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Estimating the Impact of Growth on Bond Returns

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Abstract: While growth is universally recognized as an important factor for determining stock return, it is rarely considered a relevant factor for determining bond returns. This paper sheds light on the relationship between two important risk factors: growth and default risk. While it is well known that corporate bond returns and stock returns are correlated, the precise nature of such correlation is unclear because the total return is a composite of various unobservable factors. We hypothesize that a significant portion of the observed correlation between bond and stock returns originates from the unseen correlation between growth and default risk. There has not been extensive work done in analyzing such correlation, which is likely due to the problem of identifying the unobservable growth and default risk factors. In this paper, we extract the default factor return (portion of return due to change in default risk) from total bond returns. We also extract the growth factor return from the S&P return. It is found that growth return has a stronger correlation with the default factor return for junk bond portfolio than with the default factor return for investment grade bond portfolio. This explains the literature findings that junk bonds are more strongly correlated with stocks than investment grade bonds.

Key words: bond; stock; growth; default risk
JEL codes: G11, G12

1. Introduction and Literature Review

Since corporate bonds have both interest rate risk and default risk, the required return or yield for a corporate bond comprise the sum of interest rate risk premium and default risk premium. On the other hand, the required return for stocks consists of several market risk premiums, one of which is the growth risk premium, given that all traditional stock valuation models have expected growth rate as a relevant variable. However, none of these risk premiums are directly observable, which makes the analysis of the correlation between stocks and bonds challenging yet exciting.

Keim and Stambaugh (1986) found significant correlation between returns on small-firm stocks and returns on low grade bonds. We think that the correlation they found stems from the common linkage of both assets with growth. As we will show, both stocks and low grade bonds are highly sensitive to growth risk.

Fama and French (1989) found that the yield on corporate bonds moves with expected return for stocks. Furthermore, they found that expected return contain risk premium related to the long-term prospect of business conditions and that the spread between expected returns of stock and bonds tend to be low around business — cycle peaks and high near trough. Such variation is more prevalent for junk bonds than high grade bonds. In a

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later paper (1993), they defined the default factors as the difference between bond yield and government bond yield. Thus, stock returns were not used for explaining default factors. They found overlap or correlation between bond and stock returns and that the correlation with stock market factors is stronger for low grade bonds. But they did not find stock factor spillover to high grade bonds. In contrast, we did find that the returns for investment grade bonds are correlated with stock returns, although the correlation is not as strong as that between low grade bonds and stocks.

Elton, Gruber, Agrawal, and Mann (2001) found that default risk can only partially explain the spread between corporate and government bond. Much of the spread is explained by the risk premium for stock. By focusing the effect of default risk and stock risk premium on the spread between corporate and government, they might have overlooked the cross relationship between default risk factor and the stock market factor. We think that default risk and stock market risk intertwine and should not be treated separately. It would be more theoretically sound to analyze the impact of these two risk factors (default risk and stock market risk) on bond returns without neglecting the possible correlation between these two risk factors, which is what we attempt to do in this paper.

2. Our Hypothesis

Given that high yield bonds or junk bonds have greater default risk than investment grade bonds, we expect that the default risk for junk bonds is more strongly dependent on economic growth (or earnings growth) than investment grade bonds. That is because a weak economy leads to low or even negative earnings growth which will impact the default rate for marginal firms more adversely than for financially strong firms. Thus, we expect that the return of junk bonds due to change in default risk premium to have a stronger correlation with the return of stocks due to change in growth expectation than investment graded bonds.

3. Extracting Default Risk Factor Returns from Bond Returns

As treasury bonds are sometimes stripped into pure coupon interest bonds and pure par or zero coupon bonds, so it is conceivable for the corporate bond to be stripped into two separate securities: a hypothetical interest rate risk security and a hypothetical default risk security.

Based on this separation concept, corporate bonds are viewed as a combined package for two securities: hypothetical interest risk security and the hypothetical default risk security.

The return on the hypothetical interest risk security is sensitive to only interest rate risk change, whereas the return on the default risk security is sensitive to only default risk change.

Based on this concept, we dissect the total bond return into two components: return due to change in default risk (default return) and return due to changes in general interest rate (interest return).

The portion of return due to the change in default risk will be represented by AD (actual return linked to changes in the default factor) and the portion of return due to changes in general interest rate will be represented by AI (actual return linked to the changes in the interest rate factor). From here on, AD and AI will simply be referred to as default return and interest return, respectively.

The total return for the junk bond can be written as the geometric sum of the two components (AI_i and AD_i):

$$1 + AJ = (1 + AI_i)(1 + AD_i) \quad (1a)$$

Where

AJ is the actual return of the junk bond ETF.

AD_i is the actual return for the hypothetical default rate risk component of the junk ETF.

AI_i is the actual return for the hypothetical interest rate risk security.

AI_i represents the portion of return linked to purely interest rate risk; it is embedded in the total return of the corporate bond and is not directly observable. AD_i can be stripped by expressing it as a function of other returns.

Thus, we solve AD_i in (1a) alone to get:

$$AD_i = \frac{1+AJ}{(1+AI_i)} - 1 \tag{1b}$$

We choose the return of Treasury note to estimate AIi in (1b) since Treasury is mainly driven by interest rate risk. While both AI_i and the Treasury return change in the same direction with respect to interest rate, the magnitudes for AI_i and Treasury return might not be the same due to the difference in duration between corporate and Treasury.

In light of this, we use the actual return for the ten-year Treasury note (A_{TN}) adjusted for duration difference to represent AI_i. Since actual returns due to interest rate changes are proportional to the duration of the securities, the adjustment is made by multiplying the Treasury return by the duration ratio.

The derivation of AI_i from the observed values for A_{TN} is illustrated in the equations below. The actual return of bond due to interest rate change is proportionate to duration:

$$A = -D \cdot \Delta r \tag{2}$$

Where A is the actual return for bonds in general, D is the duration, and Δr is the change in required return.

Applying equation (2) to the actual return of the hypothetical bond and to the actual return for the Treasury note, we can write:

$$AIi = -D_i \cdot \Delta r \tag{3}$$

$$A_{TN} = -D_{TN} \cdot \Delta r \tag{4}$$

Dividing equations (3) by (4), we can express AI_i in terms of A_{TN}

$$AIi = \frac{D_i}{D_{TN}} A_{TN} \tag{5}$$

(5) Simply states that the AI_i (return due to interest rate change) is proportionate to A_{TN} where the proportion is based on the duration ratio of the two securities.

Inserting this value back into the AD_i equation (1b), we can write:

$$AD_i = \frac{1+AJ}{(1+\frac{D_i}{D_{TN}}A_{TN})} - 1 \tag{6}$$

Both D_i and D_{TN} are unobservable variables, which can be combined into a single ratio called Duration Ratio ($\frac{D_i}{D_{TN}}$). DR is the only unknown parameter in the right-hand-side of equation (6), whose value will be estimated by regression to be performed later in this paper.

4. Creating a Proxy for Growth Return

Unlike bonds, stocks are not directly driven by default risk. Instead, they are driven by interest rate risk and growth risk. Growth is a well-known factor for stocks because stocks are entitled to claims to future earnings which are sensitive to the fluctuation of economic growth. Taking a different angle from convention, we hypothesis that this growth factor is also important for determining bond return. That is because the perceived probability and the severity of potential default by corporate bonds are significantly correlated with the level of growth expectation. For example, when strong economic growth is anticipated, junk bonds tend to fare well because the risk of default might be viewed as less severe. However, the precise relationship between growth risk and default risk is unclear. The extraction method used in this paper sheds light to the relationship between these two important risk factors, which could explain much of the correlation between stocks and bonds.

In the real world, return attributed to change in growth (growth return) cannot be observed because it is hidden in the total return for stocks. However, we utilize a simple yet effective way to extract the return due to changes in growth expectation from the total return. Since we are dealing with portfolio returns in this paper, we focus on the macro growth rather than on firm-specific growth; thus, we extract the macro growth return from the S&P return. Specifically, the proxy for the actual return for growth (A_G) is derived from regressing the S&P return (A_{SP}) against the Utilities return (A_U).

It is generally held that utilities as a group has much lower growth than stocks in general. Thus, growth is a more predominate factor for determining the return for S&P than for utilities. Based on this concept, we derive a proxy for growth return from the differentials between the S&P return and utility return (adjusted for interest rate returns).

Applying this concept to ETF's, the actual return for S&P 500 (ticker symbol: SPY) is affected by both growth change and interest rate change, whereas the actual return for utility ETF (ticker symbol: IDU) is affected mainly by interest rate change.

To strip the total return of the S&P, we regress the S&P return against the utilities return to derive the portion of the S&P return linked to interest rate risk. The S&P return generated from this regression, which is the fitted line, represents the portion of S&P return that is correlated with utilities return. Thus, this portion of the S&P return is attributed to changes in interest rate risk. As for the remaining portion, which is the residual error or the gap between the S&P's total return and the fitted return for S&P, should be attributed to the growth-expectation differentials between S&P and utilities. Thus, the S&P return in excess of the portion of return linked to Utility return can be interpreted as the portion of return due to growth risk; such return differential can be used as a proxy for growth return (AG).

The fitted value for S&P return is calculated from the regression between actual daily return on S&P and actual daily return on utilities as follows:

$$Asp = 0.95\ A_{IDU} + 0.0003 \qquad (7)$$
$$(44.93) \qquad (1.42)$$

Where

Asp is the daily return on the ETF for S&P (SPY)

A_{IDU} is the daily return of the utilities' ETF (IDU).

The fitted values for Asp $(Asp^\wedge)$ is the portion of S&P return that is correlated with the utilities return or interest rate return. By subtracting this portion from the S&P return, the interest rate risk portion has been removed and we are left with mainly the growth return *AGi*:

$$AGi = Asp - (Asp^\wedge) \qquad (8)$$

Thus, by purging the return attributed to change in interest rate risk, we have derived AG, which will be used as a proxy for the growth return.

5. Correlation between Growth and Default Risk

A positive growth return is linked to the expectation of higher growth in corporate earnings in the future, which will result in lower expected default rate and thus higher bond prices. Thus, default return (actual return due to change in default risk) for bonds should be correlated positively with the growth return for stocks.

To analyze such correlation between Growth and Default return, AG can be regressed against AD as follows:

$$AGi = \hat{a} + \hat{b} \cdot ADi \tag{9}$$

However, ADi is not known because DR is unobservable. Thus, by substituting ADi with equation (6), we get:

$$AGi = \hat{a} + \hat{b} \cdot \left(\frac{1+AJi}{(1+\widehat{DR} \cdot A_{TN})} - 1\right) \tag{10}$$

Since $\widehat{DR}$ is unknown and thus needs to be estimated in (10), non-linear least square regression is performed on (10) for estimating $\widehat{DR}$ and $\hat{b}$.

The above steps can be summed up as follows: we began by regressing equation (7) to obtain SP return attributed to interest rate changes. Then we purge the portion of return associated with interest rate change by subtracting it in equation (8) in order to derive the growth return, which is regressed in equation (10) for estimating the correlation between growth return and default risk return.

This process of beginning with extracting default return and ending with regressing equation (10) is applied to the Junk Bond ETF (JNK) as well as to Investment Grade bond ETF (LQD). The data for daily returns on all the ETF's and the Ten Year Treasury Notes were obtained from DataStream within the time range of 1305 days beginning from March 20, 2009 to March 20, 2014.

The regression results for equation (10) are presented in Table 1 as follows:

Table 1 Regression Results for Equation (10)

	JunkBond	Investment Grade Bond
a	-0.160117E-03	-0.8E-4
b	0.307688 (11.0244)	0.45494 (7.53)
DR	1.11166 (6.29693)	1.52565 (9.73)
R2	0.1944	0.1562

The estimated values for the parameters in (10) are summarized in Table 1. The numbers inside the parentheses are the corresponding t-statistics. The coefficient b captures the correlation between AG and AD. As seen in Table 1, the estimated values for b are positive and their corresponding t-statistics are significant for both bond portfolios. This is consistent with our expectation that the return on growth (AG_i) is correlated positively with the return on default risk (AD_i) that are embedded in the total return for junk bonds and in the total return for investment grade bonds.

Based on the junk bond results, the estimated value for the duration ratio is 1.11, which means the hypothetical interest rate risk security embedded in the junk bond portfolio has a duration that is 11% higher than that of the Treasury Note.

The estimated values for DR (for both bond portfolios) can be used in equation (6) to calculate return on default risk (AD) for junk bonds and for investment grade bonds.

Having derived the numerical values for AD, AD can now be regressed against AG (instead of the other way around) so that the degree of impact of growth return on default return can be analyzed:

$$\mathrm{AD}i = \mathrm{a} + \mathrm{B}\,(\mathrm{AG}i) + e \tag{11}$$

The regression results for equation (11) for both bond ETF's (JNK) and (LQD) are summarized in Table 2 as follows:

Table 2 Regression Results for Equation (11)

	JunkBond	Investment Grade Bond
a	0.52E-3 (2.14)	0.18E-3 (1.21)
B	0.63182 (17.73)	0.34326 (15.52)
R2	0.1944	0.1562

From the result above, it can be seen that the coefficient B for both junk bonds and investment grade bonds are positive and statistically significant, which suggests that growth have significant impact on the returns on both bonds. In particular, the estimated value for B for junk bonds is higher than that for the investment grade bonds, which indicates that junk bonds are more growth dependent than investment grade bonds. Thus, the results here provide an empirical explanation for the literature findings that junk bonds being more strongly correlated with stocks than investment grade bonds.

6. Conclusion

While it is well known that stocks and corporate bonds are correlated, the underlying reason for such correlation has not been adequately explained. In this paper, we are able to strip the default return from the corporate bond return and derive a proxy for growth return from the return differentials between S&P and utilities. The regression between the default return and the growth return shows significant positive correlation. As expected, such correlation is stronger for junk bonds than high grade bonds. The results in this paper shed light on the powerful yet unseen impact of growth on bond returns.

Furthermore, the method employed in this paper might be extended to pricing stocks by extracting the unobservable growth factor and the interest rate risk factor. After a risk premium is assigned to each of these two factors, the required return for the stock can be estimated.

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