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The Cross-Section of Corporate Bond Returns†

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Abstract

Forward rates contain reliable information about cross-sectional differences in expected corporate bond returns. Many alternative bond-level and issuer-level variables, by contrast, are not reliably linked to expected bond returns or provide information about expected bond returns only through their correlation with forward rates. An exception is the issuer's prior short-term equity return. Short-term equity returns are negatively related to subsequent yield changes for the issuer's bonds in cross-sectional regressions, consistent with our finding that short-term equity returns are positively related to subsequent differences in bond returns even after controlling for forward rates. While the information in forward rates about differences in corporate bond returns tends to last for over a year, the information in short-term equity returns decays fast.

1. Introduction

Expected corporate bond returns can be decomposed into a forward rate, expected future change in bond yield, probability of default, and expected recovery rate. The first of these components of a bond's expected return, the forward rate, is observable through current yield curves.

Substantial evidence links forward rates to expected bond returns. For example, Fama (1984) uses US Treasury bill data from 1959 to 1983 and finds that forward rates contain reliable information about expected term premiums. Fama and Bliss (1987) and Campbell and Shiller (1991) extend those results to longer maturity bonds. Kolerich and Rodriguez (2012) examine how the informational content of global yield curves can be used to target higher expected returns in global bond portfolios. Turning to corporate bonds, work by Fama (1986), Giesecke (2011), and Nozawa (2017), among others, suggests a reliable relation between credit spreads and expected credit premiums.

Some recent studies propose additional variables that may be related to expected bond returns. Issuer-level characteristics such as market capitalization, relative price, and profitability (e.g., Chordia et al. 2017, Choi and Kim 2018), bond momentum (e.g., Jostova et al. 2013), equity momentum (Gebhardt et al. 2005, Haesen et al. 2017), and fixed income analogues for value (e.g., Israel et al. 2018, Houweling and van Zundert 2017) have all been studied in the literature. We contribute to this literature by asking whether these variables add information about the cross-section of bond returns after controlling for forward rates.

Unlike forward rates, these alternative variables are not explicitly related to expected bond returns based on the decomposition of expected returns described above. Their informational value in identifying differences in expected bond returns, if any, must therefore lie in serving as indirect measures of at least one of the expected return components: forward rate, expected future changes in bond yields, default probability, or expected recovery rate. This implies that some variables may be related to returns through their correlation with forward rates. To account for this possibility, we test whether a variable is related to monthly bond returns in excess of beginning-of-month forward rates. Passing this higher hurdle of identifying systematic return differences that are unexpected based on information contained in today's forward rates is a more meaningful test of a variable's marginal contribution in explaining expected returns. For reference, we also report the results from a set of empirical tests using unadjusted bond returns.

The analysis presented in this paper considers bond-level and issuer-level variables using a comprehensive panel of US corporate bonds from 2000 to 2018. Bond-level data are sourced from the Bloomberg Barclays US Aggregate and US High Yield universes. Issuer-level data for each bond are obtained from Bloomberg by linking bonds in our sample to their respective issuer or the issuer's parent company. On average, we map about 90% of bonds across the US Aggregate and US High Yield universes to a publicly listed company from 2000 to 2018, a match rate that is about double the rate obtained when matching only on CUSIP identifiers. The bond-level variables we examine are a bond's forward rate, "value" measured as default-adjusted credit spread (e.g., Israel et al. 2018), as well as two measures of bond momentum: a bond's total return momentum and its return momentum in excess of a cash flow-matched Treasury bond. Following the literature on bond momentum (e.g., Jostova et al. 2013), we measure bond and credit momentum over the past six months. We follow the common practice (e.g., Jostova et al. 2013, Chordia et al. 2017) of excluding the most recent month from our bond and credit momentum measures, but additionally include as test variables a bond's short-term total return and credit premium measured over the most recent month. The issuer-level variables we study are market capitalization, total public debt outstanding, book-to-market ratio, profitability, leverage, and distance to default. We also examine equity momentum, following earlier evidence on the relation between equity momentum and expected stock and bond returns (e.g., Carhart 1997, Gebhardt et al. 2005, Chordia et al. 2017, Haesen et al. 2017), and short-term equity returns.

We conduct two types of tests: portfolio sorts and cross-sectional regressions.

Consistent with many previous studies, we find that forward rates contain reliable information about expected corporate bond returns, while results for our other test variables are mixed but mostly weak. An exception is the issuer's short-term equity return, which we test separately from equity momentum.

Following convention, we define equity momentum as prior 6- to 12-month returns skipping the most recent month. We do not find a reliable relation between equity momentum and corporate bond returns. Our analysis strongly suggests, however, that shorter-term equity returns are related to differences in corporate bond returns. These results are robust to the definition of short term. For example, we find similar results from monthly portfolio sorts or monthly cross-sectional regressions using prior one-week, two-week, three-week, one-month, or two-month equity returns. For brevity, we include results using prior six-month equity returns skipping the most recent month for equity momentum and prior one-month equity return for short-term equity returns.

The remainder of this paper is organized as follows. The next section formally introduces a framework for expected bond returns that informs the analytical approach taken in this paper. Section 3 describes the methodology and data used in this study. Section 4 contains our empirical results, and Section 5 concludes.

2. A Framework for Expected Bond Returns

The goal of this study is to investigate whether certain variables contain reliable information about cross-sectional differences in expected bond returns. Before proceeding to the empirical tests, it is useful to have a framework to motivate how variables may be linked to returns. In this section, we expand on the framework developed in Dai et al. (2017) to accommodate a bond with non-zero default probability.

The expected return on a corporate bond depends on the expected return in the case of no default and the expected return if the bond defaults. Let $\pi_{default}$ be the probability that an issuer defaults and $\phi_{recovery} \in [0,1]$ be the expected recovery rate in case of default.

The expected return today for a zero-coupon bond with duration n over a holding period Δt, denoted $E_0(R^n_{\Delta t})$, can then be written as

$$E_0(R^n_{\Delta t}) = (1-\pi_{default})\left(E_0\left(\frac{P^{n-\Delta t}_{\Delta t}}{P^n_0} - 1\right)\right) - \pi_{default}(1-\phi_{recovery}) \tag{1}$$

In case of default, the expected return is determined by the expected recovery rate. Absent a default, the bond's expected return is determined by the expected change in its price over the next Δt. This expected price change can be further decomposed as follows.

Let y_t^n denote the continuously compounded yield to maturity at time t for a zero-coupon bond with duration n. The current price of the zero-coupon bond with duration n and yield to maturity y_0^n is $P_0^n = e^{-ny_0^n}$. Over a period of time Δt, the bond duration will become $n - \Delta t$ and its new yield to maturity $y_{\Delta t}^{n-\Delta t}$. Its price will be $P_{\Delta t}^{n-\Delta t} = e^{-(n-\Delta t)y_{\Delta t}^{n-\Delta t}}$. We then have

$$\begin{aligned} E_0\left(\frac{P_{\Delta t}^{n-\Delta t}}{P_0^n} - 1\right) &= E_0\left(\frac{e^{-(n-\Delta t)y_{\Delta t}^{n-\Delta t}}}{e^{-ny_0^n}} - 1\right) = \\ &= \underbrace{e^{\Delta t\, y_0^n}}_{(I)} \underbrace{e^{-(n-\Delta t)(y_0^{n-\Delta t} - y_0^n)}}_{(II)} E_0\left(\underbrace{e^{-(n-\Delta t)(y_{\Delta t}^{n-\Delta t} - y_0^{n-\Delta t})}}_{(III)}\right) - 1 \end{aligned} \quad (2)$$

Using this decomposition of expected returns under no-default in equation (1), we can write the expected return of a corporate bond as

$$\begin{aligned} E_0(R_{\Delta t}^n) = {} & (1 - \pi_{default})\left(\underbrace{e^{\Delta t\, y_0^n}}_{(I)} \underbrace{e^{-(n-\Delta t)(y_0^{n-\Delta t} - y_0^n)}}_{(II)} E_0\left(\underbrace{e^{-(n-\Delta t)\left(y_{\Delta t}^{n-\Delta t} - y_0^{n-\Delta t}\right)}}_{(III)}\right) - 1\right) \\ & - \pi_{default}(1 - \phi_{recovery}) \end{aligned} \quad (3)$$

The three parts of a bond's expected return under no-default as expressed in equation (3) are

I. A component related to the bond's current yield y_0^n.
II. A component related to the bond's expected capital appreciation or depreciation over the next Δt periods based on the current (at time zero) term structure. Over the next Δt periods, an n-year bond yielding y_0^n will have $n - \Delta t$ periods to maturity with yield $y_0^{n-\Delta t}$ due to movements along the current (time 0) yield curve.
III. A component related to changes in the bond's yield in the next Δt.

This decomposition is useful for guiding empirical tests. Terms (I) and (II), the current yield and expected capital appreciation, are observable at time 0 and form the forward rate. If a variable is correlated with components (I) and (II), it may predict bond returns in tests that do not control for forward rates. Such predictability is not useful to investors. It is better to use observable forward rates than a noisy proxy for forward rates.

The return decomposition suggests that for a variable to contain additional information about cross-sectional differences in expected returns, it must predict cross-sectional differences in changes in yields, default probabilities, or recovery rates. When we combine these channels into one test to examine the predictability of returns in excess of the forward rate, we find little evidence for predictability, except in the case of short-term equity return.

3. Methodology and Data

3.1 Corporate Bond Data

The data used in this analysis are sourced from the Bloomberg Barclays US Aggregate and US High Yield databases. Our sample comprises monthly data on a total of 7,240 US corporate bonds and 900 unique issuers over the period from January 2000 to December 2018.[1] On average, the sample contains 1,492 bonds and 377 unique issuers per month. To ensure an adequate sample of bonds for constructing yield curves for forward rates, we focus on bonds with stated S&P credit ratings between AAA and B and duration between 1 and 10 years. We exclude bonds rated CCC or below because the small number of such bonds meeting our sample criteria does not allow for adequate yield curve construction. Bonds with optionality (other than make whole calls) are excluded from the sample, as are convertible and floating rate bonds.[2] As detailed in section 3.4, we also restrict our sample to bonds that can be linked to a publicly listed company for which we have issuer-level characteristics. To account for returns after bonds are dropped from the index universe, we include monthly returns for all bonds present at the beginning of a month, not just those present at the end of a month. This is required to avoid survivorship bias.

3.2 Constructing Treasury and Corporate Spot Yield Curves

To compute forward rates, we construct spot yield curves for each credit rating in three steps.

First, we use US Treasury data contained in the Bloomberg Barclays US Aggregate universe to construct zero-coupon (or spot) Treasury curves for each month using a bootstrap method. Beginning with the shortest-maturity Treasury, we iteratively calculate spot yields from Treasuries' prices. We use linear interpolation to compute yields between points on the Treasury spot curve. Because the Bloomberg Barclays data excludes bonds with maturities below one year, we supplement the zero-coupon Treasury yield curve with Treasury bill data from the Federal Reserve Board's H.15 release for maturities below one year.

Second, we create a synthetic Treasury security each month that mimics each bond's promised cash flows. We then discount each cash flow using the appropriate rate from the Treasury spot curve constructed in the previous step. The sum of the discounted values is the price of the corporate bond's synthetic Treasury. A corporate bond's credit spread is then defined as the parallel shift in the Treasury spot curve that sets the synthetic Treasury's price equal to the corporate bond's price (also referred to as the Z-spread). Similarly, cash flow-matched synthetic Treasuries can be used to calculate corporate bond excess returns. Following Gilchrist and Zakrajsek (2012) and Nozawa (2017), we choose cash flow-matching over maturity- or duration-matching Treasuries, as excess returns and credit spreads across corporate bonds are least affected by any change in the Treasury yield curve using this approach.

Finally, we derive credit spread curves for each credit rating group each month by fitting a cubic spline over the credit spread-duration pairings of all bonds within that rating group. We then add this spread curve to the zero-coupon Treasury curve constructed in step one to obtain corporate spot curves for each rating group.

3.3 Calculating Forward Rates

We compute continuously compounded one-month forward rates for each bond. This requires the corporate bond's beginning-of-month yield and a term structure to calculate the bond's expected yield one month into the future, absent any changes in the yield curve. We define the one-month forward rate of a corporate bond with an n-year duration as

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1. Subsidiaries of a parent company do not count as distinct issuers. For example, GEICO and Berkshire Hathaway count as one issuer.
2. Make whole calls allow issuers to pay off debt early, typically by way of a lump sum payment based on the net present value of future coupon payments that will not be paid because of the call. Because the cost is often high, these call options are rarely exercised.

$$f_{corp}^{n-\frac{1}{12}\to n} = \frac{1}{12} y_{0,corp}^{n} + \left(n - \frac{1}{12}\right)\left(y_{0,corp,curve}^{n} - y_{0,corp,curve}^{n-\frac{1}{12}}\right) \quad , \tag{4}$$

where $y_{0,corp}^{n}$ is the bond's yield today (at time zero), $y_{0,corp,curve}^{n}$ is the yield of an n-year duration bond according to the corporate spot yield curve corresponding to the bond's credit rating, and $y_{0,corp,curve}^{n-\frac{1}{12}}$ is the yield of an $\left(n - \frac{1}{12}\right)$-year duration bond today according to the corporate spot yield curve corresponding to the bond's credit rating.[3] That is, we assume the bond's expected capital appreciation or depreciation is based on the corporate spot curve corresponding to the bond's credit rating group.

3.4 Mapping Bond and Equity Data

Some of the variables used in our analysis are issuer-level or equity variables such as an issuer's book-to-market ratio or profitability, thus requiring us to link bonds to their issuing entity. We link debt securities to a parent company using the first six digits of their CUSIP code or the Parent Ticker field in the Bloomberg Barclays data. A sizable number of securities require manual mapping using additional information, such as a company's stock ticker, name, or exchange code, because CUSIP and Parent Ticker matching fail or produce incorrect or incomplete links.

On average, we match 93% of market value and 90% of bonds to a publicly listed company from 2000 to 2018, a much higher rate than previous studies. This is mainly due to our extensive efforts to map securities manually. The match rate is persistently high throughout our sample period, with a minimum, early in the sample, of 89% of market value and 82% of names mapped. As of December 2018, we map 96% of market value and 94% of names to a publicly listed company. Average match rates were higher in the Bloomberg Barclays US Aggregate universe (98% of market value and 97% of names) than in the Bloomberg Barclays US High Yield universe (76% of market value and 74% of names).[4]

3.5 Variable Definitions

In addition to forward rates, we also examine a set of issuer-level variables that are motivated by the asset pricing literature in equities, namely a company's market capitalization, book-to-market, and profitability, which is measured as operating income before depreciation and amortization minus interest expense, divided by the book value of equity (see, for instance, Fama and French 2015). We also include the issuer's total public debt outstanding, an alternative measure of company size potentially relevant in the context of corporate bond returns. In addition, we consider a company's leverage and distance to default, two variables commonly deemed relevant to a company's debt (e.g., Chordia et al. 2017 and Israel et al. 2018). We define leverage as a company's market leverage, that is, its net debt divided by the sum of net debt and market capitalization. Net debt is defined as the company's short-term and long-term debt minus cash, marketable securities, and collaterals. For industrials, financial subsidiaries are excluded from the net debt calculation. To calculate an issuer's distance to default—a standard, model-derived measure that uses accounting and return data to quantify an issuer's default risk—we follow Bharath and Shumway (2008). An additional variable we examine is a bond's credit spread, adjusted for default risk. Earlier work examines related measures in the context of value investing in corporate bonds (e.g., Israel et al. 2018). Specifically, each month, we regress the natural logarithm of credit spread on the natural logarithm of distance to default and take the residuals of this cross-sectional regression to be our test variable.

[3] We make the minor assumption that a bond's duration decreases by 1/12 over one month. This holds for zero-coupon bonds but may not necessarily hold for coupon-bearing bonds.

[4] It is worth noting that attaining a match rate of 100% is not possible, as some bonds are issued by non-listed entities such as privately held companies.

In addition, we evaluate two variables calculated from past returns of the issuer's stock, short-term equity return and equity momentum. We define equity momentum as the cumulative stock return over the past six months, excluding the most recent month. This approach follows the common practice of excluding the most recent month from measures of equity momentum (e.g., Chordia et al. 2017). In addition, we include the issuer's short-term equity return measured over the past one month. Our analysis suggests that short-term equity returns contain reliable information about expected corporate bond returns, and that most of the information about expected bond returns contained in equity momentum measures not excluding the most recent month can be attributed to short-term equity returns.

Our test variables also include short-term bond return and bond momentum, defined respectively as a bond's total return over the past month and as a bond's cumulative total return over the past six months, excluding the most recent month (Jostova et al. 2013). Finally, we examine as test variables short-term credit premium and credit momentum, defined respectively as a bond's excess return over a cash flow-matched Treasury over the past one month and over the past six months, excluding the most recent month (Chordia et al. 2017).

3.6 Summary Statistics

Table 1 presents the summary statistics of our sample. The values are averages of monthly observations from 2000 to 2018. The average of the monthly market value weighted average duration of bonds in our sample is 4.27 years, and the average of the monthly weighted average credit rating is just above A− (6.89 on a scale where AAA=1 and B−=16). The average monthly credit spread over a matching Treasury is 1.68%. Forward rates are, on average, positively correlated with default-adjusted credit spread (0.75), duration (0.73), and credit rating (0.50) across bonds and negatively correlated with the issuer's market capitalization (-0.40).

4. Empirical Results

This section reports our main empirical results. We report quartile portfolio results and Fama-MacBeth regression results for total returns and for total returns subtracting beginning-of-month forward rates.

4.1 Identifying differences in expected and unexpected total bond returns

4.1.1 Quartile portfolios formed on test variables

Table 2 shows average monthly returns for quartile portfolios formed monthly on beginning-of-month characteristics. Each portfolio contains approximately 25% of the aggregate market value of bonds in the sample each month, and securities within each portfolio are weighted in proportion to their market value.[5] We report average monthly return differences between the high and low portfolios and corresponding t-statistics. Panel A of Table 2 shows average monthly returns, and Panel B shows returns in excess of the beginning-of-month forward rate.

As suggested by the theoretical framework outlined in Section 2 and by prior evidence, our tests show that differences in forward rates across bonds are strongly related to subsequent return differences. The average monthly total return difference between the high and low forward rate portfolios is 0.28% with a t-statistic of 2.09. As shown in Panel A Table 2, total return differences for portfolios sorted on variables other than the forward rate are generally small and not reliably different from zero. Panel B shows similar results when subtracting a bond's forward rate.

5. We obtain similar results when forming quartile portfolios by name count.

There are two exceptions. The first is default-adjusted credit spread. The average monthly return spread generated by default-adjusted credit spread is large and reliably different from zero in Panel A (0.29%, t=3.13). However, Panel B indicates that forward rates subsume the information about expected returns contained in default-adjusted credit spreads, indicating that default-adjusted credit spreads contain information about expected bond returns mainly through their positive correlation with forward rates (0.75). The other exception is the issuer's short-term equity return (0.38%, t=4.51). Equity momentum, while noticeably weaker than short-term equity return, also produces a sizable average return spread with a t-statistic close to but below 2 (0.17%, t=1.78). These results suggest that most of the information about expected corporate bond returns contained in recent issuer equity returns appears to be concentrated in the most recent month, or the issuer's short-term equity return.

Panel B yields similar conclusions. The average return spread is 0.39% (t=4.67) for short-term equity return and 0.22% (t=2.27) for equity momentum. These results indicate that the information about expected bond returns contained in short-term equity return, and to a lesser extent equity momentum, does not appear to be subsumed by forward rates. We will cover the result on short-term equity return in more detail in section 4.4.

4.1.2 Fama-MacBeth regressions of corporate bond returns on test variables

In this section, we report the results from monthly Fama and MacBeth (1973) regressions of bond returns on lagged test variables. We run the following cross-sectional regression each month to examine whether our test variables contain information about differences in expected bond returns.

$$R_{i,t} = \alpha_t + \beta_t x_{i,t-1} + \varepsilon_{i,t} \tag{5}$$

Total bond returns in month t are denoted by $R_{i,t}$, and the respective test variable at time $t-1$ is denoted by $x_{i,t-1}$. The monthly regression intercept and coefficient are denoted by α_t and β_t, respectively, and $\varepsilon_{i,t}$ is the error term.

Except for forward rates, we normalize variables each month by dividing each observation by the variable's monthly standard deviation.[6] The interpretation of the regression coefficients for these variables is thus the average change in monthly return associated with a one standard deviation change in the explanatory variable. For forward rates, the interpretation of the coefficient is the average monthly return change associated with a one percentage point increase in beginning-of-month forward rates. A coefficient close to one indicates that returns have had a one-to-one cross-sectional relation with forward rates, on average.

In addition, we estimate the following regression, adjusting a bond's total return in month t on the left-hand-side of equation (5) for its beginning-of-month forward rate, $f_{i,t-1}^{t-1\rightarrow t}$ as defined in equation (4).

$$R_{i,t} - f_{i,t-1}^{t-1\rightarrow t} = \alpha_t + \beta_t x_{i,t-1} + \varepsilon_{i,t} \tag{6}$$

The Fama-MacBeth regression results in Panel A of **Table 3** strongly suggest that forward rates contain reliable information about expected corporate bond returns, as evidenced by a coefficient t-statistic of 2.25. A coefficient of 0.78 suggests that differences in forward rates are followed, on average, by subsequent return differences of similar magnitude. The coefficient is not reliably

[6] We choose not to normalize forward rates in these regressions to retain the natural interpretation of the regression coefficient on forward rates as the change in subsequent returns associated with a one percentage point difference in forward rates. When normalizing forward rates, the regression coefficient is 0.22 (t=2.94) and the R^2 value is 0.17.

different from one. Consistent with the quartile portfolio results reported in the previous section, the results for the other test variables are mostly weak, with coefficients and t-statistics mostly close to zero. Exceptions are total public debt outstanding (−0.05, t=−1.98), default-adjusted credit spread (0.18, t=3.69), and short-term equity return (0.17, t=4.68). The R^2 values associated with each of the three variables are low, indicating that most of the cross-sectional variation in expected bond returns remains unexplained by these variables.

Turning to Panel B of Table 3, we find similar results when subtracting a bond's beginning-of-month forward rate from the total corporate bond return as described in equation (6). Results are mostly weak, as evidenced by coefficients close to zero and t-statistics that are low in absolute value. Forward rates subsume information about expected returns in total public debt outstanding (−0.02, t=−0.71) and default-adjusted credit spreads (0.05, t=1.11) but do not appear to subsume information about expected bond returns contained in short-term equity return (0.18, t=4.95). Taken together, the evidence presented suggests that, except for short-term equity return and possibly equity momentum, none of the test variables appear to be reliably related to the components of a bond's total return not captured by the forward rate.

4.2 A summary view of 162 bond return regressions

When conducting many tests and examining many variables, it is expected that some results will appear reliable due to random chance alone. As pointed out in earlier literature (see, for instance, Harvey et al. 2016), this may lead to selection issues regarding the variables and tests covered in published research. In this section, we broaden our analysis to additional regression tests covering a variety of methodology choices. This allows us to more comprehensively assess the robustness of our findings.

Figure 1 shows the regression coefficients from 162 univariate regressions of bond returns on our test variables, and whether the coefficient t-statistic is above 2 in absolute value (dark gray) or not (light gray). Across all specifications, variables are normalized each month by dividing each observation by the variable's monthly cross-sectional standard deviation. For comparability across test variables included in Figure 1, we also normalize forward rates. The interpretation of the coefficients is thus the average change in monthly return associated with a one standard deviation change in the explanatory variable.

The regressions use two different return types, total return (top chart of Figure 1) and total return minus forward rate (bottom chart of Figure 1). For each combination of test variable and return type, Figure 1 presents results for six different univariate regression specifications. These include monthly Fama-MacBeth regressions of returns on explanatory variables as used throughout this paper. An alternative specification we consider is monthly Fama-MacBeth regressions where the explanatory variable is the bond's monthly cross-sectional rank when sorted on a test variable from low to high. That is, for a month with n bond observations in the cross-section, the bond with the lowest value of the test variable is assigned rank one and the bond with the highest value is assigned rank n. This approach addresses both the potential issue of outliers and additionally replaces the precise quantitative relations of explanatory variable observations across bonds with an ordinal ranking, serving as an additional robustness check. The third specification is a Fama-MacBeth regression using as explanatory variables the monthly cross-sectional ranks when sorted on a test variable within a bond's credit rating category to control for credit quality. We also examine three specifications of panel regressions, an alternative regression technique to Fama-MacBeth regressions commonly used to analyze panel data (Petersen 2009). Among other differences, the panel regressions used here differ in how observations are weighted (equally across all observations) relative to Fama-MacBeth regressions (equally within months, then equally across months). The first such specification is a panel regression of returns on the explanatory variables. Finally, we include panel regressions using the monthly cross-sectional variable rank and rank within a bond's credit rating category as explanatory variables in our fifth and sixth regression specifications for the same reasons described above in the context of Fama-MacBeth regressions. In the panel specifications, we cluster standard errors by issuer and month to account for correlation of errors across returns on bonds issued by the same company and across observations within the same month. We also include monthly fixed effects.

Forward rates are consistently reliably related to differences in expected bond returns throughout these various regression tests. They also produce comparatively large regression coefficients, indicating the expected return differences associated with differences in forward rates are larger than is the case for most other test variables. Consistent with the other test results reported in this paper, Figure 1 indicates a reliable relation between short-term equity return and expected bond returns. This relation does not appear to be subsumed by beginning-of-month forward rates, as shown in the bottom chart of Figure 1. By contrast, the information about expected bond returns contained in default-adjusted credit spreads seems to be subsumed by forward rates. As shown in the bottom chart of Figure 1, most specifications using default-adjusted credit spreads do not indicate a reliable relation to expected bond returns once controlling for forward rates. Similarly, the three instances that indicate a reliable relation for total public debt outstanding in the total return regressions do not remain reliable when the dependent variable is total return minus beginning-of-month forward rates. As shown in Figure 1, results for the other test variables are mostly weak, with small regression coefficients and coefficient t-statistics below 2 in absolute value. This includes equity momentum, which is not reliably related to the cross-section of bond returns across most regression specifications.

4.3 Can we predict cross-sectional differences in future yield changes?

The expected return framework introduced in Section 2 suggests that cross-sectional differences in expected returns can be decomposed into cross-sectional differences in forward rates and information about yield changes, default probabilities, and recovery rates. The tests reported thus far examine cross-sectional return predictability in excess of the forward rate, thus combining yield changes, default probabilities, and recovery rates into one channel.

In this section, we examine directly whether a test variable contains reliable information about future changes in yields in the cross-section. Because results have been strongest for corporate bond forward rates and short-term equity returns throughout our tests, we focus on these two variables in this section.

Following the approach of Fama and MacBeth (1973), we estimate the following regression each month.

$$y_{i,t} - y_{i,t-1} = \alpha_t + \beta_t x_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

In equation (7), the yield to maturity of bond i in month t is denoted by $y_{i,t}$, and the respective test variable at time $t-1$ is denoted by $x_{i,t-1}$. The monthly regression intercept and coefficient are denoted by α_t and β_t, respectively, and $\varepsilon_{i,t}$ is the error term.

We normalize test variables by dividing each observation by the monthly cross-sectional standard deviation of all observations of the respective variables.

The results reported in Table 4 reveal the channel through which short-term equity returns predict cross-sectional differences in future bond returns. **Table 4** contains the results of monthly Fama-MacBeth regressions of yield changes on corporate bond forward rates and short-term equity returns. While forward rates do not appear to contain reliable information about cross-sectional differences in subsequent changes in yield (0.00, t=–0.12), Table 4 shows that short-term equity returns (-0.05, t=–4.51) provide reliable information about cross-sectional differences in yield changes over the next month. A low R^2 of 0.03, however, indicates that short-term equity return does not explain most of the variation in future yield changes.

4.4 Understanding the investment implications of the relation between short-term equity return and corporate bond returns

In this section, we examine the time horizon associated with the information contained in short-term equity returns about expected corporate bond returns. We find that the information about expected bond returns contained in short-term equity returns decays fast.[7] This is relevant for investors evaluating whether and how best to incorporate information contained in short-term equity returns in a portfolio. For example, compared to longer-term drivers of expected returns, fast-decaying information about expected returns can require high levels of turnover and higher execution costs when used as an input into buy and sell decisions, which some investors may find undesirable. Instead, short-term information about expected returns may lend itself to complementing buy and sell decisions at the point of trade.

Figure 2 shows evidence that the information about cross-sectional differences in expected bond returns contained in short-term equity returns is fast-decaying. Because the results for short-term equity return are much stronger than those for equity momentum throughout our tests, we focus on short-term equity return here. Every month, we form quartile portfolios on short-term equity return. Then, we record the average total return difference between the high and low quartile portfolios and the market over the 12 months after portfolio formation. The market return is defined as the return of the market value weighted portfolio of all bonds in the sample. Figure 2 also shows the two-standard-error bands associated with each average.

The top chart of Figure 2 shows the results when forming quartile portfolios on short-term equity return. From the fourth month following portfolio formation onward, both standard error bands cross the horizontal axis representing no premium over the market. The point estimates of the average premiums also quickly converge to zero with no discernible difference beyond five months.

The bottom chart of Figure 2 repeats the analysis using forward rates instead of short-term equity return to form quartile portfolios. In stark contrast to the results for short-term equity return, both the point estimates of the average premiums and the standard error bands remain clearly delineated 12 months following portfolio formation. This indicates that the information about expected returns contained in forward rates is relatively long-lived.

All the portfolio tests reported thus far are rebalanced monthly. **Figure 3** compares average monthly total return differences of high and low quartile portfolios formed on forward rates and short-term equity return that are rebalanced monthly, semi-annually, or annually.

In line with the results reported in Figure 2, Figure 3 presents strong evidence that forward rates are reliably related to differences in expected bond returns and that this information about expected returns is longer-term in nature than that contained in short-term equity return. From 2000 to 2018, the average monthly return difference between the high and low quartile portfolios formed on forward rates is large and robust when rebalancing monthly (0.28%, t=2.09), semi-annually (0.26%, t=2.21), and annually (0.25%, t=2.54). This suggests that forward rates allow for a cost-effective way of targeting higher expected returns.

By contrast, Figure 3 shows that the average monthly return difference between the high and low quartile portfolios formed on short-term equity return depends strongly on the rebalancing frequency.

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[7] In additional, unreported results on short-term equity return, we find that the observed effect does not appear to be confined only to less liquid bonds. We also find that the relation between short-term equity return and expected bond returns is noticeably weaker, but still present, in the more recent half of the sample period from 2010 to 2018. Evidence from additional tests suggests that, compared to short-term equity return, equity issuer returns are less strongly linked to expected bond returns when shortening the equity return period taken into consideration below one month and when lengthening it beyond one month, with little evidence of a reliable relation to expected bond returns beyond three months into the past. In line with this finding, decomposing the equity momentum (2,6) measure shows that most of its information about expected bond returns stems from information contained in months t-2 and t-3. Finally, the results reported in this paper, including on short-term equity return, do not change meaningfully when excluding the financial crisis years of 2008 and 2009.

While the average monthly return difference is large and robust when rebalancing monthly (0.38%, t=4.51), average return spreads are much smaller and not reliably different from zero when rebalancing semi-annually (0.15%, t=1.63) or annually (–0.04%, t=–0.68).

Conclusion

Yield curves contain reliable information about the cross-section of expected bond returns. This paper uses a return decomposition framework to evaluate whether a host of additional variables can further enhance our understanding of returns across corporate bonds beyond the information contained in forward rates. However, the results for these additional variables are mostly weak to nonexistent in explaining the cross-section of US corporate bond returns. A notable exception is short-term equity return, defined as the issuer’s stock return over the past month. Throughout a variety of tests documented in this paper, we find that short-term equity return appears to contain reliable information about cross-sectional differences in corporate bond returns. Further analysis indicates that information about cross-sectional differences in future yield changes at the bond level may be the link between short-term equity return and expected corporate bond returns.

The framework and analysis presented in this paper suggest several promising paths for future work. One such path is to extend our data to global corporate bonds, which may provide additional insights and serve as a robustness check on the results presented here. Furthermore, our expected return framework suggests that a more direct test of the relation between some of the tested variables and default rates as well as recovery rates may help improve our understanding of differences in expected corporate bond returns. Extending predictive horizons for returns and yield changes beyond one month may also provide relevant insights. Finally, further research on how best to incorporate a variable into real-world strategies targeting higher expected returns may be of interest for variables found to contain information about differences in expected corporate bond returns.

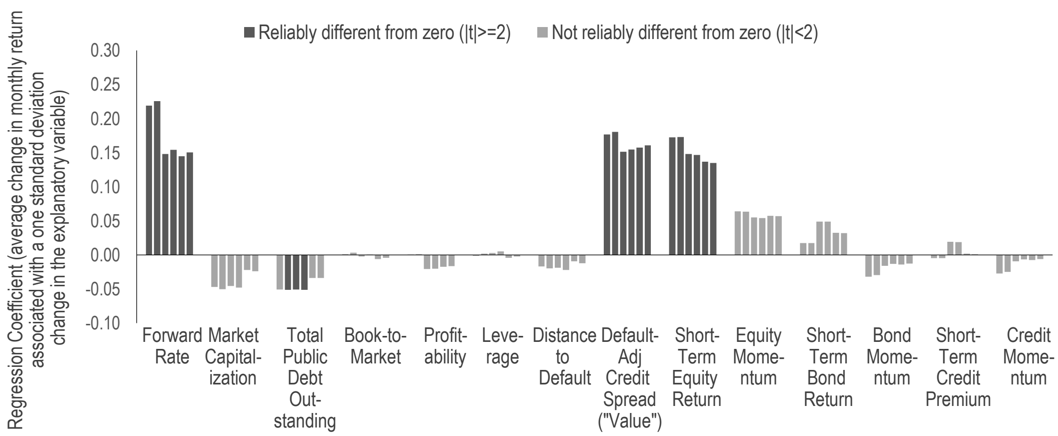
Figures

FIGURE 1

Slope coefficients from 162 regressions of corporate bond returns on test variables

This figure shows the regression coefficients from 162 univariate regressions of corporate bond returns on our test variables. Test variables are normalized each month by dividing each observation by the variable's cross-sectional standard deviation. The regressions use two different return types as dependent variables: total returns (top chart) and total returns minus beginning-of-month forward rates (bottom chart). When forward rates are the explanatory variable, we only show total return regressions. Six different regression specifications are used for each variable: Fama-MacBeth regressions on the explanatory variable, Fama-MacBeth regressions on the monthly cross-sectional rank of the explanatory variable, Fama-MacBeth regressions on the monthly cross-sectional rank of the explanatory variable within its credit rating category, panel regressions on the explanatory variable, panel regressions on the monthly cross-sectional rank of the explanatory variable, and panel regressions on the monthly cross-sectional rank of the explanatory variable within its credit rating category. Panel regressions include monthly fixed effects, and standard errors are clustered by issuer and month. Regression coefficients with a t-statistic larger than or equal to 2 in absolute value are colored in dark gray, and regression coefficients with a t-statistic smaller than 2 in absolute value are colored in light gray. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Profitability is defined as operating income before depreciation and amortization minus interest expense, divided by the book value of equity. Leverage is defined as net debt divided by the sum of net debt and market capitalization. Net debt is total debt minus cash, marketable securities, and collaterals. Distance to Default follows the method of Bharath and Shumway (2008). Default-Adjusted Credit Spread ("Value") is the residual from monthly cross-sectional regressions of the natural logarithm of credit spread on the natural logarithm of distance to default. Short-Term Equity Return is the issuer's stock return over the past month. Equity Momentum is the issuer's cumulative stock return from month t-6 to t-2. Short-Term Bond Return is a bond's total return over the past month. Bond Momentum is a bond's cumulative total return from month t-6 to t-2. Short-Term Credit Premium is a bond's return in excess of a matching Treasury over the past month. Credit Momentum is a bond's cumulative return in excess of a matching Treasury from month t-6 to t-2.

TOTAL RETURN



TOTAL RETURN MINUS FORWARD RATE

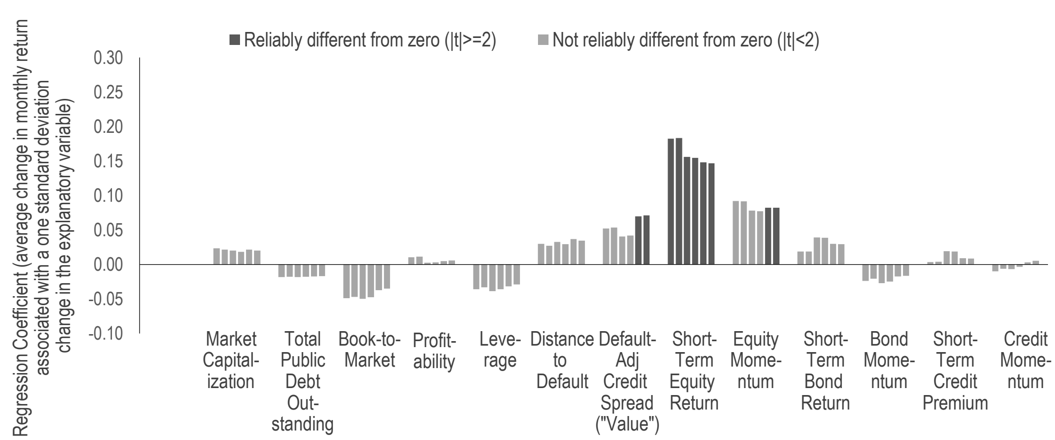
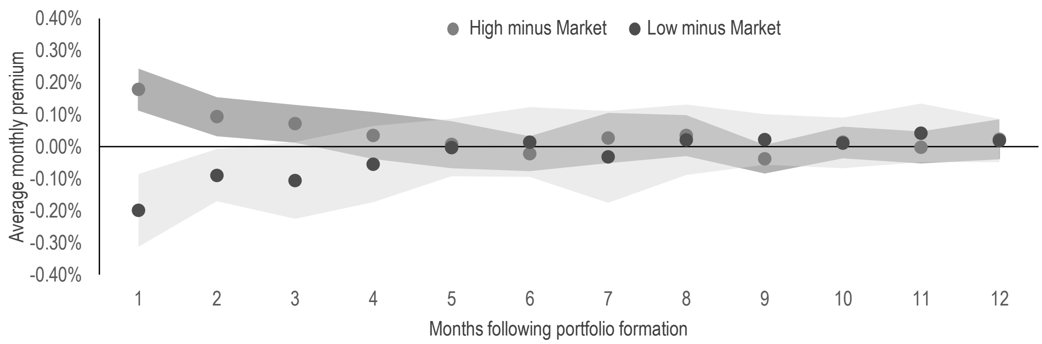


FIGURE 2

Short-term equity return and forward rate quartile portfolios, high minus market and low minus market, average monthly premium t+1 to t+12 with two-standard-error bands, 2000–2018

This figure shows the average monthly premium over the market of high short-term equity return and low short-term equity return quartile portfolios (top chart) and of the high forward rate and low forward rate quartile portfolios (bottom chart) over the 12 months following portfolio formation. Shaded areas are two-standard-error bands. The high and low quartile portfolios are market value weighted and formed monthly on short-term equity return (top chart) and corporate bond forward rate at the beginning of the month (bottom chart) and contain approximately 25% of total market value at the time of formation. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Short-Term Equity Return is the issuer's stock return over the past month.

SHORT-TERM EQUITY RETURN



FORWARD RATE

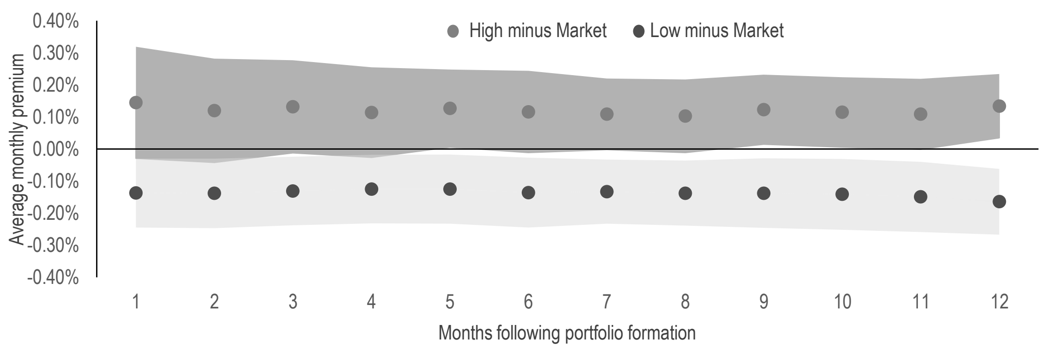
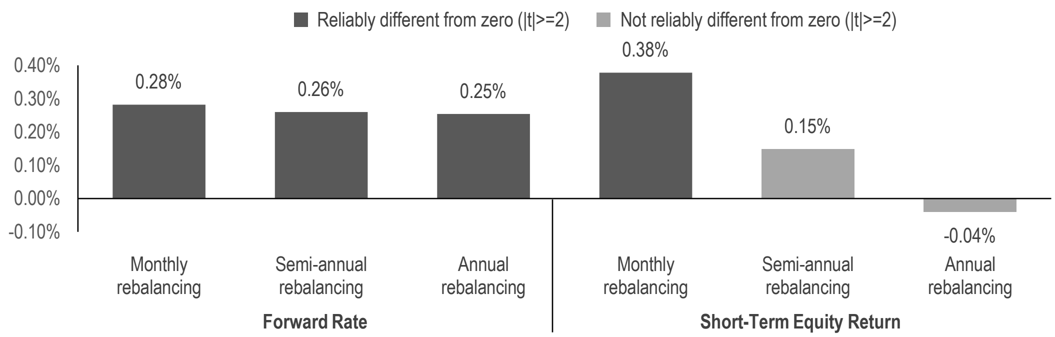


FIGURE 3

Average monthly return difference between high and low quartile portfolios formed on forward rates and short-term equity return using monthly, semi-annual, or annual rebalancing, 2000–2018

This figure shows the average monthly total return difference between the high and low quartile portfolios formed on forward rates and short-term equity return. Each quartile portfolio contains approximately 25% of the aggregate market value of all bonds in the sample at the time of formation. Bonds within each portfolio are weighted by market value. Portfolios are rebalanced monthly, semi-annually at the end of December and at the end of June, or annually at the end of December. Average monthly return differences with a t-statistic testing for the difference from zero larger than or equal to 2 in absolute value are colored in dark gray, and average monthly return differences with a t-statistic testing for the difference from zero smaller than 2 in absolute value are colored in light gray. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Short-Term Equity Return is the issuer's stock return over the past month.



Tables

TABLE 1

Average monthly characteristics and average monthly characteristic percentiles, 2000–2018

This table reports summary statistics of our sample. 5th Percentile through 95th Percentile are the cross-sectional percentiles of a characteristic. Each statistic is calculated monthly and then averaged over the sample period from 2000 to 2018. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Profitability is defined as operating income before depreciation and amortization minus interest expense, divided by the book value of equity. Leverage is defined as net debt divided by the sum of net debt and market capitalization. Net debt is total debt minus cash, marketable securities, and collaterals. Distance to Default follows the method of Bharath and Shumway (2008). Default-Adjusted Credit Spread ("Value") is the residual from monthly cross-sectional regressions of the natural logarithm of credit spread on the natural logarithm of distance to default. Short-Term Equity Return is the issuer's stock return over the past month. Equity Momentum is the issuer's cumulative stock return from month t-6 to t-2. Short-Term Bond Return is a bond's total return over the past month. Bond Momentum is a bond's cumulative total return from month t-6 to t-2. Short-Term Credit Premium is a bond's return in excess of a matching Treasury over the past month. Credit Momentum is a bond's cumulative return in excess of a matching Treasury from month t-6 to t-2.

	Equally Weighted Average	Market Value Weighted Average	Standard Deviation	Spearman rank correlation with Forward Rate	5th Percentile	10th Percentile	20th Percentile	50th Percentile	80th Percentile	90th Percentile	95th Percentile
Market Value (USD '000)	688,557	1,289,564	640,496	-0.10	234,694	252,443	294,378	471,942	915,133	1,381,638	1,952,399
Yield to Maturity	4.57%	4.41%	1.93%	0.96	2.75%	2.96%	3.30%	4.21%	5.37%	6.36%	7.57%
One-Month Forward Rate (annualized)	5.70%	5.55%	2.23%	1.00	3.20%	3.52%	4.07%	5.41%	6.84%	7.93%	9.16%
Maturity	5.14	5.11	3.16	0.75	1.37	1.70	2.33	4.42	7.69	9.04	10.74
Duration	4.24	4.27	2.11	0.73	1.33	1.62	2.20	3.92	6.25	7.16	7.92
Credit Rating (AAA=1, B-=16)	7.45	6.89	2.73	0.50	3.26	4.31	5.50	7.09	9.45	10.58	12.58
Credit Spread (over m. Treasury)	1.84%	1.68%	1.74%	0.82	0.60%	0.72%	0.90%	1.36%	2.34%	3.38%	4.59%
Forward Rate Spread (over m. Treasury)	2.13%	1.97%	1.84%	0.86	0.69%	0.85%	1.07%	1.64%	2.77%	3.84%	5.09%
ln(Market Capitalization)	23.89	24.39	1.39	-0.40	21.58	22.05	22.70	23.90	25.21	25.79	26.13
ln(Total Public Debt Outstanding)	15.73	16.35	1.38	-0.22	13.36	13.88	14.51	15.76	17.01	17.71	17.95
ln(Book-to-Market)	-0.81	-0.76	0.75	0.25	-2.13	-1.73	-1.36	-0.74	-0.21	0.05	0.30
Profitability	0.35	0.36	0.37	-0.14	0.06	0.11	0.17	0.28	0.43	0.62	0.92
Leverage	31%	34%	32%	0.18	-11%	0%	9%	30%	54%	70%	79%
Distance to Default	8.38	7.54	5.20	-0.25	1.65	2.31	3.79	7.59	12.41	15.44	18.29
Default-Adj Credit Spread ("Value")	0.00	-0.11	0.56	0.75	-0.87	-0.68	-0.46	-0.03	0.45	0.75	0.97
Short-Term Equity Return	0.73%	0.67%	7.55%	-0.02	-10.79%	-7.73%	-4.57%	0.66%	5.89%	9.03%	12.35%
Equity Momentum	3.78%	3.57%	16.61%	-0.08	-21.03%	-14.64%	-8.16%	3.12%	15.35%	22.86%	30.52%
Short-Term Bond Return	0.48%	0.49%	1.75%	0.10	-1.40%	-0.72%	-0.23%	0.44%	1.19%	1.75%	2.49%
Bond Momentum	2.47%	2.52%	3.85%	0.15	-1.96%	-0.45%	0.70%	2.36%	4.21%	5.57%	7.25%
Short-Term Credit Premium	0.12%	0.13%	1.71%	0.03	-1.69%	-0.95%	-0.44%	0.10%	0.69%	1.24%	2.01%
Credit Momentum	0.64%	0.68%	3.76%	0.06	-3.63%	-2.00%	-0.83%	0.56%	2.09%	3.41%	5.11%

TABLE 2

Average monthly returns of quartile portfolios formed on test variables

This table reports the average monthly returns of quartile portfolios sorted on our test variables. Portfolios are formed monthly, and each portfolio contains approximately 25% of the aggregate market value of all bonds in the sample in each month. Bonds within each portfolio are weighted by market value. Panel A uses unadjusted average monthly total returns. Panel B subtracts a bond's beginning-of-month forward rate from its total return to reflect its known expected return components. T-statistics greater than or equal to 2 in absolute value are shown in bold. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Profitability is defined as operating income before depreciation and amortization minus interest expense, divided by the book value of equity. Leverage is defined as net debt divided by the sum of net debt and market capitalization. Net debt is total debt minus cash, marketable securities, and collaterals. Distance to Default follows the method of Bharath and Shumway (2008). Default-Adjusted Credit Spread ("Value") is the residual from monthly cross-sectional regressions of the natural logarithm of credit spread on the natural logarithm of distance to default. Short-Term Equity Return is the issuer's stock return over the past month. Equity Momentum is the issuer's cumulative stock return from month t-6 to t-2. Short-Term Bond Return is a bond's total return over the past month. Bond Momentum is a bond's cumulative total return from month t-6 to t-2. Short-Term Credit Premium is a bond's return in excess of a matching Treasury over the past month. Credit Momentum is a bond's cumulative return in excess of a matching Treasury from month t-6 to t-2.

	Panel A: Average Monthly Total Return (%)						Panel B: Average Monthly Total Return - Forward Rate (%)					
2000–2018, AAA-B	Low	2	3	High	High-Low	t-stat	Low	2	3	High	High-Low	t-stat
Forward Rate	0.31	0.41	0.48	0.59	0.28	**2.09**	—	—	—	—	—	—
Market Capitalization	0.46	0.46	0.42	0.45	-0.01	-0.15	-0.06	0.01	0.00	0.05	0.12	1.58
Total Public Debt Outstanding	0.50	0.44	0.41	0.46	-0.04	-0.55	0.01	-0.01	-0.02	0.02	0.01	0.09
Book-to-Market	0.46	0.46	0.46	0.42	-0.04	-0.35	0.05	0.03	0.01	-0.09	-0.14	-1.27
Profitability	0.48	0.45	0.42	0.45	-0.03	-0.43	0.00	0.01	-0.01	0.01	0.01	0.14
Leverage	0.45	0.47	0.46	0.42	-0.03	-0.29	0.04	0.04	0.00	-0.08	-0.12	-1.07
Distance to Default	0.45	0.43	0.47	0.45	0.00	-0.01	-0.05	-0.03	0.04	0.05	0.10	0.82
Default-Adj Credit Spread ("Value")	0.30	0.41	0.49	0.59	0.29	**3.13**	-0.04	-0.01	0.03	0.01	0.04	0.48
Short-Term Equity Return	0.25	0.44	0.47	0.63	0.38	**4.51**	-0.22	0.01	0.04	0.17	0.39	**4.67**
Equity Momentum	0.35	0.47	0.45	0.53	0.17	1.78	-0.14	0.04	0.02	0.08	0.22	**2.27**
Short-Term Bond Return	0.42	0.40	0.45	0.52	0.11	1.11	-0.05	-0.01	0.03	0.03	0.08	0.83
Bond Momentum	0.46	0.43	0.44	0.47	0.01	0.11	0.00	0.02	0.01	-0.03	-0.03	-0.23
Short-Term Credit Premium	0.47	0.41	0.44	0.47	0.00	0.03	-0.02	0.01	0.03	-0.02	0.00	0.02
Credit Momentum	0.45	0.42	0.44	0.49	0.05	0.39	-0.04	0.01	0.02	0.00	0.04	0.36

TABLE 3

Monthly Fama-MacBeth regressions of corporate bond returns on test variables

This table reports the results from monthly Fama-MacBeth regressions of corporate bond returns on our test variables. Except for forward rates, test variables are normalized each month by dividing each observation by the variable's cross-sectional standard deviation. Panel A provides regression results when the dependent variable is a bond's unadjusted total return. Panel B shows regression results when the dependent variable is a bond's total return minus its beginning-of-month forward rate. Coefficient t-statistics greater than or equal to 2 in absolute value are shown in bold. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Profitability is defined as operating income before depreciation and amortization minus interest expense, divided by the book value of equity. Leverage is defined as net debt divided by the sum of net debt and market capitalization. Net debt is total debt minus cash, marketable securities, and collaterals. Distance to Default follows the method of Bharath and Shumway (2008). Default-Adjusted Credit Spread ("Value") is the residual from monthly cross-sectional regressions of the natural logarithm of credit spread on the natural logarithm of distance to default. Short-Term Equity Return is the issuer's stock return over the past month. Equity Momentum is the issuer's cumulative stock return from month t-6 to t-2. Short-Term Bond Return is a bond's total return over the past month. Bond Momentum is a bond's cumulative total return from month t-6 to t-2. Short-Term Credit Premium is a bond's return in excess of a matching Treasury over the past month. Credit Momentum is a bond's cumulative return in excess of a matching Treasury from month t-6 to t-2.

	Panel A: Total Return			Panel B: Total Return - Forward Rate		
2000–2018, AAA-B	Coefficient	t-stat	R^2	Coefficient	t-stat	R^2
Forward Rate	0.78	**2.25**	0.17	—	—	—
Market Capitalization	-0.05	-1.49	0.03	0.02	0.75	0.03
Total Public Debt Outstanding	-0.05	-1.98	0.01	-0.02	-0.71	0.01
Book-to-Market	0.00	0.02	0.03	-0.05	-1.04	0.03
Profitability	0.00	0.02	0.01	0.01	0.67	0.01
Leverage	0.00	-0.03	0.02	-0.04	-0.99	0.02
Distance to Default	-0.02	-0.43	0.04	0.03	0.77	0.04
Default-Adj Credit Spread ("Value")	0.18	**3.69**	0.10	0.05	1.11	0.08
Short-Term Equity Return	0.17	**4.68**	0.03	0.18	**4.95**	0.03
Equity Momentum	0.06	1.23	0.03	0.09	1.77	0.03
Short-Term Bond Return	0.02	0.33	0.09	0.02	0.36	0.08
Bond Momentum	-0.03	-0.49	0.09	-0.02	-0.38	0.08
Short-Term Credit Premium	0.00	-0.09	0.08	0.00	0.07	0.08
Credit Momentum	-0.03	-0.42	0.08	-0.01	-0.15	0.08

TABLE 4

Monthly Fama-MacBeth regressions of yield changes on forward rates and short-term equity returns

This table reports the results from monthly Fama-MacBeth regressions of corporate bond yield changes on corporate bond forward rates and short-term equity returns of the issuer. Test variables are normalized each month by dividing each observation by the variable's cross-sectional standard deviation. Coefficient t-statistics greater than or equal to 2 in absolute value are shown in bold. Corporate bond forward rates are calculated from a bond's beginning-of-month yield and an expected capital appreciation component based on a corporate bond spot yield curve that corresponds to the bond's credit rating. Short-Term Equity Return is the issuer's stock return over the past month.

	Yield change in month t		
2000–2018, AAA-B	Coefficient	t-stat	R^2
Forward Rate	0.00	-0.12	0.12
Short-Term Equity Return	-0.05	**-4.51**	0.03

Disclosures

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