Portfolio Risk Consequences of Fixed-Income Exposures

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Most investors would agree that interest rate and credit exposure are two of the more pervasive influences on the returns arising from fixed-income portfolios. It is not always recognized, however, that such exposures can have markedly different implications for risk, depending on the portfolio context. This article focuses on the dichotomy that exists when interest rate and credit exposures are viewed in a fixed-income portfolio context versus a total portfolio context. For a fixed-income portfolio, additional interest rate exposure tends to increase volatility, while credit exposure can act as a diversifying asset. The converse tends to hold at the total portfolio level, where increasing credit exposure typically augments risk, while interest rate exposure has a minimal or possibly even a dampening effect on volatility. These contrasting implications stem from the fact that fixed-income portfolio volatility is largely driven by interest rate fluctuations, whereas credit adds to the equity risks that dominate most balanced portfolios.

The dichotomy between risk in a fixed-income portfolio context and a total portfolio context can give rise to agency problems when management is delegated. Fixed-income managers can face incentives to pursue exposures that may run counter to the objectives of the end-investor. This is particularly the case for credit, which appears to be a diversifying asset to fixed-income managers, but augments risk at the total portfolio level. These agency issues provide cause to reconsider how fixed-income mandates are designed. Two alternative approaches are discussed in general terms. The first is to structure fixed-income mandates around a core sovereign benchmark, while treating credit exposure as a discrete return-seeking activity. The second involves adopting explicit targets for duration and credit exposure, coupled with return hurdles that are applied when managers deviate from the target exposures.

DIFFERING PERSPECTIVES AND RISK DRIVERS

Most investors aim to maximize the trade-off between risk and return in their portfolios. In working toward this aim, the impact of a particular asset will depend on the portfolio under consideration. While an asset should have similar implications for returns across portfolios,[1] the contribution to risk depends on its covariance with the portfolio of concern. This article will contrast the implications of interest rate and credit exposures for risk in a fixed-income portfolio context versus a total portfolio context. The fixed-income portfolio context reflects the view taken by fixed-income investment managers and investors who evaluate their investments within a narrow frame of reference. The total portfolio context takes the perspective of end-investors who are

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concerned with their entire portfolio, be it a balanced portfolio of assets or a liability-driven situation.

The key drivers of portfolio risk differ significantly across these two portfolio contexts. As a broad generalization, fixed-income portfolio risk is related to interest rate fluctuations, while risk at the total portfolio level is dominated by equities. Exhibit 1 illustrates this point for U.S. investors by using the Barclays U.S. Aggregate Index to represent the fixed-income portfolio and a constructed balanced portfolio to represent the total portfolio.[2] Exhibit 1 reports the R-squared from multiple regressions that relate portfolio returns to equity returns and changes in U.S. interest rates. For the fixed-income portfolio, around 54% of the return variance is explained by the interest rate changes, with equities making only a modest contribution. For the balanced portfolio, U.S. and non-U.S. equities together explain nearly 98% of the variance, while the contribution from interest rate changes is modest. The latter is consistent with Leibowitz and Bova [2007], who examined U.S. balanced portfolios and found that "roughly 90% or more of [their] total volatility is explained by the correlation with U.S. equity."

An asset's contribution to portfolio risk will reflect its relation to the key risk drivers within the particular portfolio. In a fixed-income portfolio context what matters most is the covariance with interest rate fluctuations. For a typical balanced portfolio, the covariance with equity returns is the main concern. Under liability-driven investing, the drivers of liabilities come into consideration. This potentially introduces a relation with interest rates that is the converse of that for a fixed-income portfolio, to the extent that interest rates influence the discount rate used in valuing liabilities.

With this background, the influence of interest rate and credit exposure on risk within different portfolio contexts can now be examined in greater depth.

INTEREST RATE EXPOSURE AND PORTFOLIO RISK

The concept that increasing interest rate exposure (i.e., extending duration) usually increases risk for a fixed-income portfolio is well recognized. The impact on total portfolio risk, however, is less straightforward. For balanced portfolios, the correlation between interest rates and equity returns is a key consideration. This correlation has been unstable through time. Exhibit 2 plots the 10-year (240-month) rolling correlation between yield changes for long U.S. Treasury bonds and U.S. equity returns.[3] The average correlation over the period is –0.11, but there are periods when the correlation becomes positive, notably including the last 10 years or so. The associated implications for the relation between equity and bond *returns* are the reverse (i.e., moderately positive correlation on average, with some periods of negative correlation).

Exhibit 2 is broadly consistent with findings reported elsewhere (Gulko [2002], Ilmanen [2003], and Baele, Bekaert, and Inghlebrecht [2007]) that have pointed to a long-run average correlation between equity and bond returns in the order of +0.20, interspersed with periods of negative correlation. Evidence also exists that equity and bond returns tend to be negatively correlated during equity market sell-offs (sometimes associated with flight-to-quality effects). Thus, interest rate exposure may play an additional role of protecting a balanced portfolio against equity market volatility when most needed.

In liability-driven situations, the link between interest rate exposure and total portfolio risk will depend on portfolio design. For a fund that has adopted a minimum risk position by matching the duration of its assets and liabilities, portfolio risk increases with *any* change in fixed-income portfolio

EXHIBIT 1
Portion of Portfolio Variance Explained

Monthly Data, December 1979 to September 2008	**Fixed-Income Portfolio** (*Barclays U.S. Aggregate*)	**Balanced Portfolio** (*Constructed, see below**)
Explanatory Variables:	***R-Squared from Regression***	
Equity Returns, as represented by – Russell 3000 Index – MSCI EAFE Index	0.053	0.978
Yield Changes, as represented by – 3-month T-Bills – 2-year T-Bond (constant maturity) – 10-year T-Bond (constant maturity)	0.540	0.089
Equity Returns and Yield Changes	0.551	0.989

*Note: *Balanced portfolio comprises 45% U.S. equities, 20% non-U.S. equities, 5% listed property, 27% U.S. fixed income, and 3% U.S. cash (more details in Exhibit 3).*

Source: Russell, MSCI, Barclays, FTSE/NAREIT, Citi, St Louis Fed.

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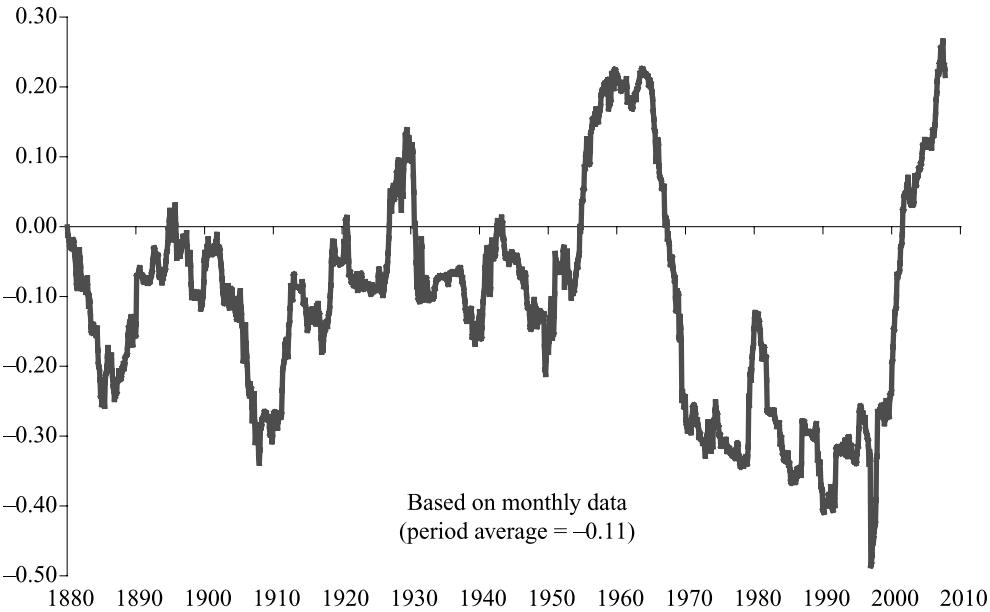
EXHIBIT 2

Rolling 10-Year Correlation: Equity Returns and Long-Bond Yield Changes



Sources: www.econ.yale.edu/~shiller/data.htm, St Louis Fed, Datastream.

duration, regardless of direction. However, liability-driven funds are not always managed to a minimum risk position. Many sponsors prefer to accept some equity risk to enhance returns and hence reduce expected funding costs. In such circumstances, the correlation between interest rates and equities becomes relevant in a fashion not dissimilar to that discussed for balanced portfolios.

Exhibit 3 provides some sense for the portfolio risk implications of increasing interest rate exposure across differing portfolio contexts and time periods. Barclays indices for U.S. "bellwether" Treasuries of 2, 5, 10, and 30 years are used to proxy the returns to fixed-income portfolios of differing durations. For these indices, volatility clearly increases with duration, rising from 2.7% per year for the 2-year bond to 11.4% per year for the 30-year bond over the period from January 1981 to September 2008. These results are indicative of the impact of increasing duration for a fixed-income portfolio in isolation.

To gauge the effect at a total portfolio level, the same bellwether bond indices are taken to represent differing fixed-income components within a constructed balanced portfolio.[4] In this case, the impact of lengthening duration is diluted by the broader asset pool and is dependent on time period. Over the full sample period, the volatility for the constructed balanced portfolio increases moderately from 9.8% to 10.6% as the fixed-income portfolio moves from the 2-year to the 30-year bond. For the subperiod of October 1998 to September 2008, balanced portfolio volatility initially declines when moving from the 2-year bond to the 10-year bond. It then kicks up for the 30-year bond. These results reflect the fact that the second subperiod contains a positive correlation between bond yield changes and equity returns.

In summary, while extending duration typically increases volatility for fixed-income portfolios, the implications at the total portfolio level are less clear, but unlikely to be substantial. At worst, total portfolio volatility should increase modestly. Portfolio risk might even be reduced if 1) positive correlation prevails between bond yield changes and equity returns, as seen since the late-1990s; 2) emphasis is placed on the tendency for bonds to rally during extreme equity market weakness; or 3) liabilities are better hedged when fixed-income duration is lengthened.

CREDIT EXPOSURE AND PORTFOLIO RISK

A similarly stark dichotomy emerges for credit exposure. Because credit contains an equity-like element, increasing exposure tends to augment total portfolio risk. For a fixed-income portfolio, however, credit acts as a

EXHIBIT 3
Impact of Duration on Portfolio Volatility

U.S. Fixed-Income Portfolio (*Barclays Bellwether Indices*)	2-Year Treasuries	5-Year Treasuries	10-Year Treasuries	30-Year Treasuries
Portfolio Standard Deviation, % per year				
Fixed-Income Portfolio				
Jan 1981–Sep 2008	2.7%	5.5%	8.0%	11.4%
Subperiods:				
Jan 1981–Sep 1998	2.9%	5.8%	8.5%	11.8%
Oct 1998–Sep 2008	1.9%	4.6%	6.9%	10.5%
Balanced Portfolio				
Jan 1981–Sep 2008	9.8%	9.9%	10.2%	10.6%
Subperiods:				
Jan 1981–Sep 1998	9.8%	10.1%	10.5%	11.0%
Oct 1998–Sep 2008	9.7%	9.5%	9.5%	9.6%
Balanced Portfolio Composition	***Index***	***Weight***		
U.S. Equities	*Russell 3000*	*45%*		
International Equities	*MSCI EAFE*	*20%*		
U.S. Listed Property	*FTSE NAREIT*	*5%*		
U.S. Fixed Income (variable)	*Barclays*	*27%*		
U.S. Cash	*Citi 3-mo. T-Bill*	*3%*		
Total		*100%*		

Source: Barclays, Russell, MSCI, FTSE/NAREIT, Citi.

diversifier that may reduce fixed-income portfolio volatility up to some level of exposure. The precise implications depend on the existing portfolio structure and the correlation between equities and interest rates.

Considerable evidence exists that returns and yield spreads for lower quality credit are correlated with equity returns (see Cornell and Green [1991], Shane [1994], Reilly and Wright [2001], and Avramov, Jostova, and Philipov [2007]). The underlying logic for the connection between credit and equities can be established from two directions. First, corporate profits act as a shared driver for equities and corporate bonds via their common influence on expected future cash flows accruing to equityholders and on expected default losses for bondholders. Second, bonds subject to default risk may be considered a hybrid security, comprising a default-free bond and a granted put option over the value of assets in the firm. This notion stems from Black and Scholes [1973] and Merton [1974] and underpins the so-called structural models for pricing bonds with default risk. As credit exposure increases, the put option component becomes more influential.

Exhibit 4 investigates the relation between credit exposure and volatility in both the fixed-income portfolio and balanced portfolio contexts. The analysis involves constructing notional fixed-income portfolios of differing degrees of credit exposure, composed of various combinations of the Barclays U.S. Treasury Index, U.S. Aggregate Index, and U.S. Corporate High Yield Index.[5] Standard deviation is reported for the fixed-income portfolios and a balanced portfolio that contains the fixed-income portfolios. Analysis is conducted over the period from January 1987 to September 2008[6] and for two subperiods using September 1998 as the dividing date. Exhibit 5 plots the full-period results. Fixed-income portfolio volatility initially decreases as the credit component is raised, before increasing at higher credit exposure levels. The minimum-volatility fixed-income portfolio amongst those reported comprises about 80%–90% of the Aggregate index and 10%–20% of the High Yield index. In contrast, volatility of the balanced portfolio rises continuously as credit exposure increases.

The results reflect the notion that credit exposure helps diversify interest rate risk in the fixed-income portfolio context. Indeed, the volatility of the fixed-income portfolio that comprises only Treasuries is relatively high and not dissimilar to that of a 50/50 combination of the Aggregate and High Yield indices. Meanwhile, greater credit exposure unambiguously increases total portfolio risk because it effectively adds to equity exposure.

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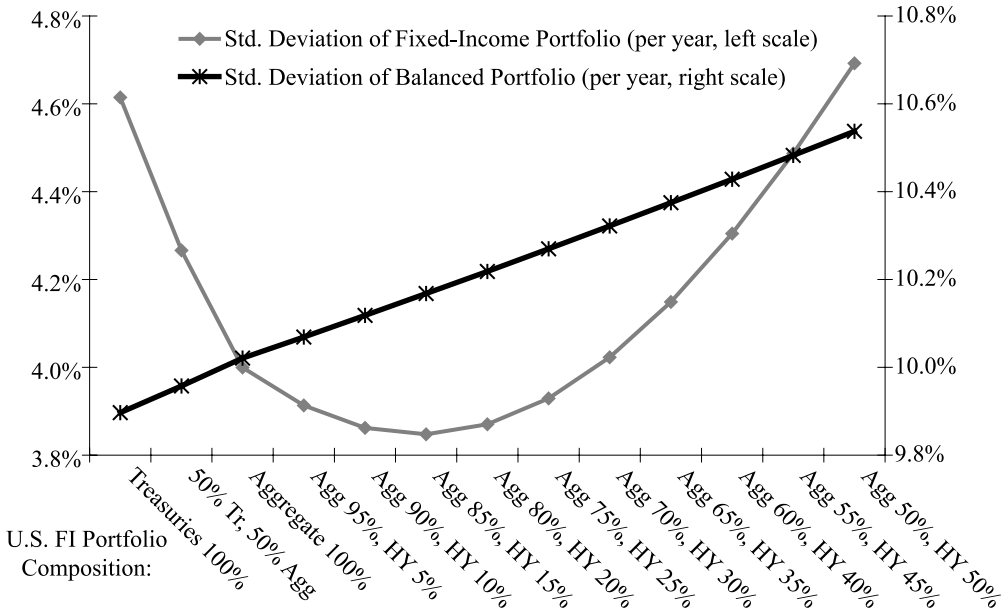
EXHIBIT 4
Impact of Credit on Portfolio Volatility

Fixed-Income Portfolio Composition (compiled from Barclays indices)								
U.S. Treasury	100%	50%	–	–	–	–	–	–
U.S. Aggregate	–	50%	100%	90%	80%	70%	60%	50%
U.S. Corporate High Yield	–	–	–	10%	20%	30%	40%	50%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%
Portfolio Standard Deviation, % per year								
Fixed-Income Portfolio								
Jan 1987–Sep 2008	4.61%	4.27%	4.00%	3.86%	3.87%	4.02%	4.30%	4.69%
Subperiods:								
Jan 1987–Sep 1998	4.63%	4.48%	4.35%	4.21%	4.18%	4.27%	4.47%	4.76%
Oct 1998–Sep 2008	4.57%	3.96%	3.48%	3.34%	3.39%	3.63%	4.02%	4.53%
Balanced Portfolio								
Jan 1987–Sep 2008	9.90%	9.96%	10.02%	10.12%	10.22%	10.32%	10.43%	10.54%
Subperiods:								
Jan 1987–Sep 1998	10.11%	10.12%	10.14%	10.21%	10.28%	10.35%	10.43%	10.51%
Oct 1998–Sep 2008	9.59%	9.70%	9.82%	9.95%	10.09%	10.23%	10.37%	10.52%

Note: For balanced portfolio composition, see Exhibit 3.
Source: Barclays, Russell, MSCI, FTSE/NAREIT, Citi.

EXHIBIT 5
Credit Exposure: Fixed-Income Portfolio Volatility versus Balanced Portfolio Volatility, January 1987–September 2008



Source: Barclays, Russell, MSCI, FTSE/NAREIT, Citi.

Exhibit 6 delves further into the relation between credit and equities by estimating "equity" betas relative to the Russell 3000 for various credit categories over the period from August 1988 to September 2008.[7] Estimates are based on the Barclays excess return indices that measure return spreads relative to Treasuries of equivalent duration. Abstracting from the influence of interest rate fluctuations helps to isolate the "marginal" beta associated with the

EXHIBIT 6
Betas of Credit Exposure

	Beta versus Russell 3000*		
	Aug 88–Sep 08	**Aug 88–Sep 98**	**Oct 98–Sep 08**
U.S. Corporate, Excess Returns			
Investment Grade:			
Aaa	0.05	0.04	0.05
Aa	0.06	0.05	0.08
A	0.10	0.06	0.13
Baa	0.15	0.09	0.19
High Yield:			
Ba	0.31	0.20	0.39
B	0.45	0.38	0.50
Caa	0.72	0.62	0.82
Ca to D	na	na	0.95
Broad Sector, Excess Returns			
U.S. Investment Grade	0.11	0.07	0.14
U.S. High Yield	0.44	0.33	0.51
Global High Yield	na	na	0.52
Note: Beta of U.S.Treasuries	–0.03	0.12	–0.14

*Note: *Betas estimated using method of Dimson [1979] to adjust for serial correlation.*
Source: Barclays, Russell.

credit component of the underlying index. The estimated betas increase reliably as credit quality declines. For instance, beta estimates over the full period were 0.11 for the Investment Grade index and 0.44 for the High Yield index. Both subperiods reveal a pattern of rising beta as credit quality deteriorates, suggesting that the broad relation is robust through time. Nevertheless, beta estimates are higher for the second subperiod of October 1998 to September 2008. Note that the beta on the Treasury index changed sign between the two subperiods, consistent with the shift in correlation between bond yield changes and equity returns.

In summary, while raising exposure to credit will unambiguously increase risk for a total portfolio that is equity dominated, the implications at the fixed-income portfolio level are less straightforward. In many cases, increasing credit exposure can reduce fixed-income portfolio risk due to diversification effects.

AGENCY PROBLEMS

The starkly differing impacts of interest rate and credit exposure on risk in the fixed-income portfolio and total portfolio contexts creates potential for agency problems when management of the fixed-income portfolio is delegated. Fixed-income managers will tend to perceive duration as risky and credit as a diversifying asset. Indeed, a fixed-income manager may face a strong incentive to increase credit exposure to the extent that it simultaneously reduces overall portfolio variability and offers an expected risk premium. Meanwhile, the end-investor may consider duration as somewhere between relatively innocuous and a diversifying exposure, while viewing credit as adding to the equity risk that dominates the portfolio.

The disconnection between the objectives of fixed-income managers and of the end-investor is exacerbated by the benchmarks toward which fixed-income portfolios are managed. Typical benchmarks include either a broad fixed-income index, such as the Barclays Aggregate, or a *cash-plus* return target. Exposures implicit within such benchmarks are not necessarily aligned with the investor's preferred policy position. The duration and credit exposures of an index reflect its constituents, which change over time with the retirement and issuance cycle. A cash-plus approach specifies short duration as the baseline and gives little guidance on the interest rate or credit exposure preferences of the end-investor.

There is no guarantee that investors will get the fixed-income portfolio they want under the current approach to structuring fixed-income investments. Indeed, incentives can be created for activities that are unwelcome or even dysfunctional from the viewpoint of the end-investor, such as augmenting equity-related risk through escalation of credit exposure in seeking to outperform a particular benchmark.

BETTER PORTFOLIO DESIGN

Two approaches are suggested that may help mitigate the agency problems just discussed. The first is easier to implement within the current industry structure. The second is more ambitious. It aims to closely align the incentives faced by managers with investor objectives. These approaches are discussed here only in general terms.

Approach #1: Structure Around a Sovereign Core

Under this approach, the core benchmark for the fixed-income portfolio becomes a representative sovereign

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bond or Treasury index that best matches the investor's preferred duration. Credit exposure is then risk budgeted and evaluated as a distinct return-seeking activity. Credit might be admitted into the fixed-income portfolio in two ways. The first is through investing in dedicated credit portfolios. The second is allowing fixed-income managers to invest in credit, based on the understanding that performance in this sector would be evaluated separately and that a return premium is required to compensate for the risk added at the total portfolio level. CAPM-style estimates might provide a guide to the required premium (as will be discussed in Approach #2).

Risk reduction is often the primary motivation for holding fixed income within a total portfolio context. Structuring around a sovereign benchmark keeps the fixed-income portfolio focused on this role, while still accommodating credit exposure in a controlled fashion.

Approach #2: Set Explicit Exposure Targets and Return Hurdles

This approach involves establishing a tailored benchmark based around exposure targets for duration and for various credit-category buckets.[8] The exposure targets would reflect the investor's preferred policy position. The benchmark return is estimated based on a constructed fixed-income portfolio that imitates the target exposures. Performance evaluation could involve the charging of return hurdles when exposures deviate from the targets. These hurdles would reflect the return required by the investor to compensate for the risk added at the total portfolio level. Managers need not know the basis of these return hurdles; they just need be told their magnitude.

For example, a fixed-income manager may be advised that adding a year of duration attracts a return hurdle of, say, 20 basis points (bps) per year or that overweighting an A-rated credit relative to the target will be subject to a hurdle of, say, a return spread of 40 bps per year over Treasuries. The duration return hurdle might be derived from estimates of the impact of duration on total portfolio volatility, coupled with some specified trade-off between portfolio volatility and required return. (In instances when duration does not add to portfolio risk, no hurdle would be required.) The CAPM might be used to estimate the credit return hurdles. For instance, a 40 bps per year hurdle on an A-rated credit is consistent with multiplying the beta of 0.10 reported in Exhibit 6 by a notional target equity risk premium of 4% per year.

This second approach establishes alignment through communicating the investor's preferred position via the exposure targets and accounting for the expected impact of various exposures on total portfolio risk via the return hurdles. Measurement is the main challenge.

CONCLUSION

The implications of exposures contained within fixed-income portfolios can differ starkly from the perspectives of a fixed-income manager and of an end-investor concerned with the total portfolio. While interest rate exposure typically adds to the risk of a fixed-income portfolio, it can play a diversifying role within a broader portfolio context. Conversely, credit exposure augments risk at the total portfolio level, but can act as a diversifier within the fixed-income portfolio. This dichotomy creates potential for agency problems. Two alternative approaches for designing fixed-income mandates have been suggested that might improve the alignment of the fixed-income portfolio with investor objectives. The first is to structure around a sovereign bond benchmark and to explicitly control any credit investments. The second entails specifying the desired target exposures, and charging return hurdles for deviations from targets that add to risk at the total portfolio level.

ENDNOTES

[1]This comment is only strictly true of *gross* returns, because *net* returns after costs and taxes can differ depending on the investor.

[2]Asset class weightings for the constructed balanced portfolio broadly reflect the average for the top 1,000 U.S. defined benefit plans during 2007, as reported by *Pensions and Investments*. Monthly rebalancing at zero cost is assumed.

[3]The long-bond yield reported by Shiller is used prior to April 1953, and the U.S. 10-year constant maturity Treasury bonds are used thereafter.

[4]Portfolio returns reported in Exhibits 3–5 are estimated under the assumption of monthly rebalancing at zero cost.

[5]The constructed fixed-income portfolios may contain differences in exposures other than credit. Of particular interest is any difference in duration. Average duration over the period was 5.24 for the Treasury index, 5.11 for the Aggregate index, and 4.87 for the High Yield index. These differences are statistically insignificant (t-statistics of 0.60 or less).

[6]The start date of January 1987 reflects the availability of the Barclays U.S. Treasury Index.

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[7]The start date of August 1988 reflects the availability of the Barclays excess return indices.

[8]The approach could be expanded to incorporate any measurable exposures that are deemed relevant, such as currency, liquidity, or volatility.

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