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There is comparatively little guidance on how to build an efficient income portfolio. Traditional portfolio optimization research has typically focused on total return strategies, which combine price and income returns. Although total return portfolios do generate income, of course, they may not be appropriate for investors who wish to consume portfolio income while maintaining principal.

In recent years, demography and volatile markets have increased demand for income-oriented investments. The effects of the 2008 credit crisis remain fixed in the minds of many, and concerns over prospects for slow growth in much of the developed world have led large numbers of investors to become more risk-averse and seek comparatively predictable returns[1].

Demand appears to be strongest among those in or near retirement. But though demand may be strong, the type of product mix best suited to these investors isn't well defined; generating consistent income from a portfolio is not easy. Although we don't believe there is one right solution—a mix of guaranteed and capital market assets may be best for retirees—we believe that a multiasset, income-oriented fund is a necessary component of most people's retirement portfolios.

In this article we explore the concept of efficient income investing by contrasting a notional income investor with a total return investor and modifying the standard total return portfolio optimization problem. We use stylized examples to contrast the total return frontier with the efficient income frontier, and incorporate taxes to show the considerable effect they can have on the results. Our results suggest that this approach maximizes an income investor's utility.

INCOME RETURN VERSUS TOTAL RETURN

A common critique of building a portfolio that's focused on income generation is that it will be inefficient when viewed within a total return framework. This critique, however, assumes a total-return investor and is based on the idea that investors are indifferent to the source of their returns. We argue that, if the investor is an income investor, this critique is misplaced. Broadly, the investing world is moving away from esteeming the absolute and benchmark-relative, and toward investor-focused, outcome-oriented investing. The income investor places more value on current income, and might even be willing to pay higher taxes on that income in order to receive a relatively stable stream of payments. This isn't a radical concept and can be defended on traditional utility and asset-pricing grounds (see Cochrane [2001]).

To flesh this out, we define an income investor simply as one who seeks to maximize current income at some level of risk aversion. Formally, the income investor has a high rate of time preference and low rate of intertemporal substitution (the utility associated with trading current for future income and vice versa). The level of risk aversion to fluctuations in income might be high, but the level of risk aversion to principal fluctuation (i.e., price return) may vary—in the limit, principal fluctuation, to the extent that it doesn't effect income generation, is of little concern. Given the focus on current income, the income investor is often willing to pay the higher current taxes associated with income generation, as opposed to gaining the tax benefit of taking periodic withdrawals from a total-return portfolio.

However, an income preference does not necessarily imply indifference to price fluctuations, even if such fluctuations cannot practically be construed as effecting future income. An income investor who is consuming current income, is also observing price fluctuations, which can be viewed as the market's signal on the risk associated with future cash flows. This can be both disturbing for investors and economically material if the investor has liquidity needs or a short or uncertain time horizon. However, for the type of multiasset, diversified portfolios we examine here, the historical record shows that the realized relationship between price fluctuation and income risk is extremely low. Historically, investors have been able to take on a good deal of price risk (at the asset class level) with limited income risk.

Exhibit 1 plots historical annual price return and income return for the S&P 500 and the Ibbotson Associates SBBI Long-Term Government Bond Index in panels A and B, respectively.

As the panels in Exhibit 1 make clear, price return has historically been far more variable than income return for both stocks and long-term bonds. For example, the standard deviation of price return for stocks (bonds) has been 19.38% (8.74%), versus a standard deviation of 1.63% (2.84%) for income return. Investors with high aversion to income fluctuation, limited liquidity needs, and high levels of tolerance to principal fluctuations benefit from an income-oriented portfolio.

DECOMPOSING THE EFFICIENT FRONTIER

Although the efficient frontier is generally depicted on a total-return basis, it can be decomposed into its respective income-return and price-return components. The returns for riskier investments (e.g., stocks) tend to be driven more by price return than income return, and vice versa. The concept is illustrated in Exhibit 2.

The total-return efficient frontier in Exhibit 2 is the traditional mean-variance efficient frontier created without regard to the source of return, where the goal is to maximize total return per unit of total risk. The income-return frontier and the price-return frontier are simply the component parts that sum to the portfolio's total return. If we change the definition of "optimal" to focus on income return[2] (versus total return), we get a different efficient frontier that plots below the total-

EXHIBIT 1
Historical Price Return and Income Returns for Stocks and Bonds

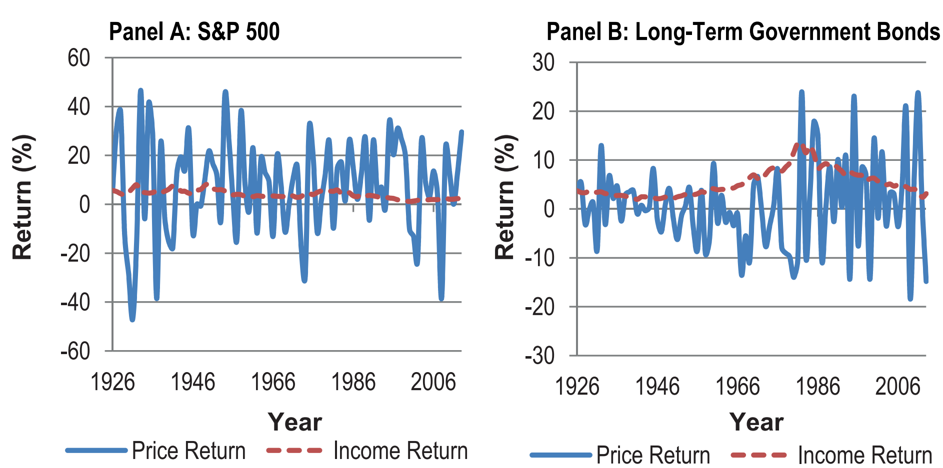


EXHIBIT 2
Efficient Frontier Components

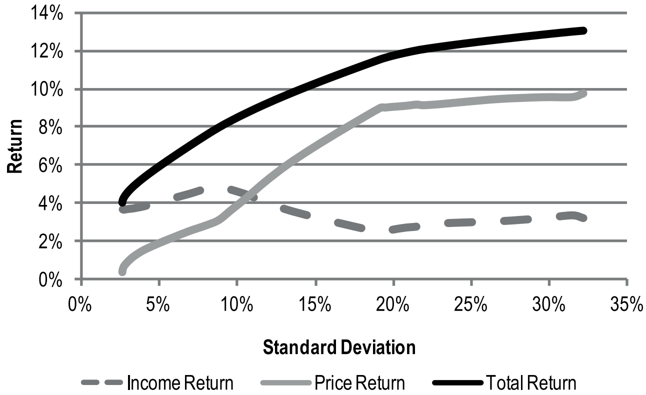
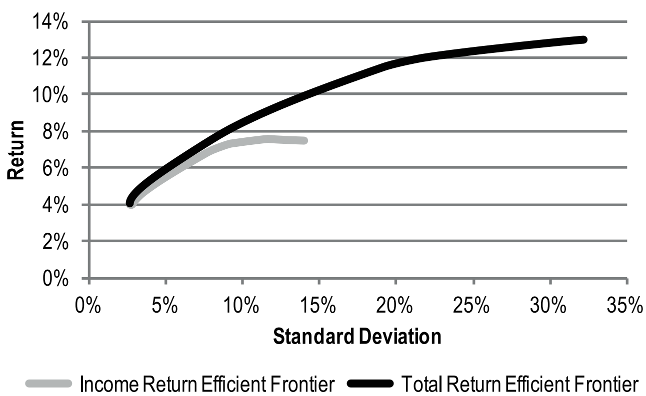


EXHIBIT 3
Total-Return Efficient Frontier vs. Income-Return Efficient Frontier



return efficient frontier (when plotted in total return space). This is depicted in Exhibit 3.

The income-efficient frontier in Exhibit 3 is truncated because it is limited to one component of total return—income—and thus the opportunity set is limited. In this case, the income-efficient frontier extends from the most conservative total return portfolio—consisting almost solely of short- to intermediate-term investment-grade bonds—and extends only as far as the highest-yielding investment which, in this case, is high-yield bonds.

An investor seeking income greater than this amount (7.5%) would need to liquidate some of the portfolio (i.e., dip into principal) to achieve a given consumption objective. However, we will focus on the differences in the portfolio allocations that fall within the same total-return range and demonstrate the considerable differences that result from the different allocation methodologies.

The Income Portfolio Utility Function

The traditional mean-variance utility function, as noted in Equation (1), can be written as maximizing return for a given level of risk, where w is a vector of asset class weights, r_{TR} is a vector of total returns, λ is the risk aversion level, and V_{TR} is a total return covariance matrix.

$$MAX[w\lambda r_{TR} - \lambda/2\; w\lambda V_{TR}\; w] \qquad (1)$$

Equation (1) is typically subject to variety of constraints, such as ensuring that portfolio weights are positive (i.e., no shorting) and sum to 100%. If we define r_{TR} as total return and r_I as income return, we can define r^* as

$$r^* = r_{TR}(1 - \pi) + r_I \pi. \qquad (2)$$

We can then substitute r^* into Equation (1) to get the efficient income-return objective function.

$$MAX\,[w^{\lambda} r^* - \lambda/2\; w\lambda V_{TR}\; w] \qquad (3)$$

Note that the quadratic part of Equations (1) and (3) are identical. If π is zero (in Equation (2)) the investor is a total-return investor indifferent to the source of return. If π is one, the investor is an income investor wanting to receive return only from interest and dividends. The value of λ defines the level of total risk the investor is comfortable assuming. As λ rises, the investor becomes increasingly conservative and is forced into the most conservative region of the frontier. As it rises, the investor becomes completely indifferent to risk and invests in the highest-yielding asset class. Although we could use price return to measure risk, the very low variance of income return is dominated by price risk. Thus, there's no practical reason to separate the two.

Note that r^* can be applied to other forms of portfolio optimization. Given that investors are averse to downside risk, a risk measure focusing on potential losses may be more appropriate. Focusing on downside risk is particularly important for an income portfolio because many higher yielding assets, such as REITs and below-investment-grade bonds, exhibit negative skewness (infrequent but very high losses).

A key assumption of mean-variance optimization (MVO) is that returns are normally distributed, or follow a bell curve. Xiong and Idzorek [2011] note that most asset classes and portfolios have returns that have fatter tails than those implied by a normal distribution. In addition, the normal distribution assigns what most people would characterize as meaninglessly small probabilities to extreme events that empirically have occurred approximately 10 times more often than the normal distribution predicts.

There are different models that can be used to account for fat tails, such as the Lévy stable hypothesis (Mandelbrot [1963]), the student's *t*-distribution (Blattberg and Gonedes [1974]), and the mixture-of-Gaussian-distributions hypothesis (Clark [1973]). For our analysis we truncate the tails of the Lévy stable distribution (to remove the complications associated with infinite variance), which results in the truncated Lévy flight (TLF) distribution. Xiong [2010] demonstrated that the TLF model provides an excellent fit to the returns for a variety of asset classes and, if properly parameterized, is quite tractable.

For the analysis in this article, we specify a mean-conditional value at risk (mean-CVaR) approach, which should better align the total-return risk characteristics of the portfolio with the risk aversion of the income investor. Such an approach is especially effective over short- to intermediate-term horizons when negative shocks can predominate. In the function, R_{TR} is an N-by-K matrix of total returns on each asset class, p is a conditional probability level, and $CVaR(\lambda)$ is the conditional value-at-risk function. Note that, though the income preference factor π will vary by individual, we assume it is 1 for purposes of exposition.

$$MAX \ \frac{1}{\lambda} w\, r^* - CVaR\left(w, R_{TR}, p\right) \tag{4}$$

In Equation (4) the linear term (r^*) is identical to that in the MVO version and the aversion to total-return risk is expressed indirectly through λ We take its reciprocal, converting it into a risk-tolerance number. Note that p is the probability level on which $CVaR(\lambda)$ is conditioned, and could be used to express the investor's level of risk aversion instead. As with traditional mean-variance optimization, the choice of parameters is vital. In the case of mean-CVaR, the choice of probability distribution can have an enormous effect on the results.

Opportunity Set

We use the asset classes listed in Exhibit 4 in our analysis. The opportunity set is not limited to higher-yielding asset classes. Our goal is to strike a balance between total return, total risk, and income. This is not to suggest that more exotic areas of the fixed-income market wouldn't add value, but rather to focus the analysis more generally on the portfolio construction problem.

Predicting returns is difficult, and optimization can result in portfolios lacking in intuitive appeal and economic value. For example, Chopra and Ziemba [1993] estimate that at moderate risk-tolerance levels, minimum variance optimization is 11 times more sensitive to estimation error of returns than to estimation error in the covariance matrix.

To keep the analysis as transparent as possible, we limit ourselves to the historical record, beginning with the shortest-lived series (U.S. TIPS), which began in October 1997 and ended in December 2014. It is thus imperative to view our results not as specific recommendations, but as an illustration of the approach outlined herein.

To calculate income return in cases where it wasn't readily available, we took the geometric difference of each monthly total return and monthly price return. For fixed income, we counted all pay-downs (e.g., mortgage-backed securities) and currency effects as income. The one area in which we departed from history was to assume that the price return for fixed income was zero, although we preserved the higher moments. In fact, though this has been true over long horizons, the period under consideration was marked by falling rates and the massive impact of the 2008 crisis. Calculating price returns from the indexes in Exhibit 4 reveals that long-duration TIPS and nominal government bonds produced an annualized price return of 3.5% and 2.8%, respectively, while high-yield had a price return of negative 1.3%. Additionally, we see negative skew on all asset classes, something that at monthly intervals is not too surprising for hybrid asset classes such as REITs and high-yield, but is less typical for equities

E X H I B I T 4

Asset Classes, Proxies, Total Returns, and Income Returns

		Total Return				Income Return			
Asset Class	Asset Class Proxy	Expected Return	Standard Deviation	Skewness	Excess Kurtosis	Expected Return	Standard Deviation	Skewness	Excess Kurtosis
LCV	Russell 1000 Value USD	8.33%	15.55%	-0.73	1.76	2.41%	0.20%	1.23	3.13
LCG	Russell 1000 Growth USD	7.19%	17.91%	-0.69	1.04	1.20%	0.19%	0.82	-0.02
SCV	Russell 2000 Value USD	9.87%	18.57%	-0.68	1.47	2.12%	0.21%	0.44	-0.29
SCG	Russell 2000 Growth USD	8.28%	24.01%	-0.35	0.83	0.55%	0.07%	0.91	1.02
US REITS	FTSE EPRA/NAREIT US USD	11.43%	21.93%	-0.75	6.89	5.07%	0.67%	1.06	1.16
non-US REITS	FTSE EPRA/NAREIT Dvlp Ex US USD	8.82%	20.73%	-0.51	2.14	3.76%	0.56%	0.54	-0.34
EAFE Value	MSCI EAFE Value GR USD	7.21%	18.19%	-0.53	1.42	3.31%	0.80%	1.84	4.40
EAFE Growth	MSCI EAFE Growth GR USD	4.94%	17.19%	-0.67	1.13	2.14%	0.50%	1.33	0.74
EME	MSCI EM GR USD	9.48%	24.64%	-0.73	1.77	2.60%	0.41%	0.74	-0.02
ST Bond	Barclays US Govt/Credit 1-3 Yr USD	4.11%	1.48%	0.37	0.85	4.11%	0.43%	-0.01	-1.17
IT Govt	Barclays US Govt Interm USD	4.07%	2.96%	-0.02	1.04	4.07%	0.43%	-0.05	-1.18
LT Govt	Barclays US Government Long USD	5.29%	10.00%	0.14	1.78	5.29%	0.29%	-0.41	-0.85
MBS	Barclays US MBS USD	4.52%	2.60%	0.10	1.97	4.52%	0.48%	-0.18	-0.97
IT IG Corp	Barclays US Interm Credit USD	5.54%	4.03%	-0.99	5.18	5.54%	0.30%	-0.30	-0.85
LT IG Corp	Barclays US Long Credit USD	6.42%	9.01%	-0.20	4.56	6.42%	0.25%	-0.02	-0.80
HY	Barclays US Corporate High Yield USD	8.39%	9.57%	-1.03	7.97	8.39%	0.31%	1.25	3.26
TIPS	Barclays US TIPS	2.55%	5.89%	-0.90	4.73	2.55%	0.26%	-0.15	-1.15
Ex US Gov	Barclays Global Treasury ex-US	4.07%	8.14%	0.16	0.34	4.07%	7.41%	0.16	-0.09
EMD	Barclays USD Emerging Mkt Agg	7.77%	11.95%	-3.17	20.51	7.77%	0.46%	0.65	-0.19

and non-long-term governments. Incorporating skewness into the analysis is particularly valuable for the sort of higher-yielding credit that is likely to dominate an income portfolio. Such securities are given to infrequent but periodically extreme losses. The higher moments on the income returns, though necessary for generating the policy portfolios, are not material given the very low standard deviation.

Exhibit 4 provides some clarity about how an investment's relative efficiency could vary based on the investor's underlying goal. For example, an investor entirely focused on income ($\pi = 1$, λ high) would likely consider long-term government bonds, high-yield bonds, long-term credit, and hard-currency emerging-market bonds attractive, but an investor with some aversion to principal fluctuation would not likely tolerate the high levels of price volatility that can be inferred from the total returns.

OPTIMIZATION RESULTS

In this section we touch on the differences that result from optimizing a portfolio assuming complete income preference ($\pi = 1$) and a total-return preference ($\pi = 0$). Exhibits 5 and 6 contrast the composition of the income-return efficient frontier with that of the total-return efficient frontier for portfolios with total returns ranging from 4.5% to 8.0%. Both frontiers were constructed by adding a total-return constraint while maximizing r^* relative to CVaR. We constrained each equity asset class to be no more than 30% of the total allocation and each bond asset class—with the exception of short-term bonds, which is unconstrained—to receive no more than a 40% allocation. These are wider ranges than what would typically be implemented in practice, but our point is to contrast the income approach with that of the total-return approach.

Given that we are concentrating in the conservative part of the frontier—beginning with the minimum-CVaR portfolio—it's unsurprising that there is considerable overlap. But there are also important differences. The income frontier's equity exposure is comparatively low and largely concentrated in REITs, with very small exposure to small-cap value, which reaches a maximum of 2% in the terminal portfolio. The total-return portfolio, by contrast, has most of the equity exposure in small-cap value, which reaches 14% in the most aggressive portfolio. Long-term government bonds also receive a larger lower allocation in the total-return portfolios, due to their lower correlation with equities, which serves to reduce total-return risk. Lastly we have far heavier allocations to emerging-market debt (EMD) in the income portfolio than in the total-return portfolio. Again, EMD is attractive from an income perspective

EXHIBIT 5
Income-Return Efficient Frontier Area Graph

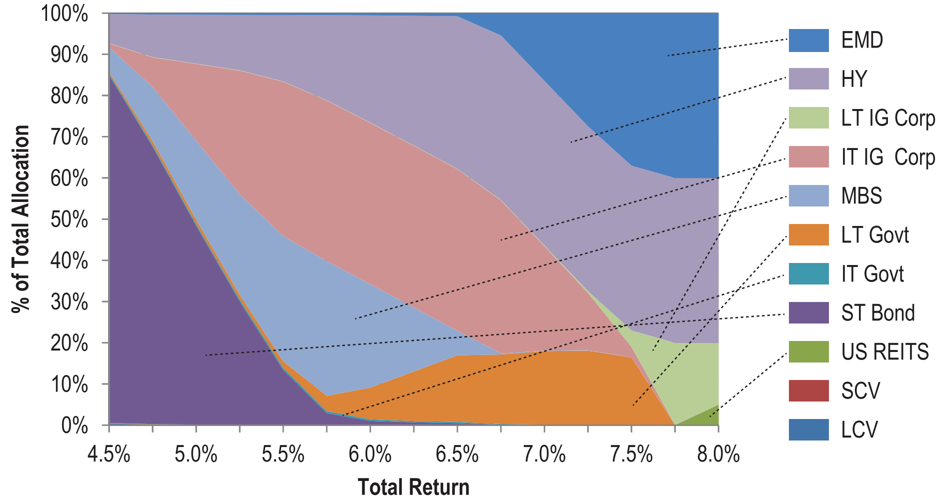
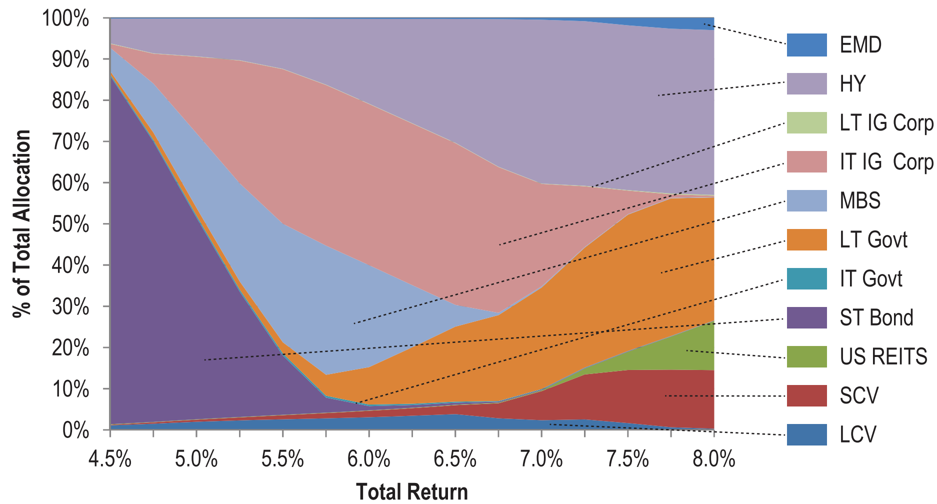


EXHIBIT 6
Total-Return Efficient Frontier Area Graph



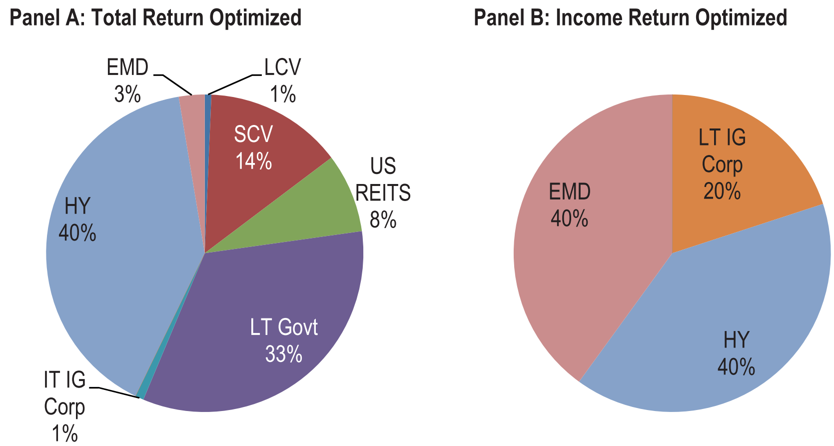
but less attractive when considered from a risk-mitigation perspective, as in the total-return portfolios.

We emphasize that it is important to view these results in the context of the market from which the returns were drawn. For example, the risk-mitigation advantage of long-term Treasuries is a function of the risk-on/risk-off market that characterized most of the period under examination. In a period of rising real rates, for example, the diversification benefit would have been lost, resulting in an allocation biased toward shorter-term governments, lower-tier credit, and equities.

Exhibit 7 presents a more precise example of the differences in the two approaches. It compares the optimal allocations for the income return and total-return methodologies, given an expected return of 7.5%.

The income-return portfolios are less diversified than their total-return counterparts, largely because

EXHIBIT 7
7.5% Expected Return Portfolios



the emphasis on income limits the opportunity set. However, while the expected return for both portfolios is identical, the income return for the total-return portfolio is 140 basis points below that of the income portfolio. Not surprisingly when looked at from traditional efficiency metrics, such as Sharpe ratio or total return-to-CVaR ratio, the total-return portfolio is more attractive, with values of 1.05 versus 1.02 and 0.83 versus 0.77, respectively. But in this case, the income investor is indifferent to total-return efficiency and more concerned with income predictability. That said, even in the total-return space, the decline in Sharpe and total return-to-CVaR ratios seems comparatively modest.

The income portfolios held fewer asset classes, but show reasonable diversification nonetheless. The information in Exhibits 6 and 7 suggest that an investor seeking to build an income-efficient portfolio should consider including asset classes such as high-yield debt, emerging-markets bonds, international bonds, long-term U.S. bonds, and (potentially) short-term U.S. bonds to create efficient portfolios.

INCORPORATING TAXES

We have thus far ignored the implications of taxes on income efficiency. Although taxes are obviously not a concern for a tax-deferred investor, taxes are a very real concern for an investor, such as a retiree, withdrawing income from a taxable account. Taxes are especially important when we consider the fact that different types of income are taxed differently. For example, gains on appreciated securities that are held for more than a year (i.e., long-term capital gains) and qualified dividends are generally taxed at a lower rate (15%) than income from fixed-income securities, which is generally taxed at ordinary tax rates (generally the marginal tax rate, which is 35% at the federal level).

We explore taxes' potential effect using two different approaches: First, we introduce a utility function that measures an investor's potential preference for assets that are heavily taxed. Second we explore taxes' actual effect on an efficient portfolio allocation by adjusting the returns to account for taxes.

The Utility of Tax Inefficiency

A common critique of income-oriented approaches is that they are tax-inefficient. This follows because investments that tend to generate the highest and safest level of income are taxed at higher rates than are securities that generate more return through appreciation. Although this is important to note—and is directly addressed in the following section—taxes increasingly become a price worth paying as preference for income increases. To illustrate this effect, we use the utility function noted in Equation (5), where c is the consumption income, λ is the income risk aversion level, and t is the tax rate.

$$u\left(c(1-t)\right)=\frac{\left(c(1-t)\right)^{1-\lambda}-1}{1-\lambda} \quad (5)$$

We include two utility curves in Exhibit 8 for two different levels of risk aversion, moderate ($\lambda = 2.5$) and high ($\lambda = 5$), in panels A and B, respectively. The assumed tax rate for the post-tax analysis is 35%.

In Exhibit 8, panels A and B, we define utility as consumption financed by investment income. This illustration demonstrates that as the income level increases, the after-tax utility and the pretax utility converge, albeit very slowly for a moderate-risk investor. As risk aversion goes up, however, we see the curves converge rapidly as the utility associated with income outweighs the tax cost. It is trivial to show that as tax liability drops and risk aversion increases, the utility values converge with increasing speed. An important economic takeaway may be that less-wealthy investors in comparatively low income brackets with relatively little risk capacity will derive the greatest utility from an income-oriented strategy.

The Effect of Taxes on Portfolio Allocations

Taxes reduce the total return, depending on the nature of income, and therefore are an important consideration for some investors. To determine the effect of taxes on optimal total-return and income portfolios, we made a number of adjustments to the return assumptions we used earlier, holding standard deviations and correlations constant. These adjustments were:

- All bond income is taxed at ordinary income tax rates, assumed to be 35%.
- We assume that some portion of the dividend income from equities is "qualified dividends," taxed at 15%. The percentages of the income return that we assume are qualified dividends for the 10 equity asset classes included in the analysis are:
  - Large Growth and Large Value: 100%
  - Small Growth and Small Value: 80%
  - Non-U.S. Large Growth and Non-U.S. Large Value: 80%
  - Preferred Stock: 50%
  - Emerging Markets: 70%
  - Non-U.S. and U.S. Real Estate: 0%
- We assume that all price return is taxed at 20%, which is a blend of long-term capital gains and short-term capital gains, with a slight tilt to long-term capital gains.

The total-return tax rate is based on the respective tax weights between the income-return and price-return components. Including taxes increases the relative attractiveness of certain asset classes from an income-return perspective, such as equities given the preferential treatment of qualified dividends versus the income from bonds. Exhibit 9 compares the equity allocations for both the pre-tax and after-tax optimizations for the income-return Equation (2) and total-return Equation (1) optimizations in panels A and B, respectively.

EXHIBIT 8
The Utility of Tax Inefficiency

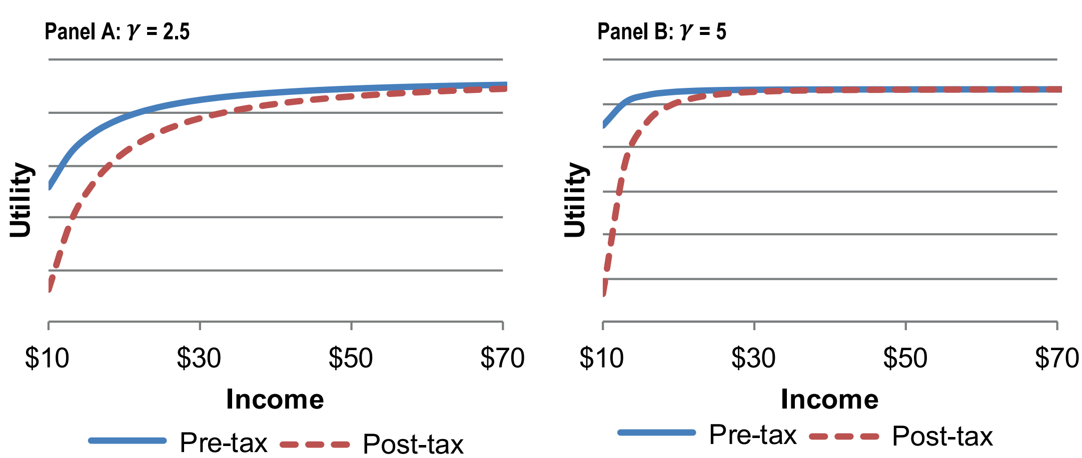


Exhibit 9
Allocation to Equities under the Different Optimization Tax Structures

Panel A: Income Return Optimization

Expected Total Return		Pre-Tax	Post-Tax	Δ
	4.5%	0.5%	14.9%	14.4%
	5.0%	0.3%	19.1%	18.8%
	5.5%	0.2%	27.5%	27.4%
	6.0%	0.1%	31.7%	31.5%
	6.5%	0.1%	40.8%	40.7%
	7.0%	0.1%	57.7%	57.6%

Panel B: Total Return Optimization

Expected Total Return		Pre-Tax	Post-Tax	Δ
	4.5%	2.0%	21.1%	19.1%
	5.0%	3.0%	28.4%	25.4%
	5.5%	3.9%	39.1%	35.2%
	6.0%	5.0%	54.1%	49.1%
	6.5%	6.4%	68.5%	62.2%
	7.0%	9.9%	82.2%	72.3%

Including taxes increased the equity allocation for both the income-return and total-return optimized portfolios. The pretax equity allocations for the income-return and total-return portfolios are very different with taxes pushing the allocation from the tax-inefficient, fixed-income asset classes to the more efficient, though lower-yielding equity asset classes. The higher-yielding value and REIT sub-asset classes claim the largest portions of the equity portfolio.

CONCLUSIONS

Growing interest in income-oriented investments continues. Increasing levels of risk aversion due to both demographics and concerns about increased market volatility are pushing investors toward less-risky options. Despite the appeal of income-focused products, there has been relatively little work on a method for developing such a portfolio.

This article introduces a framework determining how to build an asset allocation with an income focus by contrasting an income investor with a total-return investor and adjusting the return component of the portfolio optimization function. Portfolios focused on income are likely to be less diversified than their total-return counterparts, but tend to produce higher levels of income, and may be attractive alternatives to total-return strategies for investors focused on current consumption.

ENDNOTES

[1]It's instructive to keep in mind that, in a zero-growth economy, investors would only receive income (the cost of capital).

[2]Based on Equation (2), which is introduced later in the article.

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