



Wilshire Funds Management

# INCOME-ORIENTED RETIREMENT PORTFOLIOS: CHALLENGES AND SOLUTIONS

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**Wilshire Funds Management**

1299 Ocean Avenue, Suite 700

Santa Monica, CA 90401

Phone: 1-310-451-3051

[wilshire.com](http://wilshire.com)

*As defined contribution plans have become increasingly popular, plan participants are faced with the challenge of managing their own assets before and during retirement. One of the key challenges for individuals in retirement is to generate sufficient income while minimizing the risk of depleting their assets. This paper considers the role of broad classes of assets, including stock exchange-listed REITs, as a component of income generating retirement portfolios. One of the key findings is that the addition of stock exchange-listed REITs to the retirement portfolio allows a higher level of stable income for any given level of risk tolerance. As a result, REIT allocations are found to be an important component of income generating retirement portfolios over a range of investor risk tolerances and income requirements.*

## 1. FUNDING RETIREMENT EXPENSES: THE CHALLENGE

As advances in health and medical care have lengthened the average lifespan, it has become normal for Americans to live far beyond their working years. In the past, many retired workers relied on a combination of defined benefit pensions and social security to maintain a reasonable standard of living in retirement. As defined contribution retirement plans become increasingly prevalent, retirees increasingly rely on their own savings and investments in these vehicles to fund a significant portion of their post-retirement expenditures.

Individuals saving to fund their own retirement must deal directly with several sources of uncertainty that defined benefit plan administrators previously addressed on their behalf. These sources of uncertainty include risks associated with the possibility of default on contracted payments, interest rate fluctuations, reduced purchasing power caused by inflation, variation in account balances caused by portfolio-level volatility, and the risk of depleting retirement resources prior to death.

To protect against these risks, we believe that Americans must make use of what we call an “extended portfolio” of investment opportunities. The extended portfolio includes traditional asset classes like stocks, bonds, and cash, supplemented with other assets that provide additional income and more effectively diversify return streams. The purpose of this paper is both to develop the argument for an extended portfolio of retirement investment opportunities and to provide a guide for investors—and, in particular, their financial advisors—to make optimal use of such an extended portfolio during retirement.

This paper introduces a new application of a widely accepted analytical approach specifically developed to optimize income-oriented retirement portfolios. By extending the traditional optimization framework of modern portfolio theory, we demonstrate how individual retirement portfolios can be constructed to provide a fully adequate level of steady, dependable income while seeking preservation of retirees’ wealth. We evaluate several versions of a model retirement portfolio to draw lessons that may help financial advisors develop more adequate plans for clients in a wide variety of personal financial situations.

The model results show that an income generating portfolio has several unique attributes that differentiate it from the standard optimal portfolio.

*One of the key challenges for individuals in retirement is to generate sufficient income while minimizing the risk of depleting their assets*

The income-oriented portfolio provides slightly less annual total return, but a greater income return. For many retirees this may be the appropriate trade-off.

Compared to the traditional portfolio, the income-oriented portfolio increases allocations to securities that provide steady income returns, including high yield and global bonds, non-U.S. stocks, preferred stocks, and REITs.

The extended portfolio of investment opportunities is a critical component of the income-oriented portfolio. The paper demonstrates that extended portfolio assets make up more than half of the income-oriented portfolio.

The addition of REITs to the opportunity set improves the performance of the income-oriented portfolio. Equity and Mortgage REITs combined account for up to 16 percent of the optimal income-oriented portfolio. The addition of stock exchange-listed REITs improves portfolio performance because of their low correlation with other asset classes and high total return and dividend rates. The addition of REITs to the retirement portfolio is critical to achieving the goal of generating a stable income with a reasonable level of risk tolerance.

The income-oriented approach produces a REIT allocation that is double the allocation produced by the traditional optimization framework for a mid-retirement individual.<sup>1</sup>

*The extended portfolio of investment opportunities is a critical component of the income-oriented portfolio*

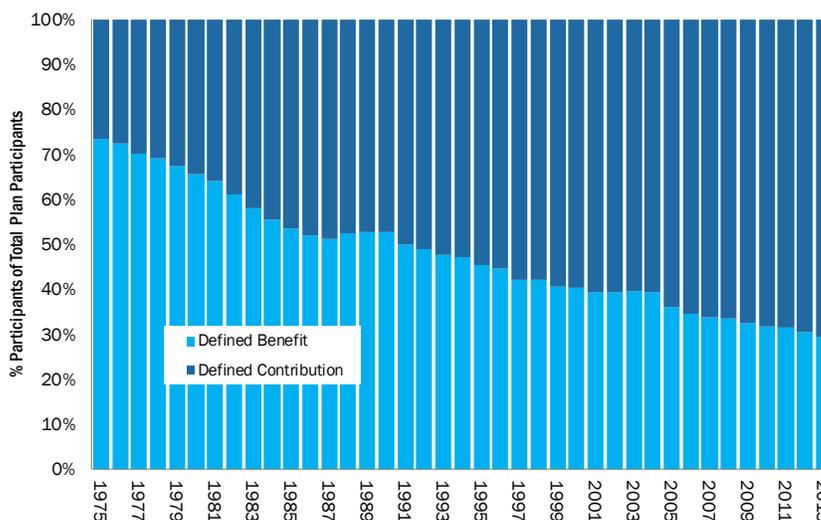
## 1.1 THE GROWING IMPORTANCE OF DEFINED CONTRIBUTION RETIREMENT PLANS

Since the 1990s, a number of factors – including financial risks to employers of defined benefit (DB) plans as well as employee preferences and increased mobility among employees – have caused a significant decline in the proportion of employees covered under such plans.

From 1975 to 2013, the share of private-sector employees covered by such defined benefit plans dropped sharply from 74% to 30%, as shown in Figure 1.<sup>2</sup>

As private sector employers have moved away from DB pension plans, they have increasingly offered their employees defined contribution (DC) plans as an alternative structure for individual savings and investments. DC plans – including 401(k) plans for employees of for-profit companies as well as 403(b) and 457(b) plans for employees of tax-exempt entities such

**Figure 1: Aggregate Trends in Defined Benefit and Defined Contribution Participation**



1 Wilshire Associates, “The Role of REITs and Listed Real Estate in Target Date Fund Allocations,” 2016. <https://www.reit.com/data-research/research/wilshire-research-new-results-optimizing-target-date-fund-performance-reits>

2 “EBRI Databook on Employee Benefits” Chapter 5. Table 5.2. Retrieved from <https://www.ebri.org/pdf/publications/books/databook/DB.Chapter%2005.pdf> (2015).

Source: The Employee Benefit Research Institute (EBRI) - U.S. Department of Labor, Employee Benefit Security Administration, Tabulations off the Form 5500 – Updated October 2015.

as governments, schools and charitable organizations – do not offer any guaranteed retirement benefit, and therefore do not expose the employer to the financial risks of a DB plan. Those risks, however, do not disappear, but are transferred to the individual employee.

Employees can also establish Individual Retirement Accounts (IRAs), which like DC plans, may benefit from certain tax advantages. As employees leave the workforce, retirement assets in DC plans will usually shift into rollover IRAs.

## 1.2 RISK FACTORS ASSOCIATED WITH GENERATING RETIREMENT INCOME

After decades of diligent and careful saving, those making the transition into retirement are faced with the task of turning their savings into a steady stream of income. The risks associated with generating retirement income are many, though there are two key risks that are particularly relevant to this analysis: path risk and asset depletion risk.

### Path Risk

Variation in asset values means that, at different times, an investor’s wealth will rise or decline. If retirement expenditures are financed in part by systematic withdrawals of capital beyond interest and/or dividends from the investment portfolio, withdrawals taken at a time when the value of the portfolio is at a low level can amount to a relatively large percentage of total wealth. This makes asset balance recovery through subsequent investment returns very difficult. This risk is often called path risk or sequence risk. In short, portfolio volatility and the order in which investments earn good or bad returns can matter during the drawdown period.<sup>3</sup>

Figure 2 illustrates an example of two investments with the same overall returns and withdrawal rates but different levels of volatility. The example considers the performance of two portfolios from 1999 to 2014. The low volatility portfolio consists of the Barclays U.S. Aggregate Bond Index which has an annualized return of 5.28% and annualized volatility of 3.47% in the observation period; while the high volatility portfolio consists of the Wilshire 5000 Index with a leverage ratio of 0.87 so that this portfolio has exactly the same annualized return as the low volatility portfolio, but with a much higher annualized volatility of 13.55%. The two portfolios start with \$100,000 and we assume a monthly withdrawal of \$500 was exercised during the investment period on both portfolios. We show that when assets in the portfolio are liquidated to generate income (that is systematic withdrawals), the path of asset values matters. In this example, the high-volatility

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**Figure 2: Effect of Volatility on Portfolio Balance with Systematic Withdrawal Plans**



<sup>3</sup> Zweig, J. (2015). “Why Buying the Dips Doesn’t Always Work,” *The Wall Street Journal*. August 29-30, 2015. Retrieved from <http://blogs.wsj.com/moneybeat/2015/08/28/buying-the-dips-doesnt-work-for-everyone/tab/print/>.

Source: Wilshire Compass

portfolio would have been worth only \$45,633 at the end of the period, or almost 45% less than the \$82,807 value of the low-volatility portfolio, even though, by construction, both assets had exactly the same annualized returns for the considered period and the same withdrawal rate. In this example, the early systematic withdrawals reduced wealth more in a high-volatility portfolio than in a low-volatility portfolio.

### Longevity or Depletion Risk

Longevity or depletion risk is the possibility that a retiree’s wealth will decline to zero while the retiree is still living. Retirees often need to finance a level of consumption that generally is not dramatically lower than when they were employed. A commonly cited rule of thumb is that retirement expenditures generally equal about 70% of pre-retirement expenditures. Financing this consumption requires more resources as life expectancy increases.

While annuities can in principal meet retirees’ need for protection against depletion risk, they have not been especially popular due to pricing and consumer behavior reasons. Instead, many investors have looked to their own savings and investments to provide retirement security even though they often face an unacceptably high risk of depletion. Table 1 illustrates the depletion risk for a diversified stock and bond retirement portfolio as a function of the amount of the portfolio balance withdrawn periodically to cover retirement expenses.<sup>4</sup> For example, a retiree withdrawing 5% per year, which is increased with inflation, on an initial portfolio balance would face a 17% risk of depleting the portfolio entirely at some point during the retiree’s lifetime. Increasing the withdrawal rate to 7% per year would make portfolio depletion more likely to occur than not.

*While annuities can in principal meet retirees’ need for protection against depletion risk, they have not been especially popular due to pricing and consumer behavior reasons*

**Table 1: Systematic Withdrawal Plans and Depletion Risk in Diversified Retirement Portfolios**

Initial Withdrawal Rate	3%	4%	5%	6%	7%	8%	9%	10%
Depletion Risk	0%	4%	17%	39%	62%	79%	89%	96%

Source: Wilshire Associates

Path risk and depletion risk are intrinsically linked. Higher income generating portfolios may lead to a lower withdrawal rate thus reducing the depletion risk; however, higher income generating portfolios often exhibit greater volatility, which increases path risk. The optimal income generating portfolio maximizes the return necessary to meet the income requirements and minimizes the volatility resulting in less path and depletion risk.

<sup>4</sup> Bernard, G. “Systematic Withdrawal Programs: Unsafe at Any Speed,” *Journal of Financial Service Professionals*, January 2011 (<http://www.annuityace.com/wp-content/uploads/2012/03/Systematic-Withdrawals-Unsafe-at-Any-Speed.pdf>). The assumptions include a retirement time horizon of 25 years, a portfolio allocation of 50 percent to common stocks and 50 percent to bonds, a three percent annual cost-of-living increase in the withdrawal rate, and annual investment management fees of 100 basis points for equities and 60 basis points for bonds.

## 2. THE TRADITIONAL AND EXTENDED PORTFOLIOS

Investors managing their individual savings and investments, as well as the financial advisors working with them, can choose from a wide variety of assets to meet their retirement objectives. A useful way to organize the menu of assets available for constructing a retirement portfolio is to divide them into what were historically the components of a traditional portfolio – cash, stock and bonds – and the asset classes that have been added to create today’s extended portfolio. The assets in the extended portfolio represent some of the cornerstones of modern portfolios and include real estate – a fundamental asset class with powerful diversification benefits – and global stocks and bonds which provide diversification benefits and income producing assets.

The traditional portfolio includes:

- ☞ Cash and Cash Equivalents: Including FDIC-insured bank deposits, short-term Treasury notes, and money market products;
- ☞ Bonds: Including inflation-protected bonds (TIPS) and investment quality bonds, for example bonds issued by the U.S. Treasury or companies of high credit ratings;
- ☞ U.S. Common Equities: Including public-listed securities on U.S. exchanges.

The extended portfolio includes:

- ☞ High Yield Bonds: bonds issued by companies with higher default risk;
- ☞ Global Bonds: bonds issued by foreign governments or companies;
- ☞ Non-U.S. Common Stocks: securities traded on non-U.S. exchanges;
- ☞ Commodities: raw materials, agricultural products, precious metals, and others;
- ☞ U.S. Preferred Stocks: stocks which provide a fixed stream of dividends;
- ☞ Listed Real Estate: public listed companies that specialize in income producing properties or investing in real estate backed mortgages and mortgage backed securities.

There are other asset classes such as municipal bonds, private equities, master limited partnerships (MLPs), and others which may be selected by some retirement fund managers; however, those listed above under the extended portfolio satisfy capacity and liquidity criteria which make them most suitable for building a retirement investment portfolio.

*Investors managing their individual savings and investments, as well as the financial advisors working with them, can choose from a wide variety of assets to meet their retirement objectives*

Each asset class exhibits specific investment characteristics to be utilized in an income-oriented retirement portfolio. Table 2 shows historical risk and total return profiles (which includes price and income returns) for each asset class over the past forty years (1975 through 2015).

**Table 2: Historical Total Returns and Volatilities of Traditional and Extended Portfolio Assets as of 12/31/2015<sup>5</sup>**

Asset	Proxy	Three Year		Ten Year		Twenty Year		Forty Year	
		Ann. Return	Ann. Volatility						
<b>Traditional Portfolio</b>									
Cash and Equivalents	<i>3-Month U.S. Treasury Bill</i>	0.05	0.02	1.11	0.52	2.38	0.62	4.18	0.87
Inflation-Protected Bonds	<i>Barclays U.S. TIPS</i>	-2.27	5.07	3.93	6.32	5.52	5.74	5.59	5.76
Investment Grade Bonds	<i>Barclays U.S. Aggregate IG Bonds</i>	1.44	2.92	4.51	3.22	5.34	3.47	7.72	5.43
<b>U.S. Common Equities</b>									
Large-Cap Value Stocks	<i>Wilshire U.S. Large-Cap Value</i>	13.45	10.31	6.41	14.84	8.33	14.03	9.39	13.27
Large-Cap Growth Stocks	<i>Wilshire U.S. Large-Cap Growth</i>	16.78	11.46	8.22	15.96	7.92	18.15	8.57	17.03
Small-Cap Value Stocks	<i>Wilshire U.S. Small-Cap Value</i>	11.76	12.47	7.84	19.89	10.75	17.83	12.06	16.77
Small-Cap Growth Stocks	<i>Wilshire U.S. Small-Cap Growth</i>	12.71	14.50	8.49	20.35	7.81	23.54	9.07	22.15
<b>Extended Portfolio</b>									
High-Yield Bonds	<i>BAML High Yield Master II</i>	1.64	5.36	6.81	10.55	6.69	9.02	8.39	8.19
Global Bonds	<i>Barclays Global Treasury ex-U.S.</i>	-4.17	5.77	3.12	7.80	3.82	7.89	5.89	8.82
<b>Non-U.S. Common Stocks</b>									
Developed Markets	<i>MSCI EAFE</i>	5.01	12.64	3.03	18.48	4.42	16.74	9.41	17.01
Emerging Markets	<i>MSCI Emerging Markets</i>	-6.76	14.25	3.61	23.60	8.39	22.85	8.88	22.93
U.S. Preferred Stocks	<i>BAML Preferred Stock</i>	6.30	4.09	5.21	19.18	5.55	17.54	5.54	17.66
Commodities	<i>S&amp;P GSCI</i>	-23.71	19.08	-10.56	23.87	-1.01	22.79	4.81	19.30
<b>Listed Real Estate</b>									
U.S. Equity REITs	<i>FTSE NAREIT All Equity REITs</i>	10.63	13.74	7.38	25.31	10.88	20.28	13.75	16.99
U.S. Mortgage REITs	<i>FTSE NAREIT Mortgage REITs</i>	1.74	14.50	-1.16	19.40	4.77	21.26	7.03	18.49

Source: Wilshire Associates

Table 3 decomposes the 40 year total return into price and yield components for each asset.<sup>6</sup> It shows that equity assets have a greater portion of return from price appreciation than from income generation. Fixed-income assets returns are primarily from income. There are some stand-out assets with hybrid features of equity and fixed-income:

- ☞ U.S. Preferred Stocks act more like a fixed-income asset because of the interest payment structure embedded in their contracts;
- ☞ Commodities have total volatility similar to Non-U.S. Common Stocks but generated much less return; and
- ☞ U.S. Equity REITs have balanced price appreciation and dividend incomes, while U.S. Mortgage REITs have negative price returns and the highest income returns for the investment time span among all the assets.

<sup>5</sup> For indices which don't have data back to 1975, since inception data was used.

<sup>6</sup> Those proxies with a price-return index have their income/yield returns equal to differences between the total-return index returns and the price-return index returns; those without a price-return index but with a yield index have their price returns equal to differences between the total-return index returns and the yield index returns; for those without neither a price-return index nor a yield index, these assets are deemed to generate solely income returns, e.g., in the case of Cash and Cash Equivalents; or solely price returns, e.g., in the case of Commodities.

Table 3: Total 40 Year Return Decompositions of Traditional and Extended Portfolio Assets<sup>7</sup>

Asset	Proxy	Price Return		Dividend/Yield Return		Total Return	
		Ann. Return	Ann. Volatility	Ann. Return	Ann. Volatility	Ann. Return	Ann. Volatility
<b>Traditional Portfolio</b>							
Cash and Equivalents	<i>3-Month U.S. Treasury Bill</i>	0.00	0.00	4.18	0.87	4.18	0.87
Inflation-Protected Bonds	<i>Barclays U.S. TIPS</i>	1.43	5.82	4.13	0.55	5.59	5.76
Investment Quality Bonds	<i>Barclays U.S. Aggregate IG Bonds</i>	0.75	5.42	6.92	0.86	7.72	5.43
<b>U.S. Common Equities</b>							
Large-Cap Value Stocks	<i>Wilshire U.S. Large-Cap Value</i>	6.20	13.25	3.01	1.05	9.39	13.27
Large-Cap Growth Stocks	<i>Wilshire U.S. Large-Cap Growth</i>	7.40	17.02	1.10	0.47	8.57	17.03
Small-Cap Value Stocks	<i>Wilshire U.S. Small-Cap Value</i>	9.54	16.76	2.31	0.27	12.06	16.77
Small-Cap Growth Stocks	<i>Wilshire U.S. Small-Cap Growth</i>	8.38	22.14	0.64	0.25	9.07	22.15
<b>Extended Portfolio</b>							
High-Yield Bonds	<i>BAML High Yield Master II</i>	-0.99	8.14	9.47	0.47	8.39	8.19
Global Bonds	<i>Barclays Global Treasury ex-U.S.</i>	0.67	3.03	5.20	8.11	5.89	8.82
<b>Non-U.S. Common Stocks</b>							
Developed Markets	<i>MSCI EAFE</i>	7.05	17.01	2.21	0.39	9.41	17.01
Emerging Markets	<i>MSCI Emerging Markets</i>	6.39	22.91	2.35	0.37	8.88	22.93
U.S. Preferred Stocks	<i>BAML Preferred Stock</i>	-1.66	17.63	7.30	0.85	5.54	17.66
Commodities	<i>S&amp;P GSCI</i>	4.81	19.30	0.00	0.00	4.81	19.30
<b>Listed Real Estate</b>							
U.S. Equity REITs	<i>FTSE NAREIT All Equity REITs</i>	6.02	16.94	7.30	2.26	13.75	16.99
U.S. Mortgage REITs	<i>FTSE NAREIT Mortgage REITs</i>	-4.81	18.40	12.35	2.75	7.03	18.49

Source: Wilshire Associates

## 2.1 THE TRADITIONAL PORTFOLIO

An optimal income-oriented retirement portfolio aims to provide price appreciation opportunities while at the same time meeting the income requirement of the retiree investor. This requires including assets with high income generating capabilities, while taking advantage of the price appreciation diversification benefits among all available asset classes. Before introducing a portfolio construction method developed by Wilshire Associates and exploring the impact of including assets from the extended portfolio in an income-oriented retirement portfolio, we first briefly describe each asset class within the traditional and extended portfolios.

The traditional portfolio encompasses three asset classes: cash and cash-equivalent assets, investment quality bonds, and common stocks of U.S. companies. These asset classes account for the large majority of holdings in most retirement portfolios managed by individual investors, but they are most likely inadequate by themselves to meet the retirement objectives of most individuals.

*An optimal income-oriented retirement portfolio aims to provide price appreciation opportunities while at the same time meeting the income requirement of the retiree investor*

<sup>7</sup> Table 3 shows the return decomposition of each asset class represented by its respective proxy within the period from 12/1975 to 12/2015 when both the proxy's total return and price return indices are available. The total return value may not exactly equal the sum of price and dividend returns because of the monthly compounding effect when calculating the annualized returns from monthly data.

## Cash and Cash Equivalent Assets

The defining characteristic of the “cash” asset class is the practical elimination of several investment risks, including path risk and credit risk. Indeed, cash is sometimes referred to as a “risk-free” asset. Cash-equivalent assets typically include FDIC-insured bank deposits such as savings accounts and certificates of deposit (CDs), money market mutual funds, short-term U.S. Treasury bills and arguably shorter-term Treasury notes. The principal problem with cash and cash equivalent assets as a component of retirement portfolios is that returns have been very low, particularly since the financial crisis. Especially for the past three years through the end of 2015, shown in Table 2, when the interest rate was held at a historical low level, this asset class has a negligible return of 0.05%.

## Investment-Quality Bonds

Investment-quality bonds have long played a very important role in retirement portfolios. For example, data compiled by the Employee Benefit Research Institute (EBRI) indicate that the average allocation to bonds is 18% in IRAs and 27% for public pension funds.<sup>8</sup> Investors particularly value investment-quality bonds for the protection they provide against path risk, both because the returns on investment-quality bonds themselves are less variable than those of most other assets (aside from cash) and because they share a low correlation with most other assets, a source of portfolio diversification. From Table 3, we can see that income returns of 6.92% account for most of the 7.72% annualized total returns for this asset class over the past 40 years. Investment-quality bonds expose investors to relatively little credit risk, but consequently provide relatively low returns that expose investors to portfolio depletion risk.

*The cornerstone of most retirement portfolios remains the equity allocation, in particular, the ownership of common stocks in public U.S. corporations*

## U.S. Common Stocks

The cornerstone of most retirement portfolios remains the equity allocation, in particular, the ownership of common stocks in public U.S. corporations. Data compiled by EBRI indicate that equities account for more than half of funds in IRAs and more than 60% of funds in 401(k) plans.<sup>9</sup> The most significant risk associated with common stocks is path risk. The uncertainty of corporate earnings causes the market value of their common shares to fluctuate over time much more than the market value of bonds. U.S. common stocks, using large-cap value as proxy for the past 40 years through the end of 2015, have returned 9.39% per year; approximately 1.5% more each year than investment-quality bonds. For retirees, stock dividends can provide an important source of income in the retirement portfolio. U.S. large-cap value and small-cap value stocks, shown on Table 3, provided more than 2% returns through dividend payments individually.

<sup>8</sup> Copeland, C. “IRA Asset Allocation – 2011,” ([http://www.ebri.org/publications/notes/index.cfm?fa=notesDisp&content\\_id=5281](http://www.ebri.org/publications/notes/index.cfm?fa=notesDisp&content_id=5281)) and “Public Pension Plan Asset Allocations,” ([http://www.ebri.org/publications/notes/index.cfm?fa=notesDisp&content\\_id=4232](http://www.ebri.org/publications/notes/index.cfm?fa=notesDisp&content_id=4232)).

<sup>9</sup> Copeland, C. “IRA Asset Allocation – 2011,” ([http://www.ebri.org/publications/notes/index.cfm?fa=notesDisp&content\\_id=5281](http://www.ebri.org/publications/notes/index.cfm?fa=notesDisp&content_id=5281)) and VanDehei, J., S. Holden, L. Alonso and S. Bass. “401(k) Plan Asset Allocation, Account Balances, and Loan Activity in 2012,” ([http://www.ebri.org/publications/ib/index.cfm?fa=ibDisp&content\\_id=5325](http://www.ebri.org/publications/ib/index.cfm?fa=ibDisp&content_id=5325)).

## 2.2 THE EXTENDED PORTFOLIO

While a typical traditional portfolio of stocks, bonds and cash is effective in diversifying away some of the major risks that retirement investors face, a broader portfolio can improve performance, particularly in the income-oriented portfolio. The extended portfolio introduces assets that are high yielding, have low correlations with traditional assets, or have both attributes.

### High-Yield Bonds

As noted above, investment-quality bonds expose investors to relatively little credit risk, but consequently provide relatively low returns that expose investors to portfolio depletion risk. As their name suggests, high-yield bonds are bonds that pay higher income yields than their investment-quality counterparts because they have been assigned lower credit ratings reflecting increased credit risk. High-yield bonds have a lower volatility than common stocks, implying lower path risk. Historical data suggest that high-yield bonds may also provide a measure of protection against inflation. Monthly returns on high-yield bonds have had a correlation of 0.26 with investment-quality bonds, and fairly low correlation with common stocks – a correlation coefficient of around 0.60 – indicating that they can contribute to portfolio diversification that reduces path risk. High-yield bonds provide a steady stream of current income which helps retirees meet living expenses without the liquidation risk inherent in systematic withdrawal plans. As an income generating asset class, it had 9.47% of income returns, but a negative price appreciation return of -0.99% for the past 40 years through the end of 2015.

*Historical data suggest that high-yield bonds may also provide a measure of protection against inflation*

### Non-U.S. Common Stocks

Many investors have embraced non-U.S. common stocks because they are generally expected to provide long-term average returns comparable to or above those of U.S. common stocks, while also providing important diversification to reduce path risk because of their relatively low correlation with U.S. common stocks. In this analysis we consider both non-U.S. developed and emerging market equities. The correlation of monthly total returns between U.S. and non-U.S. common stocks was around 0.66 to 0.74 for the past 40 years through the end of 2015, confirming the modest diversification benefits of non-U.S. common stocks.

### Preferred Stocks

Like common stocks, preferred stocks give the owner a claim on the earnings as well as the assets of the corporation after its contractual obligations have been satisfied, including interest payments on any corporate bonds it has issued plus interest payments on any mortgages and bank loans. However, preferred stock holders' claims are senior to those of common stock holders. Moreover, preferred stock ordinarily carries a specified dividend payment, which is paid before any distributions to common stock holders but after interest payments to debt holders. Thus, the stream of income from preferred stock is generally more certain than the stream of income from common stock. In fact, given the low or negative price return and high yield return typically associated with preferred stock, they can be considered a vehicle for converting capital to income.

Average total returns of preferred stock in the past 40 years through the end of 2015 have been relatively low at 5.54% per year. Monthly preferred stock returns share low correlations with other assets, including U.S. common stocks (correlation coefficients from 0.49 to 0.70), investment-quality bonds (correlation coefficient of 0.21) and high-yield bonds (correlation coefficient of 0.63). Preferred Stocks are an income generating asset class: the asset class has income returns of 7.30% versus price appreciation returns of -1.66% over the past 40 years.

## Commodities

Commodities are an asset class that investors have long considered a good source of protection from loss of purchasing power. Moreover, commodities are often considered a portfolio diversifier because of their generally low correlations with other asset classes. For example, for the past 40 years through the end of 2015, commodity returns have had particularly low correlations with U.S. large-cap common stocks (correlation coefficients around 0.40), non-U.S. common stocks (correlation coefficients around 0.35, investment-quality bonds (correlation coefficient of 0.24), high-yield bonds (correlation coefficient of 0.41) and preferred stocks (correlation coefficient of 0.47). Three problems limit the usefulness of commodities specifically for income-oriented retirement portfolios. First, the total returns of commodities in recent years have been disappointing, averaging just 1.01% over the past 20 years, with a 40-year annualized return of 4.81%. Second, commodity returns have been extraordinarily volatile at 22.79% over the 20-year period and 19.3% over the 40-year period. Third, commodity investments ordinarily provide no income return, requiring retirees to liquidate some of their investments in commodities or other assets in order to provide usable income.

*Commodities are an asset class that investors have long considered a good source of protection from loss of purchasing power*

## Real Estate

Real estate has long been valued for its portfolio diversification properties. Real estate also produces a reliable stream of income from property rents or mortgage interest payments and potential inflation hedging that can be particularly important for income-oriented retirement portfolios. REITs are widely recognized as a low-cost, liquid approach to real estate asset exposure. REITs provide higher total returns than other assets intended to provide income such as high yield bonds and preferred stocks. Plus, REITs provide more income return and better diversification benefits than other classes of equities.

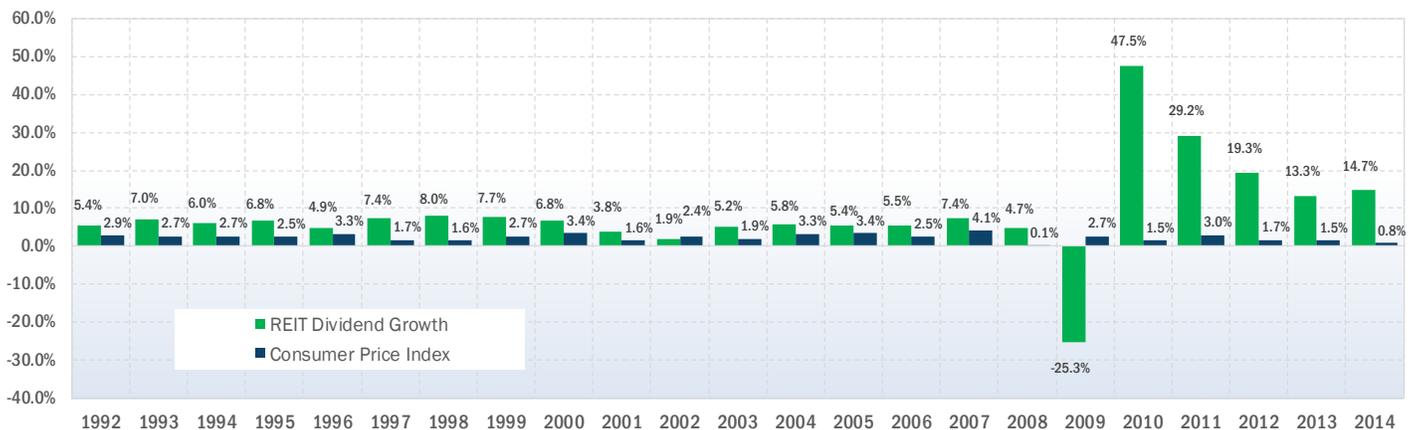
There are two main opportunities for investing in real estate assets. Investment in real estate equity includes the ownership, directly or indirectly, of income-producing properties. Income producing properties are a diverse set including office buildings, apartments, industrial and warehouse facilities, retail properties, hotels, health care properties, data centers, self-storage facilities, single-family rental properties, manufactured housing communities, telecommunications towers and other types of permanent structures. Investment in real estate debt includes the ownership, directly or indirectly, of mortgages secured by real property, both owner-occupied as well as income-producing properties, or of securities collateralized by such mortgages, including both residential and commercial mortgage-backed securities.

For essentially all investors saving and investing for retirement, investing in both real estate equity and debt through stock exchange-listed real estate investment trusts (REITs) is the simplest, most liquid, and lowest cost strategy for accessing the real estate asset class. For real estate equity investment, historical data reveal that investment returns of listed Equity REITs have outpaced the returns on otherwise similar properties owned directly or through unlisted funds.<sup>10</sup> Furthermore, directly owned real estate is extraordinarily illiquid, and investments in individual assets are typically very large relative to the total value of the investment portfolios of most individual investors. For these reasons, only two forms of real estate investment are included in the opportunity set of our analysis of income-oriented retirement portfolios: listed Equity REITs and listed Mortgage REITs.

Perhaps the most important attribute of REITs for income-oriented retirement portfolios is their relatively high and reliable dividend income. Unlike other companies, most REITs generally distribute nearly all of their taxable income to their shareholders every year in the form of stock dividends.<sup>11</sup> As illustrated in Figure 3, REIT stock dividends over many years have also increased more rapidly than inflation. In fact, REIT dividend growth has outpaced the Consumer Price Index in 22 of the past 24 years through 2015.

*Perhaps the most important attribute of REITs for income-oriented retirement portfolios is their relatively high and reliable dividend income*

**Figure 3: REIT Dividend Growth per Share Compared with the Consumer Price Index**



10 Ling, D. and A. Naranjo. "Returns and Information Transmission Dynamics in Public and Private Real Estate Markets," January 2014 ([http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2391393](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2391393));

Andonov, A., P. Eichholtz and N. Kok. "Value Added From Investment Managers in Private Markets? An Examination of Pension Fund Investments in Real Estate," April 2014 ([http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1996819](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1996819));

Fisher, M. and D. Hartzell. "Real Estate Private Equity Performance: A New Look," May 2013 (<http://areas.kenan-flagler.unc.edu/finance/PERC/REPE%20Performance%20May%202013%20v2.pdf>).

Beath, Alexander. 'Asset Allocation and Fund Performance of Defined Benefit Pension Funds in the United States Between 1998-2014'. June 2016 ([https://www.reit.com/sites/default/files/media/DataResearch/2016CEMStudy\\_full.pdf](https://www.reit.com/sites/default/files/media/DataResearch/2016CEMStudy_full.pdf))

11 Under rules of the U.S. Internal Revenue Code, REITs are required to distribute every year at least 90 percent of their taxable income as dividends, and most REITs distribute 100 percent of their taxable income each year to their shareholders in the form of stock dividends.

## Equity REITs

Equity REITs are real estate companies that own a wide range of types of income-producing properties and lease those properties. Equity REITs distribute each year most, if not all, of their taxable income to shareholders as stock dividends. Each year this significant dividend distribution makes listed Equity REITs an effective income producing investment. Listed Equity REITs own approximately \$1.3 trillion of gross real estate assets in the U.S., including more than 190,000 properties in all 50 states and the District of Columbia. Equity REITs today own real estate tied to almost all sectors of the economy.<sup>12</sup>

During the last 40 years, through the end of 2015, listed Equity REITs delivered total returns averaging 13.75% per year, higher than all other investments considered in this paper. The robust total returns suggest that listed Equity REITs can help retirees protect themselves from depletion risk. Monthly total returns of listed Equity REITs over the 40-year period were relatively volatile at 16.99%. At the same time, Equity REIT returns had relatively low correlations with U.S. common stocks (correlation coefficient from 0.48 to 0.69), investment-quality bonds (correlation coefficient of 0.21), high-yield bonds (correlation coefficient of 0.62), non-U.S. common stocks (correlation coefficients of 0.48 and 0.51), preferred stocks (correlation coefficient of 0.14) and commodities (correlation coefficient of 0.58), indicating that they play an important role in portfolio diversification which reduces portfolio volatility. Equity REITs have the highest share of total return derived from income of any equity considered other than preferred stocks and Mortgage REITs.

## Mortgage REITs

Mortgage REITs are companies that invest in residential and commercial real estate mortgages or mortgage-backed securities (MBS), primarily earning income from the interest on their investments. Like Equity REITs, Mortgage REITs are required to distribute nearly all of their taxable income to their shareholders as stock dividends each year.

The total return on listed Mortgage REITs averaged 4.77% per year over the 20-year period through the end of 2015. In the same period, Mortgage REIT returns have had relatively low correlations with U.S. common stocks (correlation coefficient from 0.37 to 0.46), investment-quality bonds (correlation coefficient of 0.25), high-yield bonds (correlation coefficient of 0.41), preferred stocks (correlation coefficient of 0.07), non-U.S. common stocks (correlation coefficients of 0.33 and 0.34), commodities (correlation coefficient of 0.46) and even listed Equity REITs (correlation coefficient of 0.47).

The most important benefit of listed Mortgage REITs for retirees is their steady current income. As with preferred stock, Mortgage REITs can be viewed as an investment that converts portfolio capital value into monthly income. The income return from Mortgage REITs has historically been greater than the total return for the past 40 years, with an average income returns of 12.35% per year and average price appreciation of -4.81% per year.

*The most important benefit of listed Mortgage REITs for retirees is their steady current income*

<sup>12</sup> See <http://www.reitsacrossamerica.com/>

### 3. CONSTRUCTION OF INCOME-ORIENTED RETIREMENT PORTFOLIOS

Empirical methods intended to help identify optimal asset allocations for investment portfolios have been known for more than 60 years. This paper extends the traditional framework to apply additional constraints requiring a minimum flow of income to fund living expenses. This modified framework identifies the optimal asset mixes for income-oriented retirement portfolios. We will construct alternative portfolios with and without the income requirement using a portfolio set that (1) excludes listed REITs, (2) includes listed U.S. Equity REITs, and (3) includes both listed U.S. Equity and Mortgage REITs.

#### 3.1 Mean-Variance Portfolio Optimization

The most widely-used analytic method for constructing optimal investment portfolios is Mean-Variance Optimization (MVO), originally developed in 1952 by Nobel Prize winning economist Harry Markowitz. For a specific opportunity set of investment choices, MVO identifies the asset allocation across the opportunity set that maximizes expected portfolio return for a target level of portfolio volatility, or equivalently, the asset allocation that minimizes expected portfolio volatility for a target level of portfolio return. MVO accounts for the correlation of investment returns across the available investments in the opportunity set to create a diversified portfolio that maximizes portfolio returns and minimizes portfolio risk.

Mathematically, the MVO algorithm can be expressed as the solution to the following optimization problem:

Maximize  $w' R_t$

Subject to  $w_i \geq 0$

$$\sum w_j = 1$$

$$\sqrt{w' V w} = \text{risk target}$$

where  $w$  is a vector of portfolio allocation weights to each asset class in the opportunity set,  $R_t$  is a vector of expected total returns from each asset class, and  $V$  is the corresponding covariance matrix of total returns.

As noted, however, the MVO algorithm focuses entirely on maximizing portfolio value without regard to whether monthly returns come from income or price appreciation. Assets with total returns that come primarily from price appreciation clearly contribute to portfolio value, but must be exchanged for cash before they can be used to meet retirement expenses, thus exposing investors to path risk or the risk of excessive withdrawals that can ultimately deplete the portfolio. Assets with returns that come largely from income, through a dividend or income component, contribute not only to wealth but also directly to paying retirement expenses.

*The most widely-used analytic method for constructing optimal investment portfolios is Mean-Variance Optimization (MVO), originally developed in 1952 by Nobel Prize winning economist Harry Markowitz*

### 3.2 Income-Oriented Mean-Variance Portfolio Optimization

Traditional MVO can be modified to address the more specific needs of investors seeking a targeted amount of income from their portfolios to help finance living expenses while also identifying the optimum asset allocation across the opportunity set. To accomplish this objective, Wilshire Associates developed Income-Oriented Mean-Variance Optimization (IOMVO), which incorporates an additional constraint requiring a specified income yield on the portfolio. IOMVO may be expressed as the solution to the following modified optimization problem:

$$\text{Maximize } w' R_T$$

$$\text{Subject to } w_i \geq 0$$

$$\sum w_j = 1$$

$$\sqrt{w' V w} = \text{risk target}$$

$$w' R_I = \text{income target}$$

where  $w$ ,  $R_I$  and  $V$  are the same as defined for MVO, but where  $R_I$  is a vector of expected income returns for each asset class in the opportunity set.

To construct income-oriented retirement portfolios using IOMVO, we set the targeted value for the portfolio annual income return as a percentage of total portfolio value. It is important to note that in this framework the income derived from the portfolio comes entirely from interest and dividends. There is no principal depletion assumed in this analysis. However, given that principal liquidation is a small fraction of each year's income during retirement, this should not fundamentally alter the conclusions discussed below. Other than the addition of the targeted income constraint, IOMVO portfolios are constructed and computed identically to MVO portfolios.

The IOMVO framework provides an ideal avenue for investors with a particular risk tolerance and desired income requirement to still maximize their capital appreciation over time. IOMVO portfolios provide the required portfolio income with the highest possible return, limiting depletion and longevity risk. As noted, this approach explicitly solves for income without consideration of the depletion of principal. If the liquidation of assets was also considered, then one could argue for a lower expectation of income generation from the portfolio.

### 3.3 The Opportunity Set of Asset Classes

To construct optimal income-oriented portfolios for retirees, we applied the MVO and IOMVO methodology to opportunity sets that include up to 15 asset classes from both the traditional and extended portfolios that investment advisors might realistically consider for their clients.

We generate the vector of expected returns and volatilities for each of the 15 asset sub-classes included in the opportunity set by applying the Capital Asset Pricing Model reverse optimization process developed by Nobel prize-winning economist William F. Sharpe. Using an initial "efficient"

*Income-oriented investors as well as their financial advisors may be quick to note that MVO neglects to differentiate between price returns and income returns*

market or reference portfolio<sup>13</sup>, a reverse optimization process generates forward looking expected returns using historical covariance and volatilities.

In particular,

$$E(R_t) = R_F + \frac{\text{Cov}(R_t, R_b)}{\text{Var}(R_b)} [E(R_b) - R_F]$$

where  $E(R_t)$  represents the expected portfolio return of asset class  $t$  in the opportunity set,  $R_b$  represents the return of the reference (benchmark) portfolio, and  $R_F$  represents the assumed risk-free rate.

The volatility and covariance inputs are derived using 40 years of monthly historical total returns spanning from 1975 to 2015 for each asset class and an exponential smoothing process that uses a half-life of seven years. The exponential smoothing process creates an ex-ante estimate by placing a greater emphasis on the more recent volatility and correlation of each asset class, while not ignoring the longer term behavior.

Table 4 summarizes the expected returns, volatilities and other attributes across the asset sub-classes in the opportunity set used to construct IOMVO income-oriented retirement portfolios. In order to limit individual asset sub-classes from dominating portfolio allocations, we imposed constraints on the possible allocation to each asset sub-class in a way that we believe matches the tolerance levels of most individual investors and their financial advisors. Table 4 also includes the income share of total return associated with each of the 15 asset sub-classes in the opportunity set which is represented in the context of the IOMVO optimization problem as  $R_I/R_T$ .  $R_I/R_T$  is estimated by computing the historical average of the ratio of monthly income return to monthly total return using an exponential smoothing process with a half-life of seven years. Estimates for  $R_I/R_T$  for each asset class are capped at 100%, and the ratio estimate for preferred stock was manually set to 80% due to its hybrid structure of equity and fixed income characteristics.

<sup>13</sup> The reference portfolio is inferred from Wilshire's Trust Universe Comparison Service (TUCS). TUCS data is provided to Wilshire Associates on a regular basis from various trust banks. This information includes the current asset allocation preferences of more than \$3.5 trillion of sponsor assets, encompassing approximately 1,500 plans.

Table 4: Opportunity Set of Asset Classes for Income-Oriented Retirement Portfolios

Asset	Proxy	Expected Ann. Total Return	Expected Ann. Volatility	Maximum Allocation	R <sub>t</sub> /R <sub>f</sub>
<b>Traditional Portfolio</b>					
Cash and Equivalents	<i>3-Month U.S. Treasury Bill</i>	2.50	2.20	40%	100%
Inflation-Protected Bonds	<i>Barclays U.S. TIPS</i>	3.10	6.40	40%	71%
Investment Quality Bonds	<i>Barclays U.S. Aggregate IG Bonds</i>	2.90	3.80	80%	81%
<b>U.S. Common Equities</b>					
Large-Cap Value Stocks	<i>Wilshire U.S. Large-Cap Value</i>	7.40	15.00	40%	28%
Large-Cap Growth Stocks	<i>Wilshire U.S. Large-Cap Growth</i>	7.40	15.70	40%	15%
Small-Cap Value Stocks	<i>Wilshire U.S. Small-Cap Value</i>	8.30	19.00	20%	20%
Small-Cap Growth Stocks	<i>Wilshire U.S. Small-Cap Growth</i>	8.60	20.30	20%	7%
<b>Extended Portfolio</b>					
High-Yield Bonds	<i>BAML High Yield Master II</i>	5.10	9.10	13%	100%
Global Bonds	<i>Barclays Global Treasury ex-U.S.</i>	3.50	7.80	13%	79%
<b>Non-U.S. Common Stocks</b>					
Developed Markets	<i>MSCI EAFE</i>	8.2	18.9	25%	35%
Emerging Markets	<i>MSCI Emerging Markets</i>	9.30	22.80	13%	25%
U.S. Preferred Stocks	<i>BAML Preferred Stock</i>	6.50	17.40	13%	80%
Commodities	<i>S&amp;P GSCI</i>	5.50	23.60	13%	0%
<b>Listed Real Estate</b>					
U.S. Equity REITs	<i>FTSE NAREIT All Equity REITs</i>	8.10	21.50	13%	44%
U.S. Mortgage REITs	<i>FTSE NAREIT Mortgage REITs</i>	5.80	18.80	5%	100%

Source: Wilshire Associates

Table 5 shows the expected (ex-ante) correlation matrix calculated from the exponentially smoothed covariance matrix. Both of the optimization models select assets partly based on their correlation coefficients: the lower the correlation coefficient between two assets, the higher diversification benefit that can be extracted by combining the assets.

Table 5: Expected Correlation Coefficients across Assets using Total Returns

	Cash and Equivalent	Inflation-Protected Bonds	Investment Quality Bonds	Large Value Stocks	Large Growth Stocks	Small Value Stocks	Small growth Stocks	High Yield Bonds	Global Bonds	Developed Market Stocks	Emerging Market Stocks	U.S. Preferred Stocks	Commodities	U.S. Equity REITs	U.S. Mortgage REITs
Cash and Equivalents	1.00	0.27	0.00	0.00	-0.01	-0.01	-0.01	-0.01	0.01	0.01	0.02	-0.01	-0.02	-0.01	-0.02
Inflation-Protected Bonds	0.27	1.00	0.50	0.08	0.09	0.05	0.05	0.28	0.56	0.16	0.18	0.26	0.23	0.26	0.24
Investment Quality Bonds	0.00	0.50	1.00	0.07	0.08	0.06	0.02	0.26	0.47	0.13	0.16	0.21	0.24	0.21	0.25
Large Value Stocks	0.00	0.08	0.07	1.00	0.80	0.83	0.82	0.63	0.15	0.74	0.69	0.63	0.45	0.63	0.45
Large Growth Stocks	-0.01	0.09	0.08	0.80	1.00	0.73	0.77	0.63	0.10	0.70	0.68	0.49	0.37	0.48	0.37
Small Value Stocks	-0.01	0.05	0.06	0.83	0.73	1.00	0.87	0.60	0.12	0.66	0.64	0.70	0.46	0.69	0.46
Small Growth Stocks	-0.01	0.05	0.02	0.82	0.77	0.87	1.00	0.61	0.07	0.69	0.72	0.55	0.40	0.55	0.40
High Yield Bonds	-0.01	0.28	0.26	0.63	0.63	0.60	0.61	1.00	0.29	0.62	0.67	0.63	0.41	0.62	0.41
Global Bonds	0.01	0.56	0.47	0.15	0.10	0.12	0.07	0.29	1.00	0.31	0.25	0.28	0.18	0.28	0.19
Developed Markets Stocks	0.01	0.16	0.13	0.74	0.70	0.66	0.69	0.62	0.31	1.00	0.74	0.51	0.32	0.51	0.33
Emerging Markets Stocks	0.02	0.18	0.16	0.69	0.68	0.64	0.72	0.67	0.25	0.74	1.00	0.49	0.35	0.48	0.34
U.S. Preferred Stocks	-0.01	0.26	0.21	0.63	0.49	0.70	0.55	0.63	0.28	0.51	0.49	1.00	0.47	0.14	0.07
Commodities	-0.02	0.23	0.24	0.45	0.37	0.46	0.40	0.41	0.18	0.32	0.35	0.47	1.00	0.58	0.46
U.S. Equity REITs	-0.01	0.26	0.21	0.63	0.48	0.69	0.55	0.62	0.28	0.51	0.48	0.14	0.58	1.00	0.47
U.S. Mortgage REITs	-0.02	0.24	0.25	0.45	0.37	0.46	0.40	0.41	0.19	0.33	0.34	0.07	0.46	0.47	1.00

Source: Wilshire Associates

### 3.4 Optimal Portfolios

We estimate optimal portfolios for an income oriented investor, at the end of 2015, across a range of risk preferences and income requirements under different asset allocation rules (1) without REITs, (2) with listed U.S. Equity REITs, and (3) with Equity and Mortgage REITs. Section 3.4.1 compares asset allocations between a traditional MVO framework and income oriented framework. Section 3.4.2 explores the role of real estate represented by REITs in enhancing the income oriented portfolio across a range of risk preferences and income requirements

The results in this section are based on risk preferences that range between 6% and 10%. While this is a fairly conservative range of risk tolerances, it is a reasonable range for an in-retirement investor population. While the midpoint 8% volatility target is a reasonable measure of risk tolerance among a broad spectrum of retirees, many financial advisors have become concerned that retirees may be too aggressive, or too conservative, and are making investment choices that increase the probability of having inadequate retirement wealth.<sup>14</sup> The assumed income requirements range between 3.0% and 3.5% income return. This range is roughly in-line with the 3 to 4% range often cited as a conservative income range. As noted above, this analysis does not factor in potential asset liquidation, so a slightly lower range of income targets is appropriate.

#### 3.4.1 Optimal Portfolios – Comparing Standard and Income Oriented Portfolios

To illustrate the impact of changing from a standard (MVO) approach to the income oriented (IOMVO) approach we consider the optimal portfolio of an opportunity set without real estate under each approach. For the purposes of this comparison we use risk and income targets at the center point of our range, 8% and 3.25%. We chose 3.25% as our base case because that is the maximum feasible income return (without REIT allocations) at an 8% risk tolerance. Figure 4 and Table 6 show the results. For a given risk tolerance, there will be a tradeoff between annual total return and annual income return. One way to think about the optimization process is essentially to minimize the reduction in total return while hitting the income return target.

- ☞ Impact of Income-Oriented Portfolio on Investment Objectives: Comparing annual income return, we see that the income oriented portfolio provides more than a third more income with a compounded annual return that is 25 basis points lower than the standard optimization. As noted above, the highest possible income that can be generated is 3.25%, given the allocation constraints and targeted risk of 8%. In the next section we will consider the impact of expanding the potential investment universe to include real estate in the form of Equity and Mortgage REITs.
- ☞ Use of Extended Portfolio in Income Oriented Portfolio: Table 6 shows that more than half of the capital (62.0%) is allocated into asset classes in what we termed the Extended Portfolio for the income oriented (IOMVA) portfolio; while the standard (MVO) portfolio only allocates slightly more than a quarter of its capital to the

*One way to think about the optimization process is essentially to minimize the reduction in total return while hitting the income return target*

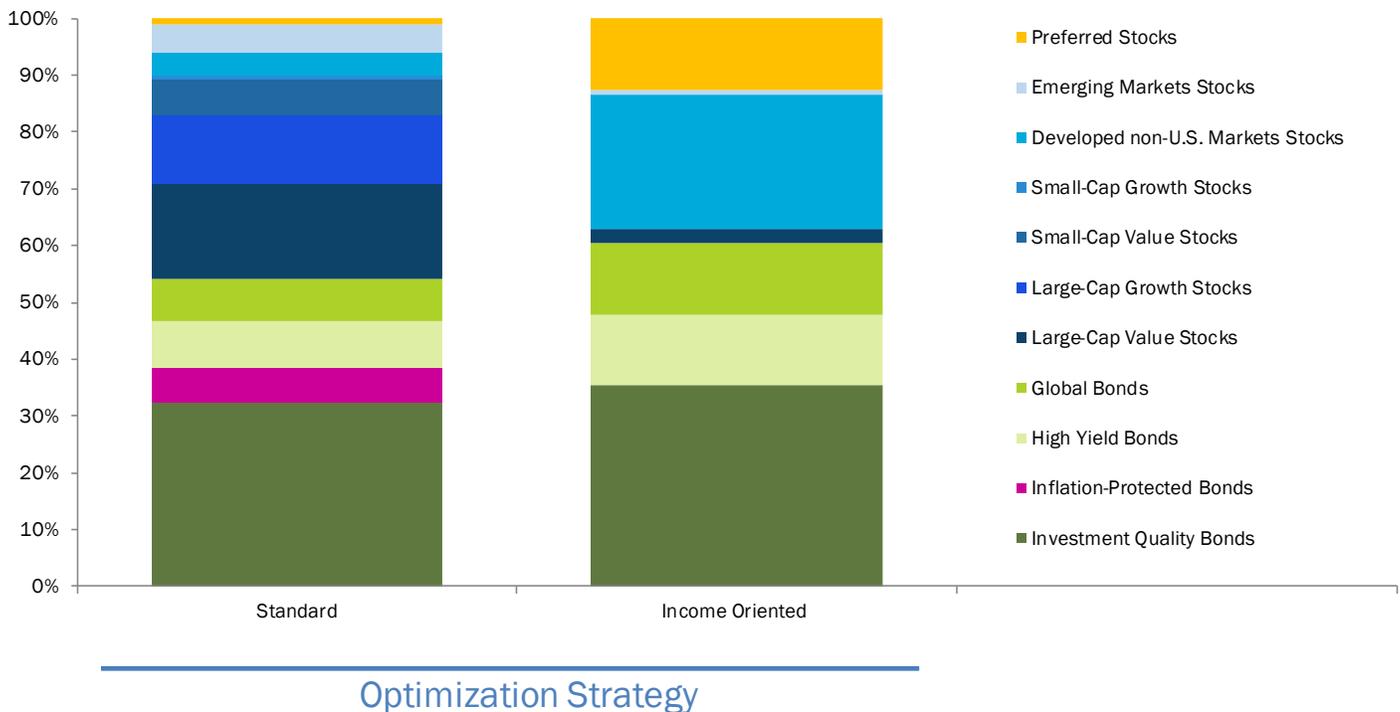
<sup>14</sup> For more on “certainty of inadequacy” see Javier Estrada, “The Glidepath Illusion: An International Perspective,” 2012 (<http://blog.iiese.edu/jestrada/files/2013/10/Glidepath.pdf>) and Robert D. Arnott, Katrina F. Sherrerd & Lillian Wu, “The Glidepath Illusion...and Potential Solutions,” *Journal of Retirement* 1(2):13-28, Fall 2013 (<http://www.ijournals.com/doi/abs/10.3905/jor.2013.1.2.013?journalCode=jor#sthash.Pz1DcOUy.dpbs>).

Extended Portfolio (26.2%). This illustrates the importance of the use of the broader universe of available assets.

☞ Transition to Income-Oriented Portfolio and “Shelf Space”: Comparing asset allocations between the standard and income oriented portfolios we see the transfer of allocations from traditional assets like TIPS and U.S. equities to those in the Extended Portfolio. Notably, the income oriented portfolio transfers a significant weight out of U.S. equities. U.S. equities decline from over 35% of the MVO portfolio to less than 3% of the IOMVO portfolio. Developed market global equities take a large share of that shelf space (rising from 4.1% to 23.5%) due to its relatively attractive income to total return ratio compared to the U.S. equity counterparts. Income producing assets also see increases in allocations. Preferred stocks rise from 1.15% of the MVO portfolio to 12.50% of the IOMVO portfolio. High yield and global bonds also increase to 12.5% of the IOMVO portfolio. Overall, we see a change in allocation towards income generation at the expense of total return.

☞ Constrained Assets: There are three assets that reach their constrained maximum: high-yield bonds, global bonds and preferred stocks. Not surprisingly, these three are the assets with the highest income generating potential when real estate allocations are not included.

**Figure 4: Optimal Portfolios, Comparing Traditional and Income Oriented Optimizations without REITs**



Source: Wilshire Associates

### 3.4.2 Optimal Portfolios – The Role of Real Estate in Income Oriented Portfolios

In this section we consider the impact on the optimal income oriented portfolio when we add real estate investments to the opportunity set and describe the changes to the portfolio across a spectrum of risk tolerances and income needs.

To illustrate the impact of real estate to the income oriented approach, we consider the optimal income oriented portfolio for an opportunity set: 1) excluding REITs (Table 6), 2) including Equity REITs, and 3) including both Equity and Mortgage REITs. For the purpose of this comparison we again start with baseline risk and income targets, 8% and 3.25%. Figure 5 and Table 7 display the results.

🔗 **Impact of REITs on Investment Objectives:** Comparing annual income return, we see that the addition of REITs to the opportunity set allows the portfolio to meet the key investment objectives of 8% risk and 3.25% annual income return, but with higher annual total returns. The addition of Equity REITs raises the annual total return by 9 basis points, and the inclusion of both equity and mortgage REITs raises the annual total return by 15 basis points.

🔗 **Impact on Shelf Space of Adding Equity REITs to the Opportunity Set:** When Equity REITs are included in the opportunity set the optimization process reallocates 14.6% of capital from global bonds and developed non-U.S. equities into U.S. large cap value (7.96%) and Equity REITs (7.63%). The balanced price appreciation and income yielding profiles of Equity REITs enable the portfolio to tilt away from asset classes like global bonds and developed non-U.S. equities which have exhibited relatively low risk-adjusted returns historically. The addition of income generating Equity REITs allows the portfolio to also increase its allocation to U.S. large cap value equities which has approximately the same total returns as developed non-U.S. equities, but exhibits the lowest risk level among all non-fixed-income assets in the opportunity set.

🔗 **Impact on Shelf Space of Adding Equity and Mortgage REITs to the Opportunity Set:** When both Equity and Mortgage REITs are included in the opportunity set the optimization process sets its allocation to Mortgage REITs at the 5% constraint because Mortgage REITs are the highest yielding asset class in the opportunity set. The allocation to Mortgage REITs comes in part from Equity REITs and in part from preferred stock and developed non-U.S. equities. The addition of Mortgage REITs also allows an increased allocation to U.S. large cap value which provides less income, but higher total returns, with relatively low volatility.

**Table 6: Allocations of Standard and Income Oriented Portfolios**

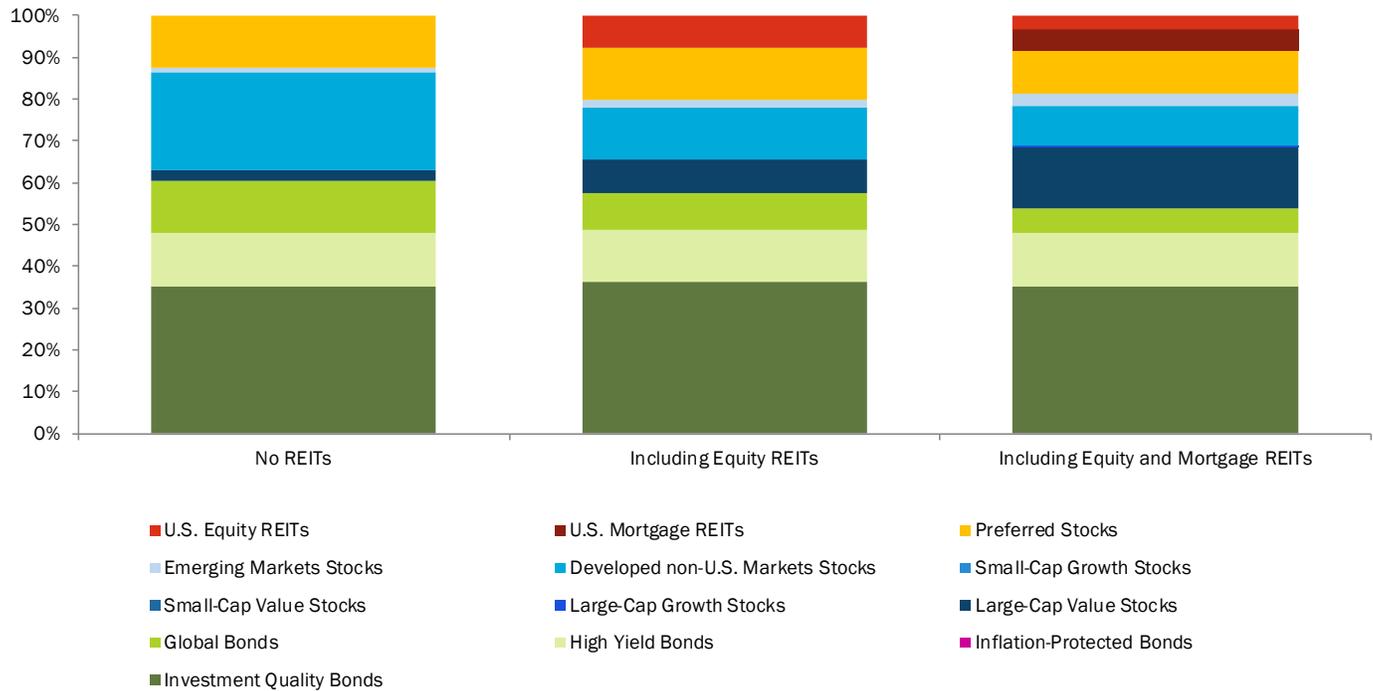
Asset	Optimization Approach	
	Standard	Income Oriented
Cash & Equivalents	0.00	0.00
Investment Quality Bonds	32.24	35.39
Inflation-Protected Bonds	6.07	0.00
Large-Cap Value Stocks	16.777	2.64
Large-Cap Growth Stocks	12.05	0.00
Small-Cap Value Stocks	6.05	0.00
Small-Cap Growth Stocks	0.59	0.00
High Yield Bonds	7.98	12.50
Global Bonds	7.47	12.50
Developed non-U.S. Markets Stocks	4.11	23.47
Emerging Markets Stocks	4.91	1.01
Commodities	0.61	0
Preferred Stock	1.15	12.50
Equity REITs	NA	NA
Mortgage REITs	NA	NA

Portfolio Performance		
Annual Total Return	5.37	5.12
Annual Income Return	2.37	3.25
Expected Volatility	8.00	8.00
Satisfies Income Target?	No	Yes

Source: Wilshire Associates

Figure 5: Optimal Portfolios: Comparing Income Oriented Optimizations With and Without REITs



Source: Wilshire Associates

Table 7: Allocations of Income Oriented Portfolios with and without Real Estate

Asset	No REITs	Including Equity REITs	Including Equity and Mortgage REITs
Cash and Equivalents	0.00	0.00	0.00
Investment Quality Bonds	35.39	36.21	35.36
Inflation-Protected Bonds	0.00	0.00	0.00
Large-Cap Value Stocks	2.64	7.96	14.57
Large-Cap Growth Stocks	0.00	0.00	0.53
Small-Cap Value Stocks	0.00	0.00	0.00
Small-Cap Growth Stocks	0.00	0.00	0.00
High Yield Bonds	12.50	12.50	12.50
Global Bonds	12.50	8.91	6.06
Developed non-US Markets Stocks	23.47	12.41	9.23
Emerging Markets Stocks	1.01	1.87	3.24
Commodities	0	0	0
Preferred Stock	12.50	12.50	10.23
U.S. Equity REITs	0.00	7.63	3.27
U.S. Mortgage REITs	0.00	0.00	5.00
<b>Portfolio Performance</b>			
Annual Total Return	5.12	5.21	5.27
Annual Income Return	3.25	3.25	3.25
Expected Volatility	8.00	8.00	8.00
Satisfies Income Target?	Yes	Yes	Yes

Source: Wilshire Associates

## Optimal Allocations Under Alternative Risk Preferences and Income Requirements

Next we consider the optimal income oriented portfolios across a broader range of risk preferences and income targets. Figures 6 and 7 show the optimal income oriented portfolios for opportunities including equity and Equity and Mortgage REITs respectively across risk tolerances ranging from 6% to 10% and income requirements ranging from 3.00% to 3.50% of starting principal.<sup>15</sup> The center bar in each figure is the baseline case of 3.25% income return and 8% risk tolerance. It is noteworthy that not all income return targets are feasible under all risk tolerances. For example, among all the combinations, only the one including both Equity and Mortgage REITs with the 10% risk tolerance is able to achieve a 3.5% income target.

### Using Only Equity REITs in the Opportunity Set:

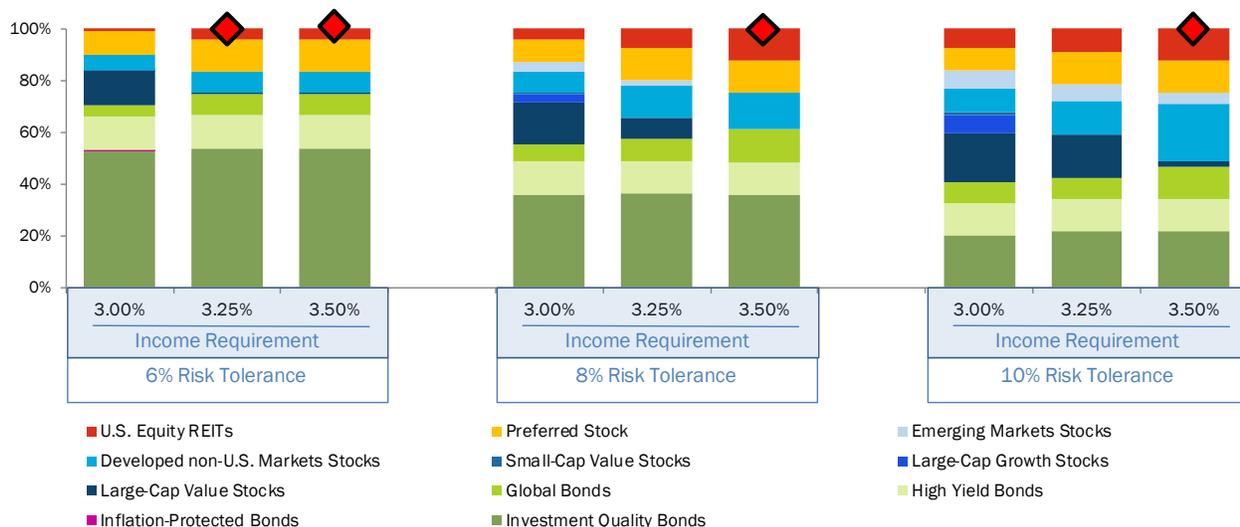
- ☞ **Impact of Risk Tolerance on Asset Allocations:** As risk tolerance rises, allocations to equities increase as a share of the total portfolio, crowding out fixed income assets. Portfolios also tend to shift from investment quality bonds to foreign assets such as global bonds and developed non-U.S. equities as risk tolerance increases. The share of Equity REITs in the portfolio generally increases with risk tolerance as well. At the 3.25% income target, the Equity REIT allocation rises from 4.16% to 9.08% between a 6% and 10% risk tolerance.
- ☞ **Impact of Income Requirements on Asset Allocations:** As income requirements rise, allocations to income-generating assets such as preferred stocks and Equity REITs increase while allocations to investment quality bonds generally decline. Developed non-U.S. equities also tend to take over the role of large cap value domestic equity as the largest-weighted equity asset class when the income requirement rises. At the 8% risk tolerance, the Equity REIT allocation likewise rises from 4.31% to 12.37% between a 3% and 3.5% income requirement.
- ☞ **Minimum and Maximum REIT Allocations:** The minimum Equity REIT allocation of 1.15% occurs at the most conservative risk tolerance of 6% and the lowest income requirement of 3%. The maximum Equity REIT allocation of 12.5% occurs at 10% risk and a 3.5% income requirement.
- ☞ **Impact of Lower Risk Tolerance Level:** At a 6% risk tolerance level, the portfolio with a lower income requirement of 3.00% can satisfy the income target with a 1.15% allocation to Equity REITs; however, as the income requirement increases to 3.25% and 3.50%, the low risk tolerance portfolio is no longer able to meet the income target even with significant asset allocation shifts from large cap value domestic equity positions to global bonds, non-U.S. equities, preferred stocks and Equity REITs. The maximum income achievable with a 6% risk tolerance level is 3.20%, with a 4.16% allocation to Equity REITs.
- ☞ **Impact of Higher Risk Tolerance Levels:** For an 8% and a 10% risk tolerance, the maximum income level achievable is 3.35% and 3.40%, respectively. For both the medium and the high risk tolerance scenarios, portfolios significantly increase allocations to Equity REITs to move closer to the higher income target. Given an 8% risk tolerance, the Equity REITs allocation is raised from 4.31% to 12.37% when the income target changes from 3.00% to 3.50% although the highest achievable income return is on 3.35%. Given a 10% risk tolerance, the Equity REITs allocation rises from 7.25% to the maximum allocation of 12.50%, although the highest achievable income return is on 3.4%.

<sup>15</sup> See Appendix Tables for portfolio composition and performance details.

### Using Both Equity and Mortgage REITs in the Opportunity Set:

- 🔗 **Role of Mortgage REITs:** The income-oriented portfolios favor Mortgage REITs and always allocate more than 4% to this asset sub-class under all scenarios from combinations of the three different risk tolerance levels and the three income targets.
- 🔗 **Mortgage REITs Investment Attributes:** When Mortgage REITs are added to the investable universe, with its higher income generating capability than all the other asset sub-classes considered, portfolios at each risk tolerance level are able to achieve higher maximum incomes, thus are more likely to satisfy income targets compared to using only Equity REITs.
- 🔗 **Impact of Risk Tolerance Levels on Allocations to Mortgage and Equity REITs:** With the three risk tolerance levels, the income-oriented portfolio is always able to meet the medium income requirement of 3.25%, and under all the three scenarios the portfolio always maximizes the allocation to Mortgage REITs to 5%, while the Equity REITs allocation increases from zero for a 6% risk tolerance level to 6.32% for a 10% risk tolerance level.
- 🔗 **Role of Mortgage and Equity REITs in Meeting Income Targets:** As noted above, no portfolio among the three different risk tolerance settings is able to hit the 3.5% income target when Mortgage REITs are not in the universe. However, the addition of Mortgage REITs to the universe enables the income-oriented portfolio with 10% risk tolerance to satisfy the highest income requirement of 3.5% with an 11.02% allocation to Equity REITs and a 5% allocation to Mortgage REITs.

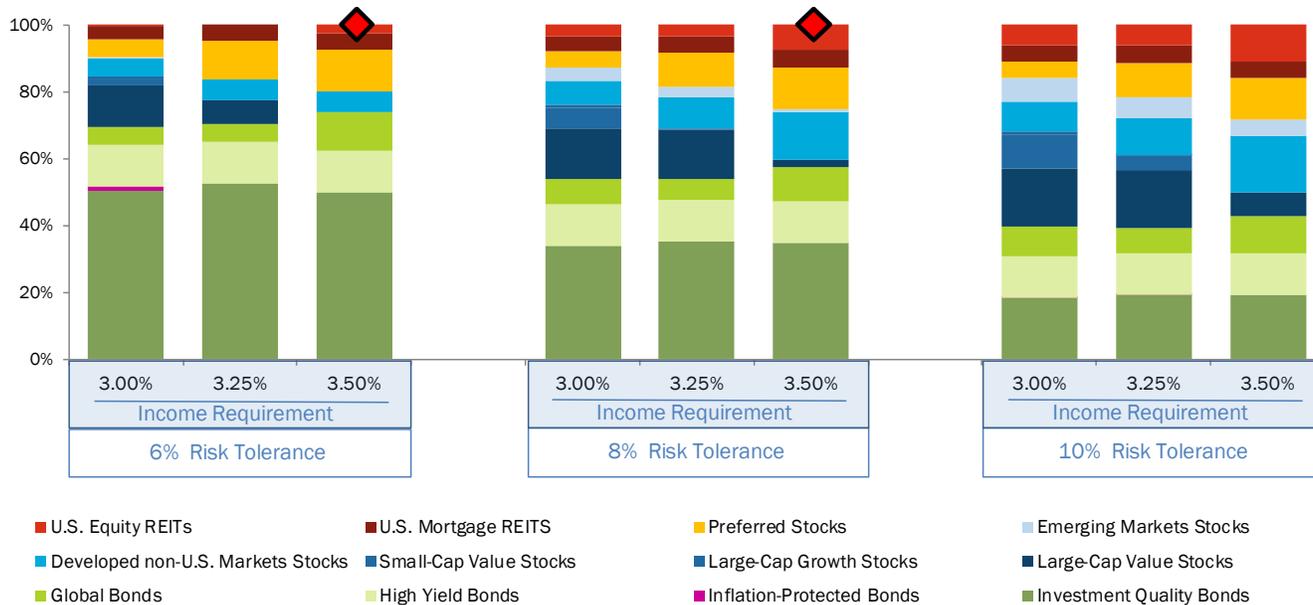
**Figure 6: Optimal Portfolios: Income Oriented Optimizations across Risk Tolerances and Income Targets Including Equity REITs**



The red diamonds indicate that the income target is not achievable given the opportunity set and risk tolerance settings. The maximum achievable income returns are 3.20%, 3.35%, and 3.40% for 6%, 8%, and 10% risk tolerance levels respectively.

Source: Wilshire Associates

Figure 7: Optimal Portfolios: Income Oriented Optimizations Across Risk Tolerances and Income Targets Including Equity and Mortgage REITs



The red diamonds indicate that the income target is not achievable given the opportunity set and risk tolerance settings. The maximum achievable income returns are 3.38% and 3.48% for 6% and 10% risk tolerance levels respectively.

Source: Wilshire Associates

### 3.5 Implementing the Optimal Income Generating Portfolio

The IOMVO framework discussed above provides investment advisors with a useful perspective of how to construct a balanced portfolio with a given client risk tolerance level and a prescribed income requirement. Specific takeaways from this analysis include, but are not limited to:

- 🔗 Listed REITs provide income and diversification benefits due to their idiosyncratic return features.
- 🔗 The income generating capability of a retirement portfolio is likely to benefit from the use of REITs, specifically Equity and/or Mortgage REITs.
- 🔗 Clients with greater risk tolerance or with higher income targets may want to consider adding a larger allocation to REITs in lieu of a high concentration to lower-risk assets such as U.S. bonds.

## 4. CONCLUSION

This paper introduces a new adaptation of a widely accepted analytical approach specifically developed to optimize income-oriented retirement portfolios. By extending the traditional optimization framework of modern portfolio theory, we demonstrate how individual retirement portfolios can be constructed to provide income while limiting risk to pre-determined levels. The model results show that an income generating portfolio has several unique attributes that differentiate it from the standard optimal portfolio.

The income-oriented portfolio provides less annual total return, but a greater income return. For many retirees this may be the appropriate trade-off.

The extended portfolio of investment opportunities is a critical component of the income-oriented portfolio. The paper demonstrates that extended portfolio assets make up more than half of the income-oriented portfolio.

Compared to the traditional portfolio, the income-oriented portfolio increases allocations to securities that provide steady income returns, including high yield and global bonds, non-U.S. stocks, preferred stocks, and REITs.

The addition of REITs to the opportunity set improves the performance of the income-oriented portfolio. REITs account for up to 16 percent of the optimal income-oriented portfolio in the highest income requirement and risk tolerance case. Because of their low correlation with other asset classes and high dividend rates, the addition of stock exchange-listed REITs to the retirement portfolio is critical to achieving the goal of generating a stable income with a reasonable level of risk tolerance.

The income-oriented framework values the income generating potential of REITs. The income-oriented approach produces a REIT allocation that is double the allocation produced by the traditional optimization framework for a mid-retirement individual.<sup>16</sup>

The application of an IOMVO (Income-Oriented Mean-Variance Optimization) methodology delivers a diversified portfolio that accounts for various market uncertainties, while allowing investors to increase their level of income with a comparable level of risk. Based on the data and analysis summarized throughout the paper, we demonstrate that an allocation to REITs not only increases the expected long-term investment performance and diversification benefits of an investment portfolio, but may be necessary to meet many common income and volatility goals. REITs have historically delivered high and stable dividends, competitive total returns, and inflation protection, making these assets a desirable investment in one's investment portfolio.

The IOMVO framework reveals that future retirees may benefit from a combined Equity and Mortgage REIT ranging from low single digits up to 16% depending on risk tolerance and income needs. Ultimately, a meaningful allocation to REITs facilitates stable portfolio income over longer periods of time.

*By extending the traditional optimization framework of modern portfolio theory, we demonstrate how individual retirement portfolios can be constructed to provide income while limiting risk to pre-determined levels*

<sup>16</sup> Wilshire Associates, "The Role of REITs and Listed Real Estate in Target Date Fund Allocations," 2016. <https://www.reit.com/data-research/research/wilshire-research-new-results-optimizing-target-date-fund-performance-reits>

## APPENDIX TABLES

Income Requirement = 3.00%									
Asset	No REITs			Equity REITs			Equity and Mortgage REITs		
	Risk Tolerance			Risk Tolerance			Risk Tolerance		
	6%	8%	10%	6%	8%	10%	6%	8%	10%
Cash and Equivalents	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investment Quality Bonds	51.84	34.04	17.67	52.50	36.03	20.31	50.43	34.03	18.26
Inflation-Protected Bonds	1.02	1.10	0.87	0.77	0.00	0.00	1.16	0.00	0.01
Large-Cap Value Stocks	13.20	17.33	20.54	13.05	16.20	18.69	12.60	15.19	17.61
Large-Cap Growth Stocks	0.00	2.26	5.24	0.02	3.60	7.41	1.74	6.14	10.07
Small-Cap Value Stocks	0.78	3.23	5.22	0.19	0.55	0.73	0.62	0.80	1.00
Small-Cap Growth Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High Yield Bonds	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Global Bonds	5.04	7.19	9.42	4.77	6.46	7.86	5.28	7.25	8.68
Developed non-U.S. Markets Stocks	5.93	7.89	9.59	5.90	7.71	9.34	5.48	7.15	8.74
Emerging Markets Stocks	0.16	3.75	6.87	0.23	3.80	6.95	0.59	4.04	7.19
Commodities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Preferred Stocks	9.52	10.70	12.06	8.92	8.83	8.96	5.24	5.09	5.01
U.S. Equity REITs	NA	NA	NA	1.15	4.31	7.25	0.24	3.42	6.29
U.S. Mortgage REITs	NA	NA	NA	NA	NA	NA	4.12	4.39	4.63

Portfolio Performance									
Annual Total Return	4.51	5.32	6.05	4.51	5.32	6.07	4.53	5.34	6.09
Annual Income Return	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Expected Volatility	6.00	8.00	10.00	6.00	8.00	10.00	6.00	8.00	10.00
Satisfies Income Target?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Income Requirement = 3.25%									
Asset	No REITs			Equity REITs			Equity and Mortgage REITs		
	Risk Tolerance			Risk Tolerance			Risk Tolerance		
	6%	8%	10%	6%	8%	10%	6%	8%	10%
Cash and Equivalents	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investment Quality Bonds	50.63	35.39	21.20	53.88	36.21	21.75	52.50	35.36	19.28
Inflation-Protected Bonds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Large-Cap Value Stocks	5.08	2.64	8.51	0.50	7.96	16.61	7.01	14.57	17.21
Large-Cap Growth Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	4.46
Small-Cap Value Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Small-Cap Growth Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High Yield Bonds	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Global Bonds	10.11	12.50	12.50	8.28	8.91	8.06	5.36	6.06	7.46
Developed non-U.S. Markets Stocks	9.17	23.47	25.00	8.18	12.41	13.23	6.14	9.23	10.90
Emerging Markets Stocks	0.00	1.01	7.79	0.00	1.87	6.27	0.00	3.24	6.47
Commodities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Preferred Stocks	12.50	12.50	12.50	12.50	12.50	12.50	11.49	10.23	10.34
U.S. Equity REITs	NA	NA	NA	4.16	7.63	9.08	0.00	3.27	6.32
U.S. Mortgage REITs	NA	NA	NA	NA	NA	NA	5.00	5.00	5.00

Portfolio Performance									
Annual Total Return	4.40	5.12	5.90	4.34	5.21	5.99	4.40	5.27	6.03
Annual Income Return	3.15	3.25	3.25	3.20	3.25	3.25	3.25	3.25	3.25
Expected Volatility	6.00	8.00	10.00	6.00	8.00	10.00	6.00	8.00	10.00
Satisfies Income Target?	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes

## APPENDIX TABLES (CONTINUED)

Income Requirement = 3.50%									
Asset	No REITs			Equity REITs			Equity and Mortgage REITs		
	Risk Tolerance			Risk Tolerance			Risk Tolerance		
	6%	8%	10%	6%	8%	10%	6%	8%	10%
Cash and Equivalents	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investment Quality Bonds	50.63	35.39	21.20	53.88	35.96	21.71	50.01	34.57	19.12
Inflation-Protected Bonds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large-Cap Value Stocks	5.08	2.64	8.51	0.50	0.00	1.83	0.00	2.35	7.06
Large-Cap Growth Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small-Cap Value Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Small-Cap Growth Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
High Yield Bonds	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
Global Bonds	10.11	12.50	12.50	8.28	12.50	12.50	11.33	10.39	11.29
Developed non-U.S. Markets Stocks	9.17	23.47	25.00	8.18	14.17	22.62	6.08	14.27	16.97
Emerging Markets Stocks	0.00	1.01	7.79	0.00	0.00	3.84	0.00	0.73	4.54
Commodities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Preferred Stocks	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
U.S. Equity REITs	NA	NA	NA	4.16	12.37	12.50	2.58	7.69	11.02
U.S. Mortgage REITS	NA	NA	NA	NA	NA	NA	5.00	5.00	5.00

Portfolio Performance									
Annual Total Return	4.40	5.12	5.90	4.34	5.09	5.87	4.29	5.13	5.91
Annual Income Return	3.15	3.25	3.25	3.20	3.35	3.40	3.35	3.45	3.50
Expected Volatility	6.00	8.00	10.00	6.00	8.00	10.00	6.00	8.00	10.00
Satisfies Income Target?	No	No	No	No	No	No	No	No	Yes

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### Wilshire Advisor Solutions

1299 Ocean Avenue, Suite 700  
Santa Monica, CA 90401  
Phone: 1-855-626-8281  
wilshire.com