Porter, White & Company

Optimizing the Fixed Income Component of a Portfolio

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In the White Paper, *Comparison of Fixed Income Fund Performance*, we show that a short-term bond index outperforms an intermediate term bond index on a risk-adjusted basis for a primarily fixed income portfolio. However, for a portfolio with a substantial equity allocation, an intermediate term bond index fund may be preferred. Two sample portfolios are shown in Table 1 below; the portfolio with intermediate fixed income has a higher return for the same level of risk as shown in Table 2.

Table 1: Portfolio Allocations

	Portfolio 1	Portfolio 2
Equity	61%	60%
Short Term Fixed Income	39%	0%
Intermediate Fixed Income	0%	40%

Note: Equity, Short Term Fixed Income, and Intermediate Fixed Income are represented by the S&P 500, the Merrill Lynch US Treasury Index 1-3 Years, and the Barclays Capital US Government Bond Index Intermediate, respectively. See "Important Disclosure Note" and "Sources & Descriptions of Data" for disclosure information.

Table 2: Portfolio Performance

(Annualized monthly returns, from July 1977 to July 2009)

	Portfolio 1	Portfolio 2
Return	9.7%	9.9%
Risk	9.7%	9.7%

See "Important Disclosure Note" and "Sources & Descriptions of Data" for disclosure information.

A portfolio with 60% equity and 40% Intermediate Fixed Income has historically outperformed a similar portfolio (with slightly more equity) with a Short Term Fixed Income component.

This paper investigates the theoretical basis for including intermediate term bonds in portfolios with substantial equity allocations and explores the level of equity where intermediate fixed income becomes the preferred choice.

The discussion herein should be understood in light of the Important Notice at the end.

I. Modern Portfolio Theory Explanation

Modern portfolio theory provides insight into the return and volatility characteristics of a combination of two or more investments. The equations in Table 3 below show the formulas to calculate expected return and variance for a multi-asset portfolio as well as a two asset portfolio (i.e., stocks and bonds).

Table 3: Modern Portfolio Theory Equations

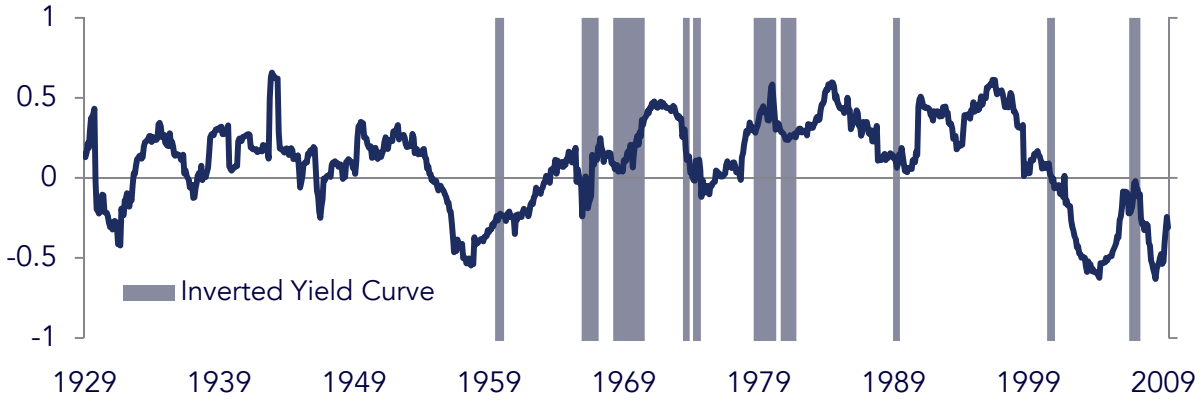
		Multi-asset Portfolio	Two Asset Portfolio
Return	$E(R_p)$	$= \sum_i w_i E(R_i)$	$= w_A E(R_A) + w_B E(R_B)$
Variance	σ_p^2	$= \sum_i \sum_j w_i w_j \sigma_i \sigma_j \rho_{ij}$	$= w_A^2 \sigma_A^2 + w_B^2 \sigma_B^2 + 2 w_A w_B \sigma_A \sigma_B \rho_{AB}$
Standard Deviation	σ_p	$= \sqrt{\sigma_p^2}$	$(w_A + w_B = 1)$

The expected return of a portfolio is the weighted average of the expected return of the components. The variance of the portfolio also includes a weighted average component of the individual variances as well as a "co-variance" term that includes correlation (ρ). There are two important aspects to note about computing portfolio variance. First, the portfolio weights of included assets are squared which causes the smaller components of the portfolio to contribute disproportionately less to the overall portfolio variance. Second, to the extent the correlation between two portfolio components is negative, the portfolio variances will be lower than the weighted average, and vice-versa if the correlation is positive.

II. Historical Stock-Bond Correlations

Historically, stock and bond returns generally exhibit a weak, positive correlation. However, the correlation is not stable through time and varies considerably, and there have been sustained periods of negative correlation, including a period as long as 10 years from 1955-1964.

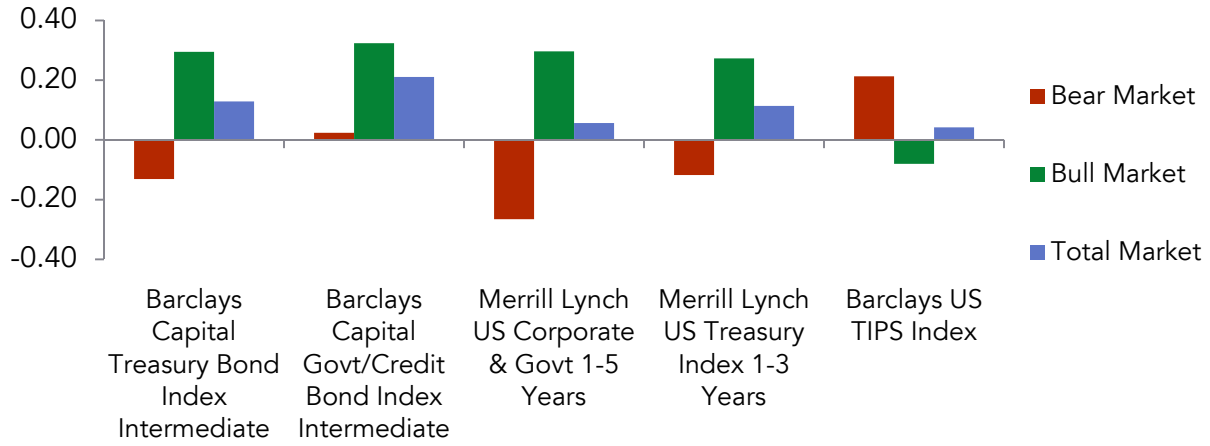
Figure 1: Average Monthly Correlations between Stocks and Bonds



Note: Trailing 3 year stock-bond correlations are shown. The Barclays Capital Treasury Bond Index Intermediate correlation with stocks was equivalent to the 5-Year Treasury correlation with stocks. The CRSP market index was used for stock return data in the correlation calculation. Inverted yield curve for periods in which the yield curve was inverted for at least 6 consecutive months using the 1-Year for short term rates and the 20-Year and 30-Year for long term rates. Bond yield data for yield curve calculation available starting in April 1953 through May 2009.

For a portfolio with equities, fixed income investments play the role of reducing risk. An equity investor particularly cares about the stock-bond correlation during down markets (or bear markets). Negative stock-bond correlations imply that bonds have a positive return, which can reduce some of the losses from the equity exposure. Monthly correlations for fixed income asset classes, containing varying credit and term risk, with equity are shown below in Figure 2. The figure shows that the correlations are substantially lower during bear markets compared to bull markets for every fixed income asset class except TIPS. The correlation drops as the credit risk drops for the intermediate term indexes.

Figure 2: Monthly Stock-Bond Correlations with Varying Equity Market Trends



Equity is represented by the S&P 500. All historical data from 1/1973 to 6/2009 is included for which data is available.[1] See "Important Disclosure Note" and "Sources & Descriptions of Data" for disclosure information. Bull and bear markets are defined in hindsight using cumulative monthly returns. A bear market (1) begins with a negative monthly return, (2) must achieve a cumulative return less than or equal to -10%, and (3) ends at the most negative cumulative return prior to achieving a positive cumulative return. All data points which are not considered part of a bear market are designated as a bull market.

III. Academic Literature Review

Based on data from January 1991 to August 2006, Anderssona et al. (2008) show that positive stock-bond correlations are associated with high inflation expectations as measured by the level of CPI growth expectation and negative stock-bond correlations are associated with low levels of inflation expectation. High (low) inflation expectations cause higher (lower) bond yields and result in lower (higher) bond prices and returns. Ilmanen (2003) shows that even though high inflation affects both the discount rate and cash flows used to value stocks, the effect on the discount rate dominates causing stocks to fall when inflation is high.

[1] The Barclays Capital Treasury Bond Index Intermediate and Barclays Capital Govt/Credit Index Intermediate date back to January, 1973. The Merrill Lynch US Treasury Index 1-3 Years dates back to July, 1977. The Merrill Lynch US Corporate & Govt 1-5 Years dates back to May, 1986. The Barclays US TIPS data dates back to March, 1977.

Consequently, stocks and bonds move together during periods of high inflation expectations. Anderssona et al. (2008) also show that high levels of market uncertainty as measured by the VIX and VDAX coincide with negative stock-bond correlations and low levels of market uncertainty coincide with positive stock-bond correlations. High levels of market uncertainty increase the equity risk premium and a 'flight to quality' results in a decoupling of stock and bond returns as investors move capital out of stocks and into bonds.

IV. Portfolio Analysis

For the portfolios in Table 2 above, the PW&Co Fixed Income Composite component of the portfolio (which includes primarily short term fixed income) exhibited superior risk-adjusted performance compared to the intermediate term fixed income portfolio as measured by the ratio of return to standard deviation on a stand-alone basis. The overall portfolio, composed predominantly of equity, performed better with the intermediate fixed income, however, due to the differing impact the two fixed income components had on the total portfolio. Both fixed income funds were negatively correlated with equities over the time period as shown in Table 4.

Table 4: Portfolio Component Returns, Standard Deviation and Correlations

(Annualized monthly returns, from January 1998 to December 2008)

	PWCO Composite Equity	PWCO Composite Fixed Income	Intermediate Fixed Income
Return	5.0%	4.8%	6.2%
Standard Deviation	16.2%	2.1%	5.6%
Correlation			
PW&Co Composite Fixed Income	-0.18	1.00	0.77
Intermediate Fixed Income	-0.01	0.77	1.00

Within portfolios that contain a majority of equity, the volatility of the fixed income portion contributes very little to the volatility of the overall portfolio. The variance term of the overall portfolio variance is computed as the sum of the products of the squared weightings of each portfolio component and its variance. Lower fixed income standard deviation does not necessarily lead to lower overall portfolio volatility under a negative stock-bond correlation scenario.

Additionally, even though short term fixed income showed a stronger inverse correlation than the intermediate term fixed income with the equity component of the portfolio, the intermediate term fixed income provided a greater diversification benefit because of its higher standard deviation being multiplied by a negative correlation to reduce portfolio variance. The volatility for short term fixed income is expected to be lower than for intermediate term fixed income.

To better understand when intermediate fixed income becomes preferable for inclusion in a portfolio, we calculate the return and standard deviation for different levels of equity (0 to 100%), as shown in Figure 3. The underlying data table shows the actual numbers for cases up to 60% equity.

Figure 3: S&P 500 with Short and Intermediate Term Fixed Income Funds

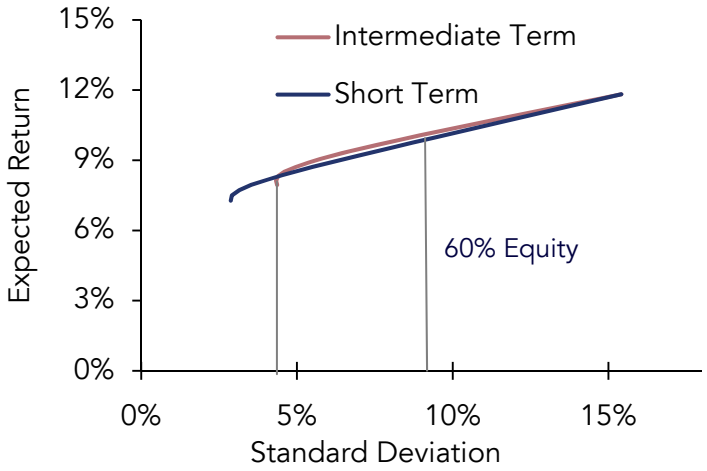


Table 5: Risk and Return with Fixed Income Funds

(Annualized monthly returns, from July 1977 to June 2009)

Portfolio Equity (% of Portfolio)	0%	10%	15%	20%	30%	35%	40%	50%	60%
Portfolio includes Short Term									
Return	*7.3*	*7.7*	*8.0*	*8.2*	8.6	8.9	9.1	9.5	10.0
Standard Deviation	*2.9*	*3.2*	*3.5*	*4.1*	5.2	5.9	6.6	8.0	9.5
Sharpe Ratio	*0.52*	*0.60*	*0.63*	*0.59*	0.54	0.53	0.50	0.46	0.44
Portfolio includes Intermediate Term									
Return	8.0	*8.3*	*8.5*	*8.7*	*9.1*	*9.3*	*9.5*	*9.9*	*10.3*
Standard Deviation	4.4	*4.4*	*4.6*	*5.0*	*5.9*	*6.4*	*7.0*	*8.3*	*9.6*
Sharpe Ratio	0.50	*0.57*	*0.59*	*0.58*	*0.56*	*0.55*	*0.53*	*0.50*	*0.47*

Note: Returns on optimal portfolios shown in *italics*, where others are grayed out. Short Term fixed income is represented by the Merrill Lynch US Treasury Index 1-3 Years. Intermediate Term fixed income is represented by the Barclays Capital Treasury Bond Index Intermediate. Equity is represented by the S&P 500. The return on One Month Treasury Bills was 5.79% over the time period which was the risk free rate used in the Sharpe Ratio calculation. See "Important Disclosure Note" and "Sources & Descriptions of Data."

The portfolio with intermediate fixed income included is at a minimum standard deviation with no equity. However, this portfolio is not optimal because the short term fixed income portfolio with 15% equity offers the same return for less risk compared to the intermediate fixed income portfolio with no equity. Accordingly, the Sharpe Ratio is higher for the short term fixed income portfolio (0.63 versus 0.50). An intermediate portfolio with 10% equity has the same return and risk as a portfolio with short term fixed income included with slightly greater than 20% equity. Both portfolios have a return and standard deviation of 8.2% and 4.6%, respectively (although the amount of equity differs). As the equity allocation is increased for the intermediate portfolio, the intermediate portfolio returns more for the same amount of risk taken with the short term fixed income portfolio. A 30% equity allocation for the intermediate portfolio and 35% equity allocation for the short term fixed income portfolio both yield standard deviations of 5.9, but the return for the intermediate portfolio is the same (9.1 versus 8.9). For port-

folios that are limited to a risk level consistent with a standard deviation of less than 4.4%, only the short-term fixed income portfolio is feasible with an equity allocation of less than 30%. For portfolios that can take risk in excess of that level (4.4%), the intermediate fixed income fund is appropriate with an equity allocation of 10% or greater.

An alternative to measuring risk as standard deviation of returns is to look at the number of negative returns periods as well as the minimum quarterly return. Since behavioral theory suggests that individuals are loss averse, we should also consider the portfolio that minimizes the number of loss periods and the size of any such loss. The measurements are shown in Table 6.

Table 6: Alternate Portfolio Risk Measurements

(Annualized monthly returns, from July 1977 to June 2009)

Portfolio Equity (% of Portfolio)	0%	10%	15%	20%	30%	35%	40%	50%	60%
Portfolio includes Short Term									
Negative Quarters (#)	*8*	*9*	*15*	21	28	31	32	34	34
Min Quarterly Return (%)	-2.5	-2.5	-2.6	-2.6	-5.0	-6.2	-7.5	-10.0	-12.4
Portfolio includes Intermediate Term									
Negative Quarters (#)	31	21	20	*23*	30	35	35	36	35
Min Quarterly Return (%)	-3.9	-3.8	-3.8	-3.8	-3.8	*-5.0*	*-6.4*	*-9.1*	*-11.8*

See "Important Disclosure Note" and "Sources & Descriptions of Data."

When considering the number of negative quarters, the short term portfolio is preferred for every equity allocation except the 20% level. Based on minimum quarterly return, the short term portfolio is preferred up to the 30% equity level after which the intermediate portfolio is preferred. These statistical preferences are consistent with the return and standard deviation analysis above.

V. Conclusion

This paper recommends extending duration (to the intermediate term range) on the fixed income portion of a portfolio that includes more than a 30% equity allocation, especially under low inflation expectations and high market uncertainty conditions. This approach focuses on taking advantage of the volatility-correlation relationships between asset classes rather than maximizing the expected risk-adjusted return of the fixed income component. Other considerations such as short term disbursements or existence of short term liabilities may create a need for an allocation to short-term fixed income. However, for a long-term investment account with a large allocation to equities (greater than 30%), intermediate fixed income is preferred.

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September 2009

Important Notice

This paper is intended to provide information to investors. Whether to invest in the intermediate term bond asset class is a decision to be made on the basis of current market conditions and the circumstances of each investor. In addition, investors should be aware of the investment principles listed below.

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iii. Fixed income securities are subject to interest rate risk because the prices of fixed income securities tend to move in the opposite direction of interest rates. In general, fixed income securities with longer maturities are more sensitive to these price changes and may experience greater fluctuation in returns.
iv. The returns and other characteristics of the allocation mixes contained in this presentation are based on models and back-tested simulations to demonstrate broad economic principles. They were achieved with the benefit of hindsight and do not represent actual investment performance.
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x. Economic factors, market conditions, and investment strategies will affect the performance of any portfolio and there are no assurances that it will match or outperform any particular benchmark.

VI. Appendix

A. Bibliography

Anderssona, M., Krylova, E., & Vahamaa, S. (2008). Why does the correlation between stock and bond returns vary over time? *Applied Financial Economics* , 139-151.

Ilmanen, A. (2003). Stock-bond correlations. *Journal of Fixed Income* , 55-66.

B. Sources & Descriptions of Data

PW&Co Composite Fixed Income
Includes all fixed income investment for all clients since inception date of December 31, 1997, net of all advisory fees, mutual funds fees and other related expenses.

PW&Co Composite Equity
Includes all equity investment for all clients since inception date of December 31, 1997, net of all advisory fees, mutual funds fees and other related expenses.

Vanguard Intermediate-Term Bond Index Fund
Vanguard Intermediate-Term Bond Index net of all fees (but not including any PWCO advisory fees).

The S&P 500
Total returns net of all fees in US$
The S&P Data are provided by Standard & Poor's Index Services Group

Barclays Capital Treasury Bond Index Intermediate
November 2008 - present: Barclays Capital Treasury Bond Index Intermediate Total returns in USD
January 1973 - October 2008: Lehman Brothers Intermediate Treasury Bond Index
Maturity range 1-10 years
Source: Barclays Capital

Barclays Capital US Government/Credit Bond Index Intermediate
November 2008 - present: Barclays Capital US Government/Credit Bond Index Intermediate Total returns in USD
January 1973 - October 2008: Lehman Brothers Government/Credit Bond Index Intermediate
Maturity range 1-10 years
Source: Barclays Capital

Merrill Lynch US Corporate and Government Index 1-5 Years
May 1986 - present: Merrill Lynch US Corporate and Government Index 1-5 Years
Total Returns in USD
Source: Merrill Lynch Index Code BVA0

Merrill Lynch US Treasury Index 1-3 Years
Total returns in USD
July 1977 - Present: Merrill Lynch US Treasury Index 1-3 Years
Source: Merrill Lynch G1O2 Index

Barclays Capital US TIPS Index
November 2008 - present: Barclays Capital US TIPS Index Total Returns in USD
March 1997 - October 2008: Lehman Brothers US TIPS Index
Maturity: 1 - 30+ Years
Issuers: US Treasury inflation-protected securities
Source: Barclays Capital

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