The Journal of
FIXED INCOME

VOLUME 26 NUMBER 3 www.iijfi.com WINTER 2017

The Credit Risk Premium

ATTAKRIT ASVANUNT AND SCOTT RICHARDSON

The Credit Risk Premium

Attakrit Asvanunt and Scott Richardson

Attakrit Asvanunt
is a vice president at AQR Capital Management in Greenwich, CT.
attakrit.asvanunt@aqr.com

Scott Richardson
is a managing director at AQR Capital Management and a professor at the London Business School in London, U.K.
scott.richardson@aqr.com

Corporate bonds are an important component of fixed-income portfolios. As of year-end 2014, 9,000 out of 16,000 securities in the Barclays Global Aggregate Index, a popular benchmark for fixed-income portfolios, were issued by corporations. This represents nearly 18% of the USD 42 trillion index market value. Accordingly, our focus is understanding the risk and returns of corporate bonds. To the best of our knowledge, this article is the first to document the existence of a credit risk premium and its additivity to other known risk premia (e.g., equity risk premium and term premium) in an accurate and consistent manner, using a long history of data.

We first confirm the existence of a positive premium for bearing exposure to default risk. Using a combination of data sources, we construct a long time series of corporate bond returns in excess of Treasury bond returns, with proper adjustment for any duration differences between corporate and Treasury bonds. This measure of "excess" corporate bond return is primarily attributable to compensation for bearing default risk, henceforth referred to as "credit excess return" or "credit risk premium." We find that the average annual credit excess return on investment-grade corporate bonds over the 193601–201412 period is 137 basis points with a Sharpe ratio of 0.37.[1] Over the more recent 198808–201412 period, with arguably higher data quality and a developed high-yield bond market, we find that the average annual credit excess return for the aggregate high-yield corporate bond index is 248 basis points with a Sharpe ratio of 0.26. We also find positive and significant returns for corporate bonds in Europe and credit default swaps in North America and Europe. Thus, we are able to document robust evidence of a credit risk premium.

A key contribution of this article is the measurement of credit excess returns, especially for the older data in our sample period. Most past research computes credit excess returns as the simple difference between long-term corporate bond returns and long-term government bond returns. As Hallerbach and Houweling [2013] have noted, however, this method is appropriate only if both sets of bonds share equivalent cash flow maturity profiles. The data suggest that long-term corporate bonds have a shorter cash flow maturity profile than long-term government bonds, as indicated by lower interest rate duration. Thus, a simple difference between corporate bond and government bond returns will "over-hedge" the interest exposure for the purpose of computing credit excess returns. Given the well-known positive term premium, this approach generates a systematic understatement of the credit risk premium. While not the focus of their work, Fama and French [1993] suffer from this shortfall when they note that the average default return is only 2 basis points per month, which is hardly compelling evidence of a credit risk premium. Indeed, over the longest time period available, 193601–201412, we also find that the average annual credit excess return under this naïve definition is not statistically significant at 7 basis points. This result contrasts with an average annual credit excess return of 137 basis points when the interest duration difference is properly accounted for.

A skeptical investor will, and should, ask whether exposure to credit risk is beneficial in a broader portfolio context. It is important to know if the credit risk premium is nothing more than the equity risk premium in disguise. You may be paying more for a well-known source of risk (credit indexes are still more expensive to trade, and have less capacity, than equity indexes). For a long-only portfolio of corporate bonds, government bonds, and equities, we find that the mean–variance optimal weights to be allocated to these asset classes are 48%, 35%, and 17%, respectively, for the 193601–201412 period. Collectively, these results support the notion that there is a risk premium to be had from gaining exposure to credit risk, and that this is sufficiently different from, and is additive to, the more commonly known term premium and equity risk premium. This inference is robust to alternative portfolio allocation choices that explicitly address non-normality of return distributions.

Our final empirical analyses explore time-series variation in the credit risk premium and evidence of its existence beyond the U.S. corporate bond market. We link variation in the credit risk premium to macroeconomic state variables and fundamental characteristics such as aggregate default rates. Intuitively, we find that the credit risk premium is larger during periods of (i) economic growth and (ii) lower-than-expected aggregate default rates. This time-series variation in the credit risk premium is intuitive as credit risk is exposed to the risk embedded in economic growth and aggregate default rates. Using data for European corporate bonds since 1999 and credit default swaps since 2004, we find that the credit risk premium exists and is additive to both equity and term risk premia in those markets as well.

Past research has been surprisingly sparse on both the existence of a credit risk premium and whether it is additive to other known sources of risk premia. While Huang and Huang [2012] show that the credit spread of a single firm is too high, given structural models and the size of the equity risk premium, the literature is silent on whether a diversified portfolio of corporate bonds has a risk premium above and beyond what would be expected, given its exposures to a broad portfolio of stocks. Most previous research has focused on explaining the credit spread, namely the difference between corporate bond and Treasury yields. Elton et al. [2001] show that a substantial portion of the credit spread is attributable to factors related to the equity risk premium. Giesecke et al. [2011] study a long time series of corporate default rates and its relationship with financial and macroeconomic variables. By taking the difference between the average corporate bond spread and the average default rate, they find that the market incorporates a positive and statistically significant premium in the corporate bond prices. They acknowledge, however, the shortfalls of their analyses, among them the potential mismatch between the bonds from which credit spreads and default losses are estimated. Several other papers also use the ratio of expected risk-neutral default intensities to actual default intensities as a measure of default premium. For example, Berndt et al. [2005] use credit default swap spreads and Moody's Analytics expected default frequency (EDF), and Driessen [2005] uses corporate bond prices and estimated default probabilities from rating migrations. Common among these papers is the use of credit spreads and expected default rates as an ex ante measure of credit risk premium. In a world of constant expected returns, the ex ante and ex post measures will be close to each other. However, in a world of time varying expected returns, there can be significant differences.

Our objective is different, as we do not focus on the credit spread, but rather on the actual returns an investor would experience from exposure to credit risk. Ilmanen [2011] notes that credit spreads do not map directly to credit excess returns, and the differences are attributable to a combination of (i) spread changes, (ii) price pressures from investors buying or selling owing to rating requirements for their portfolios, and (iii) losses from actual defaults. Together these effects can generate ex post realized credit excess returns that are materially different from initial credit spreads. Thus, it is important to document the existence of a credit risk premium by looking *directly* at credit excess returns.

The most relevant research to our study, which looks at credit risk premium from the perspective of returns to investors, are Ng and Phelps [2011], Van Luu and Yu [2011], and Sangvinatsos [2011]. Ng and Phelps [2011] document average annual spread premia of 48 and 341 basis points for the corporate investment-grade and high-yield indexes, respectively, over a relatively short time period (1990–2009), using excess returns and adjusting for spread changes. Van Luu and Yu [2011] look at investment-grade credit excess returns over a longer time horizon (1926–2010) and document an average annual excess return of 140 basis points (we find 137 basis points over the similar period). But importantly, they do not address the question of whether the credit risk premium is additive to other known risk premia. Sangvinatsos [2011] studies the role of corporate bond indexes in the context of asset allocation among stocks and bonds using investment-grade returns since 1973 and high-yield returns since 1990. Consistent with our findings, he finds that there are economically significant benefits to include corporate bonds in a portfolio of stocks and bonds. However, the author does not attempt to decompose the corporate bond returns into returns from interest rate versus credit exposure. Finally, Collin-Dufresne, Goldstein, and Martin [2001] document that changes in credit spreads are, to a large extent, driven by factors separate from equity and Treasury markets. While the focus of their research is assessing the importance of variables such as change in leverage and change in volatility to explain changes in credit spreads, their finding of a significant principal component for unexplained credit spread changes suggests that the credit risk premium is different from other known market risk premia.

To the best of our knowledge, this article is the only one that answers two important questions: (i) does a credit risk premium exist, and (ii) is it additive to the more well-known equity risk premium and term premium, in a consistent framework using a long history of data.

The remainder of the article proceeds as follows. In the next section, we discuss our data. Then we introduce our empirical estimation of duration, document the existence of the credit risk premium, and show that the credit risk premium is additive to both the equity risk premium and the term premium. Next, we describe similar evidence outside of the U.S. corporate bond market and discuss various robustness tests. Finally, we conclude.

DATA DESCRIPTION

Corporate Bonds

Ibbotson's data. We use the U.S. Long-Term Corporate Bonds total returns from Ibbotson's *Stocks, Bonds, Bills, and Inflation Classic Yearbook* (SBBI), which publishes historical returns on the U.S. capital markets since 1926. To our knowledge, this is the longest source of historical returns on corporate bonds. This return series was constructed by splicing three data sources together. From 1926 to 1945, total returns were calculated using monthly yield data from Standard and Poor's High-Grade Corporate Composite, assuming a 4% coupon and a 20-year maturity. From 1946 to 1968, Ibbotson and Sinquefield [1976] backdated the Salomon Brothers' Index using monthly yield data from Salomon Brothers, assuming a coupon equal to the beginning period yield and a 20-year maturity. Total returns on the Citigroup Long-Term High-Grade Corporate Bond Index (formerly Salomon Brothers) were used from 1969 to the present.[2]

It is important to note that risk characteristics such as durations are not available for this return series, and one must rely on empirical methods to estimate them. Hallerbach and Houweling [2013] outline two biases in the Ibbotson's data that are often ignored in the literature: (i) government and corporate bonds are not matched in maturity (or duration), and (ii) corporate bonds were of very high quality historically. A combination of these two issues can lead to a systematic understatement of the credit risk premium. First, as corporate bonds tend to have a lower duration than government bonds, and there is evidence of a positive term premium, a simple difference between corporate and government bond returns will produce a lower estimate of credit excess returns. Second, to the extent that the credit risk premium reflects compensation for bearing exposure to default risk, using corporate bond returns from the safest issuers will also understate credit excess returns. We describe in the next section how we address the first of these biases when we extract credit excess returns from total returns.

Barclays' index data. We use Barclays U.S. Corporate Investment Grade Index, U.S. Corporate High Yield Index, and their pan-European counterparts for credit excess returns since their inception. Barclays is one of the leading fixed-income index providers whose indexes have been widely used as benchmarks to assess the performance of fixed-income money managers. The indexes are designed to capture broad universes of investable securities within specified categories. For example, the U.S. Corporate Investment Grade Index includes all USD-denominated corporate bonds that are rated Baa3/BBB– or higher, at least USD 250 million par amount outstanding, and have at least one year until maturity (while also satisfying a few other criteria).[3]

Barclays provides total returns, credit excess returns, and a suite of risk characteristics such as yields, option-adjusted-spreads, durations, etc. The credit excess returns are particularly useful to us, as they are calculated as the difference between the index total return and the return of a hypothetical Treasury portfolio with the same key rate duration profile. This is a more accurate measure of credit excess returns than our calculations on Ibbotson's data for two reasons: (i) analytical durations derived from bond pricing models are superior to empirical durations that are backward-looking, and (ii) key rate durations are used to allow for other changes in the shape of the yield curve on top of a parallel shift. Credit excess returns for U.S. and European indexes are available from 1988 and 1999, respectively.

Credit Default Swap Index Data

Markit CDX and Markit iTraxx are liquid tradable credit default swap (CDS) indexes with more than USD 30 billion of notional traded daily.[4] CDSs have no direct interest rate exposure, and thus total returns computed from CDS indexes are equivalent to credit excess return for corporate bonds. For the CDX North American Investment Grade, iTraxx Europe Main, and iTraxx Europe Crossover indexes, which are quoted in spread terms, we first convert quoted spreads into prices using the ISDA CDS Standard Model and compute returns from the prices. For the CDX North American High Yield index, which is quoted in price terms, we compute returns directly from the quoted prices. Cash flows from defaults are also included in the return calculation.

Other Data

We use government bond total returns and yields of Ibbotson's U.S. Long-Term Government Bonds and Barclays U.S. Treasury Index. The Ibbotson's data come from CRSP U.S. Government Bond File from 1926 to 1976 and from the *Wall Street Journal* from 1977 onward. The U.S. Long-Term Government Bonds returns are computed by constructing a one-bond portfolio with a term of approximately 20 years.

We use equity total returns of Ibbotson's U.S. Large Company Stocks, which are the returns of the S&P Composite Index. The index is composed of 90 stocks prior to 1957 and 500 stocks (S&P 500) thereafter.

For risk-free rate returns, we use Ibbotson's U.S. 30-day Treasury Bill total returns, which are computed by constructing a one-bill portfolio holding the shortest-term bill not less than one month to maturity, using the same data sources as the U.S. Long-Term Government Bonds mentioned previously.

For credit spreads, we use Moody's Seasoned Aaa Corporate Bond Yield and Moody's Seasoned Baa Corporate Bond Yield, obtained through the St. Louis Fed's Federal Reserve Economic Data.[5]

Exhibit 1 reports annualized statistics of total returns of government and corporate bonds. R_t^{GOVT} is the total return of Ibbotson's U.S. Long-Term Government Bonds. R_t^{CORP} is the total return of Ibbotson's U.S. Long-Term Corporate Bonds. $R_t^{CORP\_IG}$ and $R_t^{CORP\_HY}$ are the total returns of Barclays U.S. Corporate Investment Grade Index and U.S. Corporate High Yield Index, respectively, which are only available for the 198808–201412

Exhibit 1

Summary Statistics of U.S. Government and Corporate Bonds Total Returns between 1936 and 2014

	R_t^{GOVT}	R_t^{CORP}	$R_t^{CORP\_IG}$	$R_t^{CORP\_HY}$
Panel A: 193601–198807				
Mean	4.39%	4.73%		
Std. Dev.	8.02%	7.19%		
Panel B: 198808–201412				
Mean	9.23%	8.76%	7.39%	8.53%
Std. Dev.	9.95%	8.70%	5.29%	8.81%
Panel C: 193601–201412				
Mean	5.98%	6.05%		
Std. Dev.	8.73%	7.74%		

Notes: This table reports annualized statistics (mean and standard deviation) of total returns. R_t^{GOVT} and R_t^{CORP} are the total returns of Ibbotson's U.S. Long-Term Government Bonds and U.S. Long-Term Corporate Bonds, respectively. $R_t^{CORP\_IG}$ and $R_t^{CORP\_HY}$ are the total returns of the Barclays U.S. Corporate Investment Grade Index and the Barclays U.S. Corporate High Yield Index, respectively.

time period. Note that in Exhibit 1, Panel B, the average annual total returns of R_t^{CORP} and $R_t^{CORP\_IG}$ over the same 198808–201412 period are different by 137 basis points (8.76%–7.39%) even though they both represent baskets of U.S. corporate investment-grade bonds. This difference is primarily attributable to composition differences in the investment-grade corporate bonds covered by Ibbotson and Barclays. We comment further on this total return difference in the next section.

RESULTS

Existence of Credit Risk Premium

As described in the previous section, to compute a measure of credit excess returns for corporate bonds over the 193601–198807 period using Ibbotson's data, we need to estimate the duration of both the U.S. Long-Term Government Bonds and the U.S. Long-Term Corporate Bonds. We do not compute credit excess returns as the simple difference between the total returns on U.S. Long-Term Government Bonds and total returns on U.S. Long-Term Corporate Bonds. Instead, we follow a two-step procedure to estimate the interest rate duration of the total returns on U.S. Long-Term Government Bonds and U.S. Long-Term Corporate Bonds, and then use these estimated durations to compute credit excess returns. To estimate these interest rate sensitivities precisely, it is important we have a long time series of data, hence our focus on the United States for which we have more than 80 years of corporate bond returns.

First, we estimate Equation 1 on a rolling 120-month basis:

$$R_t^{GOVT} = \alpha_{GOVT} + \beta_t^{GOVT\_IR} \Delta YIELD_t^{GOVT} + \varepsilon_t \qquad (1)$$

R_t^{GOVT} is the monthly total return for U.S. Long-Term Government Bonds using Ibbotson's data. $\Delta YIELD_t^{GOVT}$ is the contemporaneous change in yield for U.S. Long-Term Government Bonds. The regression coefficient, $\beta_t^{GOVT\_IR}$, is an empirical estimate for the interest rate duration of the basket of U.S. Long-Term Government Bonds.

Second, we estimate Equation 2 also on rolling 120-month basis:

$$R_t^{CORP} = \alpha_{CORP} + \beta_t^{CORP\_IR} \Delta YIELD_t^{GOVT} + \beta_t^{CORP\_SPR} \Delta YIELD_t^{Baa-Aaa} + \varepsilon_t \qquad (2)$$

R_t^{CORP} is the monthly total return for U.S. Long-Term Corporate Bonds using Ibbotson's data. $\Delta YIELD_t^{GOVT}$ is the contemporaneous change in yield for U.S. Long-Term Government Bonds, and $\Delta YIELD_t^{Baa-Aaa}$ is the contemporaneous change in the spread of Moody's seasoned Baa rated corporate bonds over Aaa rated corporate bonds. The regression coefficient, $\beta_t^{CORP\_IR}$, is an empirical estimate for the interest rate duration of U.S. Long-Term Corporate Bonds, and the regression coefficient $\beta_t^{CORP\_SPR}$ is an empirical estimate for the spread duration of U.S. Long-Term Corporate Bonds. We estimate interest rate duration in the presence of spread duration as corporate bonds face both sources of risk, and it is important to understand the partial correlations between these two sources of returns. Corporate leverage is an endogenous decision (e.g., Leland [1994]) in which riskier issuers are less likely to be able to issue longer-dated debt. Thus, we jointly estimate interest rate duration and spread duration, and our focus is on precisely estimating the former for the purpose of computing credit excess returns. Panel A of Exhibit 2 reports the full sample regression results of Equation 1 and Equation 2 using data from 192601 to 198807. Panel B of Exhibit 2 reports the average and various percentiles of the duration estimates from Equation (1) and Equation 2 on a 120-month rolling basis.

We estimate the monthly credit excess return as per Equation 3 each month. Given that we require a rolling 120-month period to estimate the respective interest rate durations, our estimate of credit excess returns is only available from 193601 onward.

$$R_t^{CORP\_XS} = R_t^{CORP} - \frac{\beta_t^{CORP\_IR}}{\beta_t^{GOVT\_IR}} R_t^{GOVT} \qquad (3)$$

Equation 3 simply recognizes that the interest rate exposure of U.S. Long-Term Government Bonds could be different from the interest rate exposure of U.S. Long-Term Corporate Bonds. As Hallerbach and Houweling [2013] note, these differences can lead to systematic errors in estimates of the credit risk premium. Over the 193601–198807 period, the average estimate of $\beta_t^{GOVT\_IR}$ is −11.76 and the average estimate of $\beta_t^{CORP\_IR}$ is −6.09, as shown in Panel B of Exhibit 2. Thus, a simple difference between U.S. Long-Term Government Bonds returns and U.S. Long-Term Corporate Bonds returns will systematically understate credit excess returns given

EXHIBIT 2

Duration Estimates for U.S. Government and Corporate Bonds between 1926 and 1988

Panel A: Full Sample Regression, 192601–198807

	(1)		(2)
Intercept	0.0044	Intercept	0.0048
	(16.67)		*(11.50)*
$\beta_t^{GOVT\_IR}$	–8.62	$\beta_t^{CORP\_IR}$	–6.84
	(–78.62)		*(–39.01)*
		$\beta_t^{CORP\_SPR}$	–0.6831
			(–2.87)
R^2	89%	R^2	67%

Panel B: Duration Estimates from 120-Month Rolling Regressions

	$\beta_t^{GOVT\_IR}$	$\beta_t^{CORP\_IR}$
Mean	–11.76	–6.09
25th Percentile	–13.96	–7.48
50th Percentile	–13.06	–7.00
75th Percentile	–10.02	–3.46

Notes: This table reports results from the regression of U.S. Long-Term Government Bonds total returns on contemporaneous changes in U.S. Long-Term Government Bonds yield and the regression of U.S. Long-Term Corporate Bonds total returns on contemporaneous changes in U.S. Long-Term Government Bonds yield and changes in the spread between Aaa- and Baa-rated corporate bond yields as specified in Equation 1 and Equation 2.

$$R_t^{GOVT} = \alpha_{GOVT} + \beta_t^{GOVT\_IR}\,\Delta YIELD_t^{GOVT} + \varepsilon_t \qquad (1)$$

$$\begin{aligned} R_t^{CORP} = \alpha_{CORP} &+ \beta_t^{CORP\_IR}\,\Delta YIELD_t^{GOVT} \\ &+ \beta_t^{CORP\_SPR}\,\Delta YIELD_t^{Baa-Aaa} + \varepsilon_t \end{aligned} \qquad (2)$$

R_t^{GOVT} is the monthly total return for Ibbotson's U.S. Long-Term Government Bonds. $\Delta YIELD_t^{GOVT}$ is the contemporaneous change in yield for U.S. Long-Term Government Bonds. R_t^{CORP} is the monthly total return for Ibbotson's U.S. Long-Term Corporate Bonds. $\Delta YIELD_t^{Baa-Aaa}$ is the contemporaneous change in the spread of Baa rated corporate bonds over Aaa rated corporate bonds.

Panel A shows the full sample regression results over the 192601–198807 period. Panel B shows the averages and quartiles of the duration estimate for U.S. Long-Term Government Bonds, $\beta_t^{GOVT\_IR}$, and U.S. Long-Term Corporate Bonds, $\beta_t^{CORP\_IR}$ from running Equation 1 and Equation 2 on a rolling 120-month basis.

a positive term premium. Similar observations were made by Blume, Keim, and Patel [1991] and Cornell and Green [1991] where they find that the beta of corporate bond returns to Treasury bond returns are significantly lower than 1. This is one potential explanation for why Fama and French [1993] did not find a significant default return. It is important to remember that we only use this empirical estimate for interest rate exposure over the 193601–198807 period when we do not have access to reliable analytics. From 198808 onward, when we have access to Barclays' data, we do not need to estimate empirical durations.

We check the validity of our credit excess return estimation methodology by applying it to the Barclays' data. The comparison starts in 199907 because yields, durations, and spreads are only available from 198906 onward, and we estimate empirical durations using Equation 1 and Equation 2 on a 120-month rolling basis. We compare three measures of credit excess returns: (i) as reported by Barclays, (ii) estimated by Equation 3 using Barclays' measure of durations, and (iii) estimated by Equation 3 using our empirical durations. Our empirical measure of duration is 90% correlated with Barclays' measure of option-adjusted duration, the three measures of credit excess return are more than 0.99 correlated to each other, and the averages are virtually identical across the three approaches (within 1 basis point of each other). We are therefore comfortable that our empirical estimate of duration for historical data is reasonable.

Panel A of Exhibit 3 reports annualized statistics of credit excess returns for the 193601–198807 period. Using our estimate from Equation 3, we find an average annual credit excess return of 180 basis points with a Sharpe ratio of 0.51 ($R_t^{CORP\_XS}$).[6] In contrast, the credit excess return based on a simple difference between U.S. Long-Term Government Bonds returns and U.S. Long-Term Corporate Bonds returns ($R_t^{CORP\_XS\_SIMPLE}$)generates a Sharpe ratio of only 0.09. This difference highlights the impact of measurement error in duration estimates across long-term government bonds and long-term corporate bonds. The simple difference between returns of long-term government bonds and long-term corporate bonds effectively "over-hedges" the corporate bond return. While the correlation between our estimate of the credit excess return and the simple difference is 0.76, there is a striking difference in the estimated credit risk premium.

Panel B of Exhibit 3 reports annualized statistics of credit excess returns for the 198808–201412 period using both Ibbotson's and Barclays' data. Over that period, we document an average annual credit excess return of 161 basis points for Ibbotson's U.S. Long-Term Corporate Bonds (R^{CORP_XS}), 50 basis points for Barclays U.S.

Exhibit 3

Excess Returns for U.S. Corporate Bonds between 1936 and 2014

	$R_t^{CORP\_XS}$	$R_t^{CORP\_XS\_SIMPLE}$	$R_t^{CORP\_IG\_XS}$	$R_t^{CORP\_HY\_XS}$
Panel A: 193601–198807				
Mean	1.80%	0.34%		
Std. Dev.	3.52%	3.97%		
Sharpe	0.51	0.09		
Panel B: 198808–201412				
Mean	1.61%	–0.47%	0.50%	2.48%
Std. Dev.	4.89%	5.50%	3.92%	9.57%
Sharpe	0.33	–0.09	0.13	0.26
Panel C: 193601–201412				
Mean	1.74%	0.07%		
Std. Dev.	4.03%	4.54%		
Sharpe	0.43	0.02		

Notes: This table reports annualized statistics (mean, standard deviation, and Sharpe ratio) for various measures of credit excess returns. Panel A contains statistics of credit excess returns over the 193601–198807 period during which only the Ibbotson's data are available. Our estimate of credit excess returns is given by Equation 3, where $\beta_t^{GOVT\_IR}$ and $\beta_t^{CORP\_IR}$ are estimated using Equation 1 and Equation 2 on a 120-month rolling basis as described in Exhibit 2. We also estimate an alternative measure of credit excess returns, $R_t^{CORP\_XS\_SIMPLE}$, which is the simple difference between R_t^{CORP} and R_t^{GOVT}.

$$R_t^{CORP\_XS} = R_t^{CORP} - \frac{\beta_t^{CORP\_IR}}{\beta_t^{GOVT\_IR}} R_t^{GOVT} \tag{3}$$

Panel B contains statistics of credit excess returns over the 198808–201412 period during which Ibbotson's and Barclays' data are available. $R_t^{CORP\_IG\_XS}$ and $R_t^{CORP\_HY\_XS}$ are excess of key rate durations matched Treasury returns on the Barclays U.S. Corporate Investment Grade Index and the Barclays U.S. Corporate High Yield Index, respectively. Finally, Panel C contains statistics of credit excess returns using Ibbotson's data over the full 193601–201412 period.

Corporate Investment Grade Index, ($R^{CORP\_IG\_XS}$), and 248 basis points for Barclays U.S. Corporate High Yield Index ($R^{CORP\_HY\_XS}$). These translate to Sharpe ratios of 0.33, 0.13, and 0.26, respectively. Again, note that the simple difference between returns of long-term government bonds and long-term corporate bonds greatly underestimates the credit risk premium (−47 basis points). It is also noteworthy that the average credit excess return of Barclays' $R^{CORP\_IG\_XS}$ is significantly lower than that of Ibbotson's R^{CORP_XS} over this time period, even though they both represent baskets of investment-grade corporate bonds. The average credit excess return for R^{CORP_XS} is 111 basis points higher than that of $R^{CORP\_IG\_XS}$ (1.61%–0.50%). However, recall from Exhibit 1 that the magnitude of this difference is similar to the 137 basis point difference in total returns between R^{CORP_IG} and R^{CORP} (8.76%–7.39%). This difference is owing to the difference in the compositions of the two portfolios of corporate bonds, and not our methodology for estimating credit excess returns.

Exhibit 4

Regression of U.S. Corporate Bond on U.S. Government Bond Returns between 1936 and 1988

	(4)
Intercept	0.0011
	(2.65)
β	0.78
	(44.12)
R^2	76%

Notes: This table reports results from the regression of U.S. Long-Term Corporate Bonds excess of risk-free rate returns onto U.S. Long-Term Government Bonds excess of risk free rate returns, as specified by Equation 4, over the 193601–198807 period.

$$R_t^{CORP} - R_t^f = \alpha + \beta(R_t^{GOVT} - R_t^f) + \varepsilon \tag{4}$$

R_t^{GOVT} is the monthly total return for Ibbotson's U.S. Long-Term Government Bonds. R_t^{CORP} is the monthly total return for Ibbotson's U.S. Long-Term Corporate Bonds. R_t^f is the monthly total return for Ibbotson's U.S. 30-day Treasury bill.

Panel C of Exhibit 3 reports annualized statistics of R^{CORP_XS} and $R^{CORP\_XS\_SIMPLE}$ for the full 193601–201412 period. Again, the naïve estimate has an average annual credit excess return of only 7 basis points compared with our estimate of 174 basis points.

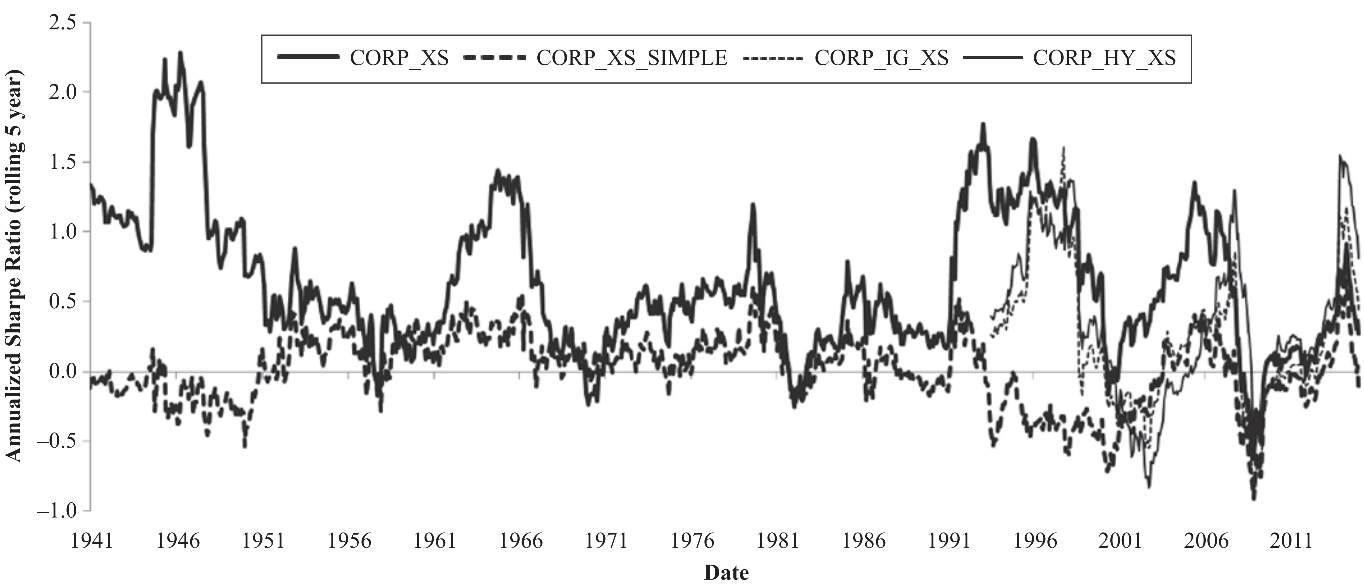
An alternative approach to assessing whether U.S. Long-Term Corporate Bonds returns provide a significant excess returns over U.S. Long-Term Government Bonds returns is simply to regress U.S. Long-Term Corporate Bonds returns (in excess of the risk-free rate as measured by U.S. 30-day Treasury bill returns) onto U.S. Long-Term Government Bonds returns (also in excess of the risk-free rate). Exhibit 4 reports the result of this regression. For the same 193601–198807 period, we find that U.S. Long-Term Corporate Bonds have significant "alpha" over U.S. Long-Term Government Bonds. The intercept from the monthly regression suggests that corporate bonds provide 11 basis points of "excess" returns per month and the significant test-statistic of 2.65 confirms the significance of the credit risk premium for this time period.[7]

Obviously, the averages reported in Exhibit 3 mask considerable time-series variation in the credit risk premium. Exhibit 5 shows the evolution of credit excess returns. We track rolling five-year annualized Sharpe ratios for four different measures of returns: (i) $R_t^{CORP\_XS}$ (labeled as CORP_XS in Exhibit 5 and indicated by the thick solid line), (ii) $R_t^{CORP\_XS\_SIMPLE}$ (labeled as CORP_XS_SIMPLE in Exhibit 5 and indicated by the thick dashed line), (iii) $R_t^{CORP\_IG\_XS}$ (labeled as CORP_IG_XS in Exhibit 5 and indicated by the thin dashed line), and (iv) $R_t^{CORP\_HY\_XS}$ (labelled as CORP_HY_XS in Exhibit 5 and indicated by the thin solid line). For the purposes of Exhibit 5, the credit risk premium based on Ibbotson's data starts in 194012, as we require the first 10 years of data to estimate interest rate duration and then a further five years to compute rolling Sharpe ratios. The credit risk premium based on Barclays' data starts in 199307, as we require five years of data to compute rolling Sharpe ratios.

The magnitude of the measurement error induced by failing to account for differences in interest rate duration across corporate and government bonds is strikingly clear. The largest difference between $R_t^{CORP\_XS}$ and $R_t^{CORP\_XS\_SIMPLE}$ is evident in the 1940s, and again in the 1990s. These differences are attributable to (i) the relative magnitude of the returns of long-term corporate and long-term government bonds, and (ii) the ratio of the interest rate sensitivity of long-term corporate bonds and long-term government bonds. The periods from 1941 to 1950 and from the late 1980s into the middle of the 1990s are characterized by strongly positive long-term government bond returns. Combining this finding with the fact that long-term corporate bonds had a lower interest rate sensitivity than long-term government bonds, it is not surprising to see such a large difference in credit excess returns across the two measures. For the more recent period, where we can use clean

EXHIBIT 5

Credit Risk Premium in Corporate Bonds (rolling five-year Sharpe ratios)



Notes: For the 194101–201412 period, we report rolling five-year Sharpe ratios of various estimates of the credit risk premium. Sharpe ratios are computed on an annualized basis using the annualized monthly credit excess return scaled by annualized volatility of monthly credit excess returns. We use four estimates of credit excess returns. The first two measures are computed using Ibbotson's data. They are CORP_XS (thick solid line) and CORP_XS_SIMPLE (thick dashed line). CORP_XS first estimates empirical interest rate durations for government and corporate bonds. CORP_XS_SIMPLE is the difference between U.S. Long-Term Government Bonds and U.S. Long-Term Corporate Bonds returns. The second two measures are computed using Barclays' data. They are CORP_IG_XS (thin dashed line) and CORP_HY_XS (thin solid line). CORP_IG_XS is U.S. Corporate Investment Grade index returns in excess of key rate durations matched U.S. Treasury returns. CORP_HY_XS is U.S. Corporate High Yield index returns in excess of key rate duration matched U.S. Treasury returns.

measures of credit excess returns from Barclays, we see that both the investment-grade and high-yield credit excess returns track each other relatively closely, with larger credit excess returns for high yield. As expected, the credit risk premium is quite cyclical. We return to this in a later section.

Is the Credit Risk Premium Different from the Equity Risk Premium and Term Premium?

We next turn to assess the potential diversification benefit of the credit risk premium. Using a standard option pricing framework, it is possible to link equity and debt claims on a given firm: they are related securities sharing in the free-cash-flow generation of the enterprise. The same deterministic links apply to aggregate equity and credit markets. Thus, it is natural to ask whether the credit risk premium is different from the equity risk premium. While the values of equity and debt securities are fundamentally linked through the firm that issues them, the way these two securities respond to changes in the firm's underlying asset value is not necessarily identical. Equity and debt values can change even when the underlying asset value of the firm does not. Wealth-transfer corporate events such as leverage buyouts tend to benefit equity holders at the expense of debt holders. Furthermore, equity and debt are traded in different markets and are typically held by different investors. This market segmentation can cause equity and debt prices to diverge as they are anchored to the risk aversion, liquidity demand, and sentiment of different investors.

Exhibit 6 reports annualized statistics of excess returns across corporate bonds, government bonds, and equities for the 193601–201412 period. For this analysis, we use the longest time series of *highest quality* data possible. Thus, we splice the credit excess returns from Ibbotson's and Barclays' data. We use the credit excess returns of Ibbotson's U.S. Long-Term Corporate Bonds, $R_t^{CORP\_XS}$, as defined in a previous section for the earlier 193601–198807 period. For consistency with the Ibbotson's data, we use the Barclays U.S. Corporate Investment Grade Index excess returns, $R_t^{CORP\_IG\_XS}$ for the later 198808–201412 period. We refer to this combined or spliced data series as $R_t^{CORP\_XS\_SPLICED}$. It is important to note that long-term corporate bonds in the older period, especially 1926–1945, are from "safer" companies rated around AA and are longer dated (see Hallerbach and Houweling [2013]). This creates two potentially offsetting issues that make comparisons with the more recent period challenging, even after we properly account for interest rate duration differences, as described earlier. First, given an upward-sloping credit term structure, longer-dated debt will attract a higher spread and hence a potentially higher excess return. Second, safer issuers (e.g., AA/A rated) have lower initial spreads, and hence a potentially lower excess return. The net effect of these two forces is ambiguous on estimates of credit excess returns for the older sample period. However, absent clean data on spread levels and credit term structure, it is not possible to resolve this empirically. We note this caveat for the older data.

Our spliced data therefore contain credit excess returns for only investment-grade issuers with a tilt toward higher-quality investment-grade issuers further back in time. We choose this splicing rule (i) to allow for consistency in our estimates of the credit risk premium through time and (ii) because the high-yield market prior to the 1980s was very different, consisting of fallen angels and making the quality of the Ibbotson's data less certain. Finally, we compare credit excess returns to the term premium, as measured by U.S. Long-Term Government Bonds excess returns, $R_t^{GOVT\_XS}$, and equity risk premium as measured by the S&P 500 Index excess returns, $R_t^{SP500\_XS}$. Both of these measures are excess of U.S. 30-day Treasury bill returns.

Panel A of Exhibit 6 reports the average annualized returns and associated standard deviations for these three measures of excess returns. Equities, government bonds, and corporate bonds all offer returns for bearing risk. Indeed, the annualized Sharpe ratios across these three primary asset classes are quite similar. In Panel B, we document the full sample pairwise correlations (parametric and nonparametric). Monthly credit excess returns are positively associated with monthly excess equity returns (correlation around 0.29). Of course, the excess returns across each asset class are time varying. Exhibit 7 shows the rolling five-year Sharpe ratio across the three measures. The positive correlation between equity and credit excess returns is evident in this exhibit, but there are notable deviations in the two series, suggesting the potential for a diversifying source of returns. We next explore these correlations to better understand whether credit markets offer an *additive* source of returns to government bonds and equity markets.

EXHIBIT 6

Excess Returns for U.S. Corporate Bonds, Government Bonds, and Equities between 1936 and 2014

	$R_t^{CORP\_XS\_SPLICED}$	$R_t^{GOVT\_XS}$	$R_t^{SP500\_XS}$
Panel A: Risk Premium across Asset Classes, 193601–201412			
Mean	1.37%	1.60%	7.83%
Std. Dev.	3.66%	5.23%	15.70%
Sharpe	0.37	0.31	0.50
Panel B: Return Correlation across Asset Classes (Pearson above, Spearman below)			
$R_t^{CORP\_XS\_SPLICED}$		–0.002	0.292
$R_t^{GOVT\_XS}$	–0.013		0.095
$R_t^{SP500\_XS}$	0.245	0.113	

Notes: This table reports annualized statistics (mean, standard deviation, and Sharpe ratio) for measures of excess returns across U.S. corporate bonds, government bonds, and equities. For corporate bond excess returns, $R_t^{CORP\_XS\_SPLICED}$ *is a spliced data series combining* $R_t^{CORP\_XS}$ *constructed from Ibbotson's data for the 193601–198807 period and* $R_t^{CORP\_IG\_XS}$ *from Barclays for the 198808–201412 period. Details on the estimation of* $R_t^{CORP\_XS}$ *can be found in Exhibit 3. This measure of credit excess returns is with respect to duration matched government bond returns. For government bond excess returns,* $R_t^{GOVT\_XS}$ *is the difference between either Ibbotson's U.S. Long-Term Government Bonds for the 193601–197212 period or Barclays U.S. Treasury Index for the 197301–201412 period and U.S. 30-day Treasury bill returns. For U.S. equity excess returns,* $R_t^{SP500\_XS}$ *is the difference between the returns of the S&P Composite Index, which later becomes the S&P 500 Index, and U.S. 30-day Treasury bill returns.*

Exhibit 8 reports formal regression analysis of credit excess returns projected onto combinations of government bond excess returns, equity excess returns, and standard risk factors in the equity market. We use the full sample of data from 193601 to 201412. As before, we lose the first 10 years of Ibbotson's data as we require 120 months to empirically estimate interest rate duration. We report results from five regressions: First, we regress credit excess returns onto $R_t^{GOVT\_XS}$ only. Second, we regress credit excess returns onto $R_t^{SP500\_XS}$ only. Third, we regress credit excess returns onto both $R_t^{GOVT\_XS}$ and $R_t^{SP500\_XS}$. Fourth, we add one-month lagged equity returns to control for possible issues with liquidity or stale pricing in the credit market. Fifth, we add the standard factor-mimicking returns from the equity market (SMB, HML, and UMD). The results show a consistently positive intercept across all five regression specifications. The magnitude of the intercept for $R_t^{CORP\_XS\_SPLICED}$ ranges from 7 to 11 basis points per month and are significant at conventional levels. Over the full sample, there is a consistently positive exposure of credit excess returns to equity excess returns, and no relation between credit excess returns and government bond excess returns. The positive and statistically significant intercepts suggest that the credit risk premium is additive to equity and term risk premia, even after controlling for liquidity and other equity risk factors.

An alternative way to assess the relative attractiveness of two (or more) series of excess returns is to determine in-sample optimal portfolio weights (e.g., Britten-Jones [1999]). To determine how much credit risk premium investors should have in a diversified portfolio, we solve for the ex post optimal allocation weights for a portfolio consisting of corporate bonds, government bonds, and equities, subject to no shorting and leverage constraints, namely

$$max_w \ \frac{w'R}{\sqrt{(w'\Sigma w)}}$$

$$\text{subject to} \qquad w'\mathbf{1} \leq 1$$

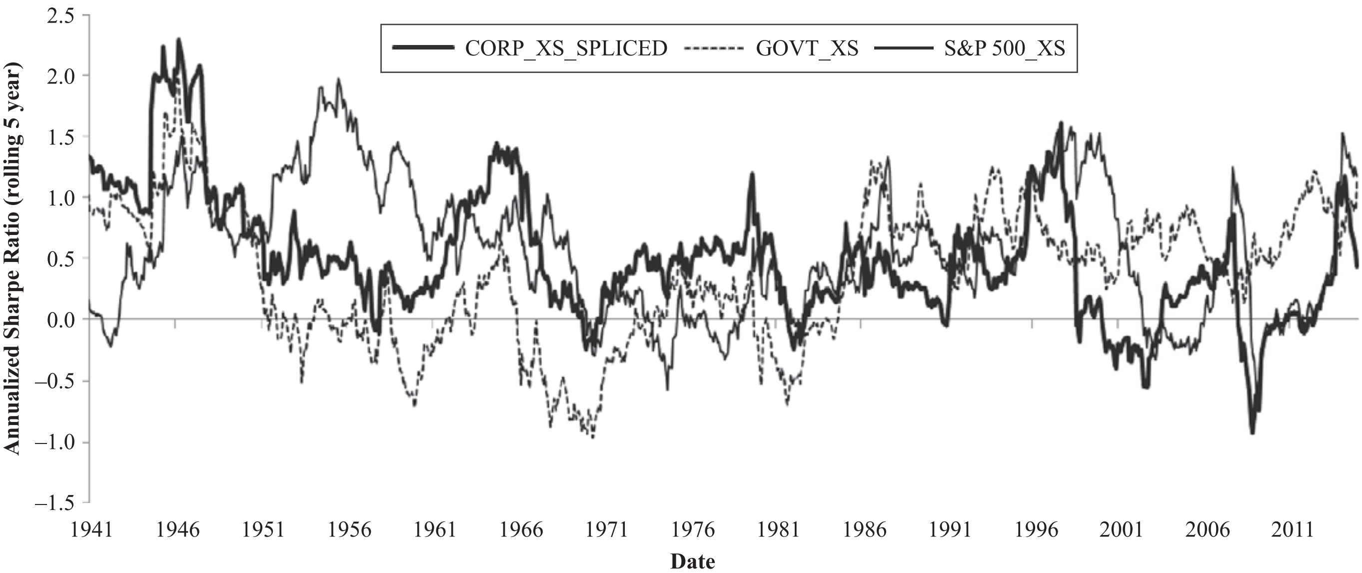
$$w_i \geq 0, \ \forall i$$

R is a vector of average corporate bonds, government bonds, and equities excess returns; w is the vector of portfolio weights to be solved for; and Σ is the corresponding covariance matrix. The optimal portfolio solution is mean–variant efficient but does not incorporate information on the expected transaction costs or capacity of each asset. Thus, the results here should be interpreted with caution for large asset allocation decisions.

Exhibit 9 reports the optimal allocations as well as the annualized statistics on the resulting optimal portfolio excess returns for the 193601–201412 period. The key inference from Exhibit 9 is that the ex post optimal portfolio has significant allocation to corporate bonds. We find that the ex post optimal portfolio allocates 48%, 35%, and 17% to corporate bonds, government bonds, and equities, respectively. While the Sharpe ratio of corporate bonds is only 0.37 compared with 0.50 of equities over the same time period, the optimal portfolio allocates more weight to corporate bonds because it has lower correlation to government bonds and hence offers more diversification. To assess the statistical significance of difference in optimal portfolio weights, we also report

EXHIBIT 7

Risk Premium across Equity, Government Bond, and Credit Markets (rolling five-year Sharpe ratios)



Notes: For the 194101–201412 period, we report rolling five-year Sharpe ratios for three measures of excess returns. Sharpe ratios are computed on an annualized basis using the annualized monthly excess return scaled by annualized volatility of monthly excess returns. For corporate bond, CORP_XS_SPLICED (thick solid line) is based on a spliced data series combining $R_t^{CORP\_XS}$ constructed from Ibbotson's data for the 193601–198807 period and $R_t^{CORP\_IG\_XS}$ from Barclays for the 198808–201412 period. Details on the estimation of $R_t^{CORP\_XS}$ are contained in Exhibit 3. This measure of credit excess returns is with respect to duration matched government bond returns. For government bond, GOVT_XS (thin dashed line) is based on the difference between either Ibbotson's U.S. Long-Term Government Bonds for the 193601–197212 period or Barclays U.S. Treasury Index for the 197301–201412 period and U.S. 30-day Treasury bill returns. For U.S. equity, S&P 500_XS (thin solid line) is based on the difference between the returns of the S&P Composite Index, which later becomes the S&P 500 Index, and U.S. 30-day Treasury bill returns.

the Britten-Jones [1999] F-statistic in the bottom right of each panel (bolded F-statistic). This F-statistic is based on the null hypothesis of equal weights across the three sources of excess returns. Failing to reject the null hypothesis implies that the optimal allocation is equal exposure to all three sources of returns. For our sample size, the critical value for the F-statistic is 3.08, so we fail to reject the null hypothesis, suggesting that the reported optimal weights are not statistically different from an equal exposure to corporate bonds, government bonds, and equities.

Time-Series Variation in Credit Risk Premium

How does the credit risk premium vary across macroeconomic environments? It is evident from Exhibit 5 that the magnitude of credit risk premium varies over time. Therefore, it is interesting to document characteristics of the macroeconomic environment when credit excess returns are unusually high or low. We focus on economic growth, inflation, and aggregated default rates as the relevant macroeconomic characteristics. To identify periods of high and low economic growth and inflation we follow the approach of Ilmanen, Maloney, and Ross [2014]. Our growth composite is defined as a simple average of two standardized series: the Chicago Fed National Activity Index and the "surprise" in U.S. industrial production growth. Similarly, our inflation composite is defined as a simple average of standardized year-on-year inflation rate and "surprise" in the U.S. Consumer Price Index. Surprise measures are defined as the difference between the realized values and consensus economist forecasts a year earlier. Thus, our analysis here is purely descriptive as we are looking at measures of changing expectations of economic growth and inflation that are measured contemporaneously with credit excess returns.

Using these macro variables, we divide the sample into "up" (+) and "down" (−) periods relative to the full

EXHIBIT 8
Analysis of Excess Returns across Asset Classes between 1936 and 2014

	$R_t^{CORP\_XS\_SPLICED}$				
	I	II	III	IV	V
Intercept	0.0011	0.0007	0.0007	0.0007	0.0010
	(3.31)	*(2.10)*	*(2.17)*	*(2.03)*	*(2.87)*
$R_t^{GOVT\_XS}$	–0.0016		–0.0213	–0.0194	–0.0065
	(–0.07)		*(–0.97)*	*(–0.88)*	*(–0.30)*
$R_t^{SP500\_XS}$		0.0680	0.0687	0.0686	0.0565
		(9.37)	*(9.42)*	*(9.41)*	*(7.52)*
$R_{t-1}^{SP500\_XS}$				0.0052	0.0010
				(0.72)	*(0.14)*
SMB_t					0.0250
					(2.16)
HML_t					0.0143
					(1.26)
UMD_t					–0.0481
					(–5.78)
R^2	0%	9%	9%	9%	13%

Notes: This table reports regressions of credit excess returns on to various market returns. $R_t^{CORP\_XS\_SPLICED}$, $R_t^{GOVT\_XS}$, and $R_t^{SP500\_XS}$ are as described in Exhibits 3 and 6. SMB_t, HML_t, and UMD_t are obtained from Kenneth French's website. The regression models estimated are listed below, and the panels reflect different time periods and different measures of credit excess returns (labeled as $R_t^{CORP\_XS}$ in the regression equations below for convenience). Regression coefficients are reported above italicized test statistics.

I $\quad R_t^{CORP\_XS\_SPLICED} = \alpha + \beta_1 R_t^{GOVT\_XS} + \varepsilon_t$

II $\quad R_t^{CORP\_XS\_SPLICED} = \alpha + \beta_1 R_t^{SP500\_XS} + \varepsilon_t$

III $\quad R_t^{CORP\_XS\_SPLICED} = \alpha + \beta_1 R_t^{GOVT\_XS} + \beta_2 R_t^{SP500\_XS} + \varepsilon_t$

IV
$$R_t^{CORP\_XS\_SPLICED} = \alpha + \beta_1 R_t^{GOVT\_XS} + \beta_2 R_t^{SP500\_XS} + \beta_3 R_{t-1}^{SP500\_XS} + \varepsilon_t$$

V
$$R_t^{CORP\_XS\_SPLICED} = \alpha + \beta_1 R_t^{GOVT\_XS} + \beta_2 R_t^{SP500\_XS} + \beta_3 R_{t-1}^{SP500\_XS} + \beta_4 SMB_t + \beta_5 HML_t + \beta_6 UMD_t + \varepsilon_t$$

EXHIBIT 9
Optimal Portfolio Allocation

	$R_t^{CORP\_XS\_SPLICED}$	$R_t^{GOVT\_XS}$	$R_t^{SP500\_XS}$	R_t^{PORT}
Mean	1.37%	1.60%	7.83%	2.56%
Std. Dev.	3.66%	5.23%	15.70%	4.17%
Sharpe	0.37	0.31	0.50	0.61
Optimal Weight	48%	35%	17%	**F: 1.17**

Notes: This table reports annualized statistics for ex post optimal portfolio of U.S. corporate bonds, U.S. Treasury bonds, and the S&P 500 Index. The optimal allocation weights are determined by maximizing ex post portfolio Share ratio over the 193601–201412 period, subject to no shorting and no leverage constraints in accordance with the objective function described below. To assess the statistical significance of difference in optimal portfolio weights we report the Britten-Jones [1999] F-statistic in the bottom right of the panel. This F-statistic is based on the null hypothesis of equal weights across the three sources of excess returns. Failing to reject the null indicates optimal exposure to all three sources of returns.

$$max_w \frac{w'R}{\sqrt{(w'\Sigma w)}}$$

subject to $\quad w'\mathbf{1} \le 1$
$\quad w_i \ge 0 \ \forall i$

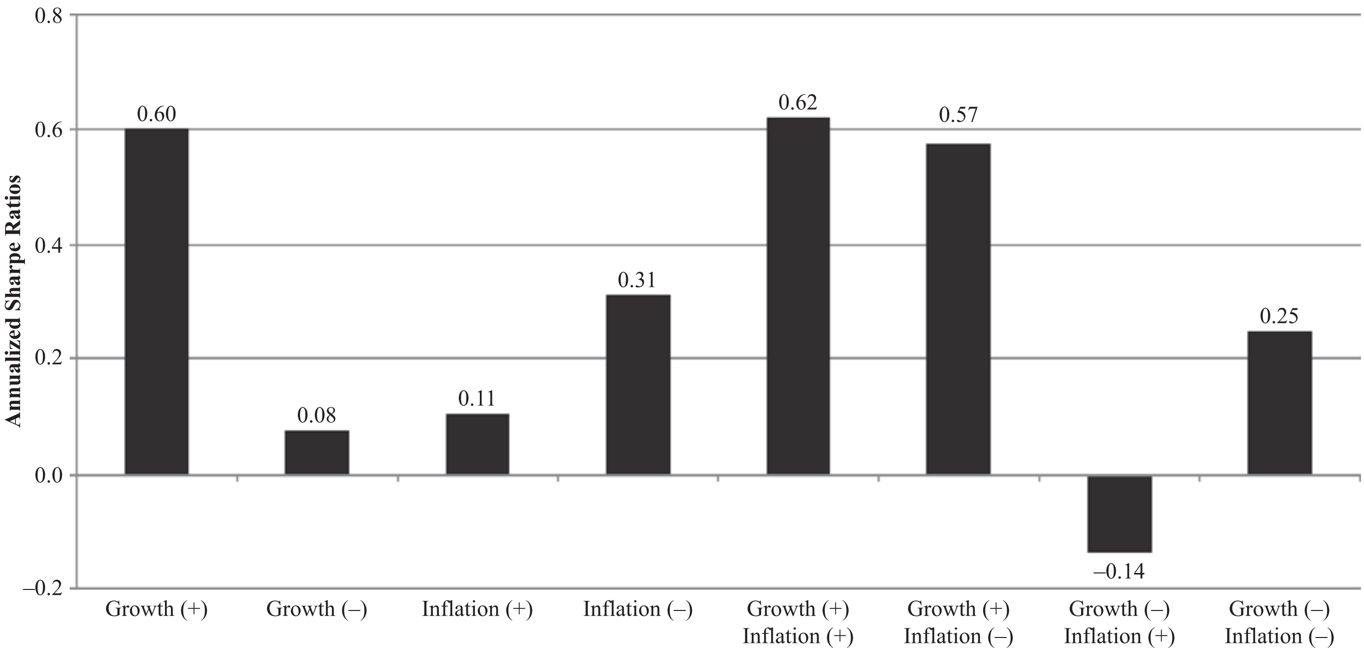
sample median. Exhibit 10 reports the Sharpe ratios of $R_t^{CORP\_XS\_SPLICED}$ for the 197201–201412 period under different macroeconomic environments. Our data period is shorter for this analysis owing to the limited time series of growth and inflation surprise data.

Corporate credit, like equities, is an asset class that will benefit from increasing expectations of economic growth. For the growth channel, companies benefit from overall economic growth as this will increase their ability to generate free cash flow that, in turn, increases their asset value, thereby making them "safer." Credit spreads naturally fall during periods of rising economic growth, giving rise to positive credit excess returns. For the inflation channel, a direct benefit of rising inflation expectations is the reduction in the credit risk attributable to nominal debt obligations. This would suggest that credit spreads would fall during periods of increasing inflation expectations, giving rise to positive credit excess returns. However, the inflation channel is confounded by any impact that this would have on a firm's free cash flow generating abilities as well as the driver of inflation. Inflation during periods of economic growth is expected to have a stronger positive association with credit excess returns.

Unsurprisingly, in Exhibit 10, we find that credit performs the best during periods of positive economic growth. Conditioning on positive growth, credit performs slightly better when inflation was positive. The only period in which credit has negative returns is

Exhibit 10

Sharpe Ratios in Growth and Inflation Environments from 1972 to 2014



Notes: Growth/Inflation is classified as positive (negative) when its composite value is above (below) the historical median. Growth composite is a simple average of standardized (z-scored) Chicago Fed National Activity Index and the "surprise" in U.S. industrial production growth. Inflation composite is a simple average of standardized (z-scored) year-on-year inflation rate and "surprise" in the U.S. Consumer Price Index. "Surprise" is measured as the difference between the realized values and consensus economist forecasts a year earlier. This analysis is descriptive, not predictive, as the identification of +/– growth and inflation periods and the credit excess returns are measured contemporaneously.

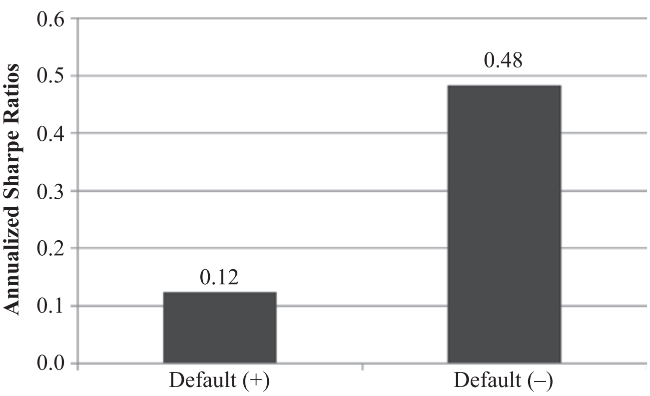
during negative growth and positive inflation. Economic growth and, to a lesser extent, inflation are sources of time-varying risk exposures that the credit risk premium captures.

How does the credit risk premium vary across the default regimes? Much has been written on the credit risk premium and linking it back to default risk. Examples include Elton et al. [2001] and Kozhemiakin [2007], where the estimated default rates are typically inferred from rating transition matrixes from the major rating agencies. A severe limitation of these rating transition matrixes is that they are very slow moving, and the rating themselves are typically made on a "through the business cycle" basis. So, if an investor wants to know if aggregated credit spreads are too high or too low to compensate for estimated default risk, using ratings is a very crude estimate. Instead, we have available both issuer-specific estimates of default probabilities and estimates of aggregate default probabilities. Past research has linked firm-level estimates of default probabilities to credit spreads and has shown that this generates a useful "anchor" to identify issuers whose spread levels are too high or too low. Correia, Richardson, and Tuna [2012] show for a large sample of corporate bonds and CDS contracts that credit spreads reflect information about forecasted default rates with a significant lag, and this generates a meaningful opportunity for value investing in credit markets.

Analyzing how effective such predictive default rate forecasts can be in making tactical allocation decisions on the credit risk premium is beyond the scope of this article. Instead, we look at how corporate bonds perform in different credit environments. Using Moody's annual global default rates for investment-grade bonds, we construct a credit default composite of the year-on-year change in aggregate default rates and a measure of the surprise in aggregate default rates. The surprise measure is the difference between the realized default rate over the 12-month period relative to the Moody's Baa–Aaa spread at the beginning of the period.

EXHIBIT 11

Sharpe Ratios in Default Environments from 1936 to 2014



Notes: Default environment is classified as positive (negative) when the default composite measure is above (below) the historical median. Our default composite measure is a simple average of standardized (z-scored) change and surprise in Moody's 12-month global investment-grade default rate. The change is measured as the year-on-year change in the default rate. The surprise is measured as the difference between Moody's Baa–Aaa spread at the beginning of the year and the default rate over that year. This analysis is descriptive, not predictive, as the identification of +/– default periods and credit excess returns are measured contemporaneously.

Again, we emphasize the descriptive nature of this analysis. We are documenting the contemporaneous relation between excess credit returns and changing expectations of default rates. In Exhibit 11, for the period 193601–201412, we find that when aggregate default rates increase, the average credit excess annual return is 0.5% with a Sharpe ratio of 0.12, while during periods of decreasing aggregate default rates, the average credit excess return is 2.2% with a Sharpe ratio of 0.48. Clearly, economic growth and its consequent effect on aggregate defaults is an important characteristic that helps explain time-series variation in the credit risk premium.

ROBUSTNESS

Normality Assumption of Returns

Our empirical analysis presented in an earlier section suggests that the credit risk premium is additive to the equity risk premium and the term premium. However, this analysis is based on a mean–variant analysis of returns. The validity of mean–variance optimization or Sharpe ratio maximization is often questioned when the underlying distribution of returns is not normal. It is well known that financial asset returns have "fat tails" and investors are concerned about the realization of "left tail" events (i.e., large negative returns). It is possible that the return profile of credit is more negatively skewed, reflecting the embedded optionality of corporate debt. In this section, we assess the robustness of the additivity of credit risk in a diversified portfolio to measures that penalize "left tail" return realizations.

First, we document the normality, or lack thereof, of excess returns across credit, equity, and Treasury markets. Exhibit 12 shows quantile–quantile plots for the three excess return measures: $R_t^{CORP\_XS\_SPLICED}$, $R_t^{GOVT\_XS}$, and $R_t^{SP500\_XS}$. We use the full sample of monthly data from 193601–201412 to standardize each excess return series. The quantiles of the resulting normalized returns are reflected on the vertical axis of each chart. The horizontal axis corresponds to the quantiles of a standard normal random variable. The closer the quantiles of the normalized returns are to the 45-degree line, the more "normal" are the excess returns. Clearly, all three excess return measures deviate from a normal distribution, but $R_t^{CORP\_XS\_SPLICED}$ more so than either $R_t^{GOVT\_XS}$ or $R_t^{SP500\_XS}$. Specifically, we see that there is a concentration of normalized returns that are below (above) the 45-degree line, for the lowest (highest) quantiles, indicative of a greater "tails" in credit excess returns. In addition, there is also a reduced incidence of smaller returns (either positive or negative) for credit excess returns. In contrast, $R_t^{GOVT\_XS}$, and $R_t^{SP500\_XS}$ are both much closer to the 45-degree line, particularly between −2 and +2.

Second, having established that excess returns deviate from normality, we now assess whether our inference that the credit risk premium is additive to both the term and equity risk premium is robust to return non-normality. For this purpose, we use the Sortino ratio (e.g., Sortino and Price [1994]). We define the Sortino ratio as

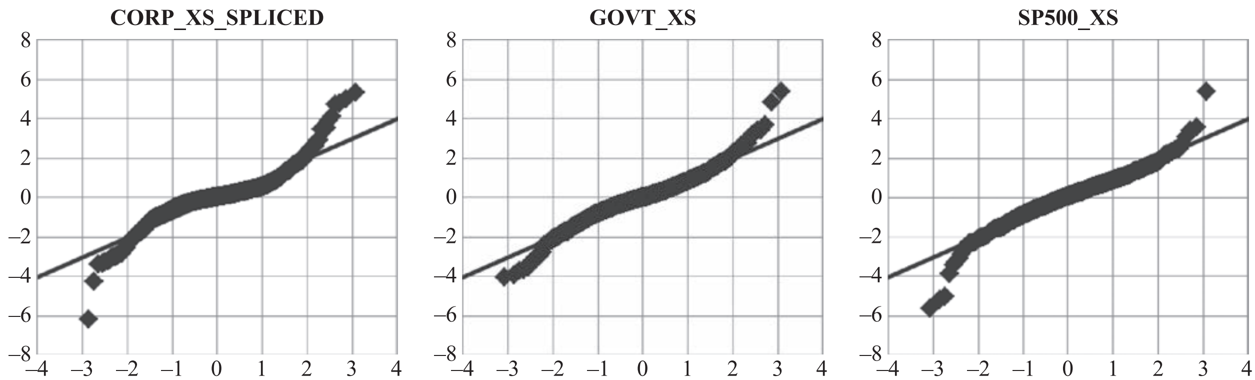
$$\textit{Sortino Ratio} = \frac{R - T}{\textit{Downside Deviation}}$$

where T is the target or required rate of return (for simplicity we set the target return to 0%), and:

$$\textit{Downside Deviation} = \sqrt{\frac{1}{N}\sum_{t=1}^{N}\min(R_t - T, 0)^2}$$

Exhibit 12

Quantile–Quantile Plots of Monthly Credit and Equity Returns from 1936 to 2014



Notes: The charts present quantile–quantile plots with standard normal random variable on the x-axis and normalized monthly returns of CORP_XS_SPLICED, GOVT_XS, or SP500_XS on the y-axis. Normalized returns are returns divided by full period realized volatility. Deviation from the 45-degree line represents deviation from the normal distribution.

Given our choice of a 0% target return, the numerator of our Sortino ratio will be the same as that for the Sharpe ratio. The difference is in the denominator, where the Sortino ratio only "penalizes" return realizations that are below the target return. Both the frequency and magnitude of below-target returns are penalized. Exhibit 13 shows, for the same time period as examined in Exhibit 9, that the ex post optimal portfolio allocates 46%, 37%, and 17% to the excess returns of corporate bonds, government bonds, and equities, respectively. The results are consistent with Exhibit 9, supporting the notion that credit risk premium is additive to the equity risk and term premia.

Evidence of Credit Risk Premium in Other Markets

High-yield corporate bonds. The U.S. high-yield corporate bond or "junk bond" market started in the late 1970s and has grown into a USD 1.3 trillion market by year-end 2014. This market is composed of bonds issued by corporations with lower credit ratings or, in other words, by those with significant risks of default. Therefore, we expect to see larger credit risk premium in the high-yield corporate bond markets.

Exhibit 14 reports annualized statistics of credit excess returns and results for solving the ex post optimal allocation weights across high-yield corporate bonds, government bonds, and equities, subject to no shorting and leverage constraints, as described formally in an earlier section, for the 198808–201412 period when the Barclays U.S. Corporate High Yield index data are available. The ex post optimal portfolio allocates 18%, 74%, and 7% to high-yield corporate bonds, government bonds, and equities, respectively. In contrast to the results shown in Exhibit 9, here we reject the null hypothesis suggesting that the reported optimal weights are statistically different from an equal exposure to high-yield corporate bonds, government bonds, and equities. However, the important inference is that even with the substantial decrease in long-term government yields over this shorter time period, there is still an economically meaningful allocation to high-yield corporate bonds.

Credit default swap. Over the past decade, the CDS market has emerged as an alternative to the corporate bond market for investors to gain credit exposures. A seller of protection in a CDS has a direct exposure to credit (i.e., default) risk of the underlying firm without an explicit exposure to interest rates. While returns on CDS indexes are the cleanest measure of credit risk premium, the results should be interpreted with caution owing to their relatively short history. Nonetheless, they are useful as a robustness test for existence and additivity of the credit risk premium. Exhibit 15 reports annualized statistics of credit excess returns and results for solving the ex post optimal allocation weights across CDS indexes, government bonds, and equity, subject to no shorting and leverage constraints as described

EXHIBIT 13

Optimal Portfolio Allocation Using Sortino Ratio

	$R_t^{CORP\_XS\_SPLICED}$	$R_t^{GOVT\_XS}$	$R_t^{SP500\_XS}$	R_t^{PORT}
Mean	1.37%	1.60%	7.83%	2.54%
Downside Dev.	2.50%	3.45%	10.58%	2.64%
Sortino Ratio	0.55	0.46	0.74	0.96
Optimal Weight	46%	37%	17%	

Notes: This table reports annualized statistics for an ex post optimal portfolio of U.S. corporate bonds, U.S. Treasury bonds, and the S&P 500 Index, under an alternative objective function. The optimal allocation weights are determined by maximizing ex post portfolio Sortino ratio (instead of Sharpe ratio) over the 193601–201412 period, subject to the same constraints described in Exhibit 9. The Sortino ratio is defined as

$$Sortino\ Ratio = \frac{R - T}{Downside\ \ Deviation}$$

where T is the target or required rate of return (= 0% in this analysis)

$$Downside\ \ Deviation = \sqrt{\frac{1}{N}\sum_{t=1}^{N}\min\left(R_t - T, 0\right)^2}$$

EXHIBIT 14

U.S. High-Yield Corporate Bonds between 1988 and 2014

	$R_t^{CORP\_XS\_HY}$	$R_t^{GOVT\_XS}$	$R_t^{SP500\_XS}$	R_t^{PORT}
Mean	2.48%	3.11%	7.85%	3.37%
Std. Dev.	9.57%	4.46%	14.41%	3.39%
Sharpe	0.26	0.70	0.54	0.99
Optimal Weight	18%	74%	7%	**F: 7.23**

Notes: This table reports annualized statistics (mean, standard deviation, and Sharpe ratio) for U.S. high-yield corporate bonds, U.S. Treasury bonds, the S&P 500 Index, and an ex post optimal portfolio among them over the 198808–201412 period, subject to the same constraints described in Exhibit 9. $R_t^{CORP\_XS\_HY}$ is the credit excess return from Barclays U.S. Corporate High Yield Index.

formally in an earlier section for the 200404–201412 period. Credit excess returns are computed from the Markit CDX North American Investment Grade index, $R_t^{CDX\_IG}$, and the Markit CDX North American High Yield index, $R_t^{CDX\_HY}$. The Sharpe ratios for credit excess returns using CDS index data are considerably higher than those reported for the corporate bond data in Exhibit 3. For example, the Sharpe ratios of $R_t^{CDX\_IG}$ and $R_t^{CDX\_HY}$ over the 200404–2014121 period are 0.45 and 0.68, respectively.

Over the 200404–201412 period, the spreads on the CDX North American Investment Grade and High Yield indexes changed from 67 to 66, and 407 to 356 basis points, respectively. Our estimates of credit risk premium for high yield over the 200404–201412 period, with a Sharpe ratio of 0.68, therefore benefits from the spread tightening over the sample period. The spread tightening of 51 basis points over a 10-year period translates to approximately 19 basis points of annualized excess returns (51 basis points times an average spread duration of 4 gives 204 basis points cumulative return benefit over the 10-year-and-nine-month period). The Sharpe ratio for high yield would be lowered to 0.66 after removing the effect of spread tightening. Thus, while high-yield credit spreads tightened, these "tailwinds" do not explain the high Sharpe ratio observed in the recent time period. Further, the estimated Sharpe ratio for investment grade is unaffected by this as spreads actually did not change over the time period. The ex post optimal allocation weights to CDS investment-grade (high-yield) index, government bonds, and equities over this period are 48 (33)%, 46 (67)%, and 6 (0)%, respectively. We find economically meaningful allocation to both investment-grade and high-yield CDS indexes.

European data. As a final robustness test, we look for evidence of a credit risk premium in European corporate bond and credit default swap markets. For this analysis, we use excess returns from (i) the Barclays Pan-European Corporate Investment Grade Index and Pan-European Corporate High Yield Index, available since 199901; and (ii) Markit iTraxx Europe Main index and iTraxx Europe Crossover index, available since 200404. Exhibit 16 reports annualized statistics of credit excess returns and results for solving the ex post optimal allocation weights across European corporate bonds, government bonds, and equity, subject to no shorting and leverage constraints as described formally in an earlier section. Panel A–Panel D of Exhibit 16 report results for corporate bond and CDS indexes separately for investment-grade and high-yield categories. In Panel A (B), we see that the Sharpe ratio for the IG (HY) cash bond index is 0.16 (0.31). The ex post optimal allocation weights to European investment-grade (high-yield) corporate bonds, government bonds, and equities over this period are 8 (13)%, 87 (86)%, and 5 (1)%, respectively. Similar to the United States, the evidence of a credit risk premium is much stronger in the

EXHIBIT 15
U.S. Credit Default Swaps between 2004 and 2014

Panel A: CDX North America Investment Grade, 200404–201412

	$R_t^{CDX\_IG}$	$R_t^{GOVT\_XS}$	$R_t^{SP500\_XS}$	R_t^{PORT}
Mean	0.97%	2.72%	7.33%	2.15%
Std. Dev.	2.17%	4.23%	14.32%	2.14%
Sharpe	0.45	0.64	0.51	1.01
Optimal Weight	48%	46%	6%	**F: 2.52**

Panel B: CDX North America High Yield, 200404–201412

	$R_t^{CDX\_HY}$	$R_t^{GOVT\_XS}$	$R_t^{SP500\_XS}$	R_t^{PORT}
Mean	6.06%	2.72%	7.33%	3.81%
Std. Dev.	8.96%	4.23%	14.32%	3.42%
Sharpe	0.68	0.64	0.51	1.11
Optimal Weight	33%	67%	0%	**F: 3.38**

Notes: This table reports annualized statistics (mean, standard deviation, and Sharpe ratio) for credit default swap indexes, U.S. Treasury bonds, the S&P 500 Index, and an ex post optimal portfolio among them over the 200404–201412 period, subject to the same constraints described in Exhibit 9. R_t^{CDX-IG} *is the credit excess returns from Markit CDX North American Investment Grade index, and* R_t^{CDX-HY} *is from Markit CDX North American High Yield index.*

CDS index data. Panel C (D) reports the Sharpe ratio for the IG (HY) CDS index over the 200404–201412 period is 0.44 (0.80). The ex post optimal allocation weights to European investment-grade (high-yield) CDS, government bonds, and equities over this period are 41 (29)%, 58 (71)%, and 1 (0)%, respectively. While in all cases in Exhibit 16 the null hypothesis of equal allocation across credit, government, and equity markets is rejected, credit still receives an economically important ex post optimal allocation, and more so than equity markets.

Liquidity and Other Factors Influencing Credit Risk Premium

Our focus has been linking the credit risk premium to expectations of default risk. Past research has also attempted to link liquidity to the credit risk premium. We are open to this possibility but want to emphasize that liquidity risk is ultimately determined by expectations about uncertainty of future prices, which is much the same type of risk that is related to default risk. That said, our estimates of credit risk premium based on synthetic indexes is less susceptible to concerns about liquidity, and we still observe a sizable credit risk premium.

EXHIBIT 16
European Corporate Bonds and Credit Default Swaps between 1999 and 2014

Panel A: European Corporate Investment Grade, 199901–201412

	$R_t^{CORP\_EU\_IG\_XS}$	$R_t^{GOVT\_EU\_XS}$	$R_t^{EUROSTOXX\_XS}$	R_t^{PORT}
Mean	0.56%	3.07%	2.42%	2.83%
Std. Dev.	3.49%	3.83%	19.05%	3.30%
Sharpe	0.16	0.80	0.13	0.86
Optimal Weight	8%	87%	5%	**F: 5.13**

Panel B: European Corporate High Yield, 199901–201412

	$R_t^{CORP\_EU\_HY\_XS}$	$R_t^{GOVT\_EU\_XS}$	$R_t^{EUROSTOXX\_XS}$	R_t^{PORT}
Mean	4.03%	3.07%	2.42%	3.19%
Std. Dev.	12.83%	3.83%	19.05%	3.44%
Sharpe	0.31	0.80	0.13	0.93
Optimal Weight	13%	86%	1%	**F: 5.85**

Panel C: iTraxx Europe Main, 200404–201412

	$R_t^{CDX\_EU\_IG}$	$R_t^{GOVT\_EU\_XS}$	$R_t^{EUROSTOXX\_XS}$	R_t^{PORT}
Mean	1.05%	3.86%	5.11%	2.73%
Std. Dev.	2.38%	4.00%	17.07%	2.51%
Sharpe	0.44	0.97	0.30	1.09
Optimal Weight	41%	58%	1%	**F: 4.57**

Panel D: iTraxx Europe Crossover, 200404–201412

	$R_t^{CDX\_EU\_HY}$	$R_t^{GOVT\_EU\_XS}$	$R_t^{EUROSTOXX\_XS}$	R_t^{PORT}
Mean	6.79%	3.86%	5.11%	4.71%
Std. Dev.	8.50%	4.00%	17.07%	3.51%
Sharpe	0.80	0.97	0.30	1.34
Optimal Weight	29%	71%	0%	**F: 6.80**

Notes: This table reports annualized statistics (mean, standard deviation, and Sharpe ratio) for European corporate bonds and credit default swap indexes, European government bonds, the Eurostoxx 50, and an ex post optimal portfolio among them over the 200404–201412 period, subject to constraints described in Exhibit 9. $R_t^{CORP-EU-IG-XS}$ *is the credit excess returns from Barclays Pan-European Corporate Investment Grade Index,* $R_t^{CORP-EU-HY-XS}$ *is from Barclays Pan-European Corporate High Yield Index,* $R_t^{CDX-EU-IG}$ *is from Markit iTraxx Europe Main index, and* $R_t^{CDX-EU-HY}$ *is from Markit iTraxx Europe Crossover index.*

CONCLUSION

Using a long sample of corporate bond returns, we document a significant Sharpe ratio for credit excess returns. We find that the average annual credit excess return on investment-grade corporate bonds for the 1936–2014 period is 137 basis points with a Sharpe ratio of 0.37. This is an important result as past researchers have commented that nongovernment bonds might not deserve a strategic allocation in institutional portfolios (e.g., Swensen [2009] and Ilmanen [2011]). We suspect that much of this skepticism results from analysis of corporate bond excess returns that suffered from measurement error. Long-term corporate bonds tend to have a lower duration than long-term government bonds, and simple differences between long-term corporate bond returns and long-term government bond returns will thus suffer from an "over-hedging" problem. This creates a downward bias on estimated credit excess returns owing to the positive term premium over our sample period. Our evidence of a substantial credit risk premium extends to the (i) U.S. high-yield corporate bond market, (ii) European investment-grade and high-yield corporate bond markets, and (iii) CDS markets.

We find that the optimal weights across corporate bonds, government bonds, and equities are 48%, 35%, and 17%, respectively, over the 1936–2014 period. We also document that during periods of increasing expectations of economic growth and inflation, credit excess returns are larger. This finding suggests that investors interested in tactical variation in exposure to credit risk premium require good forecasts of (i) changing expectations of economic growth, and (ii) changing expectations of inflation.

Collectively, these results support the notion that (i) there is a risk premium to be had from gaining exposure to credit risk, (ii) the credit risk premium is sufficiently different from both the term and equity risk premium to be a valid diversifying source of returns, and (iii) the credit risk premium is higher during periods of economic growth and inflation. Institutional investors should consider exposure to corporate credit, both as a strategic and a tactical allocation, in their portfolios.

ENDNOTES

The authors thank Maria Correia, Antti Ilmanen, Ronen Israel, Johnny Kang, Thomas Maloney, Tobias Moskowitz, Chris Palazzolo, Diogo Palhares, Peter Pope (discussant), Kari Sigurdsson, Mark Stein, and participants at the 4th Annual Bernstein Quant Conference, the CERF Symposium at Cambridge University, the U.K. Inquire Conference, University of Porto, London Business School, and the Norwegian Ministry of Finance for helpful discussion and comments. AQR Capital Management LLC invests in, among other strategies, securities studied in this article. The views and opinions expressed herein are those of the authors and do not necessarily reflect the views of AQR Capital Management, LLC (AQR), its affiliates, or its employees. This information does not constitute an offer or solicitation of an offer, or any advice or recommendation, by AQR, to purchase any securities or other financial instruments, and may not be construed as such. The credit excess return data used in this article is available at the AQR data library (https://www.aqr.com/library/data-sets). Use of this data is encouraged, provided that users reference this article.

[1]Because we combine credit excess return data from multiple sources, we use YYYYMM labels for the start and end dates for each time period for the sake of brevity. For example, 198808–201412 means that we have data for the period August 1988 through December 2014 inclusive.

[2]See Ibbotson [2014] and Ibbotson and Sinquefield [1976] for more details on the return calculations.

[3]See Lehman Brothers [2008] for complete index rules.

[4]This figure includes the combined traded volume of CDX North American Investment Grade, CDX North American High Yield, iTraxx Europe Main, and iTraxx Europe Crossover indexes reported by the Intercontinental Exchange.

[5]End-of-month values for credit yields are only available since 1986. From 1962 to 1985, we use weekly average yields on the last week of a given month. From 1926 to 1961, we use monthly average yields.

[6]Our credit excess return measure starts on 193601 because we require 10 years of data to estimate empirical durations. To include the first 10-year period, which includes the Great Depression, we use in-sample regression over the same period for empirical durations to estimate credit excess returns. We find that the average annual credit excess return for the 192601–198807 period is 247 basis points, with a Sharpe ratio of 0.66.

[7]We restrict this analysis to the 193601–198807 period, as this is the time period in which we rely on our methodology to estimate the credit excess returns.

REFERENCES

Berndt, A., R. Douglas, D. Duffie, M. Ferguson, and D. Schranz. "Measuring Default Risk Premia from Default Swap Rates and EDFs." Working paper, 2005.

Blume, M.E., D.B. Keim, and S.A. Patel. "Return and Volatility of Low-Grade Bonds 1977–1989." *The Journal of Finance*, Vol. 46, No. 1 (1991), pp. 49-74.

Britten-Jones, M. "The Sampling Error in Estimates of Mean–Variance Efficient Portfolio Weights." *The Journal of Finance*, Vol. 54, No. 2 (1999), pp. 655-671.

Collin-Dufresne, P., R.S. Goldstein, and J.S. Martin. "The Determinants of Credit Spread Changes." *The Journal of Finance*, Vol. 56, No. 6 (2001), pp. 2177-2207.

Cornell, B., and K. Green. "The Investment Performance of Low-Grade Bond Funds." *The Journal of Finance*, Vol. 46, No. 1 (1991), pp. 29-48.

Correia, M., S. Richardson, and I. Tuna. "Value Investing in Credit Markets." *Review of Accounting Studies*, Vol. 17, No. 3 (2012), pp. 572-609.

Driessen, J. "Is Default Event Risk Priced in Corporate Bonds?" *The Review of Financial Studies*, Vol. 18, No. 1 (2005), pp. 165-195.

Elton, E.J., M.J. Gruber, D. Agrawal, and C. Mann. "Explaining the Rate Spread on Corporate Bonds." *The Journal of Finance*, Vol. 56, No. 1 (2001), pp. 247-277.

Fama, E.F., and K.R. French. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics*, Vol. 33, No. 1 (1993), pp. 3-56.

Giesecke, K., F.A. Longstaff, S. Shaefer, and I. Strebulaev. "Corporate Bond Default Risk: A 150-Year Perspective." *Journal of Financial Economics*, Vol. 102, No. 2 (2011), pp. 233-250.

Hallerbach, W.G., and P. Houweling. "Ibbotson's Default Premium: Risky Data." *The Journal of Investing*, Vol. 22, No. 2 (Summer 2013), pp. 95-105.

Huang, J.-Z., and M. Huang. "How Much of the Corporate–Treasury Yield Spread Is Due to Credit Risk?" *The Review of Asset Pricing Studies*, Vol. 2, No. 2 (2012), pp. 153-202.

Ibbotson, R.G. *Stocks, Bonds, Bills, and Inflation Yearbook 2014*. Chicago: Ibbotson Associates, 2014.

Ibbotson, R.G., and R. Sinquefield. "Stocks, Bonds, Bills, and Inflation: Year-by-Year Historical Returns." *The Journal of Business*, Vol. 49, No. 1 (1976), pp. 11-47.

Ilmanen, A. *Expected Returns: An Investor's Guide to Harvesting Market Rewards*. Wiley Finance, 2011.

Ilmanen, A., T. Maloney, and A. Ross. "Exploring Macroeconomic Sensitivities: How Investments Respond to Different Economic Environments." *The Journal of Portfolio Management*, Vol. 40, No. 3 (2014), pp. 87-99.

Kozhemiakin, A. "The Risk Premium of Corporate Bonds." *The Journal of Portfolio Management*, Vol. 33, No. 2 (Winter 2007), pp. 101-109.

Lehman Brothers. "A Guide to the Lehman Brothers Global Family of Indices," 2008.

Leland, H. "Corporate Debt Value, Bond Covenants, and Optimal Capital Structure." *The Journal of Finance*, Vol. 49, No. 4 (1994), pp. 1213-1252.

Ng, K.-Y., and B.D. Phelps. "Capturing Credit Spread Premium." *Financial Analysts Journal*, Vol. 67, No. 3 (2011), pp. 63-75.

Sangvinatsos, A. "Strategic Asset Allocation: The Role of Corporate Bond Indices?" *The Quarterly Journal of Finance*, Vol. 1, No. 2 (2011), pp. 355-422.

Sortino, F.A., and L.N. Price. "Performance Measurement in a Downside Risk Framework." *The Journal of Investing*, Vol. 3, No. 3 (1994), pp. 59-64.

Swensen, D.F. *Pioneering Portfolio Management: An Unconventional Approach to Institutional Investment*. New York: Free Press, 2009.

Van Luu, B., and P. Yu. "The Credit Risk Premium: Should Investors Overweight Credit, When, and by How Much?" *The Journal of Investing*, Vol. 20, No. 4 (Winter 2011), pp. 132-140.