Porter, White & Company

Considering TIPS

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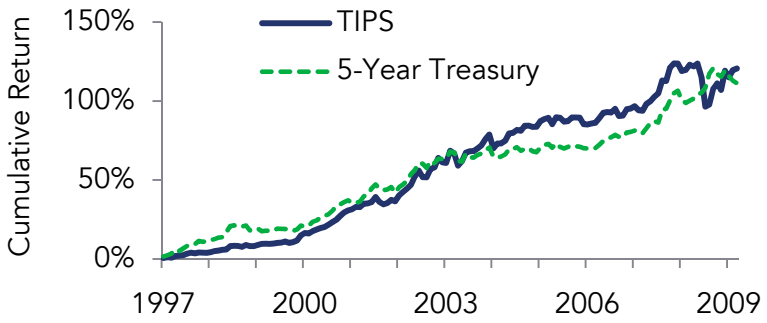
The government started issuing Treasury Inflation Protected Securities (TIPS) in March, 1997 to offer investors protection from unexpected increases in inflation. Since inception in March, 1997, the Barclays Capital US TIPS Index has returned 6.5% per year versus 6.2% per year for the 5-Year Treasury. The annualized volatility of monthly returns was 6.1% and 4.7%, respectively. Because TIPS have a limited history, it is even more difficult than usual to make assumptions about the future by drawing from historical data. This paper examines the available information related to expected future performance of TIPS and whether they belong in well-diversified portfolios.

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

Figure 1: Historical Return Comparison



Source: Barclays Capital US TIPS Index, Ibbotson Intermediate Five Year Treasury Notes
Data from 3/1/97 to 6/30/09.

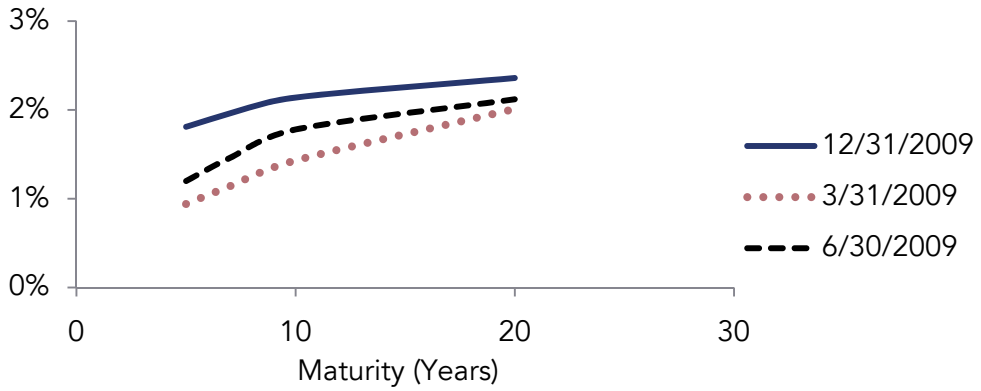
I. TIPS Defined

TIPS are fixed income instruments that provide investors a hedge against inflation by paying a fixed rate that is applied to principal which adjusts up and down based on the CPI index. If, for example, an investor purchases a TIPS promising a fixed rate of 2% on $1,000 in principal and the CPI rises 5%, the investor will receive a payment of 2% of $1050, or $21. The investor, in effect, retains purchasing power, assuming that the CPI is a good measure of inflation. In deflationary environments, however, investors are assured the greater of the adjusted principal or original principal at maturity.

A. Expected Return

While TIPS have a historical return of 6.5%, the current yield curve is a better estimate of future returns. The expected return on TIPS is composed of the TIPS real yield curve and expected inflation. The real TIPS yield for recent time periods is shown below in Figure 2.

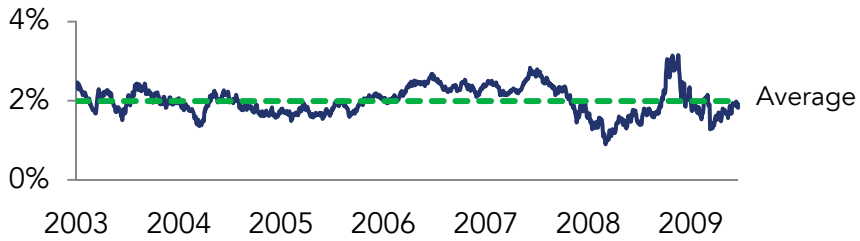
Figure 2: The Real TIPS Yields



Source: http://www.federalreserve.gov/releases/h15/data.htm

The real TIPS yield curve shows that the expected return on TIPS rises as the maturity of the security is extended. Fixed income securities are more sensitive to interest rate movement as the term is extended so investors demand a higher return for the higher level of volatility. The 10-year historical real TIPS yield, shown below in Figure 3, ranged from just less than 1% to a little less than 3% since the beginning of 2003 and averaged 2% over that time period.

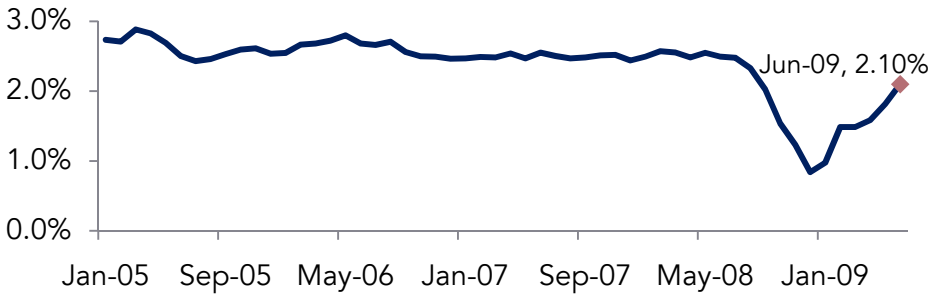
Figure 3: Historical 10-Year Real TIPS Yield



Source: http://www.federalreserve.gov/releases/h15/data.htm.
Data from 1/1/03 to 6/30/09.

Implied inflation, shown in Figure 4 below, is found by dividing one plus the nominal yield by one plus the real yield of equal maturity and subtracting one. The twenty year rate of inflation implied by nominal and real yields at the end of June 2009 was a little more than two percent. However, the spread may need to be adjusted for risk factors relating to inflation and liquidity. Investors must pay for inflation protection, which lowers the yield on TIPS and increases the spread. Liquidity risk affects the spread in the opposite direction. TIPS are less liquid than nominal treasury securities. Investors require a higher yield for less liquidity, which reduces the spread. The spread may also need to be adjusted for an embedded option in TIPS which provides that TIPS receive not less than the original full value at maturity despite periods of deflation (Jacoby & Shiller, 2007).

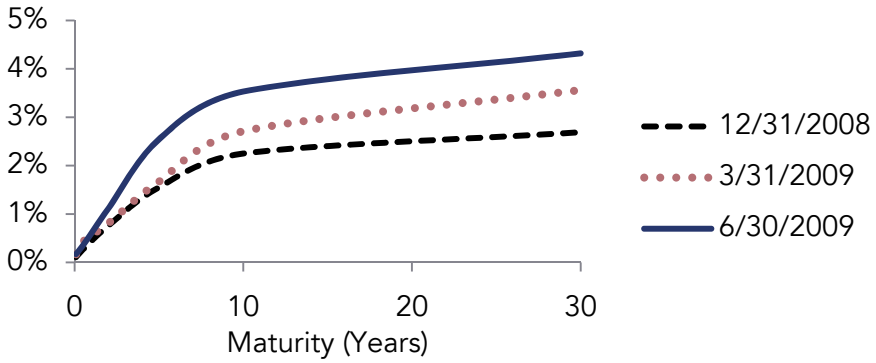
Figure 4: Adjusted 20-Year TIPS Derived Implied Inflation



Data from 1/1/05 to 6/30/09.

The nominal treasury yield curve is shown below in Figure 5. Similar to the real TIPS yield curve, yields increase as the term is extended to compensate investors for greater interest rate sensitivity. Over the year, the yield curve has steepened slightly at the short end and has shown a parallel shift upwards at the long end, perhaps due to greater long-term inflation expectations.

Figure 5: The Nominal Treasury Yield Curve



Source: http://ustreas.gov/offices/domestic-finance/debt-management/interest-rate/yield.shtml

The expected return on TIPS should be no different from the expected return on nominal bonds of matched duration. The expected return of TIPS is composed of both the real TIPS yield and expected inflation of the par value of the bond, while the nominal bond yield compensates investors for interest rate as well as inflation risk with no change in par value.

B. Volatility

The volatility of an asset class is an important consideration for investors, particularly for fixed income investments which typically lower the risk and volatility of the portfolio. TIPS' volatility is lower than nominal bond volatility when the securities are matched on the basis of maturity because TIPS only have interest rate risk, while nominal treasuries have both interest rate and inflation risk (Roll, 2004). Therefore, nominal yields are much more volatile than real yields. Kothari and Shanken (2004) use historical yields on Treasury bonds and an inflation forecasting model to find that the nominal and real returns on inflation-indexed bonds are less volatile than returns on nominal bonds as shown in Table 1. The study assumed that investors have rational expectations and used the ex post relationship between realized inflation and interest rates to

forecast inflation rates using a regression model. The log of the real price of the simulated inflation indexed bond was calculated as the difference between nominal yield and the inflation forecast. A time series of real prices was produced by repeating this method. The real return of simulated inflation indexed bonds could then be calculated by subtracting 1 from (Real Price (t+1))/(Real Price (t)). The nominal return for the simulated inflation indexed bonds was calculated by subtracting 1 from (Real Return)(Realized Inflation). The approach of simulating inflation indexed bond returns was necessary to create a larger sample size because TIPS were not issued until 1997. Nominal returns on actual nominal bonds were calculated directly using the historical nominal prices from the Wharton Research Data Services (WRDS) database. Real returns on actual nominal bonds were calculated by subtracting 1 from (1 + Nominal Return)/(1+Realized Inflation).

Table 1: Standard Deviation of Returns Comparison

	Simulated Inflation Indexed Bonds	Actual Nominal Bonds
Standard Dev. of Nominal Returns	6.58%	7.15%
Standard Dev. of Real Returns	5.88%	7.55%

Source: (Kothari & Shanken, 2004). Five-year zero coupon bond (overlapping annual returns), June 1953 to December 2000.

The volatility of an asset class contributes to the overall portfolio volatility in the variance and covariance term (See PW&Co White Paper, *Optimizing The Fixed Income Component)*. The covariance term has the potential to reduce the impact of an asset class on overall portfolio volatility when the asset class does not account for a large majority of the portfolio, making the correlation of the asset class with the other asset classes in the portfolio very important.

C. Correlation

The correlation of an asset class with other asset classes drives the diversification benefit the investment will provide. The diversification benefit gets smaller as the correlation approaches 1. Stocks and bonds both fall during periods of high inflation expectations and, therefore, are positively correlated (Ilmanen, 2003). However, as inflation expectations rise, the return on TIPS also rises, meaning that they become less correlated with stocks and nominal bonds during periods of increasing inflation expectations. Fama and Gibbons (1982) find that the correlation between the change in unanticipated inflation and real interest rates is negative. Therefore, unlike equity and nominal bonds, TIPS will increase in value when unanticipated inflation rises, providing a valuable diversification benefit.

Additionally, Kothari and Shanken (2004) use the inflation forecasting model, described in the volatility section above, to report that the correlation between nominal and inflation-indexed bonds is moderate as shown in Table 2. Not surprisingly, the correlation between the real and nominal returns for the same bond type is high. However, the correlations between the simulated inflation indexed bonds and actual nominal bonds for real and nominal returns is much weaker.

Table 2: Correlation Nominal and Inflation-Indexed Bond Returns

	Sim. Inflation Indexed Nominal Return	Sim. Inflation Indexed Real Return	Act. Nominal Bond Nominal Return
Simulated Inflation Indexed Real Return	0.89		
Actual Nominal Bond Nominal Return	0.52	0.59	
Actual Nominal Bond Real Return	0.34	0.58	0.93

Source: (Kothari & Shanken, 2004). Five-year zero coupon bond (overlapping annual returns), June 1953 to December 2000.

The combination of the weak correlation with equities and nominal bonds and lower volatility make TIPS an attractive asset class during periods of rising inflation expectations due to the diversification benefits they offer.

Under stable inflation expectations, TIPS lose their inflation hedge benefit and behave more like nominal bonds. This result is consistent with Hunter et al. (2005) who find that the correlation of nominal bond and TIPS returns is higher when the yield curve is flatter. Therefore, TIPS provide less of a diversification benefit under stable inflation conditions. However, Roll (2004) uses expected return, volatility, correlation, and inflation estimates to find the percentage of assets that should be allocated to each asset class to obtain the portfolio with the optimal risk-return profile and shows that TIPS belong in the optimal portfolio even when inflation is expected to be low. Historically, TIPS correlate with equity in the same direction as Treasury securities but exhibit a weaker correlation with equities than Treasury securities (Roll, 2004), providing a greater diversification benefit during periods when equity and fixed income are positively correlated than during periods when they are negatively correlated. The anticipated asset class correlations under varying yield curve shapes and inflation expectations are summarized in Table 3.

Table 3: Asset Class Correlations Under Different Interest Rate Environments

	Flat/Inverted Yield Curve and Low Inflation		Upward Sloping and High Inflation	
	Equity	Treasuries	Equity	Treasuries
Treasuries	Negative	1	Positive	1
TIPS	Negative	Positive	Weak	Weak

Source: Hunter et al., 2005; Ilmanen, 2003. S&P 500 and 7-10 Year Nominal Treasuries used for equity and treasury data, respectively.

TIPS are an especially attractive asset class when the yield curve is upward sloping and inflation expectations are high because they exhibit correlations distinct from nominal fixed income. TIPS are also a good diversifier of intermediate term bonds since intermediate term bonds perform poorly when interest rates increase at intermediate term maturities. One reason for intermediate term interest rates to increase is rising inflation expectations, which is when TIPS perform well.

II. Constructing Portfolios with TIPS

The following portfolio optimizer discussion should be understood in light of the Important Notice at the end of this document. Optimizer outcomes are dependent upon expected return, volatility, and correlation assumptions and such assumptions may be materially different than the actual outcome.

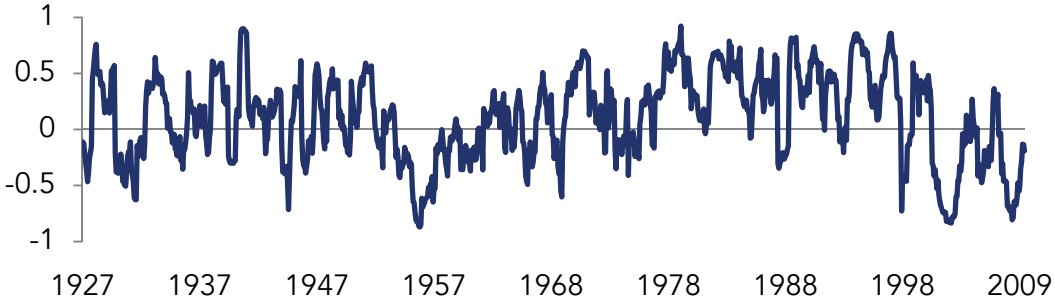
We use a portfolio optimizer that maximizes expected return for a given level of volatility to determine if and to what extent TIPS should be included in portfolios. The optimizer requires expected return, standard deviation, and correlation assumptions to determine the optimal weighting of each asset class in the portfolio.

The expected return for equities (10.05%) was determined by taking the "market" return (7.20%), primarily based on the dividend yield and earnings growth (Bogle, 2006), and adding a small cap and value premium (2.85%). The nominal fixed income return was set equal to the TIPS expected return (4.25%). The TIPS return was determined by taking the current real yield on the 20-Year TIPS (2.23%) and adding an inflation expectation. The median inflation expectation was derived by dividing one plus the nominal 20-year yield by one plus the 20-year real yield (2%) and subtracting one.

The volatility of each asset class was calculated by scaling the standard deviation over the period from March 1997 to December 2007 by the ratio of the assumed return to the sample period return. This method follows from the fundamental relationship between risk and return, which says that investors must be compensated for the level of risk they take.

Finally, the correlation between asset classes is extremely variable as shown in Figure 6. The correlation between fixed income and equity can quickly move from a strong, positive correlation to a strong, negative correlation. Therefore we use returns dating back to when TIPS were first issued to calculate correlations.

Figure 6: Historical Correlation between Stocks and Bonds



Note: The S&P 500 and 5-Year Treasury Notes were used for stock and bond data, respectively. Period from January 1926 to June 2009.

The return and volatility assumptions used in the optimizer analysis for each asset class are shown in Table 4. Three different expected return and standard deviation assumptions are shown because three different inflation assumptions were considered. Nominal fixed income is as-

sumed to have the same return as TIPS under the median inflation assumption but a higher standard deviation.

Table 4: Asset Class Return and Volatility Assumption Inputs

	TIPS			Nominal Fixed Income	Equity
Actual Inflation	1.5%	2.0%	2.5%	NA	NA
Expected Return	3.75%	4.25%	4.75%	4.25%	10.05%
Standard Deviation	2.66%	3.01%	3.37%	4.32%	17.72%

Note: Volatility is scaled based on returns from March 1997 to December 2007. The nominal fixed income returns were derived by creating a series of Treasury returns from the 5 year and 10 year maturities that had a weighted average duration equal to the duration of the Barclays Capital US TIPS Index at June 30, 2009.

The correlation assumptions used in the optimizer analysis for each asset class are shown in Table 5. TIPS have a correlation with equity close to zero. Nominal fixed income has provided greater diversification benefits with equity because of its lower correlation with equities.

Table 5: Correlation Assumption Inputs

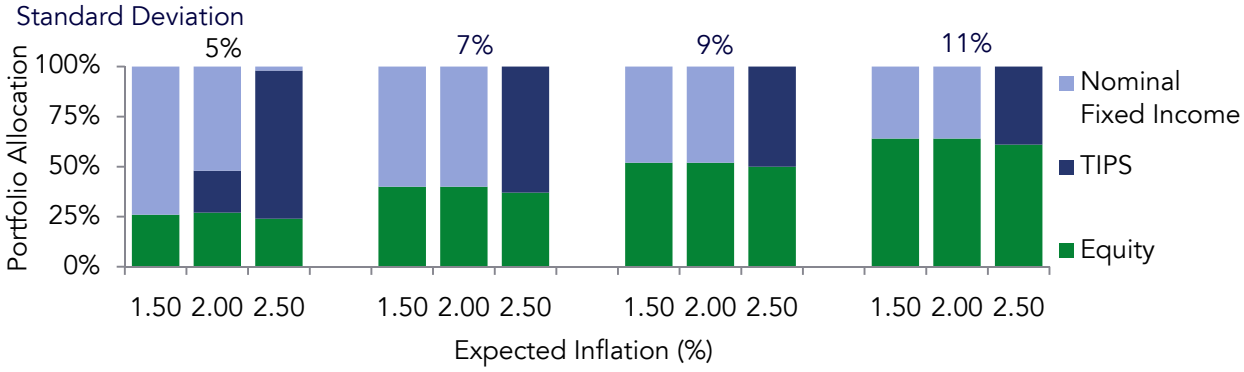
(March 1997 to May 2009)

	TIPS	Nominal Fixed
TIPS	1.00	0.62
Nominal Fixed Income	0.62	1.00
Equity	0.04	-0.23

Note: TIPS, Nominal Fixed Income, and Equity are represented by the Barclays Capital US TIPS Index, the Barclays Capital US Government Bond Index Intermediate, and the S&P 500, respectively.

The optimal weighting of equity, TIPS, and nominal fixed income in a portfolio under various expected inflation assumptions and volatility constraints is shown below in Figure 7. The horizontal shows the assumption for actual inflation used in the expected return assumption for TIPS, and the overall portfolio standard deviation constraints are centered above the columns. The figure shows that the optimum TIPS allocation within the overall portfolio increases as the inflation assumption increases and as the volatility constraint falls. Nominal fixed income is preferred as long as actual inflation is less than expected inflation.

Figure 7: Optimal Portfolio Allocations Varying Volatility and Inflation Assumptions



Since many investors benefit from having lower inflation, the lower returns from TIPS under low inflation assumptions could be offset by lower disbursement needs (or return requirements) from the investment portfolio. From this analysis we conclude that TIPS belong in a portfolio with nominal fixed income and equity due to the risk that inflation is higher than expected.

III. Conclusion

The rationale for including TIPS in a diversified portfolio is driven by inflation protection and potential diversification benefits. TIPS become an attractive asset class relative to nominal fixed income when actual inflation is greater than expected inflation. Additionally, the performance of TIPS when inflation expectations increase provides a diversification benefit to the portfolio. TIPS play an important role in diversified portfolios which have lower disbursement, or return, requirements when actual inflation is lower than expected inflation. For portfolios with disbursement requirements that are unaffected by low inflation, TIPS may not be an appropriate asset class.

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September 2009

Important Notice

A. Portfolio Optimizer

The portfolio optimizer is a tool intended to give the investor a general understanding of how asset classes affect portfolio performance when expected return, volatility, and correlation assumptions are made for each asset class. Using least squares regression analyses, an optimizer program finds the set of asset classes that produces the highest returns for each level of standard deviation given the input assumptions. The assumptions will change as current market conditions change. The assumptions that we make may be materially different from actual asset class performance characteristics, which would result in substantially different asset weighting outputs. The following outlines how our assumptions were derived.

i. Large cap equity, or "market", returns are assumed by summing the investment and speculative return. The investment return is the total of the dividend yield and earnings growth. The speculative return is the change in the price to earnings ratio assigned by the market. Nominal corporate earnings averaged 6% in the 80s and 90s and averaged 5.7% from 1999-2005. The dividend yield is at 2%, making the total investment return about 8% (Bogle, 2006). Additionally, Bogle (2006) assumes that the market price to earnings ratio will decline from 18.9 to 17.5, closer to the historical average of 15.2, over the next 10 years, which will trim 0.8% annually off stock returns, resulting in an estimated "market" return of 7.2% per year.

ii. A small cap premium is added to the expected market return. The small cap premium is the historical difference in return between Fama/French US Small Cap Index and the S&P 500.

iii. A value premium is added to the expected market return in addition to the small cap premium to arrive at the equity expected return assumed in the portfolio optimizer. The value premium is the historical difference between the Fama/French US Large Value Index (with utilities) and the S&P 500.

iv. The expected return on nominal fixed income is assumed to be the same as the expected TIPS return when actual inflation is the same as expected inflation.

v. The total expected TIPS return is found by summing projected inflation and the real yield of a TIPS instrument. Projected inflation is calculated by taking the spread between the nominal 20-Year Treasury bond and 20-Year TIPS.

vi. To estimate the standard deviation of each asset class, we use the historical standard deviation if the assumed return is the same as the historical return. However, if the assumed return is different than the historical return, the volatility must be scaled because investors must take more risk to achieve greater returns and must assume lower returns if lower risk is required. Therefore, the standard deviation is estimated by multiplying the historical return by the ratio of the assumed return to the historical return.

vii. The correlation between stocks and bonds varies based on macroeconomic expectations. Since the correlation is volatile and may change quickly we use long-term historical correlations.

B. Additional Notices

This paper is intended to provide information to investors. Whether to invest in the TIPS 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.

i. Past performance is not a guarantee of future results. Values change frequently and past performance may not be repeated. There is always the risk that an investor may lose money. Even a long-term investment approach cannot guarantee a profit. Economic, political, and issuer-specific events will cause the value of securities, and the portfolios that own them, to rise or fall.
ii. Different types of investments involve varying degrees of risk, and there can be no assurance that any specific investment will either be suitable or profitable for a client's investment portfolio. In this document, risk is equated to standard deviation, which may be an incomplete measure of risk.
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.
v. Indexes are not available for direct investment; therefore, their performance does not reflect expenses associated with management of an actual portfolio.
vi. Historical performance results for investment indexes, or categories, generally do not reflect the deduction of transaction or custodial charges or the deduction of an investment management fee, the incurrence of which would have the effect of decreasing historical performance results.
vii. Sample fixed income portfolio returns and sample model portfolios are not intended to illustrate the returns of clients of Porter, White & Company. Sample and model results do not reflect actual trading and do not illustrate the impact that material economic and market factors may have had on the returns if an adviser implemented these strategies with client funds. Furthermore, advisory fees would reduce these returns.
viii. Information presented is believed to be factual and up-to-date, but we do not guarantee its accuracy and it should not be regarded as a complete analysis of the subjects discussed. All expressions of opinion reflect the judgment of the authors as of the date of publication and are subject to change. Information presented does not involve the rendering of personalized investment advice, but is limited to the dissemination of general information on products and services. A professional adviser should be engaged before implementing any of the options presented.
ix. 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.
x. The Sharpe Ratio measures the excess return per unit of risk, calculated by dividing the investment's return less the risk-free rate by the investment's standard deviation. The Sharpe Ratio is a widely recognized metric for measuring relative risk-adjusted return.

IV. Appendix

A. Bibliography

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B. Sources & Descriptions of Data.

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

Five Year US Treasury Notes
Total returns net of all fees in USD. Source: Ibbotson Intermediate
January 1926 - Present: Five-Year US Treasury Notes

CRSP US 10 Year Constant Maturity Index
Source: CRSP, total returns net of all fees
January 1979-Present: CRSP US 10 Year Treasury Constant Maturity Index

Barclays 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

Barclays Capital US Government Bond Index Intermediate
November 2008 - present: Barclays Capital US Gov't Bond Index Intermediate Total returns in USD
January 1973 - October 2008: Lehman Intermediate Government Bond Index Intermediate
Maturity range 1-10 Years
Source: Barclays Capital

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