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Asset Allocation for Retirement Income: A Framework for Income-Oriented Investors

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EXECUTIVE SUMMARY

- Building wealth-oriented portfolios is a well-understood problem. However, building income-oriented portfolios – desired especially by retirees – comes with a complex set of trade-offs.
- Fixed income funds, a staple of income-oriented strategies, tend to trade off volatility in income for volatility in wealth.
- Bonds help provide an inherent hedge in equity-heavy, wealth-oriented portfolios. Meanwhile, capital gains from equities may help income-oriented investors preserve their wealth.
- Our research shows how an income-oriented investor can use equity and fixed income assets to trade off the level of and risks to their near-term income, long-term income, and their wealth.

INTRODUCTION

By far, the most common strategy retirees use is to anchor their spending to their income. Fixed income assets generally provide a higher level of current income than equities, but without a clear prospect for long-run income growth. For those willing to tolerate higher volatility, dividend-paying equities offer a modest current level of income and tantalize with the prospect of future capital gains and income growth, which can be accretive to future wealth. This paper addresses the very different income and wealth properties of bonds and equities, and shows how one may consider using this information to build income-oriented portfolios. We accomplish this in three ways. First, we characterize the income-wealth trade-offs faced by an investor in a bond fund and in dividend-paying equities algebraically, using simple valuation models. Second, we show the historical performance of stocks and bonds in the United States, and how the real-world income behavior mimics that of our simple models. Finally, we apply forward-looking capital market assumptions in a simulation framework to inform relevant income and wealth trade-offs for today's income-oriented investors.

A MODEL FOR BOND INCOME

Consider an investor who holds a par bond with a yield at time t given by y_t^{PAR}. Absent default, an investment held to maturity (ignoring issues such as reinvestment risk) will produce $V_t y_t^{PAR}$ in annual dollar income, where V_t is the investor's initial portfolio value. It is unlikely that y_t^{PAR} will be the investor's future income, however. Most retail investors invest in bonds through funds rather than via a direct holding of the underlying securities, which are typically regularly rebalanced to specific targets so that their risk and return characteristics do not drift too far from the bond fund benchmarks over time. This means that changes in the portfolio value will gradually be rebalanced to prevailing market yields. It is thus the *interaction* of those future yields and the portfolio's valuation changes that affect the future income of most bond investors.

Portfolio duration is the key driver of the risk and return of an income-based investor. We can see this most clearly in a simple model. Assume an investor invests $1 at time t in an income-producing par bond portfolio with modified duration D_t and yielding y_t^{PAR}. One period from now, a new yield for the bond portfolio will materialize, y_{t+1}, which produces a new portfolio value, V_{t+1}. The new portfolio value can be approximated using the portfolio's duration and the changes in yield as

$$V_{t+1} = 1 - D_t(y_{t+1} - y_t^{PAR}) \qquad (1)$$

At time t+1, we assume the investor's bond portfolio is rebalanced to its original maturity, which is, of course, priced at new prevailing yields. Given their portfolio's value of V_{t+1}, a new par bond with yield y_{t+1}^{PAR} will produce portfolio income of $I_{t+1} = V_{t+1}y_{t+1}^{PAR}$. Substituting the right-hand side of this expression for the left-hand side (1), we can express portfolio income in the next period as

$$I_{t+1} = [1 - D(y_{t+1} - y_t^{PAR})]y_{t+1}^{PAR}. \qquad (2)$$

Already, Equation 2 can provide insight into the primary drivers of bond portfolio income. The term in brackets in Equation 2 is a weighting term that determines how much of the new market yield is "passed through" to realized portfolio income. Consider the case of the simplest security, a floating-rate note ("floater"). Floaters have close to zero duration since their coupons move directly with market yields. If we plug in $D = 0$ to Equation 2, we recover $y_{t+1}^{p} = y_{t+1}^{PAR}$. In other words, a portfolio of floaters produces an income level that is equal to the prevailing market yield; if yields rise, portfolio income rises, and if yields fall , portfolio income declines. Conversely, when portfolio duration is nonzero, this means that changes in market rates only partially flow through to portfolio income, with higher levels of duration producing lower levels of income "pass through." Effectively, higher duration exposure acts as a "countervailing force" to yield changes, leading to smaller increases in portfolio income in the presence of yield increases, and vice versa. Thus, duration is the primary mechanism for seeking to produce income stability in a rebalancing fixed income strategy.

Longer duration, of course, produces higher price volatility, all else equal. In the context of portfolio income generation, however, longer duration produces *lower* income volatility. A floater, for example, produces very little portfolio volatility but can produce significant portfolio income volatility, as market yield changes immediately flow through to the portfolio yields. On the other hand, a long-duration investment will generally produce a higher level of income stability alongside a wider range of portfolio values. Therefore, bond investors face an inherent trade-off between price stability and income stability, with the duration decision determining where the investor lies on this continuum.

The linear, duration-based approximation in Equation 2 is useful for building intuition about the drivers of portfolio income and income stability but is not appropriate for large changes in market yields. To better formalize the relationship between bond yields and income, we replace the duration approximation with a complete expression for bond prices. For a simple annual coupon bond paying some positive yield y_t[1], the price at time t will be given by

$$P_t = C_t\left[\frac{1-(1+y_t)^{-T}}{y_t}\right] + FV(1+y_t)^{-T}, \qquad (3)$$

where C_t is the bond coupon, T is the years to maturity, y_t is the prevailing bond yield at time t, and FV is the face value of the bond. We assume the investor starts out holding a par bond, and therefore can simplify Equation 3 by normalizing the terminal payment and initial price as $FV = P_t = 1$ as well as the annual coupon payment with $C_t = y_t$.

Therefore, at time t+1, the bond's new price will be given by

$$P_{t+1} = \frac{y_t^{PAR}}{y_{t+1}}\left[1 - (1+y_{t+1})^{-(T-1)}\right] + (1+y_{t+1})^{-(T-1)}, \qquad (4)$$

where y_{t+1} is the bond's yield in the next period, although not necessarily a par yield. At time t+1, we assume that the investor rebalances into a new par bond. Thus, the investor sells the existing bond at price P_{t+1} and rebalances into a new par bond with yield y_{t+1}^{PAR}. After rebalancing, the new portfolio income will be given by $I_{t+1}^B = P_{t+1}y_{t+1}^{PAR}$. Hence, income in the next period can be expressed as

$$I_{t+1}^B = y_{t+1}^{PAR}\left[\frac{y_t^{PAR}}{y_{t+1}} + \frac{1}{(1+y_{t+1})^{(T-1)}}\left(1 - \frac{y_t^{PAR}}{y_{t+1}}\right)\right]. \qquad (5)$$

1 Zero- or negative-yielding bonds lead to similar conclusions but different expressions, as they lack intermediate coupon payments, have terminal payments that differ from the face values, or both.

The term $1/(1+y_{t+1})^{(T-1)}$ in Equation 5 captures the portfolio's income sensitivity to yield changes and shows that changes in yields affect bond portfolio income inversely to the bond's maturity, with longer-maturity bonds (and, to a lesser degree, bonds with higher yields) exhibiting greater income stability.[2] Importantly, this term has a different sign for price impacts than for income: While income stability in Equation 5 is increasing in T, price stability in Equation 4 is decreasing in T. This negative relationship between prices and income helps compensate fixed income-oriented investors for changes in market yields.

A MODEL FOR EQUITY INCOME

One of the major differences between investing in fixed income – at least, fixed income regularly purchased at par – and investing in equities is that equities come with the expectation of future capital appreciation and corresponding income growth. There are two primary reasons to reasonably expect such growth. First, equities earn a risk premium over fixed income given their subordinate position in a company's capital structure. And secondly, companies pay only a fraction of their income, out in the form of dividends, generally allowing the value of the company to grow over time.

Unfortunately, establishing clear relationships between equity dividend yields and future equity income is less clear than we found for bonds in the previous section. While there is a strong linkage between bond income and yields, there is a significantly weaker relationship between equity dividend yields and equity income. Dividend payments are variable and directly related to the growth and profitability of the underlying companies, an additional layer of complexity not generally found with fixed income. This difference becomes even more apparent at longer time horizons.

We begin by considering the standard Gordon model for the value of an equity security:

$$P_t^{EQ} = \frac{D_t(1+g_t)}{k_t - g_t}, \tag{6}$$

where P_t^{EQ} is the price of equity, D_t is the dividend in units of currency, g_t is the dividend growth rate and k_t is the equity discount rate. The forward dividend yield on equity, $d_t^f = D_t(1+g_t)/P_t^{EQ}$, can be expressed as

$$d_t^f = k_t - g_t. \tag{7}$$

Equation 7 may give the impression that the equity dividend yield is a simple linear function of discount rates. Certainly, this is intuitive: When discount rates (k_t) increase, this depresses equity prices, leading to an increase in the dividend yield. Unfortunately, things are not nearly so simple. In practice, all of the parameters in the Gordon model can plausibly be expressed as functions of one another. Consider the case where dividend growth g_t is related to the equity discount rate k_t, so that changes in market-wide equity discount rates affect future dividend growth. This would allow us to write Equation 7 as:

$$d_t^f = k_t - g(k_t). \tag{8}$$

To maximize intuition, consider the case in which growth is a simple linear function of $k_t: g_t = \alpha k_t$. In this expression, the sign and magnitude of α will determine the extent to which changes in the discount rate are passed through to future dividends. We show in the appendix that with such a formulation, the evolution of the forward equity dividend yield can be expressed as

$$d_{t+1}^f = d_t^f + (1-\alpha)[k_{t+1} - k_t]. \tag{9}$$

Equation 9 provides intuition behind key drivers of the equity dividend yield: discount rates, earnings growth and the extent to which the two are interconnected. However, the dividend yield is only half the story: Income-oriented investors care about the dollar income that their investment produces. To characterize dollar equity income, we must multiply Equation 9 by the equity price. In the appendix, we show that forward equity income $I_{t+1}^{EQ} = P_{t+1}^{EQ} d_{t+1}^f$ can be expressed as

$$I_{t+1}^{EQ} = (1-\alpha)k_t(1+\alpha k_{t+1}). \tag{10}$$

As shown in the appendix, equity income growth, I_{t+1}/I_t can therefore be expressed as: $I_{t+1}^{EQ}/I_t^{EQ} = P_{t+1} d_{t+1}^f / d_t^f$, which is given by

$$(1+\alpha k_{t+1}) \tag{11}$$

2 It is important to emphasize the notion of *all else equal* when describing higher-yielding bonds as exhibiting greater income stability. While Equation 5 shows that higher bond yields produce greater income stability by lessening the impact of changes in market yields, it is usually the case that higher-yielding bonds generally exhibit greater yield volatility, particularly if their higher yield comes from additional credit risk.

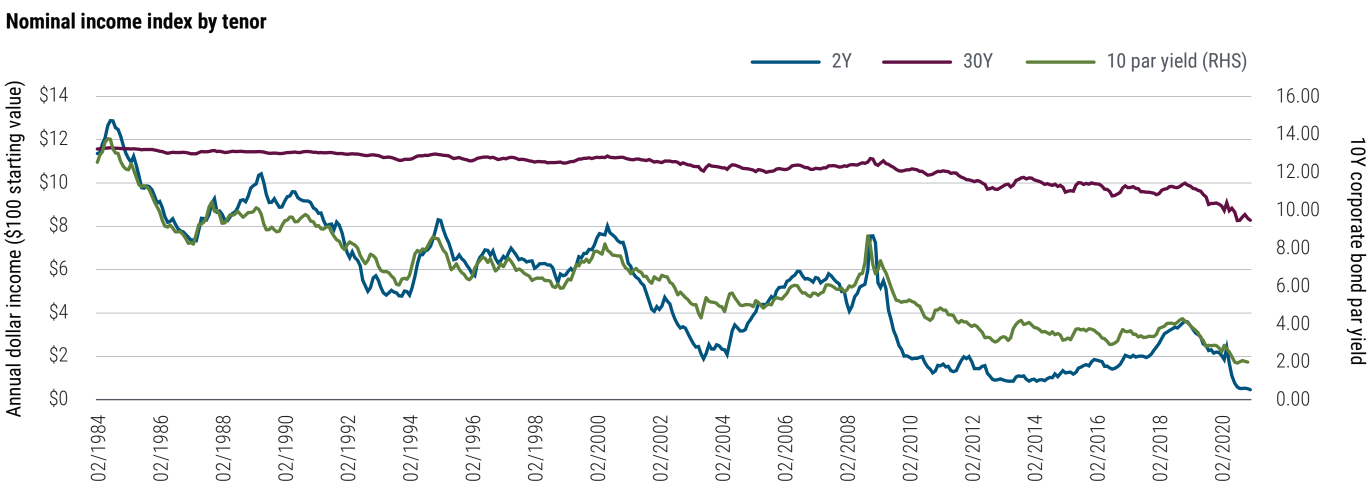
Importantly, Equations 10 and 11 show that equity investors need not rely on any notion of yield changes to have a reasonable expectation of income growth. For example, if $k_{t+1} = k_t$, then Equation 11 becomes $1 + \alpha k_t > 0$. Unlike the case of bonds, in which higher income is related directly to higher bond yields, neither the dividend yield nor the equity discount rate needs to change in order for the equity investor to experience growth in income over time. This is the fundamental reason equity investors can reasonably expect income growth, while fixed income investors will normally need higher future yields in order to obtain income growth.

THE HISTORICAL RECORD OF BOND AND EQUITY INCOME

In this section, we take the theory from the previous section to the data, by comparing equity and bond income historically for different time horizons and different bond maturity profiles. Exhibit 1 shows the dollar income that would have been generated by rebalancing a two-year and a 30-year investment grade corporate bond index each month from the perspective of an investor who invested $100 in each index in January 1984. Consistent with Equation 5, the two-year index produces substantially higher income volatility than the 30-year index, with standard deviations of $3.00/year and $0.71/year for the two-year and 30-year indices, respectively. While the income associated with both bond series has declined over the period due to the secular decline in interest rates, the reduction in income for the two-year bond index has been materially greater than for the 30-year index. In 1984, given very high levels of bond yields, both indices produced around $11/year in income, or a staggering 11%. By January 2021, the two-year index was generating $0.47/year in income while the 30-year index was producing $8.28/year, or nearly 18 times the income produced by rebalancing to a two-year bond index. The higher income associated with the 30-year index is primarily related to the income-preserving price appreciation of long-duration bonds over the period.

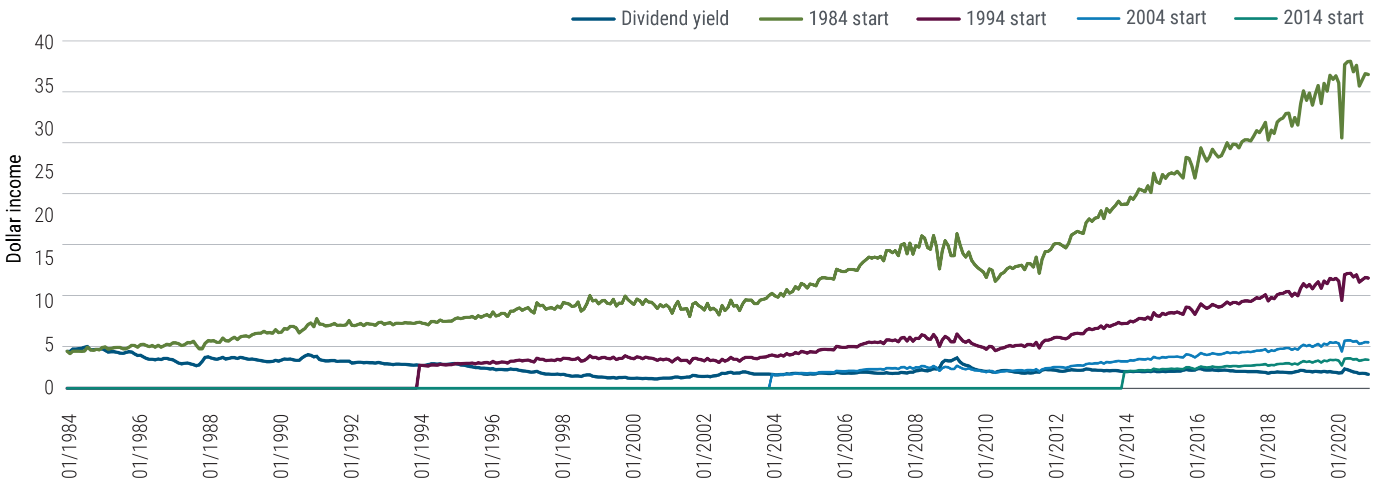
Exhibit 2 shows the income an investor in large cap U.S. equities would have earned over the same period starting in January 1984. As mentioned, the expectation for growth in equity income over time introduces time effects that are less obvious with fixed income. To highlight the importance of this time dimension, we have shown the nominal income associated with a $100 initial investment at different starting dates. Specifically, we show the income an equity investor would have received starting in 1984, 1994, 2004, and 2014. In all cases, equity income is higher than the starting yield due to growth in asset prices (dividend *yields* have actually fallen over this time period). A $100 investment in 1984 would have produced about $4/year of income initially. However, by 2020, this same investment would have produced around $35 of nominal income.

Exhibit 1: Nominal dollar income for two- and 30-year rebalanced bond indices



Source: PIMCO and Haver Analytics as of January 2021

Exhibit 2: Nominal equity income at different starting points



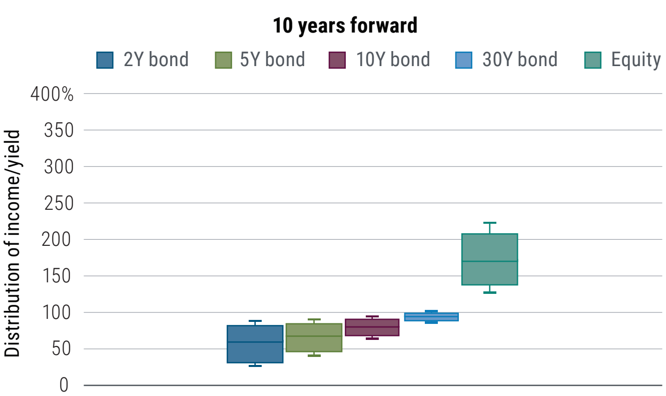
Hypothetical example for illustrative purposes only.

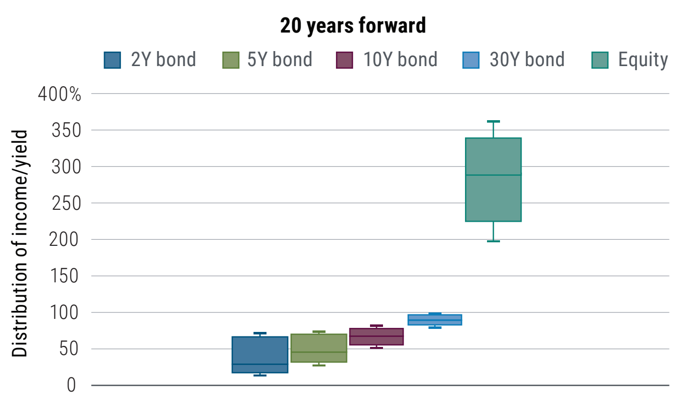
Source: PIMCO, Shiller. Shown from January 1984-December 2020. The lines indicate the annual dollar income from an initial $100 investment in equities on the indicated date.

When thinking about constructing portfolios for income generation, it is important to understand the relationship between the portfolio's starting yield and the distribution of future dollar income that the portfolio is likely to generate. Exhibit 3 shows the distribution of ending period nominal income received, divided by the starting yield for investment horizons of 10 and 20 years. The results are shown for investment grade corporate bonds with maturities of two, five, 10 and 30 years, along with large cap equities. Observations greater than 1 indicate income over the horizon higher than the starting yield, while observations less than 1 indicate a decline in income relative to the starting yield.

At a 10-year investment horizon, the median result for all bond indices is less than 1 due to the secular decline in yields since the mid-1980s. The tighter income distribution of long-maturity bonds at this horizon again illustrates the role that duration plays in helping to maintain income stability. Over a 10-year horizon, equities have enjoyed a median income-to-yield ratio of 1.71, meaning that equity income was 71% higher than its starting yield after 10 years. At a 20-year horizon, equities have a median income-to-yield ratio of 2.9 times. This reflects the impressive growth in equity dividends since the mid-1980s and highlights the importance of the time horizon for equity investors in particular.

Exhibit 3: Distribution of real income for bonds and equities for five-year and 20-year investment horizons





Hypothetical example for illustrative purposes only.

Source: FRED Database, Shiller and PIMCO. Bond data is the HQM High Quality Bond rate time-series from January 1984 to December 2020. Equity data is from the Shiller dataset. The box plots display the distribution of annual dollar income to the initial yield of the assets after a 10- or 20-year period (as indicated). Bond investments are assumed to roll over into new bonds of the indicated maturity each month. The box contains the interquartile range (25th-75th percentiles), and the whiskers cover the 5th-95th percentiles.

ASSET ALLOCATION FOR INCOME-ORIENTED INVESTORS

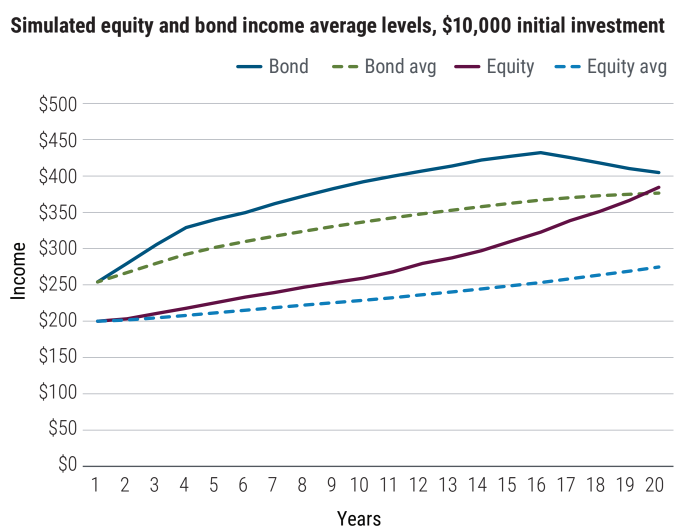
The historical results show the outsize income and wealth growth for investors who were fortunate enough to have held a substantial allocation to equity over the past 40 years. However, this outcome is unusual, in our view, and growth of this kind is highly dependent on the particular time period analyzed; from the mid-1980s to the present day, bond yields consistently fell and equity prices and dividends grew substantially. For example, equity returns between 1984 and today have been 2% higher than they were from 1901-1984.[3] Bonds also performed well over the same 1984-present time frame, as the 10-year U.S. government bond yield fell by around 1,000 basis points (bps). Historical analysis of the latter half of the 20th century in the U.S., therefore, reflects an unusually strong period of equity growth and falling interest rates. Current valuations and yields, however, suggest that future returns may well look different from those in the past, and today's investors naturally care about the *prospective* properties of bonds and equities. In this section, we simulate forward-looking equity and fixed income prices and income based on today's starting levels and characterize the resulting income and wealth implications of different asset allocation strategies.

We model a steady increase in the level of government bond yields over the next 10 to 20 years from today's historically low levels. For example, our long-run expectation for yields is 2.5% and 3.1% for the U.S. cash rate and 10-year government bond yields, respectively. Our assumption for equity dividend growth is aligned with our overall forecast for economic growth, which is lower today than what has been realized over the past 40 years.[4] For example, while U.S. real GDP grew at 3.1% per year from 1950-2020, the Congressional Budget Office (CBO) forecasts real GDP growth of 2.1% per year over the next 10 years. Consistent with this, we model an equity dividend growth rate of approximately 1% per year in real terms (3% nominal), or roughly 1% lower than long-term GDP assumptions. The full details of our simulation process, including parameters and average asset returns, are described in the appendix.

In our forward-looking simulations, we model two assets, a credit-oriented fixed income asset and a broad-based large cap equity asset. We characterize the fixed income portfolio as a simple, diversified credit bond portfolio that allocates 50% to investment grade credit, 25% to high yield and 25% to emerging markets external bonds, rebalanced annually to their fixed weights. We specifically exclude U.S. Treasuries from the bond portfolio, as the yield is likely to be too low for investors with an income orientation when compared to other fixed income alternatives. Exhibit 4 shows the average nominal income from our simulations by year for these hypothetical bond and equity portfolios, assuming a starting portfolio value of $10,000.

The solid lines in Exhibit 4 show the average simulated income level in each year, whereas the dotted lines show the average annual income realized from inception. As our assumptions reflect an environment where interest rates gradually rise alongside steady economic growth, both equity income and bond income rise over time, on average. At year 10, for example, the credit-oriented fixed income portfolio is generating an average annual income of $391 versus $259 for the equity portfolio.

Exhibit 4: Average and cumulative average simulated annual income for bonds and equities



Hypothetical example for illustrative purposes only.
Source: PIMCO

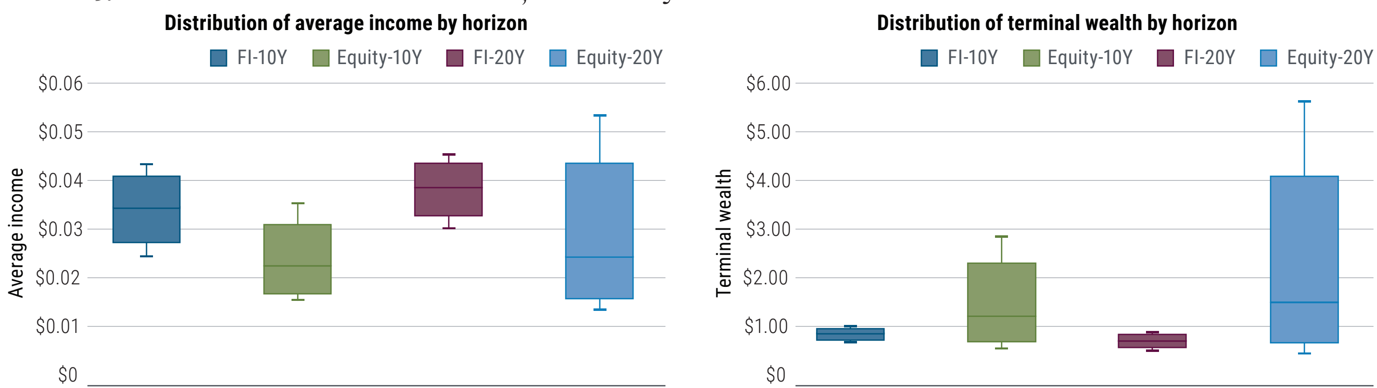
3 Measured using the Shiller online database. Quoted returns are geometric.

4 Congressional Budget Office, "An Overview of the Economic Outlook: 2021 to 2031," February 2021, https://www.cbo.gov/publication/56982

Of course, even for income-oriented investors, the expected level of their portfolio's income is not the only consideration. All investors also care about the distribution of their future *wealth*. Exhibit 5 shows the distribution of average income and terminal wealth levels for a 100% bond and 100% equity allocation for an initial investment of $1. While equity income is expected to stay below that of a credit-oriented fixed income portfolio, equities are expected to generate larger wealth balances over time as prices respond to expected earnings growth. For example, median wealth for a 100% equity allocation is 1.18 and 1.46 times the initial investment at a 10- and 20-year horizon, respectively. Hence, after consuming equity dividends, the equity investor experiences median cumulative price returns of 18% and 46%. Fixed income, on the other hand, is expected to exhibit modest declines in wealth balances over time under our base case assumptions of a gradual increase in rates, producing median wealth levels of 0.82 and 0.67 at 10- and 20-year horizons, respectively.[5]

At a 10-year horizon, equity income is expected to be around one-third lower than that of the bond portfolio's income, with a median income of $0.022 versus $0.034. At both horizons, the higher variation in wealth produced by equities is immediately

Exhibit 5: Distribution of income and wealth, 10- and 20-year horizons



	Average income				Terminal wealth			
	10Y		20Y		10Y		20Y	
	FI	EQ	FI	EQ	FI	EQ	FI	EQ
95th	$0.043	$0.035	$0.045	$0.053	0.97	2.82	0.86	5.59
75th	$0.038	$0.026	$0.041	$0.033	0.88	1.68	0.75	2.48
50th	$0.034	$0.022	$0.038	$0.024	0.82	1.18	0.67	1.46
25th	$0.030	$0.018	$0.035	$0.018	0.75	0.83	0.59	0.87
5th	$0.024	$0.015	$0.030	$0.013	0.64	0.50	0.49	0.41

Hypothetical example for illustrative purposes only.

Source: PIMCO. The box plots show the distribution of average income (left panel) and terminal wealth (right panel) for two portfolios, one entirely allocated to fixed income and one entirely allocated to equities at a 10- and 20-year horizon. The box contains the interquartile range (25th-75th percentiles), and the whiskers cover the 5th-95th percentiles.

5 This is primarily a result of our assumption of gradually rising interest rates, but is also related to a certain amount of defaults that are expected to occur over time given the credit orientation of the portfolio.

apparent; after 20 years, the difference between the 75th and 25th percentiles of wealth is only 0.16 for fixed income versus 1.62 for equities. At a 10-year horizon, both bonds and equities exhibit similar levels of income variation. However, at a 20-year horizon, equities exhibit much wider income variation than the bond portfolio, with the difference in income between the 75th and 25th percentiles for equities more than double that of fixed income. Higher equity volatility compounds over longer periods, especially as equities do not enjoy the self-regulating relationship between rates and future returns that bonds do. Since equity income is directly related to the level of equity prices, this implies much higher variation in equity income over time compared to bonds.

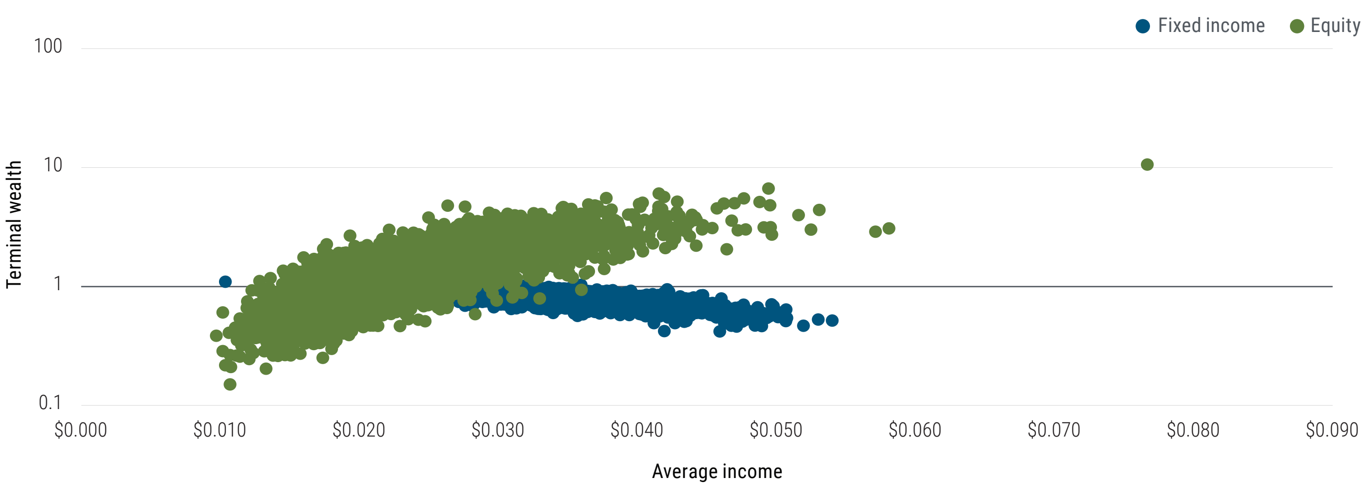
To state the obvious, future levels of income and wealth are uncertain. All else equal, this means risk- averse investors who care about both income and wealth will prefer investments for which there is an inverse relationship between the two. For example, in situations where future income is low, assets that have a negative correlation between wealth and income should produce higher wealth levels. Higher wealth in these states may offset the consequences of some or all of the lower income in such a scenario. Not only does fixed income's negative correlation between wealth and income help to provide income stability over time (as detailed in the first section), a negative correlation between wealth and income provides a "natural hedge" against the two outcomes that are of key importance to investors. On the other hand, if the correlation is positive, negative income realizations are also likely to coincide with negative wealth realizations, compounding the already adverse outcome for the investor in these states. Indeed, this is precisely the case for equities, since equity prices respond directly to expected future cash flows, meaning that prices and income are generally positively correlated.

To see the actual income-wealth trade-offs for the different assets, Exhibit 6 displays terminal wealth versus the average 10-year income for fixed income and equities. The wider vertical dispersion of equity points in the graph again shows the higher variance in wealth for equities. However, this graph makes clear the relationship between income and wealth outcomes: The negative relationship between income and wealth for bonds is as clear as the positive relation for equities.

Exhibit 7 summarizes the main trade-offs between fixed income and equities for income-oriented investors: the level of income, the degree of income and wealth growth, income and wealth volatility, and whether the assets display a negative wealth-income correlation. Fixed income is more appealing in three of the four categories, while equities are generally more suited to provide income and wealth growth over time.

An income-oriented investor must allocate between these two key asset classes to take advantage of their relative strengths and the synergies between them. Precisely which allocation an investor would select would depend on their preferences over

Exhibit 6: Terminal wealth vs. average income, 10-year horizon



Source: PIMCO

Exhibit 7: Fixed income vs. equity, primary attributes

	High income	Income/wealth growth	Low income/wealth volatility	Negative wealth-income correlation
Fixed income	+	–	+	+
Equities	–	+	–	–

Source: PIMCO

income and wealth, as well as their time horizon and risk tolerance. To illustrate the implications of various asset allocations, Exhibit 8 shows the distribution of income and wealth at 10- and 20-year horizons for asset allocations ranging from 100% fixed income (0/100) to 100% equity (100/0) in 20% increments. Income level is scaled to a $10,000 initial investment, while wealth is normalized to $1. To show the relationship between income and terminal wealth, the wealth distributions in the bottom half of each table correspond to the percentiles of income in the upper panel (i.e., the wealth and income percentiles are consistent with each other).

As expected, median income is highest for the 100% fixed income portfolio. However, the fixed income portfolio also produces the lowest median wealth levels. Increasing the allocation to equities (moving from left to right in Exhibit 8)

Exhibit 8: Income-wealth trade-off for various asset allocations

10-year horizon

			0/100	20/80	40/60	60/40	80/20	100/0
Percentiles	Income	5th	$263	$259	$251	$232	$199	$159
		25th	$299	$288	$271	$248	$217	$184
		50th	$337	$315	$293	$268	$242	$219
		75th	$375	$344	$315	$291	$276	$264
		95th	$409	$370	$337	$318	$312	$311
	Wealth	5th	0.94	1.04	1.05	0.92	0.77	0.72
		25th	0.89	0.98	1.00	0.95	0.89	0.90
		50th	0.84	0.93	0.99	1.03	1.11	1.20
		75th	0.78	0.87	0.99	1.19	1.43	1.59
		95th	0.73	0.83	1.07	1.43	1.79	2.12

20-year horizon

			0/100	20/80	40/60	60/40	80/20	100/0
Percentiles	Income	5th	$315	$304	$277	$239	$194	$148
		25th	$346	$328	$298	$261	$223	$184
		50th	$377	$353	$325	$297	$271	$245
		75th	$408	$380	$360	$346	$336	$328
		95th	$435	$410	$406	$414	$425	$442
	Wealth	5th	0.78	0.89	0.81	0.73	0.69	0.69
		25th	0.73	0.87	0.86	0.87	0.91	0.96
		50th	0.68	0.85	0.99	1.17	1.36	1.54
		75th	0.62	0.89	1.28	1.62	2.05	2.33
		95th	0.59	1.03	1.67	2.38	3.10	3.71

Source: PIMCO. Fixed Income is proxied by the Bloomberg US Aggregate Bond Index; Equity is proxied by the S&P 500 Index.

produces lower levels of median income but higher median wealth balances. For a given asset allocation, the relationship between income and wealth appears by reviewing the trade-off between them moving across percentiles. Reading down each column, we see a negative correlation between income and wealth for fixed income versus a positive relationship for equities; lower income percentiles correspond to higher wealth balances for fixed income-heavy allocations, whereas they result in lower wealth states for equities. Unsurprisingly, these correlations become more muted for asset allocations that combine fixed income and equities due to diversification between the two asset classes.

Different investors will prefer different portfolios. Those with a stronger orientation toward income will likely lean more to fixed income-oriented portfolios, while those who have a stronger preference for income and potential wealth growth will likely allocate assets to more equity-heavy solutions. Other investors, such as those who want to preserve their wealth, may want something in between. For example, investors who value income but seek to preserve wealth over time may find that a 40% equity/60% bond portfolio represents an appealing asset allocation in retirement. The 40/60 portfolio is consistent with wealth preservation, as the median wealth balance is 0.99 at both a 10- and a 20-year horizon. And while the median income level for the 40/60 portfolio is below that of the 100% fixed income allocation, it is still meaningfully higher than a 100% equity allocation. Furthermore, because equity and fixed income tend to be negatively correlated with each other, the left-tail wealth outcomes for the 40/60 portfolio are actually slightly better than even those of the 100% fixed income solution. For example, at a 10-year horizon, the 5th wealth percentile is 0.94 for the 0/100 portfolio versus 1.05 for the 40/60 allocation. In a nutshell, the 40/60 portfolio holds enough equity to help maintain median wealth balances while also providing a reasonably high level of income and diversification. For investors who value income but seek to preserve wealth over time, a 40% equity/60% bond portfolio may represent an appealing asset allocation in retirement.

CONCLUSION

Portfolio construction for wealth-oriented investors is well understood: Maximize return subject to some measure of risk. However, many investors, including and especially retirees, also care about the income their portfolio produces. These investors face several trade-offs unique to their income orientation. Most investors hold bond funds that periodically rebalance or reinvest around some target.Bonds tend to trade off volatility in income for volatility in wealth. The duration of the investment informs this exchange: Long-duration bonds have high short-term price volatility but low income volatility, and vice versa. Equity investors obviously are exposed to high wealth volatility, but the long-run capital appreciation that they may experience produces portfolio income that grows over time. Finally, and potentially most importantly, fixed income investors tend to experience “bad” states – those with lower incomes – precisely when their future wealth is high, and vice versa. Equity investors don’t enjoy this natural hedge: If markets appreciate, their income is high, and if markets draw down, their income falls along with it.

The historical data bears this out. Over the last 40 years, the combination of a supersecular decline in interest rates along with strong growth in corporate profitability produced an environment of large capital appreciation in fixed income and equities. However, today’s valuations have bond yields near zero and equity multiples near their all-time highs. In short, past performance is not a reliable indicator of future results. Our forward-looking return assumptions suggest that a sensible credit-oriented fixed income portfolio is likely to produce higher levels of income than equities, even at time horizons as long as 20 years. However, diversification between fixed income and equities, along with the prospective growth of equity prices over time, means that some allocation to equities is reasonable for most investors. For example, retirees who prefer income and desire to preserve their wealth over time may find an allocation of 40% equities and 60% bonds appealing, as it may produce a high level of income and may be more likely to sustain asset balances over long periods of time.

APPENDIX

Derivation of Equations 9 and 11

The forward dividend yield at time t+1 can be written as

$$d_{t+1}^f = k_{t+1} - g(k_{t+1}). \tag{A1}$$

Thus,

$$\frac{\partial d_{t+1}^f}{\partial k_{t+1}} = 1 - g'(k_{t+1}). \tag{A2}$$

Taking the first-order Taylor Series expansion of Equation A1 around k_t yields

$$d_{t+1}^f \approx [k_t - g(k_t)] + [1 - g'(k_{t+1})][k_{t+1} - k_t]. \tag{A3}$$

The price of equity at t+1 can be written as

$$P_{t+1} = \frac{D_{t+1}(1+g(k_{t+1}))}{k_{t+1} - g(k_{t+1})} = \frac{D_t(1+g(k_t))(1+g(k_{t+1}))}{k_{t+1} - g(k_{t+1})}. \tag{A4}$$

Without loss of generality, normalizing the price of equity at time t to 1 implies that
$D_t(1+g(k_t)) = d_t^f = k_t - g(k_t)$ and therefore

$$P_{t+1} = [k_t - g(k_t)]\frac{1+g(k_{t+1})}{k_{t+1} - g(k_{t+1})}. \tag{A5}$$

Forward equity income at time $t+1$ I_{t+1}^e is given by $P_{t+1}d_{t+1}^f$. Substituting in Equations A3 and A5 yields

$$I_{t+1}^e = [k_t - g(k_t)]\frac{1+g(k_{t+1})}{k_{t+1} - g(k_{t+1})}\big[[k_t - g(k_t)] + [1 - g'(k_{t+1})][k_{t+1} - k_t]\big]. \tag{A6}$$

Substituting in $g_t = \alpha k_t$ and Equation A1 into Equation A3 produces Equation 9 in the paper:

$$d_{t+1}^f = d_t^f + (1-\alpha)[k_{t+1} - k_t]. \tag{A7}$$

and therefore

$$I_{t+1}^e = (1-\alpha)k_t(1+\alpha k_{t+1}). \tag{A8}$$

Finally, equity income growth $I_{t+1}^g = I_{t+1}^e / I_t^e$ is given by

$$I_{t+1}^g = \frac{(1-\alpha)k_t(1+\alpha k_{t+1})}{(1-\alpha)k_t} = (1+\alpha k_{t+1}). \tag{A9}$$

Asset return simulation details

Nominal interest rates and credit spreads are modeled using a variation of the Cox-Ingersoll-Ross (CIR) model. The dynamics for yields and spreads (indexed by i) are governed by the following equation:

$$\Delta x_{i,t} = \theta_i \left(\mu_i - x_{i,t}\right)\Delta t + \sigma_i \sqrt{x_{i,t}}\sqrt{\Delta t} z_{i,t}, \tag{A10}$$

where $x_{i,t}$ is the yield or spread for tenor i in period t, z is a multivariate Wiener process with correlation matrix Σ, μ is the long-term equilibrium factor level, σ is a parameter controlling factor volatility, and θ is a mean-reversion parameter for each tenor. All simulation paths are conditioned on the current level for each factor. Bond portfolio yields are determined by creating synthetic benchmark proxies based on underlying exposures to par bonds and by measuring the estimated yield along each simulation path. Finally, the bond portfolio is repriced according to the prevailing yields each period to create capital gains (or losses) alongside portfolio income.

Equities are modeled based on the following equation:

$$r_t = r_t^f + ERP + +\sigma_r \sqrt{\Delta t}\varepsilon_t, \tag{A11}$$

where r_t^f is the risk-free rate from Equation A10, ERP is the equity risk premium, σ_r^2 is the variance of equity returns and ε_t are standard-normal shocks with the same correlation matrix as Equation A10 so that equity shocks are consistent with bond market shocks.

Forward equity dividend yields are modeled based on the estimated historical relationship between forward dividend yields and trailing equity market returns as

$$\ln(d_t) = \alpha + \beta r_{t,t-12}^{EQ} + \varepsilon_t, \tag{A12}$$

where $r_{t,t-12}^{EQ}$ is the trailing 12-month return from Equation A11, $\beta = -0.5$ as approximated using Robert Shiller's dataset from 1952-2019 and $\sigma_\varepsilon = 0.2$. α is parameterized so that the average simulated dividend yield is 2%. To impute realized equity dividend income, then, we simply multiply the dividend yield from Equation A12 by the implied price level from Equation A11.

The table below shows our calibrated parameters for the main model inputs as well as our summary returns over the coming decade.

Current and long-run levels for main simulation risk factors

	Long-run level
Cash	2.5%
2Y	2.7%
10Y	3.1%
IG spread	1.6%
HY spread	5.0%
ERP	3.3%

10-year average simulated nominal returns for assets

	Long-run level
IG bonds	2.6%
HY bonds	3.7%
EM bonds	3.1%
U.S. equity	5.2%

Source: PIMCO. Investment grade (IG) bonds proxied by the Bloomberg Investment Grade Credit Index; high yield (HY) bonds proxied by the Bloomberg High Yield Index; emerging market (EM) bonds proxied by the JP Morgan EMBI Global Index; U.S. equities proxied by the S&P 500 Index.

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