- Ultimately, imposing a yield minimum may lead to portfolios with lower Sharpe ratios. It also could result in allocations with very different concentrations.
- Imposing multiple constraints that are difficult to achieve (such as an aggressive yield target combined with a cap on below-IG exposure) potentially has the largest impact on portfolio risk/return characteristics and Sharpe ratios.

APPENDIX: METHODOLOGY

All efficient frontiers are based on an underlying set of capital market assumptions (CMAs). While the analysis is based on a single set of CMAs, the results are generalizable to any set of assumptions. These generalized CMAs correspond to the expected risk, return, and yield characteristics of different asset classes. Cash was not included as an asset in the portfolios but was used to compute Sharpe ratios.

FIGURE A1: 10-Year Generalized Capital Market Assumptions

As of June 30, 2018

	Expected Yield	Expected Return	Expected Risk	Below-IG Exposure
Global Equity	2.40%	10.40%	10.70%	0.00%
Real Estate	4.10	6.30	12.00	0.00
Global Aggregate Bonds	2.20	1.30	4.40	13.00
Global High Yield Bonds	6.50	6.40	5.70	95.00
EM Bonds	6.30	5.40	6.20	77.00
Cash	—	2.10	—	—

Source: T. Rowe Price.

FIGURE A2: 10-Year Correlation Assumptions

As of June 30, 2018

	Global Equity	Real Estate	Global Aggregate Bonds	Global High Yield Bonds	EM Bonds
Global Equity	1.00	—	—	—	—
Real Estate	0.66	1.00	—	—	—
Global Aggregate Bonds	0.34	0.59	1.00	—	—
Global High Yield Bonds	0.83	0.61	0.53	1.00	—
EM Bonds	0.58	0.72	0.70	0.74	1.00

Source: T. Rowe Price.

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Even if the asset allocation is exposed to different asset classes in order to diversify the risks, a part of these assets is exposed to specific key risks.

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Credit risk—a bond or money market security could lose value if the issuer's financial health deteriorates.

Emerging markets risk—emerging markets are less established than developed markets and therefore involve higher risks.

Real estate investments risk—real estate and related investments can be hurt by any factor that makes an area or individual property less valuable.

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