Asset Growth Anomaly of Corporate Bonds: A Decomposition Analysis

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Abstract

The asset growth anomaly – an inverse relationship between security performance and asset growth rates – prevails not only in the equity market but also the corporate bond market. This can be either attributed to risk and return tradeoff that bonds of high asset growth firms are better collateralized, driving lower default risk and expected performance, or a mispricing explanation that investors under-estimate default probabilities of high asset growth issuers leading to a poor realized performance. We differentiate between these two possibilities by decomposing bond performance to yields and yield changes. Our result suggests that the underperformance of high asset growth bond issuers mainly comes from the changes of bond yields. Among non-investment grade bonds where the anomaly effect is most intensive, the difference in bond yields spreads between extreme asset growth deciles is around 2% while the yield change component corresponds to a 5% bond performance difference. Bond issuers' collateral growth has a significant explanatory power of subsequent yield spread changes. Corroborating the mispricing interpretation, we find the collateral effect intensifies when bond market sentiment is high.

JEL Codes: G11; G22

Keywords: Bond return; Mispricing; Asset growth; Bond collateral

1 Introduction

The effect of asset growth on security performance has been well studied. Cooper, Gulen, and Schill (2008), Li and Zhang (2010), Watanabe, Xu, Yao, and Yu (2013) and Hou, Xue, and Zhang (2015) demonstrate a negative association between firm asset growth rates and subsequent stock performance. More recently, Chordia, Goyal, Nozowa, Subrahmanyam, and Tong (2017) and Choi and Kim (2018) show that asset growth rates inversely affect bond performance. However, the driving force for the inverse relationship is unclear. There are two competing views on the role of asset growth on security prices. Advocates of market efficiency view this inverse relationship reflective to the risk-return tradeoff: high asset growth firms are less risky and their cost of capital is lower, thus their expected return is lower (Hou et al., 2015). This is particularly true for bonds since high asset-growth firms have more collateral assets, resulting in a lower chance to default (Chen, 2001; Chordia et al., 2017; Fostele and Geanakoplo, 2014). On the other hand, the behavioral camp interprets the asset growth anomaly as evidence of mispricing. For example, Cooper, Gulen, and Schill (2008) suggest that the inverse relationship between asset growth rates and stock performance in the subsequent period is largely due to investors over-extrapolation of firm asset growth rates – stock prices drop when asset growth rates are lower than expected in subsequent periods. Likewise, in the corporate bond market high asset growth rates lead investors to under-estimate default probabilities and this results in a poor bond performance when investors correct their expectations on firm default probabilities afterwards.

Examining the asset growth anomaly in the corporate bond market, our study aims to differentiate between the risk-return tradeoff explanation and the mispricing interpretation. Unlike stock performance subject to both uncertainties from future cash flow and discount rates, the discount rate uncertainty is the sole source of uncertainty for bond performance. In other words, even firms may default their bond payments, such default probabilities are reflected in the discount rates of common bond pricing models, making bond performance trackable. Campello, Chen, and Zhang (2008) use corporate bond yields to estimate stock expected returns. Philippon (2009) suggests estimating firm value, as proxied by Tobin (1969)'s q, using bond market value since bond value is less affected by firm growth opportunities than equity value is. Bond performance can be decomposed into two elements i) a bond's yield to maturity and ii) a term associated with the change in the bond's yields from the current to next period. Yields reflect bond risk level thus we expect high asset-growth firms to have lower yields under the risk-return tradeoff explanation. Alternatively, a predictable pattern in yield changes is in line with the mispricing argument. As a result, the simple bond performance decomposition offers a way to differentiate between two competing driving forces for the asset growth anomaly.

We first confirm the asset growth effect on bond performance. Using a sample of 4,448 bonds issued by 455 unique firms between 2002 and 2019, we find that bonds of issuers in the top decile group of asset growth rates underperform those of the bottom asset growth decile group by 297 basis points in equal-weighted portfolios in the subsequent year and the underperformance of the top decile is 216 basis points in value-weighted portfolios. This is consistent with Chordia, Goyal, Nozowa, Subrahmanyam, and Tong (2017) and Choi and Kim (2018) showing a significant underperformance of bonds issued by high asset growth firms.[1] Further, we report that the underperformance of top asset growth decile concentrates in low-quality bonds including both low-investment grade bonds (rated between BBB- and BBB+) and non-investment grade bonds (below BBB-). Among non-investment grade bonds, the average underperformance of the top decile is 778 bps (641 bps) for the equal (value)-weighted portfolio. The underperformance of high asset growth bonds holds steadily for abnormal performance considering a comprehensive five-factor model, including the bond market return factor, the default premium factor, the term premium factor (e.g., Fama and French, 1993; Elton, Gruber, and Blake, 1995), the liquidity factor (e.g., Lin, Wang, and Wu, 2011), and the momentum factor (e.g., Jostova, Nikolova, Philipov, and Stahel, 2013). Besides, we also find that, within top asset growth decile, the average asset growth rate of low-quality bond issuers is much higher than that of high-quality bond issuers. While this is aligned with the fact that some high growth firms are either too volatile or short of established record for good bond ratings, it contrasts the conventional view that low-quality firms typically are financially constrained thus less likely to experience fast growth.

We then look into the role of collateral growth in the negative association between asset growth and bond performance. Confirming the conventional wisdom that tangible fixed and current assets have greater collateral value than intangible assets, we find that bonds with high tangible asset growth are lower in their subsequent annual performance while we do not observe the same effect between intangible asset growth and bond performance. We further show that the impact of

[1] We obtain consistent results when extending the corporate bond sample back to 1994 using the Mergent NAIC transaction database.

collateralized asset growth, proxied by the percentage change in corporate tangible assets, differs across rating groups – tangible asset growth negatively affects bond performance for non-investment grade bonds (below BBB-) and low investment-grade bonds (BBB- to BBB+), but not for high investment-grade bonds (A- to AAA). This, once again, can be justified by both rational expectation and mispricing interpretations. From the rational expectation perspective, since the default likelihood is greater among non-investment grade bonds, credit risk plays a larger role on pricing among non-investment grade bonds than it does for investment grade bonds (e.g., Huang and Huang, 2012), accommodating the stronger collateral growth effect among poorly rated bonds. Alternatively, firms issuing poorly rated bonds are a mix of companies with substantial growth opportunities but lack of good accounting numbers and firms with poor investment opportunities. Both types of firms may join the crowd of high asset growth bond issuers. As we document that among high asset growth firms, low quality bond issuers have much higher asset growth rates than high quality bond issuers, mispricing could arise when investors cannot distinguish issuer quality within the low-quality bond group (Greenwood and Hanson, 2013). When investors under-estimate high-growth firms' default probability, we expect to see a poor realized performance of corporate bonds issued by high asset growth firms in subsequent years.

In order to differentiate between the above two scenarios, we decompose bond performance to a yield component and a yield change component and examine how they are affected by collateral growth. We find that, consistent with the risk-reward interpretation, tangible asset growth and bond yield relative to treasury yield (i.e., yield spreads) evaluated in the same year with asset growth is inversely related. The result is also in line with the mispricing argument – there is a positive relation between the tangible asset growth and the following yield spreads changes. We include bond yield spreads in the regressions and find the effect of tangible asset growth remains. The result also holds after controlling for the new tangible asset growth in the subsequent year, showing that tangible asset growth has predictability power on the following yield change. The evidence shows that high tangible asset growth leads to larger following yield spreads change, driving lower bond return. This is aligned with the overvaluation hypothesis.

Finally, we perform two sets of analyses to understand the role of collateral growth on bond performance. First, we test the relative contributions of yield spreads and the changes in yield spreads and check the impact of collateral growth on individual components. We apply a four-way decomposition of individual bond annual returns including i) yield of a treasury bond with a matching maturity, ii) the change in yields of the matching treasury bond, iii) the yield spread between the individual bond and matching treasury bond, and iv) the changes in yield spreads, and examining the explanatory power of each element on the subsequent bond performance. The first two elements capture the influence of the levels and changes in macro-economic conditions while the third and fourth components capture the levels and changes of credit risk for individual bonds. Second, the asset growth effect on bond return is mainly through the changes in yield spread channel rather than the level of yield spreads. We then look at how much of yield spread changes are attributed to corporate collateral growth. To do so, we split bonds into deciles based on the collateral growth (growth rate in firm tangible assets) in year t-1 and estimate the value-weighted average yield spread changes from July of year t to June of year t+1, and develop an arbitrage portfolio which has a long position in the top collateral growth group and has a short position in the bottom collateral growth group. As we expect mispricing to be stronger among poorly rated bonds, we anticipate the factor has a stronger influence on yield spread changes among poorly rated bonds. Consistent with this expectation, we find the explanatory power of collateral growth factor is higher among relatively poor-quality bonds – R^2s are 10% for low investment-grade bonds and 20% for non-investment grade bonds, as opposed to 3% for the high investment-grade bonds. Our finding supports the argument that asset growth effect on bond performance is attributed to yield spread changes through the collateral growth channel.

The second set to differentiate between mispricing and risk involves investor sentiments. If misreaction to corporate asset growth indeed causes biased estimations of corporate bond default probability and the subsequent recovery process, then the mispricing would be much stronger in high sentiment periods. This logic can be found in, for example, Baker and Wulgler (2002), Stambaugh et al. (2012) and Greenwood and Hanson (2015) for stock performance and in Greenwood and Hanson (2013) for bond performance and it is confirmed by our empirical finding. First, the treasury adjusted yield spreads for corporate bonds of high asset growth firms are lower in high-sentiment years than in low-sentiment years, inferring that high-growth firms receive a better valuation in high asset-growth periods. We also find that collateralized asset growth can largely subsume the effect of asset growth on bond performance. Second, and more relevant to the mispricing argument, there are greater subsequent-year increases in yield spreads for high asset growth firms in high sentiment years than during low sentiment years. That is, highly-priced high-asset growth bonds experience a greater price drop in the subsequent year. Once again, the role of asset growth is subsumed by collateralized asset growth. Third, we find that there is a more pronounced inverse relation between collateral growth and subsequent bond performance exists in poor-quality bonds, including both non- and low-investment grade bonds. Our results support the over-extrapolative expectation argument (Barberis, Shleifer, and Vishny, 1998; Cooper, Gulen, and Schill, 2008; Barberis, Greenwood, Jin, and Shleifer, 1998), when sentiment is high, high collateral growth leads to greater current-year yield reduction which drives a greater reversal in subsequent bond yields.

Our study makes several important contributions to the literature. First, this study complements Greenwood and Hanson (2013) which concentrate on the time series dimension of corporate bond market mispricing from investors' extrapolation. We show that cross-sectionally yield spreads of individual bonds, a key component of bond performance considered to be not predictable under the rational expectation framework, covary with bond issuer collateral growth rates. We further show that such effect is particularly strong among non- and low-investment grade bonds where mispricing is more likely and find that the collateral growth effect intensifies in high bond market sentiment conditions. The additional cross sectional dimension allows us to take advantage of granular data on credit risk characteristics of individual bonds and bond issuers, such as bond yield spreads, rating and issuers' default probabilities, as well as firm attributes reflective of mispricing. In this sense, our paper joins the large recent literature on the effect of financial and product cycles on security performance, e.g., Greenwood and Shleifer (2014), Greenwood and Hanson (2015), Gennaioli, Ma, and Shleifer (2016).

Collateral is an important feature of corporate bonds. This study highlights an important feature of asset growth, unique to corporate bonds, that asset growth helps to improve bonds' collateral value. This recognition potentially helps two streams of empirical research. One stream of finance works attempt to understand both the level and changes of yield spreads but recognize a significant portion of the variations in both variables remain unexplained. Huang and Huang (2012), Longstaff et al. (2005), and Collin-Dufresn et al. (2001) suggest that there are undiscovered factors driving corporate spreads changes beyond conventional macroeconomic variables and firm-specific variables, such as credit-risk and liquidity. Another stream of literature is on the effect of collateral on firm value and asset price. Ai, Li, Li, and Schlag (2020) find the degree of asset collateralizability affects expected stock returns for financially constrained firms. Almeida and Campello (2007) reveal that collateral affects the sensitivity of investment on cash flow only in financially strained firms. By connecting these two streams of research together, we suggest that investor information about collateralized assets is an important determinant of the level and changes of corporate bond yield spreads.

To our best knowledge, we are the first to apply the decomposition analysis to understand the influence of an economic force on bond pricing. Unlike stock performance simultaneously affected by uncertainties in future cash flow and discount rates, bond price uncertainties solely come from the discount rate channel. Under this premise, we decompose bond performance into yields and changes in bond yields. This approach allows us to separate unexpected bond performance driven by bond yield changes and expected bond performance determined by bond yields, which can be used in future works regarding bond performance.

The article is organized as follows: Section 2 introduces a simple framework to decompose bond performance, followed by our empirical predictions, Section 3 describes the data. Section 4 presents the empirical results. Section 5 concludes.

2 Bond Performance Decomposition and Hypotheses

2.1 Decomposing Bond Performance

A large consensus is that credit risk which is often proxied by bond yields is an important determinant of bond performance. This idea is deeply embedded in extant empirical bond pricing models (e.g., Fama and French, 1989, 1993; Elton, Gruber, and Blake, 1995). Similarly, changes in bond yields affect bond performance irrespective of the sources – either driven by new information in the subsequent period or systematic factors helping predict subsequent period bond yields. Following these thoughts, we decompose the one-year bond return of a corporate coupon bond into a yield component and a yield change component. The bond is assumed to have a zero accrual interest and its performance is specified as below:

$$R_{t+1} = \frac{C + P_{t+1} - P_t}{P_t} \tag{1}$$

where P_t and P_{t+1} are prices of the bond at time t and $t+1$ and can be expressed as

$$
\begin{aligned}
P_{t+1} &= \sum_{\tau=1}^{n-1} \frac{C}{(1+y_{t+1})^{\tau}} + \frac{M}{(1+y_{t+1})^{n-1}} \\
P_t &= \sum_{\tau=1}^{n} \frac{C}{(1+y_t)^{\tau}} + \frac{M}{(1+y_t)^{n}}
\end{aligned}
$$

Expressing the yield of the bond in the beginning of year $t+1$:

$$
y_{t+1} = y_t + \Delta y_{t+1} \tag{2}
$$

and applying the first-order Taylor expansion on P_{t+1}, we have:

$$
\begin{aligned}
P_{t+1} &= P(y_{t+1}) = P(y_t) + P'(y_t)\Delta y_{t+1} \\
&= \sum_{\tau=1}^{n-1} \frac{C}{(1+y_t)^{\tau}} + \frac{M}{(1+y_t)^{n-1}} - [\sum_{\tau=1}^{n-1} \frac{C\tau}{(1+y_t)^{\tau+1}} + \frac{M(n-1)}{(1+y_t)^{n}}]\Delta y_{t+1}
\end{aligned} \tag{3}
$$

Inserting Eq. (3) in Eq. (1), as detailed in Appendix A1, we have the following expression for bond performance in the subsequent period:[2]

$$
R_{t+1} = y_t - \frac{D_{t+1}^{y_t}}{1+c_{t+1}^{y_t}} \Delta y_{t+1} \tag{4}
$$

where $P_{t+1}^{y_t}$ is the bond's forward price – it is the price in the subsequent period given the bond's yield stays constant as y_t; $D_{t+1}^{y_t}$ is the duration at t+1 when the yield stays constant at y_t; $c_{t+1}^{y_t}$ is the bond's current yield at $t+1$ given its yield to maturity at t.[3]

Denoting $\eta_t = \frac{D_{t+1}^{y_t}}{1+c_{t+1}^{y_t}}$, we have

$$
R_{t+1} = y_t - \eta_t \Delta y_{t+1} \tag{5}
$$

Now we introduce expectation to the bond return in $t+1$ for an individual bond i. Since Eq.

[2]Here we consider the bond issuer make single coupon payment over the performance evaluation horizon. A practice concern is that most corporate bonds make coupon payments semiannually. Two coupon payments would be made over the evaluation period. We discuss this case in Appendix A and offer the condition for the decomposition to hold.

[3]When a bond's price is close to its par value, its current yield approximates the yield to maturity. Then $\frac{D_{t+1}^{y_t}}{1+c_{t+1}^{y_t}}$ approximates the bond's modified duration.

(5) holds for any individual bonds we then express the bond's expected return from t to $t+1$ as:

$$E(R_{i,t+1}) = y_{i,t} - \eta_{i,t} E(\Delta y_{i,t+1}) \tag{6}$$

Separate $y_{i,t}$ into bond i's maturity matching benchmark yield, $b_{i,t}$, and the spread between the yield of bond i and the benchmark yield, $s_{i,t}$ (=$y_{i,t} - b_{i,t}$). This gives us

$$E(R_{i,t+1}) = s_{i,t} + b_{i,t} - \eta_{i,t} E\Delta s_{i,t+1} - \eta_{i,t} \Delta b_{i,t+1} \tag{7}$$

$E\Delta s_{i,t+1}$ is determined by individual firm's credit risk and $\Delta b_{i,t+1}$ is affected by macroeconomic factors. Next, we show that different expectations of $E(\Delta y_{i,t+1})$ lead to alternative testable predictions.

2.2 Testable Implications

The first case is that when $E(\Delta s_{i,t+1}) = 0$. That is, $\Delta s_{i,t+1}$ is a noise and $s_{i,t}$ is an unbiased estimator of $s_{i,t+1}$. Previous studies, e.g., Berger and Udell (1990); Jimenez, Salas, and Saurina (2006); Brumm, Grill, Kubler, and Schmedders (2015), suggest collateral is an important factor driving the pricing of commercial loans. Accordingly, we set a direct link between collateralized asset growth, specified as x, driven by corporate asset growth and a bond's yield spread, $s_{i,t}$.

$$E(R_{i,t+1}) = s_{i,t}(x) + b_{i,t} \tag{8}$$

Further consider the case of non-zero $E(\Delta s_{i,t+1})$ whereas $s_{i,t}$ is no longer unbiased estimator of the bond yield in the next year. This is illustrated in Figure **??**, in which if the $s_{i,t}$ is an unbiased estimator of $s_{i,t+1}$, there is not change in yield spreads from time t to t+1 and the line connecting $s_{i,t+1}$ and $s_{i,t}$ is horizontal. However, when the $s_{i,t}$ is no longer an unbiased estimator of $s_{i,t+1}$, there is a revision of yield spreads from time t to t+1. In other words, the bond's expected return contains both bond yield and the mispricing component. For high asset growth firm, when $E(\Delta s_{i,t+1}) > 0$, $s_{i,t}$ underestimates $s_{i,t+1}$ but overestimate the bond's expected performance. We focus on this scenario because it is consistent with lower performance for high asset-growth firms. According to Eq. (7), we have

$$E(R_{i,t+1}) = s_{i,t}(x) - \eta_{i,t} E\Delta s_{i,t+1}(x) + b_{i,t} - \eta_{i,t}\Delta b_{i,t+1} \tag{9}$$

Eq. (9) states that, besides the risk reduction effect stated in Eq. (8), collateralized asset growth could be lead to systematic mispricing. Consistent with this view, Greenwood and Hanson (2013) show that investors may make biased assessments of default probabilities. Specifically, they find that the deterioration of the credit quality after the issuance year is quite common. This results in a yield change effect that investors realize the overvaluation of collateral value of high asset growth firms, which leads to a positive yield revision. As a result, the subsequent the price goes down and yield spread becomes larger. Similarly, low asset growth firms are more likely to be subject to underestimated collateral value. A correction of the underestimation afterward pushes up the bond price and lowers the bond yield spread, a positive yield revision. Cooper et al. (2008) also find investors tend to extrapolate high growth rates. This gives rise to our first empirical prediction.

Prediction 1 *An increase in collateralized assets coming from asset growth lowers bond performance. This may be attributed either to risk reduction driven by greater collateral value of high asset growth firms or to a greater overvaluation of such firms.*

It is likely that the marginal collateral effect is stronger for low-rated bonds since their issuers have higher default risk, higher probability of adverse selection and larger degree of information asymmetry than high-rated issuers. This is documented in the literature. For example, Almeida and Campello (2007) and Livdan et al. (2009) find the heterogeneity of collateral effect across firms. Given financial constraints to poorly-rated firms, creditworthiness disproportionately affects the financing costs they face. To the extent that debt is the main source for asset growth, the collateral effect may then be particularly beneficial to poorly-rated firms. Thus the financial quality of issuers is an important determinant of the strength of the collateral effect. Accordingly, the marginal value of the collateral is larger in low-rated firms than in high-rated firms.

Moreover, low-rated bonds is more sensitive to default risk than high-rated bonds. Huang and Huang (2012) show credit risk accounts for a much larger fraction of yield spreads for junk bonds than investment grade bonds. Longstaff, Mithal, and Neis (2005) document a much larger percentage of default-risk components of yield spread for low-rated bonds than high-rated bonds.

We therefore expect the collateral growth effect to be stronger for low-rated bonds than high-rated bonds. This leads to the second empirical prediction.

Prediction 2 *The risk reduction effect and the mispricing of collateral value for high asset growth firms is more profound in low-rated bonds than in high-rated bonds.*

As collateral value impacts the risk of default and the promised payments in the event of default, the valuation of collateral growth potentially affects the yield spread and the subsequent yield spread change, two components of bond return. It is critical to examine how much variation of $r_{i,t+1}$ comes from the variations of $s_{i,t}$ and $\Delta s_{i,t+1}$. In addition, the magnitude of explanatory power of $\Delta s_{i,t+1}$ is a reflection of the magnitude of mispricing on collateral value for asset growth. On the other hand, there is little consensus on the determinants of yield spread changes. The traditional structure model values bond with contingent-claims analysis. Credit spread changes are determined by changes in these state variables related to future cash flows discounted at the risk-free rate. However, Collin-Dufresn et al. (2001) suggest these conventional factors only explain a small fraction of the variation in yield spread change.

Here we propose that collateral growth from high asset growth lowers default risk leads to lower bond yields in the current year and greater yield increase in the subsequent year. While respectively bond yields and yield changes correspond to a default risk reduction and mispricing of such influence, the relative magnitude of collateral growth explained yields and yield spread changes on bond performance helps us to identify the relative importance of two forces. This gives rise to our third prediction.

Prediction 3 *Asset growth effect on bond performance is mainly from yield spread changes through the collateral asset growth channel.*

3 Data

3.1 Corporate Bond Sample

Our main sample includes US corporate bonds the enhanced version of Trade Reporting and Compliance Engine (TRACE) database. The database starts in July 1, 2002, so is the starting time of our main sample (used to generate empirical findings). The sample ends at the end of 2019.

Besides, to address the concern that the sample horizon is not be sufficiently long, we supplement the TRACE data with Mergent NAIC transaction database which covers transactions of insurance companies and starts in 1994. The results based on the extended sample are reported in the Internet Appendix.

TRACE provides information on secondary market transactions, including transaction prices, volumes, trade direction and the exact data and time of the trade. We account for reporting errors using the data cleaning procedures commonly used for the TRACE transaction data (see, Dick-Nielsen, 2009 and Dick-Nielsen, 2014).[4] Following Bessembinder, Kahle, Maxwell, and Xu (2009), we estimate daily bond price by weighting each trade by its trading volume. This approach puts more weight on the institutional trades that incur lower transaction cost and more accurately reflect the underlying price of the bond. The month-end transaction is the last available daily price from the last five trading days of the month.[5] We then calculate monthly corporate bond return at time t as

$$R_{i,t} = \frac{P_{i,t} + AI_{i,t} + C_{i,t}}{P_{i,t-1} + AI_{i,t-1}} - 1 \tag{10}$$

where $P_{i,t}$ is the month-end transaction price, $AI_{i,t}$ is accrued interest, and $C_{i,t}$ is the coupon payment, if any, of bond i in month t. We then convert bond returns from monthly to annual frequency. Annual bond return is estimated from July of year t to June of year t+1. We also denote $r_{i,t} = R_{i,t} - r_{f,t}$, where $r_{f,t}$ is the risk-free rate proxied by the one-month Treasury bill rate.

We obtain bond characteristics from the Fixed Income Securities Database (FISD). This database contains a comprehensive set of bond characteristics, such as issue amount, maturity, provisions, coupon and credit ratings on all U.S. corporate bonds maturing in 1990 or later. We merge our transaction data with bond characteristics and exclude bonds with missing coupon, interest payment frequency, or bonds with variable coupon rates. Following Bai et al. (2019), we remove bonds that are not listed or traded in the US public market, which include bonds issued through private placement, bonds issued under the 144A rule, bonds that do not trade in US dollars, and bond issuers not in the jurisdiction of the United States. We also exclude bonds with maturity of less than one year, preferred shares, non-U.S. dollar denominated bonds, and bonds that are

[4] These include (i) same-day trade corrections and cancellations; (ii) trade reversals which refer to corrections and cancellations conducted not on the trading day but thereafter; (iii) agency and interdealer transactions.

[5] Using the last transaction within the last five trading days of the month instead of that on the last day helps increase the number of non-missing monthly observations. If there are no trades in the last five trading days, the month-end price is missing for that month.

mortgage backed, asset backed, convertible and exchangeable as well as secured bonds.[6] Finally, we mainly use the Standard & Poor's (S&P) rating from the FISD, but, if it is not available, we use the Moody's or Fitch rating when possible and drop bonds whose ratings we cannot identify. We convert ratings into a numeric scale from 1 to 22: AAA=22, AA+ = 21, AA=20, ..., C=2, D=1. Ratings 13 through 22 (BBB- through AAA) are investment grade and ratings below 13 are non-investment grade.

We combine our bond data with the CRSP database to get information on firm equity prices and returns, then merge it with COMPUSTAT to get non-financial issuer accounting information[7]. To mitigate the backfilling biases, a firm must be listed on the Compustat for 2 years before it is included in the data set (e.g., Fama and French, 1993). A main variable of interest is the annual asset growth rate (AG). Following Cooper, Gulen, and Schill (2008), the annual asset growth rate (AG) observed at the end of June of year t is calculated as the percentage change in total assets (denoted as A, Compustat data item 6) from the end of fiscal year t-2 to the end of fiscal year t-1, where fiscal year t is defined as the fiscal year ending in calendar year t.

$$AG_t = \frac{A_{t-1} - A_{t-2}}{A_{t-2}} \tag{11}$$

To compute asset growth rate, we require a firm has no zero or negative total assets in both fiscal years t-2 and t-1. We further winsorize asset growth rate at the top and bottom 1% in each year to control for the influence of outliers.

We define tangible asset growth (TG) in a similar way as AG, where, following Almeida and Campello (2007), we define tangible assets (TAN) as below:

$$TAN = Cash + 0.715 * Receivable + 0.547 * Inventory + 0.535 * Net\ Fixed\ Asset \tag{12}$$

In Eq. (12), *Cash* is Compustat data item 1; *Receivable* is Compustat data item 2; *Inventory* is Compustat data item 3; and *Net Fixed Asset* is Compustat item 8.

Another important component of AG is IG, intangible asset growth, which is measured in the

[6] Secured bonds represent a small portion of the corporate bond, about 3%. We exclude them because the focus of this study is on the collateral effect due to corporate asset growth, not the specific collateral pledged on an individual bond.

[7] Consistent with Cooper et al. (2008), we keep non-financial firms and exclude firms with four-digit SIC codes between 6000 and 6999.

same way as AG and TG, where when estimating intangible assets, we exclude goodwill (Compustat data item 204) from reported intangible assets (Compustat data item 33).

Our final sample includes 4,448 bonds issued by 455 unique firms, for a total of 22,784 bond-year observations from July 2002 to June 2020. On average, there are approximately 1,213 bonds per year over the whole sample.

3.2 Summary Statistics

Table 1 reports the summary statistics of key variables, including both bond and issuer characteristics. To be noticed that, firm specific variables are estimated at bond issuer level, while bond characteristics variables are estimated at bond issue level. The variables' descriptions are provided in Appendix B.

We first report bond characteristics at the individual bond level, including annual bond excess return (return), yield, rating, duration, coupon, issue size (par), put and call feature. Annual bond excess return has a mean of 4.5% and standard deviation of 9.12%, ranging from -5.45% in the 5th percentile to 17.7% in the 95th percentile. The average bond yield is 4.1% with a standard deviation of 2.73%. The sample contains bonds with a median rating of 16 (i.e., A-). Note that, our sample only includes bonds issued by publicly listed firms, resulting in a higher average rating and lower yield than that of the overall Trace sample. An average corporate bond has Maculay duration of 6.64 years, annual coupon rate of 5.04%, issue size of $618.8 million and Amihud illiquidity measure of 0.27% per million dollars. 76% of bonds are callable while only 1% of bonds have put options.

The key firm-level variables are the asset growth (AG) rate and tangible asset growth (TG). The mean (median) asset growth is 6.86% (3.72%) with a standard deviation of 23.25%. The average asset growth rate is smaller than that reported in Cooper, Gulen, and Schill (2008) because in our sample we consider firms with public debt issues. There is no surprise that firms with corporate bond issues tend to have a larger size and relatively smaller growth rates than average listed firms. The mean (median) tangible asset growth is 2.70% (1.88%) with a standard deviation of 10.92%. Intangible asset growth (IG) has an average growth rate of 2.25% with a standard deviation of 11.02%.

The other firm characteristics include total assets (Size, in billion dollars), leverage (LEV) and OIA. These variables are covered in previous studies, e.g., Collin-Dufresn et al. (2001),Campbell and Taksler (2003), and Chen, Lesmond, and Wei (2007). The average (median) of total assets is \$28.36 (10.66) billion. The standard deviation of leverage is 0.19 while the average is 0.28. OIA measured as operating income over total assets has an average of 0.14, ranging from 0.05 to 0.28 from 5 to 95 percentiles. Moreover, the reported means of these measures are higher than their medians, suggesting that large firms are more levered and also more profitable.

Next, we look at bond issuer and issue characteristics across asset growth decile portfolios in Table 2. At the end of June of each year from 2002 to 2019, bonds are allocated into deciles based on the issuer's annual asset growth rate, and portfolios are formed from July of year t to June of year t+1, where t is the portfolio formation year.[8] The decile 10 (D10) bonds are issued by the highest asset growth firms while decile 1 (D1) has the lowest asset growth firms. The portfolios are equal-weighted. Table 2 reports averages of the various bond issues and issuer characteristics of 10 portfolios prior to the portfolio formation date.

The average asset growth (AG) of the lowest growth firms is -14.53%. The highest asset growth portfolio has an average growth rate of 43.98%. The difference is 58.51%, significant at the one percent level. High (low) growth firms tend to be firms that have also experienced high (low) tangible asset growth (TG) over the same period. The highest growth portfolio grows with 14.18% tangible assets, while the tangible assets of the lowest growth decile drops by 6.7%. The difference in tangible asset growth is 20.89%, significant at 1% level. We also report the growth of intangible assets. The average for the top decile group is 17.82% and the difference between the top and bottom decile is 20.5%. Note the sum of tangible and intangible assets is 32% for the top decile firms, less than 43.98% for the total asset growth rate. This is mainly due to the weights placed on current asset items and net fixed assets when estimating AG.

The lowest growth firms are the largest firms in our sample, with average total assets of \$107.67 billion, while the highest growth decile has an average firm size of \$41.81 billion. We also calculate the market leverage (LEV), which is measured as the sum of total a sum of long-term debt and short-term debt over the sum of total debt and the fiscal-year end share price time, the number of shares outstanding. High growth firms have lower leverage than do the low growth firms at 0.26 and 0.38, respectively. The leverage difference between D10 and D1 is as large as -0.12 (t-statistic = -20.32), showing that high-growth firms have lower leverage prior to the formation of asset growth

[8] We follow the convention to set a 6-month gap between the calendar date of the fiscal year end and the beginning of stock return evaluation date.

portfolios. More interestingly, decile 10 has a leverage increase of 0.057 during the asset growth year while the leverage of decile 1 decreases by 0.007. The spread of leverage change (ΔLEV) is 0.064.

In the last three columns, we look at the distributions of bonds in the three rating groups: i) high investment (HI) grades with a rating of A- and above, ii) low investment (LI) grades with a rating between BBB- and BBB+, and iii) non-investment (JK) grades whose ratings are below BBB-. In the bottom decile (D1), these three types of bonds respectively account for 32%, 39% and 29% while in the top decile (D10), these three types of bonds account for 47%, 44% and 9%. More junk bonds are in low asset growth decile groups than in issuer groups of high asset growth. It shows that issuer credit quality is higher in high asset growth groups. It also shall be noted that the fractions of high investment grade bonds (junk bonds) do not monotonically increase (decrease) in issuer asset growth, suggesting that credit quality is not sole determinant of issuer asset growth.

4 Empirical Results

4.1 Asset Growth and Corporate Bond Returns

4.1.1 Portfolio Analysis

At the end of June of each year from 2002 to 2019, bonds are allocated into deciles based on the issuer's annual asset growth rate, and portfolios are formed from July of year t to June of year t+1, where t is the portfolio formation year.[9] The decile 10 (D10) bonds are issued by the highest asset growth firms while decile 1 (D1) has the lowest asset growth firms. We calculate annual asset growth rate and bond returns for equal-weighted and value-weighted portfolios from July of year t and June of year t+1. We report equal-weighted portfolio returns to allow us to compare our results with previous studies. To ensure that our results are not driven by small bond transactions, we also report value-weighted portfolio returns based on the bond's outstanding balance.

Panel A of Table 3, Section i, reports the average asset growth rate and annual bond excess return of equal-weighted asset growth decile portfolios. In the full sample, the lowest growth decile (D1) earns average EW annual portfolio returns of 6.98% and the highest asset decile (D10) earns average annual returns of 4.01%, an annual spread of -2.97% with a t-statistic of -9.09. We also

[9] We follow the convention to set a 6-month gap between the calendar date of the fiscal year end and the beginning of stock return evaluation date.

test whether the significant return difference holds across various rating groups. The full sample is classified into three rating groups: high investment grade bonds (A- to AAA), low investment grade bonds (BBB- to BBB+) and non-investment grade bonds (BB+ or lower). Similar to findings in the full sample, we show that moving from the lowest asset growth decile to the highest asset growth decile, the average annual bond returns decrease in all subsamples. In the high investment grade bond subsample, the annual bond return is 4.01% in decile 1 and 3.57% in decile 10. The t-statistic of difference is significant at 10% level.

By contrast, in the subsample analysis for low investment grade bonds and junk bonds, the return differences between D10 and D1 become much more statistically significant and have a larger economic magnitude. Reported in the column for low-investment grade bonds, the annual bond return is 6.01% in decile 1 and 4.84% in decile 10. The corresponding bond return difference between decile 10 and 1 is -1.57% with a t-statistic of 2.72. In the non-investment grade bond subsample,the annual bond return is 12.88% decile 1 and 5.10% in decile 10. The corresponding bond return difference between decile 10 and 1 is as large as -7.78% (t-stat = -4.80). The results show that the negative relation between asset growth and bond return is much stronger in non-investment bonds than in investment bonds, supporting the second prediction that the asset growth effect is stronger among low-quality bonds.

We also look at bond performance across AG decile portfolios in year t+2. Unlike the finding for performance of year t+1, there is no clear pattern across different AG deciles, and the performance difference between D10 and D1 bonds is no longer statistically significant for the full sample, low-investment grade and non-investment grade subsamples. To conserve space, we report the empirical finding in the Table A2 of Internet Appendix .

Show in Section ii of Panel A, the spreads of asset growth rates between D10 and D1 are 38.07% for high investment grade bonds and 86.76% for non-investment grade bonds, suggesting that low quality bond issuers have a higher variation in terms of firm asset growth. Specifically, the top decile portfolio has much higher average asset growth rates for low- and non-investment grade bonds (60.67% and 59.33%, respectively) than for high-investment grade bonds (29.44%). To be noticed that, firms with non-investment grade rating can also have rapid growth. For example, growth firms, in their early stage, tend to have high asset growth rate, but are rated as non-investment grade because of the lack of profitability and long operating history.

To have an understanding whether bond performance is driven by conventional risk factors, we estimate portfolio alpha by regressing the portfolio's equal-weighted averaged monthly excess returns, $r_{i,t}$, onto risk factors in the corresponding month using a 36-month rolling window.

$$r_{i,t} = \alpha_{i,t} + \beta'_{i,t} Factor_t + \epsilon_{i,t}, \tag{13}$$

where $Factor$ is a vector of five bond factors, described in Appendix C, including i) bond market factor (MKT), ii) default factor (DEF), iii) liquidity risk factor (LIQ), iv) term premium factor (TERM), and v) bond momentum factor (MOM). $\alpha_{i,t}$ represents the risk adjusted performance for portfolio i in month t based on individual bonds' past 36-month rolling performance. We obtain annual alphas by multiplying monthly alphas by 12.

In Section i of Panel A, Table 3, we report the difference of alpha in equal-weighted bond performance between the top and bottom deciles. In the full sample, the difference of annual alpha (decile 10-decile 1) is -0.82 and significant at 5%. In three sub-rating groups, the difference of alpha is -0.23% (t=-1.47) for high investment grade bonds, -0.78% (t=-2.38) for low investment bonds, -1.63% (t=-2.84) for non-investment grade bonds.[10] Notice that, among junk bonds, the difference in excess returns between D10 and D1 is -7.78% with a t-statistic of -4.80, which has a much larger magnitude than the corresponding difference in alphas. This is attributed to the differences in loadings to risk factors – in particular, performance of D10 bonds has a much lower loading to the default factor, thus shrinking the alpha difference between D10 and D1 portfolios. This nevertheless raises a concern whether or not that D10 non-investment grade bonds are indeed lower in default risk than D1 non-investment bonds, or they are perceived to be lower in default risk?

Subsequently, in Panel B we report average asset growth rate and annual bond excess returns of value-weighted asset growth decile portfolios. We find consistent findings as shown in Panel A. In the full sample, the return spread between decile 10 and decile 1 is -2.16%, significant at 1% level. Though the spread is insignificant for high investment grade bonds, the return spreads bewteen

[10]Recognizing that Bai et al. (2019) suggest that a four-factor model including the excess bond market return, the downside risk factor, the credit risk factor, and the bond liquidity risk factor works well in explaining bond performance, we apply the four-factor model to re-estimate alphas of decile portfolios sorted by asset growth rates and find the result is consistent.

decile 10 and decile 1 are -1.86% and -6.41% with t-statistics of -2.45 and -4.08 for investment and non-investment grade bonds, respectively. Overall,we find a negative relation between firms asset growth and future corporate bond returns. Bonds issued by high asset growth firms are associated with lower subsequent bond returns. In addition, the negative relation holds much stronger for low investment and non-investment grade bonds.

In the same panel, we also report the difference of alpha between decile 10 and decile 1 for value-weighted portfolios. In the full sample, the difference of alpha (decile 10-decile 1) is -0.92 and significant at 5%. In three sub-rating groups, the difference of alpha is -0.12% (t=-1.52) for high investment grade bonds, -0.76% (t=-2.15) for low investment bonds, -1.12% (t=-2.91) for non-investment grade bonds. The pattern of alpha between deceil 10 and decile 1 reveals that bonds of higher growth firms have lower bond-factors-adjusted return.

In summary, our findings of portfolio analysis are supportive to the presence of asset growth effects – bonds of high asset growth firms are lower in performance and such effect is stronger among bonds of low-quality firms.

4.1.2 Cross Sectional Regressions of Bond Returns

The result reported in the last subsection shows that our bonds with higher asset growth have lower subsequent returns. To account for drivers of on bond returns beyond asset growth rates, we perform Fama-MacBeth regressions specified below:

$$R_{i,t+1} = \beta_0 + \beta_1 AG_{i,t} + \beta_2 YS_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{14}$$

The dependent variable, $R_{i,t+1}$, is the annual bond return in excess of the three-month T-bill rate, estimated from July of year t to June of year t + 1. In the above regression, the key variable of interest is bond issuers' asset growth (AG). Measured in June of year t, yield spread (YS) is an additional critical explanatory variable included to examine whether performance is driven by an individual bond's risk level. Following the return decomposition discussed in Section 2.1, YS is considered as an unbiased estimator of bond expected return. As a result, we expect that, first, the coefficient on YS to be positive, and second, the AG effect shall be subsumed by YS. Alternatively, under the mispricing interpretation, YS is merely a subset of a bond's expected return. Therefore, the AG effect is expected to coexist with YS.

The regression specified by Eq. 19 includes a set of control variables, c, including market leverage (LEV), leverage change (ΔLEV) and the natural logarithm of total assets (Firm Size), reported in the fiscal year ending in calendar year t-1 (Fama and French, 1993), corresponding to year t used in Eq. 19. Our control variables also involve bond level variables including bond credit ratings, illiquidity, duration, bond issue size (Par), as well as dummies for puttable and callable bonds (put and call), which are evaluated in June of year t.

Table 4 reports the results of Fama-MacBeth cross-sectional regression tests. All the reported coefficients are the time-series average of the coefficients estimated from the cross sectional regressions.[11] In Column (1), we look at the asset growth effect on subsequent bond returns without control variables. The univariate regression results show the asset growth effect on future bond returns. The coefficient on AG is -0.031 with t-statistic of -2.50, suggesting that asset growth is important in the pricing of corporate bonds. The spread in average AG between deciles 10 and 1 is approximately 58.5%; multiplying this spread by the slope of 0.03 yields an estimated annual premium 180 basis point. The economic magnitude of the associated effect is similar to that shown in Table 3. In Column (2), we include both AG and yield spread in the regression. We find that the coefficient on AG is negative and significant at 5% level. In Column (3), we test whether the explanatory of AG can be subsumed by YS and firm and bond control variables. We find that the coefficient on YS is 0.010 and significant. The coefficient on AG is -0.009, smaller than that reported in Column (1), but it is significant at 5% level. Our findings are consistent with the first empirical prediction.

Next, we further examine the potential collateral channel of asset growth effect. We use tangible asset growth (TG) to measure changes in collateral assets and intangible asset growth (IG) to measure changes in non-collateral assets and perform Fama-Macbeth regressions.

$$R_{i,t+1} = \beta_0 + \beta_1 TG_{i,t} + \beta_2 IG_{i,t} + \beta_3 YS_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{15}$$

As reported in Column (4), the coefficient on TG is -0.086 with a t-statistic of -2.52 while the coefficient on IG is not significant. In the untabulated results, we include both AG and TG in the regression and find the explanatory power of AG can be largely subsumed by TG. Further in Column (5), we include yield spread in the regression and find that the coefficient on TG remains

[11] We use Fama-MacBeth regressions in the rest of the paper unless otherwise specified.

negative and significant. As yield spread is a proxy for bond risk level, we interpret this result as an additional piece of supporting evidence to the mispricing argument.

Next, in column (6), we repeat the above regressions with bond yield spread and control variables. We find the coefficient on YS is 0.010 and significant at 5% level. The coefficient of TG is -0.058 (t-statistic = -2.66) with a smaller economic magnitude but stronger significance. It suggests that a one standard deviation increase in asset growth rate, it leads to 58 bps increase in bond price. In Table A1, we further decompose total asset growth into 6 component: cash and short term investment growth (CG); noncash current asset growth(NCG); property, plant and equipment growth (PPENTG); intangible asset growth; investments growth (IVSTG) and other asset growth (AOG). Then we examine the effect of each component on future bond returns. We find growth of current assets and PPENT has a negative effect on future bond returns while growth of intangible assets and investments have significant effect on returns. The result shows that tangible asset growth, where tangible asset is a main component of collateral value, subsumes the explanatory power of asset growth on returns, suggesting the collateral channel is critical for the impact of asset growth on bond return. Also, the result shows that the asset growth effect is unlikely to be driven by intangible asset change.

In general, as tangible assets reduce credit risk, bonds with lower ratings have higher credit risk and thus are more sensitive to tangible asset growth than bonds with the higher rating. By examining asset growth effect on bond return within different bond ratings, we can explore whether the collateral channels of asset growth effect is priced differently with bond ratings. Bonds are grouped by rating into three portfolios: high investment (A- to AAA), low investment (BBB- to BBB+) and non-investment (BB+ or below). We follow the regressions specification (6) and perform cross-sectional regressions for three rating groups from Column (7) to (9). In Column (7), the coefficients on TG and IG are both insignificant. The results shows in high investment bonds, asset growth has no impact on bond returns. An explanation is the collateral change from asset growth has a trivial marginal impact on the default risk of investment-grade bonds.

In Column (8), the coefficient on TG is -0.037 with a t-statistic of -2.26 while the coefficient on IG is insignificant. The results show the explanatory power of collateral channel on asset growth effect on bond return in low investment-grade bonds. In Column (9), we focus on non-investment grade bonds, in which we expect the strongest asset growth effect. The coefficient on TG is -0.155

and significant at 1% level. The results show the most profound asset growth effect on bond returns is among non-investment grade bonds, which could be completely explained by the largest collateral channel effect in this group.

Overall, the results indicate that asset growth is priced in the corporate bond market. The asset growth effect is mainly for low investment grade and non-investment grade bonds resulting from collateral value change from asset growth.

4.2 Asset Growth Rates and Default Probability

Firm's asset growth may have mixed effects on the default risk. On the one hand, firms that have high asset growth should be less risky because of more collateralized assets (Almeida and Campello, 2007; Chen, 2001; Chordia et al., 2017; Fostele and Geanakoplo, 2014). On the other hand, if asset growth is largely financed with debts rather than retained earnings, financial leverage increases default risk (Altman, 1968; Traczynski, 2017). To explore the role of asset growth on default risk, we perform the following cross-sectional regression of asset growth on changes in a firm's expected default probability at the firm level.

$$\Delta EDF_{i,t} = \beta_0 + \beta_1 AG_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{16}$$

The results are reported in Table 5. The regression dependent variable is expected default frequency (EDF), estimated following Bharath and Shumway (2008), with details provided in Appendix B. In Column (1) to (4), we look at the effect of asset growth on changes in expected default frequency (ΔEDF_t) from year t-1 to t. The key variable in the regression is asset growth. $c_{i,t}$ includes yield spread (YS), market leverage (LEV), leverage change (ΔLEV) and the natural log of total assets ($Size$).

In Column (1), the coefficient on AG is -0.047, significant at 1% level, suggesting that a one standard deviation increase of asset growth is associated with a 1.1% decrease in expected default frequency. Consistent with our conjecture, high asset growth leads to a lower firm's default risk. It is also worth noting that the coefficient on changes in leverage (ΔLEV) is 0.612 with a t-statistic of 6.07. In contrast, firms with higher change in financial leverage are associated are more risky. Next, we examine the asset growth effect on firm's default risk across various rating categories from Column (2) to (4). The asset growth effect on EDF is relatively weaker for high investment grade bonds with the coefficient on EDF significant at 10% level and stronger for non-investment grade bonds.

To further explore the potential channel of asset growth effect on firm's default risk, we include tangible asset growth (TG) and intangible asset growth (IG) in the following regression.

$$\Delta EDF_{i,t} = \beta_0 + \beta_1 TG_{i,t} + \beta_2 IG_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{17}$$

As reported in Column (5), the coefficient on tangible asset growth is -0.111, with a t-statistic of -5.79, while the coefficient on intangible asset growth is insignificant. This is consistent with our hypothesis that asset growth lowers default risk because of the growth of tangible assets. Almeida and Campello (2007) estimate liquidation value using a firm's tangible assets. Instead, intangible asset growth that is not traditionally considered as eligible collateral have trivial impact on default risk. Similar as previous findings, changes in leverage are associated with a higher changes in EDF, suggesting that a higher financial leverage results in a higher default risk. In addition, coefficients on TG are negative and significant across all three rating categories while IG is only significant for non-investment grade bonds. Thus far, we have documented a direct link between asset growth and default risk.

4.3 Effect of Collateral Growth on Yield Spreads and Changes in Yield Spreads

In the last subsection, we show both asset growth and tangible asset growth significantly lower firm default probabilities, which potentially drive a negative link between bond yield spreads and asset growth as well collateral asset growth. In this section, we look at the collateral value effect on the yield spreads and the changes in yield spreads, respectively.

4.3.1 Sorted Portfolios

We first perform sorted portfolio analysis. In Panel A of Table 6, we report yield spreads across asset growth decile portfolios, where yield spreads are evaluated in the month of June in year t and reflect information of firm asset growth rates in year t-1. Equal-weighted (EW) and value-weighted (VW) portfolios, respectively, are reported in Column (1) to (4) and Column (5) to (8). The first and fifth columns report the average yield spreads of individual decile portfolios based on the full sample. The lowest asset growth decile D1 has EW (VW) average yield spread of 3.26% (2.49%)

while the highest asset growth decile D10 has EW (VW) average yield spread of 1.49% (1.29%). The EW (VW) yield spread difference between D10 and D1 is -1.77% (-1.20%) and significant at the 1 percent level.

Next, we study the pattern under three rating groups, respectively reported in Column (1) to (4) for EW and Column (5) to (8) for VW. In the high investment grade bond group (HI), the EW (VW) yield spread in D1 is 0.03% (0.05%) lower than that in D10 though none of the difference is statistically significant. In the low investment grade bond group (LI), the EW (VW) yield spread in D10 is 0.40% (0.39%) lower than that in D10 and both EW and VW differences are highly significant at 1% level. In the non-investment grade bond group (JK), the EW (VW) yield spread in D10 is 2.15% (2.19%) lower than that in D10 and both EW and VW differences are significant. The result shows that the yield spread is slightly higher in D10 in the investment grade than in D1, which is much lower in D10 than in D1 in low investment grade bonds and non-investment grade bonds.

We further look at whether there is any pattern in terms of the changes in yield spreads subsequent to the asset growth year. Panel B of Table 6 shows the yield spread change from July of year t to June of year t+1. For the full sample, EW and VW yield spread changes are 0.55% and 0.37% higher for D10 issuers relative to D1 issuers and the differences are both significant at the 1 percent level. Further, in the low investment grade bond group (LI), the changes in yield spreads for D10 are 19 (20) bps higher than that for D0 for EW (VW) portfolios, significant at 1% level. More strikingly, in the non-investment grade bond group (JK), the differences are increased to 88 bps and 83 bps for EW and VW portfolios, respectively. As shown in Section 2.1, an individual bond's expected return can be decomposed into yields spreads at year t and a second component related to the change in yield spreads from year t to year t+1, $\eta_{i,t}\Delta y_{t+1}$ where $\eta_{i,t}$ is approximately the bond's effective duration. Given the sample of average effective duration of 6 years, the difference of yield spread changes across extreme deciles suggests bonds of the top decile underperform the bottom decile bonds by 5% among non-investment grade bonds, which roughly reconcile the magnitude of bond annual performance difference reported in Table 3.

The fact of positive change of yield spreads in the highest asset decile and negative change of yield spreads in the lowest asset growth decile implies a correction of bond pricing at time t – the collateral value changes are overvalued in the highest asset growth portfolio. The reversal of pricing in time t+1 is the key driving factor of the negative relationship between asset growth and bond return. This finding provides a complementary evidence of Greenwood and Hanson (2013)'s mispricing theory on asset growth bond return.

4.3.2 Regression Analysis

First, we examine the effect of collateral value on yield spreads. High asset growth comes with high tangible asset growth and corresponding high collateral value growth, which lowers cost of capital and credit risk. Thus, we expect a negative relationship between tangible asset growth and yield spreads.

We perform the following regression to examine the effect of collateral growth on bond yield spreads:

$$YS_i = \beta_0 + \beta_1 TG_{i,t} + \beta_2 TG_{i,t} * Low_{i,t} + \beta_3 YS_{i,t} + \beta_4 YS_{i,t} * low_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{18}$$

where $Low_{i,t}$ represents bonds with a below A- rating.

The regressions results are presented in Table 7. In Column 1, we include TG and the size, leverage, ratings, duration, coupon, par, put and call. The coefficient on TG is -0.019 with a t-statistic of -8.24, suggesting that high tangible asset growth is negatively related to yield spreads. This is consistent with our conjecture that asset growth increases the tangible asset and collateral value, leading to a low yield spread. Consistent with existing literature, we also find that firm and issue size are negatively related to yield spreads while leverage and bond illiquidity are positively associated with the level of yield spread.

If the impact of tangible asset on bond pricing is through the collateral channel, we expect tangible asset plays a more important role among low-rated bonds where the default risk is larger than high-rated bonds. To test this hypothesis, we add the interaction term between TG and a dummy variable for low investment grade bonds $LowRating$. We classify all bonds in our sample into two groups: high-rated bonds (rated A- or higher) and low-rated bonds (BBB+ or lower). In Column 2, the coefficient on the interaction term is -0.027 with a t-statistic of -8.51, almost 50% higher than the coefficient on TG for all the bonds in Column 1. This suggests that the tangible asset effect is largely driven by low investment grade bonds, supporting the collateral channel story.

We subsequently perform the regression to examine the effect of collateral growth on changes in yield spreads:

$$\Delta YS_i = \beta_0 + \beta_1 TG_{i,t} + \beta_2 TG_{i,t} * Low_{i,t} + \beta_3 YS_{i,t} + \beta_4 YS_{i,t} * Low_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{19}$$

Regression results are reported in Table 7. In Column 3, we include TG and the size, leverage, ratings, duration, coupon, par, put and call. The coefficient on TG is 0.011 with a t-statistic of 4.17, confirming a positive relationship between tangible asset growth and changes in yield spreads.

In Figure 1, we look at how asset growth (Panel A) and collateral growth (panel B) evolve over time. Specifically, the figures, respectively, plot the difference in asset growth rates across the top and bottom asset growth decile issuers in portfolio formation year t and portfolio evaluation year t+1. Both variables are apparently not persistent‘over time – average differences in AG and TG in extreme AG deciles is fairly close to 0 in year t+1 – the same pattern holds for high-investment grade bonds, low-investment grade bonds and non-investment grade bonds while the decline in asset growth rates is high for low- and non-investment grade bonds. This results in two implications. First, if the over-extrapolation bias truly exists, the non-persistent asset growth will cause mispricing. Second, bond yields of high asset growth firms in the subsequent year might rise after pick up the new asset growth information.

The second consideration in the above paragraph motivates us to include the asset growth in year t+1 . In other words, we examine the overvaluation effect by controlling asset growth persistence by including the realized asset growth rate in the year of t+1. The result is shown in Column 5. Consistent with our expectation, we have the coefficient on TG_{t+1} to be -0.015, which is significant at the 1 percent level. Nevertheless, the coefficient on TG_t is 0.007 (t-stat = 2.56), which confirms that tangible asset growth has a positive relation with the following yield change, a relationship not assumed by the impact from the realized tangible asset growth from t to t+1.

Subsequently in Column (5), we additionally interact TG_t and TG_{t+1} with Low. The coefficient on $TG_t * Low$ is 0.020 with a t-statistic of 4.33, far higher than the coefficient on TG for all bonds reported in Column 4. Once again, the coefficient on TG_{t+1} is negative and significant and we observe the same for the coefficient on $TG_{t+1} * Low$. These results display the strongest positive relationship between tangible asset growth and the following change of yield spreads.

In Column (6), we further add the YS (yield spreads) and the interaction term between YS

and dummy variable for low investment grade bonds Low. YS is no significant and the interaction term is -0.006 and significant at 10%. Finally, as shown in Column (7), the coefficient on interaction term between TG and Low increases to 0.063 and significant at 5% level. The results show the explanatory power of TG for low rated investment grade bonds is not assumed by YS.

4.4 Bond Performance Decomposition: Time Series Analysis

We have shown a negative relation between tangible asset growth and future corporate bond returns. Particularly, tangible asset growth affects bond returns through two channels: yield spreads and changes in yield spreads. But which one is the primary driver of the negative asset growth effect on bond return? To answer this question, we first examine the explanatory power of yield spreads and yield spreads change on bond returns. Then we construct and apply tangible asset growth factors to explain the explanatory power of tangible asset growth on yield spreads and yield spreads change.

Following the bond return decomposition in eq. (9), we perform the following regressions:

$$\begin{aligned} R_{i,t+1} &= \alpha_1 + \beta_1 b_{i,t} + \epsilon_{i,t+1} \\ R_{i,t+1} &= \alpha_2 + \beta_2 \Delta b_{i,t+1} + \epsilon_{i,t+1} \\ R_{i,t+1} &= \alpha_3 + \beta_3 s_{i,t} + \epsilon_{i,t+1} \\ R_{i,t+1} &= \alpha_4 + \beta_4 \Delta s_{i,t+1} + \epsilon_{i,t+1} \end{aligned} \tag{20}$$

The dependent variable, $R_{i,t+1}$, is excess return on bond i in month t. $b_{i,t}$ is the bond i's maturity-matching treasury bond yield in month t; $\Delta b_{i,t+1}$ is the changes in treasury bond yield from month t to t+1; $s_{i,t}$ is the yield spread of bond i in month t and $\Delta s_{i,t+1}$ is the changes in yield spreads from month t to t+1. For each month, we form bivariate portfolios by independently sorting bonds into five quintiles based on their asset growth rate and three rating groups based on their bond ratings (high investment grade, low investment grade and non-investment grade). Then we run time-series regression of bond return in each of the fifteen groups.

Panel A of Table 8 shows univariate time-series regression results of bond excess returns on bonds' matching treasury bond yields. The coefficients on treasury bond yields ($b_{i,t}$) are insignificant for investment-grade bonds (HI and LI), with an average R^2 of 0.01% for HI and 0.01% for LI. For non-investment grade bonds, only asset growth group 3 and 4 have negative and significant coefficients on $b_{i,t}$, but the average R^2 in five groups is only 1.4%. The results suggest that treasury bond yields have a low explanatory power on bond returns.

Panel B reports regression results of bond returns on changes in treasury bond yields. The coefficients on changes in treasury bond yield ($b_{i,t+1}$) are negative and significant at 1% level for investment-grade bonds. The average R^2s are 41.3% and 15.3% for high- and low-rated investment grade bonds, suggesting that a large part of the variation of investment-grade bond returns can be explained by changes in treasury bond yield which captures changes in macroeconomic conditions. In contrast, for non-investment bonds, $b_{i,t+1}$ is not significant in all groups and the variation of the changes in treasury bond yields can explain less than 1% variation of bond returns, a trivial impact of changes in treasury bond yields on non-investment bond return.

The regression results of bond returns on yield spreads ($s_{i,t}$) are reported in Panel C. The average R^2s are 5.1%, 7.1% and 10.4% for the high-investment grade group (HI), the low-investment grade group (LI) and the non-investment group (JK). The range of R^2s are [2.7%, 7.3%] in HI, [4.4%, 9.1%] in LI and [5.5%, 17.8%] in LI. The average R^2 of yield spreads is higher than that of treasury bond yields in Panel A, indicating that yield spreads have a stronger explanatory power on bond returns than treasury bond yields.

Panel D shows regression results of bond returns on changes in yield spreads. The coefficients of change in yield spreads ($\Delta s_{i,t+1}$) in all groups are negative and statistically significant. In addition, the range of R^2s are [10.2%, 22%] in high-investment grade groups, [35.1%, 57.1%] in low-investment grade groups and [62.6%, 85.1%] in non-investment groups. The results reveal that the changes in yield spreads on bond returns can explain a much larger part of the variation of bond returns than that by treasury bond yields, changes in treasury bond yields or yield spreads. Moreover, we find that changes in yield spreads has a stronger explanatory power on non-investment grade bonds with an average R^2 of 83.5% than high investment-grade bonds (average R^2 of 18%), suggesting that changes of idiosyncratic risk of individual bond matter more for bonds with lower ratings.

Concerning that the sample period from 2002 to 2018 could be too short for a time-series analysis, we augment the sample by including the period from 1994 to 2001 using the Mergent

NAIC corporate bond returns of insurance companies. The results are reported in Appendix C. The patterns in terms of the explanatory powers of the four elements resemble what we have reported in Table 8.

Taken together, these results show that changes in yield spreads and changes in treasury yield spreads capture most return variation in corporate bonds. Specifically, changes in yield spreads have the strongest explanatory power for non-investment grade bonds while changes in treasury yield spreads have played a more important role on bonds with higher ratings.

4.5 Explanatory Power of Collateral Growth on Yield Spread Changes

So far, we demonstrate that, cross-sectionally, collateral growth is a significant determinant of both bond yield spreads and yield spread changes (see sections 8 and 4.6) and that both treasury yield changes and yield spread changes are the primary drivers of bond performance (as noted in section 4.3.2). Both treasury yields and treasury yield changes are primarily influenced by macro economic factors and thus they are unlikely affected by collateral growth of individuals firms. As a result, we focus on the question how much yield spread changes can be explained by a firm's collateral growth. To address this question, following prior studies such as Fama and French (1993) and (Bai et al., 2019) that develop factor portfolios capturing the covariance between security performance and underlying economic factors, we extract factors potentially driving bond yield spread changes. Within each rating group, we breakdown bonds into ten equal-numbered groups based on collateralized asset growth in year t-1. We calculate the value-weighted average monthly yield spreads changes of each portfolio July of year t to June of year t+1, denoted as Δ YS$_{jt}$, where j = 1 to 10. Then we estimate collateral growth factors using the average yield spread changes (Π) of the top (j=10) and bottom (j=1) deciles:

$$\Pi_t = \Delta YS_{10,t} - \Delta YS_{1,t} \tag{21}$$

Under the hypothesis that mispricing drives bond yields, we expect individual bonds' yield spread changes to comove with the spread of the arbitrage portfolio. Moreover, mispricing is expected to be stronger among poorly rated bonds. For this reason, we anticipate the factor has a stronger influence on yield spread changes among poorly rated bonds.

In order to test these expectations, within each bond rating category, high-investment grade, low-investment grade, and junk bonds, we sort insurers into quintiles based on bond issuers' asset growth rates, then test how the above two factors determine yield spreads and changes in yield spreads using the following regressions:

$$\Delta YS_{i,t} = \alpha_i + \beta_i \Pi_t + \epsilon_{i,t} \tag{22}$$

Note that the dependent variables are yield spreads (YS) of individual bond portfolio i in month t and changes in yield spreads (ΔYS) of bond portfolio i from month t to month t+1.

Table 9 reports the result when regressing yield spread changes onto the tangible-asset-growth-based yield spreads change factor ($F^{\Delta YS}$). The coefficients of the yield spread factor are not significant in HI and HI bonds groups except one group. In contrast, the coefficients are significant in JK bond groups. The average R^2s for HI and LI are 3.3% and 10.5% while 20.6% for JK. This means, for non-investment grade bonds, tangible asset growth can explain about one fifth of variations of yield spreads change component of bond returns, corroborating the strongest mispricing effect collateral growth in explaining non-investment grade bond returns.

Note that, in order to address the concern that the sample period from 2002 to 2019 could be too short for a time-series analysis, we augment the sample by including the period from 1994 to 2001 using the Mergent NAIC corporate bond returns of insurance companies. The results are reported in the internet Appendix A2. The patterns in terms of the explanatory power of collateral growth on yield spread changes is consistent with that in Table 9.

Altogether, we find collateral growth is the main driver of bonds returns through the change in yield spreads channels for poorly rated corporate bonds, rendering supports to the mispricing explanation of the asset growth anomaly.

4.6 Role of Investor Sentiment

A large literature shows investor sentiment plays an active role in driving security prices. For example, Baker and Wurgler (2006) shows when sentiment is high, stocks that are attractive earn relatively low subsequent returns due to overoptimistic and hard-to-arbitrageurs. Mispricing is expected to be stronger in high sentiment periods. Greenwood and Hanson (2013) point out that in the high sentiment periods, featured by heightened investor risk appetites or overoptimism, poor quality firms are more likely to issue bonds which experience low returns when the firms' credit quality becomes worse later.

We specifically apply issuer quality (IQ) used in Greenwood and Hanson (2013) to proxy for market sentiment. IQ evaluates the equal-weighted average expected default frequency (EDF) of firms with high amount of debt issues relative to the equal-weighted average EDF of firms with low amount of debt issues. Investor sentiment is considered to high when high debt issuers have a low issuer quality, i.e., a high expected default frequency.

$$IQ_t = \frac{\sum_{i \in High\, d_{it}} \text{EDF Score}_{it}}{N_t^{High\, d_{it}}} - \frac{\sum_{i \in Low\, d_{it}} \text{EDF Score}_{it}}{N_t^{Low\, d_{it}}} \tag{23}$$

where EDF Score is the decile rank (from 1 to 10) of a bond issuer's EDF; $d_{it} = \Delta D_{it}/A_{it}$ denotes debt issuance; $N^{High\, d_{it}}$ and $N^{Low\, d_{it}}$ respectively denote the numbers of high and low debt issuance firms (top and bottom quintiles based on d using NYSE cutoffs). Construction details of the measure can be found in Appendix B.[12] Precisely, a high score of IQ in a particular year corresponds to the average issuer quality in that year is low. More issuance of low-quality bonds corresponds to booming periods in the corporate bond market.

The construction of IQ solely involves the Compustat data, to compare our IQ measure with the original measure reported in Greenwood and Hanson (2013), in Figure 2, we plot IQ, the red dash line, back to 1990. Based on the figure, the bond market sentiment is high in 1995 - 98 and 2004 - 07 (right before the dot com bubble burst and the financial crisis), and 2013-14 (short-term bond market booming attributable to U.S. economic stimulus policies). The pattern is consistent with the finding documented in Greenwood and Hanson (2013) showing the bond market sentiment from 1962 to 2008.[13]

Depicted as the blue solid line, Figure 2 simultaneously plots a second issuer quality, CGQ by comparing average EDF scores of high and low collateral growth bond issuers:

[12]Greenwood and Hanson (2013) also introduce a second sentiment measure â the high-yield share, the proportion of high yield bonds among all bond issuance. We obtain consistent results when applying the alternative sentiment measure.

[13]Greenwood and Hanson (2013) note that the measure "tends to be low in recessions and high in expansions. However, this relation is not exact, and the lead-lag relationship between the business cycle" and it varies over time. For instance, IQ falls during many recessions but rises during the 1982 recession as the 1980s high-yield boom was getting underway.

$$CGQ_t = \frac{\sum_{i \in High\,TG_{it}} \text{EDF Score}_{it}}{N_t^{High\,TG_{it}}} - \frac{\sum_{i \in Low\,TG_{it}} \text{EDF Score}_{it}}{N_t^{Low\,TG_{it}}} \quad (24)$$

CGQ is constructed in the same way as IQ except that we use collateral growth, proxied by tangible asset growth rates, to split bond issuers. When the mispricing argument holds, high collateral growth issuers on average have lower issuer quality in high sentiment periods than in low sentiment period. We thus expect CGQ to be highly correlated with IQ under the mispricing argument. This prediction is confirmed by Figure 2, where we find the two data series move closely with each other. The correlation between CGQ and IQ is 0.73. The strong association between bond issuers' asset growth quality and bond market sentiments is parallel to empirical finding reported in Section 4.5 showing a high explanatory power of the collateral growth factor on bond yield spreads.

Next, we examine whether the anomaly effect intensifies in high sentiment periods. We perform the following regression:

$$Ret_i = \beta_0 + \beta_1 TG_{i,t} + \beta_2 TG_{i,t} * Sent_{i,t} + \beta_3 YS_{i,t} + \beta_4 YS_{i,t} * low_{i,t} + \gamma' c_{i,t} + \epsilon_{i,t} \quad (25)$$

where $Sent$ is an indicator representing a high sentiment years equal to 1 when IQ is above the sample median and 0 otherwise. The interaction between TG and HS is to capture the influence of high sentiment on the effect of collateral growth.[14]

Sentiment analysis on the effect of tangible asset growth on bond returns are reported in Table 10. Column (1) reports the result for the full sample. The main explanatory variable is the interaction term between TG and dummy variable for high sentiment period (HS). The control variables include TG, HS, yield spreads (YS), firm size, leverage (LEV), change in leverage (ΔLEV), rating, duration, coupon, par, put and call. The coefficient on $TG * HS$ is -0.017 with a t-statistic of -2.63. We find the inverse relation between the tangible asset growth and bond return is more pronounced in the high sentiment period than in the low sentiment period. Specially, a one standard deviation increase in tangible asset growth reduces bond return by 17 bps more in high sentiment period than in low sentiment period.

[14] We obtain consistent results under two variations. First, we use IQ itself instead of the sentiment dummy. Second, we alternatively use CGQ as a sentiment measure.

We then divide the full sample into three subgroups: i) high investment-grade bonds (A- and above), ii) low investment-grade bonds (BBB- to BBB+) and iii) non-investment-grade bonds (below BBB-). We run the regressions in three subgroups respectively. The coefficient on $TG * HS$ is 0.01 (t-stat = 0.65), -0.011 (t-stat = -1.92) and -0.025 (t-stat = -2.19) in the high, low and non-investment grade group respectively. (YS) is only significant for low- and non-investment grade bonds. The results show the impact of tangible asset on lowering bond return is magnified most for the non-investment grade bonds in the high sentiment period among all bonds.

Sentiment analysis on the effect of tangible asset growth on yield spreads and change of yield spreads is reported in Table 11. Columns (1) to (4) are the result of the analysis on the yield spreads. The dependant variable is bond return. The main explanatory variable is the interaction term between TG and dummy variable for high-sentiment period (HS). The control variables include TG,the size, leverage, ratings, duration, coupon, par, put and call. In the full sample, the coefficient on $TG * HS$ is -0.002 with a t-statistic of 1.88. Then we run the regression in the three rating subgroups respectively. The coefficient on $TG * HS$ is -0.000 (t-stat = -0.66), -0.001 (t-stat = -2.03) and -0.002 (t-stat = -2.65) in the high, low and non-investment grade group respectively. The result shows the inverse relationship between tangible asset growth and yield spreads is most pronounced for non-investment grade bonds in the high sentiment period than in the low sentiment period among all bonds. Further, Columns (5) - (8) are the result of the analysis on the change of yield spreads. Besides the same set of control variables in the regression of yield spreads, we add yield spreads variable. In the full sample, the coefficient on $TG * HS$ is 0.005 with a t-statistic of 3.07. Then we run the regression in the three rating subgroups respectively. The coefficient on $TG * HS$ is 0.002 (t-stat = 1.36), 0.008 (t-stat = 1.85) and 0.010 (t-stat = 2.45) in the high, low and non-investment grade group respectively. The result shows the inverse relationship between tangible asset growth and change of yield spreads is most pronounced for non-investment grade bonds in the high sentiment period than in the low sentiment period among all bonds.

In summary, on the one hand, a higher collateral value results in lower yield spread at time t in the high sentiment period than in the low sentiment period. On the other hand, a higher collateral value results in lower yield spread at time t in the high sentiment period than in the low sentiment period, a contribution to the more pronounced inverse relation between the asset growth and bond return in the high sentiment period. This pattern is strongest for the non-investment grade bonds among all bonds. This evidence supports the notion that the pricing on collateral value for low-rated bonds at time t is overvalued, with the price reversal magnitude subject to the sentiment level.

4.7 Collateral Growth Effect after Bond Risk Adjustments

In this section, we examine whether the asset growth effect on corporate bond returns can be explained by systematic variation or traditional risk premiums in the corporate bond market. We investigate this issues using bond-level cross-sectional regressions. Specifically, for each bond and each month in our sample, we estimate the factor loadings from the 36-month fixed window rolling regressions of excess bond returns on the five-factor mode (Fama and French, 1993; Elton et al., 1995; Bessembinder et al., 2009; Jostova et al., 2013; Lin et al., 2011) with the bond market factor (MKT), the default factors (DEF), the term factor (TERM), the bond momentum factor (MOM), and the bond liquidity factor (LIQ).

$$R_{i,t+1} = \alpha_0 + \alpha_1 TG_{i,t} + \theta' \beta_{it} + \gamma' c_{i,t} + \epsilon_{i,t} \tag{26}$$

where $Factor_t$ is one of the four value-weighted bond market factors, DEF, TERM, MOM and LIQ, and $\beta_{i,t}^{Factor}$ is one of the four factor betas: $\beta_{i,t}^{DEF}$, $\beta_{i,t}^{TERM}$, $\beta_{i,t}^{MOM}$, and $\beta_{i,t}^{LIQ}$ of bond i in month t.

We examine the asset growth effect on expected returns controlling bond risk factors at the bond level using Fama and MacBeth (1973) regressions. The results are reported in Table 12. Regression (1) and (2) are for the full sample. Regression (1) presents negative and statistically significant relations between tangible asset growth and the cross-sectional future bond return controlling for five bond factor betas. Regression (2) adds the other bond characteristics (rating, illiquidity, duration an d size) as the controlling variables. In regression (1), the coefficient on TG is -0.0039 (t-statistic =-1.84), suggesting that a one standard deviation increase in TG leads to 0.39% decrease in monthly bond return (i.e. 4.68% annual bond return). In regression (2), the coefficient on TG is -0.0025 (t-statistic =-1.83). The results indicate that the collateral growth effect cannot be captured by common bond risk factors. Another notable point is that common risk factors have strong explain power on future bond returns as the adj. R^2 equals 22% in regression (1). However, their predictability of future returns become much weaker in our sample, which only consider bonds issued by listed firms.

Regressions (3)-(5) repeat the regression (2) in three subrating groups. The cross-sectional relation between TG and future bond returns are negative and significant for the low and non-investment grade bonds while insignificant for high investment grade bonds. Specifically, the coefficient on tangible asset growth is -0.0034 and significant at 10% level for low investment grade bonds and -0.0059 and significant at 10% level for non-investment grade bonds. A one-standard deviation increase of TG is associated with a 6.4% decrease of monthly bond returns.

The results show that the effect of tangible asset growth on future bond return can not be subsumed by five common bond factors and other bond characteristics.

5 Conclusions

High asset growth rates lead to a rise in firm collateralized assets which lower default risk and lead to a lower expected performance for bonds issued by such firms. On the other hand, if the anticipated collateralized asset growth may be overestimated, especially for low-quality issuers, then bonds issued by high asset-growth firms may experience a lower realized performance. In this study, we separate these two explanations by decomposing bond performance into yield and yield change components. It follows the idea that when bond yields are an unbiased estimator of bond expected performance, then on average yield changes are expected to be zero.

We find that over 80 percent of bond performance variations of non-investment grade performance come from yield spread changes while bond yield spreads can explain roughly 10 percent of performance variations. We also find that collateral growth play a significant role in both elements. Further along, we report that collateral growth is significant determinant of yield spread changes and the effect intensifies in years of high bond market sentiment. More interestingly, our empirical finding shows that, over time, bond issuers' credit quality is highly negatively correlated with bond market sentiment. We conclude that our findings reinforce the overreaction explanation where investors over-extrapolate corporate growth in collateralized assets when firm assets grow rapidly.

Appendix A: Bond Return Decomposition

Performance of a coupon bond is expressed as $R_{t+1} = \frac{C+P_{t+1}-P_t}{P_t}$, where

$$
\begin{aligned}
P_{t+1} &= \sum_{\tau=1}^{n-1} \frac{C}{(1+y_{t+1})^{\tau}} + \frac{M}{(1+y_{t+1})^{n-1}} \\
P_t &= \sum_{\tau=1}^{n} \frac{C}{(1+y_t)^{\tau}} + \frac{M}{(1+y_t)^{n}}
\end{aligned}
$$

Bond yield in the beginning of year $t+1$ can be expressed as follows:

$$
y_{t+1} = y_t + \Delta y_{t+1} \tag{A1}
$$

Applying the first-order Taylor Expansion on P_{t+1}, we have:

$$
\begin{aligned}
P_{t+1} &= P(y_{t+1}) = P(y_t) + P'(y_t)\Delta y_{t+1} \\
&= \sum_{\tau=1}^{n-1} \frac{C}{(1+y_t)^{\tau}} + \frac{M}{(1+y_t)^{n-1}} - [\sum_{\tau=1}^{n-1} \frac{C\tau}{(1+y_t)^{\tau+1}} + \frac{M(n-1)}{(1+y_t)^{n}}]\Delta y_{t+1} \\
&= \sum_{\tau=2}^{n} \frac{C}{(1+y_t)^{\tau-1}} + \frac{M}{(1+y_t)^{n-1}} - [\sum_{\tau-2}^{n} \frac{C\tau}{(1+y_t)^{\tau}} + \frac{M(n-1)}{(1+y_t)^{n}}]\Delta y_{t+1}
\end{aligned} \tag{A2}
$$

It can be shown,

$$
C + P_{t+1} = (1+y_t)P_t - [\sum_{\tau=2}^{n} \frac{C(\tau-1)}{(1+y_t)^{\tau-1}} + \frac{M(n-1)}{(1+y_t)^{n-1}}]\Delta y_{t+1}/(1+y_t) \tag{A3}
$$

$$
\begin{aligned}
R_{t+1} &= \frac{C + P_{t+1} - P_t}{P_t} \\
&= \frac{(1+y_t)P_t - [\sum_{\tau=2}^{n} \frac{C(\tau-1)}{(1+y_t)^{\tau-1}} + \frac{M(n-1)}{(1+y_t)^{n-1}}]\Delta y_{t+1}/(1+y_t) - P_t}{P_t} \\
&= y_t - \frac{\sum_{\tau=1}^{n-1} \frac{C\tau}{(1+y_t)^{\tau}} + \frac{M(n-1)}{(1+y_t)^{n-1}}}{P_t} \frac{\Delta y_{t+1}}{1+y_t}
\end{aligned} \tag{A4}
$$

We can express bond price at t as below:

$$
\begin{aligned}
P_t &= \sum_{\tau=1}^{n} \frac{C}{(1+y_t)^{\tau}} + \frac{M}{(1+y_t)^{n}} \\
&= \frac{C + P_{t+1}^{y_t}}{1+y_t}
\end{aligned} \tag{A5}
$$

where $P_{t+1,t}$ is the forward price of the bond – bond price at t+1 given y_t.

Inserting P_t into R_{t+1}, we have:

$$R_{t+1} = y_t - \frac{P_{t+1}^{y_t}}{C + P_{t+1}^{y_t}} D_{t+1}^{y_t} \Delta y_{t+1} \tag{A6}$$

where $P_{t+1}^{y_t}$ is the bond's forward price – the price in the subsequent period given the bond's yield stays constant as y_t; $D_{t+1}^{y_t}$ is the duration at t+1 when the yield stays constant at y_t.

Using $c_{t+1}^{y_t}$, the bond's current yield at $t+1$ given its yield to maturity at t, we express bond performance R_{t+1} as

$$R_{t+1} = y_t - \frac{D_{t+1}^{y_t}}{1 + c_{t+1}^{y_t}} \Delta y_{t+1} \tag{A7}$$

There are two practical issues to be addressed. First, U.S. corporate bonds typically make semiannual coupon payments. Given that asset growth rates are measured annually, two coupon payments are involved to calculate annual bond performance. It can be easily shown that under the assumption that coupon payments are reinvested at the current yield to maturity, y_t, Eq. (A7) still holds. Second, when a bond is transacted between two coupon payments, we evaluate bond performance using dirty prices, see Eq. (10). The return decomposition also holds.

Appendix B: Key Variables

The variables used in the paper are listed below (with Compustat data items in parentheses).

- *Bond Excess Return* is defined as the monthly return of an individual bond in excess of the one-month T-bill rate.
- *Yield* is an individual bond's annual yield to maturity.
- *Yield Spread* is measured as the difference between a bond's annual yield to maturity and the corresponding annual yield to maturity of the treasury bond with the same maturity.
- *Rating* is the bond's numerical credit rating based on the following letter rating conversion scheme: AAA=22, AA+=21, ..., C=2 and D=1.
- *Duration* is an individual bond's Macaulay duration in years.
- *Coupon* is the bond's annual interest rate in percentages.
- *Par* is the principal amount outstanding of a given bond in million dollars.
- *ILLIQ* is the Amihud illiquidity measure (Amihud, 2002). The monthly Amihud measure for any bond i in month j is:

$$\text{Amihud}_{i,j} = \frac{1}{N}\sum_{t=1}^{N}\frac{R_t}{Q_t} \tag{B1}$$

  where N is the number of positive-volume trading days in a given month. R_t and Q_t are the return and dollar trading volume, per million dollars when there is at least a trade in day t.

- *Asset Growth* (*AG*) is the 1-year percentage change in total firm assets from Cooper et al. (2008), where assets are Compustat data item 6.
- *Tangible Asset Growth* (*TG*) is the year-over-year percentage change in tangible assets scaled by total assets (Almeida and Campello, 2007), where tangible assets = Cash (data1) + 0.715 * Receivables (data2) + 0.547 * Inventory (data3) +0.535 Net * Fixed Assets (data8).
- *Intangible Asset Growth* (*IG*) the year-over-year percentage change in intangible assets (data33) other than goodwill (data204) scaled by total assets (Barth and Kasznik, 1999).

- *Size* is the firm's total (book value of) assets in billion dollars, Compustat data item 6.
- *Leverage* (LEV) is the sum of long-term debt (data9) and short-term debt (data34) over the sum of total debt and the fiscal-year end share price times the number of shares outstanding (data199*data25).
- *OIA* is the operating income before depreciation (data13) scaled by total assets (data6).
- *EDF* is the expected default frequency developed by Moody's Analytics estimating Merton (1974)'s default probability. Its estimation involves two steps. In the first step, we estimate the distance to default (DD) measure for each individual bond issuer:

$$DD = \frac{ln(V/D) + (\mu - 0.5\sigma_v^2)T}{\sigma_v\sqrt{T}} \tag{B2}$$

  where V is the firm's market value; D is the sum of a firm's current assets (Compustat data item 34) and half of long-term liabilities (Compustat data item 9) (Bharath and Shumway, 2008); T is the forecasting horizon of 1 year. Besides, μ (the firm's asset return) and σ_v (the firm's asset volatility) are estimated following Bharath and Shumway (2008). Then in the second step, we estimate the default probability as (1 - Norm(DD)) where $Norm$ represents a normal cumulative density function.

- *IQ*, issuer quality, is measured as the default risk of high-debt issuers with that of low-debt issuers, following Greenwood and Hanson (2013). We compare the credit quality of firms that issue large amounts of debt to that of firms that issue little debt or that are retiring debt.

$$IQ_t = \frac{\sum_{i \in High\, d_{it}} \text{EDF Score}_{it}}{N_t^{High\, d_{it}}} - \frac{\sum_{i \in Low\, d_{it}} \text{EDF Score}_{it}}{N_t^{Low\, d_{it}}} \tag{B3}$$

  where EDF Score is the decile rank score of a bond issuer's expected default frequency; $d_{it} = \Delta D_{it}/A_{it}$ denotes debt issuance; $N^{High\, d_{it}}$ and $N^{Low\, d_{it}}$ respectively denote the numbers of high and low debt issuance firms. Debt issuance is calculated as the change in assets minus the change in book equity from Compustat, scaled by lagged assets. A bond issuer's expected default frequency is the Merton (1974) expected default frequency, computed following Bharath and Shumway (2008). IQ compares the average EDF Score of high net debt issuers (net debt issuance in the top sample quintile) with that of low net debt issuers (net debt issuance in the bottom sample quintile). IQ reflects a broader measure of investors' sentiment in both loan and bond markets and is a barometer of credit market overheating, taking higher values when there are more debt issuers with poor credit quality (Greenwood and Hanson, 2013).

Appendix C: Bond Risk Factors

We largely follow Bai et al. (2019) to include a set of common systematic risk factors including common five factors, including the bond market return factor, the default premium factor, the term premium factor, the liquidity factor, and the momentum factor.

- *Bond market return factor, MKT* is the monthly return of an individual bond in excess of the one-month T-bill rate (e.g., Fama and French, 1993; Elton, Gruber, and Blake, 1995).
- *Default factor, DEF* is the difference between the monthly returns of long-term investment-grade corporate bonds and long-term government bonds. The long-term investment-grade bond returns are based on a value-weighted market portfolio that includes all investment-grade bonds (Aaa to Baa3) in the sample with at least ten years to maturity. The weight is determined by the market value of a bond, which equals the number of units outstanding multiplied by the market price of the bond (e.g., Fama and French, 1993; Elton, Gruber, and Blake, 1995).
- *Term factor, TERM* is defined as the difference between the monthly returns of long-term government bond and the one-month Treasury bill. We proxy the term factor using the difference between 10-year treasury bond yield and the one-month Treasury bill (e.g., Fama and French, 1993; Elton, Gruber, and Blake, 1995).
- *Bond momentum factor, MOM* is constructed from decile portfolios of bond momentum defined as the cumulative returns over months from t-6 to t-1 (formation period) (e.g., Jostova, Nikolova, Philipov, and Stahel, 2013).
- *Liquidity risk factor, LIQ* is the average return difference between the high liquidity beta portfolio and the low liquidity beta portfolio. Specifically, we follow Lin, Wang and Wu (2011) and estimate the liquidity beta over a five-year rolling window for each individual bond. We then sort individual bonds into ten decile portfolios each month by the preranking liquidity betas.

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Table 1: Summary Statistics

The table reports summary statistics of bond issue and issuer characteristics from July 2002 to June 2020. Bond characteristics variables include return (the monthly return of an individual bond in excess of the one-month T-bill rate), yield (the annual yield to maturity), rating (the bond's numerical credit rating based on the following letter rating conversion scheme: AAA=22, AA+=21, ..., C=2 and D=1), duration (Macaulay duration in years), coupon (the bond's annual interest rate in %), par (the face value of bond's issue size in millions of $), Amihud (the Amihud illiquidity measure in % per million dollars), and dummy variables for the puttable and callable bonds. Firm characteristics variables include asset growth (AG, the year-over-year percentage change in total assets from Cooper et al. (2008)), tangible asset growth (TG, the year-over-year percentage change in tangible assets scaled by total assets from Almeida and Campello (2007)), intangible asset growth (IG, the year-over-year percentage change in intangible assets), size (the firm's total assets in billions of $), market leverage LEV (the sum of long-term debt and short-term debt over the sum of total debt and the fiscal-year end share price times the number of shares outstanding), changes in market leverage (ΔLEV) and OIA (the operating income over total assets). Details on the construction of these variables are provided in the Appendix B. The distributional attributes include the 5th, 25th, 75th and 95th percentiles, as well as the mean, median and standard deviation (STD) of each variable.

Variables	N	P5	P25	Mean	Median	P75	P95	STD
Bond Characteristics								
Return	22,784	-0.0545	0.0006	0.0450	0.0308	0.0794	0.1770	0.0912
Yield	22,784	0.0124	0.0259	0.0410	0.0382	0.0515	0.0761	0.0273
Rating	22,784	11	14	15.69	16	17	21	3.01
Duration	22,784	1.39	3.08	6.64	5.46	9.02	15.75	4.48
Coupon (%)	22,784	1.95	3.60	5.04	5.13	6.50	8	1.89
Par	22,784	149.39	298.14	618.80	495.69	748.10	1602.81	564.59
Amihud (%)	22,784	0.01	0.06	0.27	0.14	0.32	0.95	0.44
Put	22,784	0	0	0.01	0	0	0	0.09
Call	22,784	0	1	0.76	1	1	1	0.43
Firms Characteristics								
AG	3,938	-0.1327	-0.0190	0.0686	0.0372	0.1000	0.3328	0.2325
TG	3,938	-0.0815	-0.0113	0.0270	0.0188	0.0538	0.1597	0.1092
IG	3,938	-0.0404	-0.0043	0.0225	0.0000	0.0129	0.1487	0.1102
Size	3,938	1.91	4.90	28.36	10.66	25.59	98.60	66.96
LEV	3,932	0.0499	0.1349	0.2778	0.2279	0.3949	0.6494	0.1876
ΔLEV	3,925	-0.1095	-0.0340	0.0044	-0.0018	0.0359	0.1451	0.0808
OIA	3,930	0.0553	0.0942	0.1427	0.1339	0.1789	0.2775	0.0910

Table 2: Main Attributes of Bond Issuers and Issues by Asset Growth Deciles

At the end of June of each year from 2002 to 2019, the bonds are allocated into deciles based on their issuers' annual asset growth rates. D1 (D10) represents the issuers' decile with the lowest (highest) asset growth rate. The table reports bond issue and issuer characteristics prior to the portfolio formation date. AG is the annual asset growth rate, defined as the year-over-year percentage change in total assets from Cooper et al. (2008). TG is the annual growth rate of tangible assets from Almeida and Campello (2007). IG is the annual growth rate of intangible assets. $Size$ is the total assets in billions of $ at the fiscal year end in calendar year t-1. ΔLEV is the changes in leverage. The fraction of high investment bonds (HI) containing the bonds with ratings of A- or higher, the fraction of low investment grade bonds (LI) receiving ratings from BBB- to BBB+, and the fraction of junk bonds (JK) rated below BBB- are reported. Details on the construction of these variables are provided in the Appendix B. All numbers, except for t-statistics, are expressed in percentage. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

Decile	AG	TG	IG	ΔLEV	$\%HI$	$\%LI$	$\%JK$
1	-14.53	-6.70	-2.68	-0.69	28.15	41.06	30.78
2	-4.51	-2.06	-0.85	-0.50	45.02	35.45	19.53
3	-1.42	-0.30	-0.43	-0.22	44.56	43.29	12.14
4	0.92	0.88	-0.11	-0.05	50.15	42.42	7.43
5	2.95	1.68	0.23	0.11	59.08	33.74	7.18
6	4.77	2.81	0.54	-0.06	61.76	33.97	4.26
7	6.82	3.37	0.92	0.03	63.54	29.61	6.85
8	9.47	4.45	1.65	0.86	69.17	27.59	3.24
9	13.82	7.37	2.63	2.05	64.69	32.47	2.85
10	43.98	14.18	17.82	5.70	49.49	42.07	8.44
Spread (10-1)	58.51***	20.89***	20.50***	6.40***	21.34***	1.00	-22.34***
t-stat (spread)	(63.27)	(59.75)	(-37.09)	(23.42)	(14.33)	(-0.65)	(-18.66)

Table 3: Asset Growth Decile Portfolios: Annual Bond Performance

This table reports the annual bond performance across decile groups sorted by issuers' annual asset growth rates, AG, measured at the end of June of each year from 2002 to 2019. D1 (D10) represents the issuers' decile with the lowest (highest) asset growth rate. Panel A reports equal-weighted average annual excess returns (section i), equal-weighted average asset growth rates (section ii), and annual alpha based on equal-weighted bond performance (section iii). Panel B reports value-weighted average annual excess returns (section i), value-weighted average asset growth rates (section ii), and annual alphas based on value-weighted bond performance (section iii). Bond excess return is calculated as the difference between a bond's monthly return and the T-bill rate from July of year t to June of year t+1. In both panels, we additionally sort bond issuers into deciles with the following bond rating groups: i) high investment bonds (HI) containing the bonds with ratings of A- or higher, ii) low investment grade bonds (LI) receiving ratings from BBB- to BBB+, and iii) junk bonds (JK) rated below BBB-. The return spreads between the highest growth (10) and the lowest growth (1) portfolios are presented at the bottom. Annual alphas are the coefficients estimated from the regression of bond excess return on five bond factors, including the default factor, the liquidity risk factor,the term factor, the bond momentum factor, multiplied by 12. t-stat (spread) shows the t-statistics for the high-low bond performance. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

Panel A: Equal-Weighted Portfolios

	i. Raw Performance (%)				ii. AG (%)			
Decile	All	HI	LI	JK	All	HI	LI	JK
1 (Low)	6.98	4.01	6.41	12.88	-14.53	-8.63	-15.96	-27.43
2	5.41	4.00	4.84	8.66	-4.51	-2.28	-4.54	-13.01
3	5.08	3.72	4.43	9.67	-1.42	0.41	-1.67	-9.44
4	3.67	3.64	4.17	6.59	0.92	2.60	0.49	-5.42
5	4.14	3.6	4.58	7.62	2.95	4.22	2.47	-4.25
6	4.17	3.26	5.08	4.37	4.77	5.95	4.20	-0.94
7	4.04	3.64	4.24	6.59	6.82	7.72	5.90	0.56
8	3.86	3.46	4.05	5.8	9.47	10.02	8.81	4.34
9	3.63	3.73	3.49	6.69	13.82	13.30	16.7	12.01
10 (High)	4.01	3.57	4.84	5.11	43.98	29.44	60.67	59.33
Diff (10-1)	-2.97***	-0.44*	-1.57***	-7.78***	58.51	38.07***	76.63***	86.76***
t-stat	(-9.09)	(-1.66)	(-2.72)	(-4.80)	(63.27)	-57.64	(40.07)	(18.08)

	iii. Alpha (%)			
Diff (10-1)	-0.82**	-0.23	-0.78**	-1.63***
(t-stat)	(-2.80)	(-1.47)	(-2.38)	(-2.84)

Panel B: Value-Weighted Portfolios

	i. Raw Performance (%)				ii. AG (%)			
Decile	All	HI	LI	JK	All	HI	LI	JK
1 (Low)	6.07	4.45	5.8	11.95	-13.92	-9.57	-16.40	-25.62
2	4.88	4.35	4.57	8.84	-4.31	-2.58	-4.27	-13.11
3	5.39	5.18	5.08	9.03	-1.32	-0.17	-1.44	-11.14
4	4.21	4.08	4.74	7.43	0.67	2.13	0.38	-5.80
5	4.27	3.57	4.14	8.56	2.77	3.70	2.45	-4.42
6	4.43	4.00	5.35	4.18	4.55	5.51	4.34	0.12
7	4.34	3.88	4.57	6.31	6.76	7.20	6.10	0.46
8	4.05	3.69	3.95	5.36	9.52	10.34	8.88	5.30
9	3.35	3.91	3.10	5.15	13.68	13.15	18.62	14.00
10 (High)	3.91	4.11	3.97	5.55	44.17	28.15	67.47	64.15
Diff (10-1)	-2.16***	-0.34	-2.03***	-6.41***	58.09***	37.71***	83.86***	89.76***
(t-stat)	(-6.24)	(-1.27)	(-2.65)	(-4.08)	(66.21)	(64.29)	(44.15)	(18.39)

	ii. Alpha (%)			
Diff (10-1)	-0.76**	-0.12	-0.76**	-1.12***
(t-stat)	(-2.64)	(-1.52)	(-2.15)	(-2.91)

Table 4: Cross-sectional Regressions of Annual Bond Returns on Asset Growth

In this table, the annual bond excess returns are regressed on the issuers' lagged accounting variables and bond variables. Asset growth (AG) is the annual percentage change in total assets from Cooper et al. (2008). Tangible asset growth (TG) is the annual percentage change in tangible assets from Almeida and Campello (2007). Intangible asset growth (IG) is the annual percentage change in intangible assets. Issuers' accounting variables include leverage (LEV), changes in leverage (ΔLEV) and natural logarithm of total assets ($Size$). Bond characteristics variables include credit ratings ($Rating$), illiquidity (ILQ), duration (in years), coupon rate (%), issue size (Par) and dummy variables for puttable and callable bonds. Rating groups are defined by sorting bonds into one of three rating group. High investment bonds (HI) contain bonds with ratings of A- or higher. Low investment grade bonds (LI) receive ratings from BBB- to BBB+. Junk bonds (JK) are rated below BBB-. Beta estimates are time-series averages of the cross-sectional regression betas obtained from the annual cross-sectional regressions. Newey and West (1987) t-statistics are reported in parentheses to denote the statistical significance of the average intercept and slope coefficients. *, ** or *** denote the significance at the 10%, 5%, or 1% level, respectively.

	Full Sample						HI	LI	JK
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AG	-0.031**	-0.009**	-0.009**						
	(-2.50)	(-2.26)	(-2.60)						
TG				-0.086**	-0.058**	-0.050**	-0.018	-0.037**	-0.155***
				(-2.52)	(-2.66)	(-2.77)	(-1.32)	(-2.26)	(-3.02)
IG				0.006	0.006	0.014	-0.001	0.018	0.010
				(0.49)	(0.68)	(1.06)	(-0.12)	(1.21)	(0.17)
YS		0.010**	0.008*		0.010**	0.008*	0.001	0.011*	0.015**
		(2.37)	(1.79)		(2.31)	(1.82)	(0.95)	(1.86)	(2.43)
$Size$			0.009*			0.008*	0.013***	0.012	0.001
			(1.94)			(1.83)	(3.05)	(1.77)	(0.15)
LEV			0.003			0.004	-0.000	0.001	0.006
			(1.68)			(1.69)	(-0.05)	(0.85)	(1.03)
ΔLEV			-0.015			-0.015	-0.009	-0.021***	0.013
			(-1.61)			(-1.68)	(-1.28)	(-2.92)	(0.38)
Ratings			-0.003*			-0.002	0.001	-0.001	-0.004
			(-1.74)			(-1.64)	(1.07)	(-0.50)	(-1.04)
ILQ			-0.550			-0.580	0.007	-0.009	-2.706**
			(-0.90)			(-0.94)	(0.03)	(-0.04)	(-2.46)
Duration			0.003***			0.003***	0.002**	0.003**	0.007***
			(3.01)			(2.98)	(2.81)	(2.59)	(3.59)
Coupon			0.101			0.097	0.103*	0.059	0.165
			(1.39)			(1.34)	(1.87)	(0.95)	(0.62)
Par			0.006***			0.006***	0.007***	0.007***	-0.000
			(3.79)			(3.78)	(3.65)	(3.21)	(-0.05)
Put			-0.016***			-0.016***	-0.003	-0.014	-0.051**
			(-4.01)			(-4.07)	(-0.78)	(-1.59)	(-2.40)
Call			-0.001			-0.001	-0.001	0.004	0.005
			(-1.10)			(-1.05)	(-1.14)	(0.86)	(0.47)
Constant	0.047***	0.039***	-0.062*	0.047***	0.031***	-0.065**	-0.097***	-0.075	-0.015
	(4.01)	(3.82)	(-2.03)	(3.98)	(3.79)	(-2.17)	(-3.98)	(-1.30)	(-0.31)
Observations	21,801	21,801	21,591	21,801	21,801	21,591	11,716	7,732	2,143
$Adj.R^2$	0.013	0.195	0.410	0.015	0.197	0.452	0.380	0.354	0.365

Table 5: Asset Growth and Changes of Bond Issuer Expected Default Probability

This table reports the effect of annual asset growth, tangible asset growth and intangible asset growth on the changes in the expected default frequency. The dependent variable is the change in expected default frequency in from t-1 to year t . EDF is the expected default frequency estimated based on Bharath and Shumway (2008). Asset growth (AG) is the year-over-year percentage change in total assets from Cooper et al. (2008). Tangible asset growth (TG) is the annual percentage change in tangible assets from Almeida and Campello (2007). Intangible asset growth (IG) is the annual percentage change in intangible assets. Control variables include yield spread (YS), leverage (LEV), changes in leverage (ΔLEV) and natural logarithm of total assets ($Size$). We conduct the cross-sectional regression at the firm level. AG, TG, IG and ΔLEV are estimated at the end of year t. YS, LEV and $Size$ are estimated at the end of year t-1. Newey and West (1987) t-statistics are reported in parentheses to denote the statistical significance of the average intercept and slope coefficients.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AG	-0.047***	-0.017*	-0.014**	-0.068***				
	(-6.00)	(-2.06)	(-2.53)	(-3.15)				
TG					-0.111***	-0.020**	-0.056**	-0.153***
					(-5.79)	(-2.50)	(-2.63)	(-3.13)
IG					-0.066	0.003	-0.014	-0.155**
					(-1.10)	(0.83)	(-0.37)	(-2.22)
YS	-0.003	-0.001	-0.009	-0.003	-0.003	-0.002	-0.010	-0.004
	(-1.54)	(-0.83)	(-1.54)	(-1.01)	(-1.67)	(-0.90)	(-1.62)	(-1.34)
LEV	-0.015	-0.015	-0.020*	-0.014	-0.017	-0.014	-0.022*	-0.017
	(-0.70)	(-1.06)	(-1.79)	(-0.23)	(-0.78)	(-1.06)	(-1.92)	(-0.29)
ΔLEV	0.612***	0.075**	0.276**	1.024***	0.620***	0.059	0.275**	1.040***
	(6.07)	(2.43)	(2.54)	(9.11)	(6.36)	(1.72)	(2.61)	(8.84)
$Size$	-0.004	-0.002	-0.000	-0.007	-0.004	-0.002	-0.000	-0.008
	(-1.41)	(-0.73)	(-0.08)	(-0.92)	(-1.47)	(-0.75)	(-0.08)	(-1.00)
Constant	0.035	0.021	0.010	0.061	0.037	0.021	0.013	0.076
	(1.25)	(0.79)	(0.42)	(0.97)	(1.37)	(0.80)	(0.52)	(1.08)
Observations	3,891	1,451	1,737	703	3,891	1,451	1,737	703
"$Adj.R^2$ "	0.304	0.193	0.314	0.487	0.314	0.194	0.319	0.509

Table 6: Asset Growth Decile Portfolios: Yield Spreads and Changes in Yield Spreads

At the end of June of each year from 2002 to 2019, the bonds are allocated into deciles based on their issuers' annual asset growth rates. D1(D10) represents the issuers' decile with the lowest(highest) asset growth rate. The portfolios are formed based on the asset growth deciles in June (year t). The table reports the average yield spreads (year t) and the subsequent changes in yield spreads (year t+1) of equal-weighted and value-weighted portfolios. In Panel A, the yield spreads are estimated prior to the formation of asset growth portfolios, i.e. June of year t. In Panel B, the changes in yield spreads are estimated from July of year t to June of year t+1.

Panel A: Asset Growth Decile Portfolios and Yield Spreads

	Equal-Weighted Portfolios				Value-Weighted Portfolios			
Decile	All	HI	LI	JK	All	HI	LI	JK
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 (Low)	3.26	0.84	1.84	5.52	2.49	0.80	1.72	5.19
2	1.96	0.86	1.78	4.59	1.73	0.88	1.67	4.82
3	1.60	0.86	1.56	4.08	1.42	0.86	1.50	4.04
4	1.43	0.86	1.65	3.96	1.22	0.89	1.56	3.82
5	1.36	0.90	1.63	3.86	1.25	0.96	1.47	3.49
6	1.39	0.86	1.65	3.97	1.26	0.85	1.55	3.64
7	1.26	0.83	1.54	3.80	1.15	0.78	1.50	3.51
8	1.16	0.79	1.57	3.72	1.02	0.76	1.45	3.83
9	1.18	0.84	1.59	3.11	1.00	0.77	1.50	3.09
10 (High)	1.49	0.87	1.44	3.38	1.29	0.85	1.33	3.00
Spread (10-1)	-1.77***	0.03	-0.40***	-2.15****	-1.20***	0.05	-0.39***	-2.19***
t-stat (spread)	(-14.20)	(0.98)	(-7.97)	(-8.51)	(-14.41)	(1.40)	(-9.05)	(-10.02)

Panel B: Asset Growth Decile Portfolios and Changes in Yield Spreads

	Equal-Weighted Portfolios				Value-Weighted Portfolios			
Decile	All	HI	LI	JK	All	HI	LI	JK
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 (Low)	-0.38	-0.02	-0.11	-0.43	-0.24	0.00	-0.12	-0.38
2	0.16	-0.02	-0.11	-0.28	0.06	-0.04	-0.13	-0.21
3	0.08	0.04	-0.06	0.10	0.09	0.11	-0.03	0.04
4	0.04	-0.05	0.01	0.22	-0.02	-0.07	0.04	0.11
5	0.05	-0.04	0.02	0.26	0.07	-0.07	0.03	0.23
6	0.10	0.01	0.03	0.18	0.17	-0.02	0.02	0.26
7	0.02	-0.04	0.04	0.29	-0.04	-0.06	0.00	0.26
8	0.00	0.03	0.04	0.35	0.03	0.06	0.04	0.29
9	0.01	-0.01	0.12	0.37	-0.01	-0.02	0.09	0.31
10 (High)	0.17	-0.03	0.08	0.45	0.13	-0.03	0.08	0.45
Spread (10-1)	0.55***	-0.01	0.19***	0.88***	0.37***	-0.03	0.20***	0.83***
t-stat (spread)	(3.66)	(-0.73)	(2.35)	(3.73)	(3.48)	(-1.56)	(2.11)	(3.84)

Table 7: Cross-sectional Regressions of Yield Spreads and Change in Yield Spread on Asset Growth

This table reports the results of Fama-MacBeth regressions of bond yields and changes in bond yields. In the first two columns, the dependent variables are individual bonds' yield spreads at June of year t where yield spreads are evaluated as the difference between yields of individual bonds and yields of treasury bonds with closest maturities. In the subsequent three columns, the dependent variables are changes in yield spreads (Δ Yield Spread) from July of year t to June of year t+1. All independent variables are estimated prior to the formation of asset growth portfolios. TG stands for changes in tangible assets scaled by total assets (t-1) from Almeida and Campello (2007). TG_{t+1} are measured at the end of year t+1. *Low* is the dummy variable for bonds rated BBB+ or lower. Accounting variables include market leverage (LEV), ΔLEV and firm size ($Size$) (logarithm of total assets). Bond characteristics variables include credit ratings ($Rating$), illiquidity (ILQ), duration, coupon rate, par (logarithm of issue size) and dummy variables for puttable and callable bonds. Newey and West (1987) t-statistics are reported in parentheses to denote the statistical significance of the average intercept and slope coefficients.

	Yield Spread		$\Delta YieldSpread$			
	(1)	(2)	(3)	(4)	(5)	(6)
TG	-0.019***	0.001	0.011***	0.007**	-0.001	0.015
	(-8.24)	(0.09)	(4.17)	(2.56)	(-0.58)	(0.86)
$TG * Low$		-0.027***			0.020***	0.063**
		(-8.51)			(4.33)	(2.32)
TG_{t+1}				-0.015***	-0.004**	-0.020*
				(-5.34)	(-2.35)	(-1.90)
$TG_{t+1} * Low$					-0.017***	-0.025**
					(-3.63)	(-2.21)
YS						-0.001
						(-0.120)
$YS * Low$						-0.006*
						(1.89)
Low		-0.005***			-0.000	-0.001
		(-10.10)			(-0.06)	(-0.13)
$Size$	-0.004***	-0.004***	0.002***	0.003***	0.003***	-0.004
	(-7.79)	(-6.90)	(2.66)	(3.30)	(3.05)	(-1.12)
LEV	0.034***	0.033***	-0.022***	-0.028***	-0.027***	0.003
	(15.63)	(15.48)	(-7.06)	(-8.52)	(-8.46)	(0.21)
ΔLEV	0.016***	0.015***	0.005	0.004	0.004	0.020
	(5.36)	(5.29)	(1.38)	(1.11)	(1.11)	(0.59)
$Rating$	-0.003***	-0.004***	-0.000	-0.000	-0.000	0.001
	(-14.67)	(-14.45)	(-1.07)	(-0.30)	(-0.20)	(0.27)
ILQ	100.457***	99.673***	2.200	2.125	2.160	2.160
	(5.34)	(5.26)	(1.30)	(1.26)	(1.29)	(1.29)
$Duration$	0.000***	0.000***	0.000***	0.000***	0.000***	0.001
	(15.10)	(15.19)	(4.74)	(4.62)	(4.56)	(0.77)
$Coupon$	0.093***	0.091***	-0.005	-0.007	-0.006	-0.254
	(9.31)	(9.05)	(-0.37)	(-0.54)	(-0.51)	(-1.61)
Par	-0.003***	-0.003***	0.001	0.001	0.001	0.005
	(-4.30)	(-4.18)	(0.73)	(0.78)	(0.77)	(1.31)
Put	-0.001	-0.001	-0.001	0.000	0.000	-0.001
	(-1.33)	(-1.12)	(-0.57)	(0.02)	(0.02)	(-0.11)
$Call$	0.001**	0.001**	0.000	0.000	0.000	-0.012
	(2.19)	(2.03)	(0.21)	(0.46)	(0.48)	(-1.59)
Constant	0.155***	0.160***	-0.017	-0.024	-0.022	-0.031
	(9.59)	(9.74)	(-0.87)	(-1.21)	(-1.10)	(-0.50)
Observations	18,503	18,503	18,503	17,514	17,514	17,514
Adj. R^2	0.594	0.599	0.247	0.250	0.252	0.284

Table 8: A Decomposition of Bond Performance

This table reports the results of the decomposition of bond returns to four components including i) treasury yield, ii) the change in treasury yields, iii) yield spread between an individual bond and a treasury bond with nearest maturity, and iv) the change in yield spreads. The dependent variable is monthly bond excess return, evaluated as the difference between the monthly return of an individual bond and monthly yield of the 1-month Treasury bill. Bonds are sorted into i) high investment bonds (HI) containing bonds with ratings of A- or higher, ii) low investment grade bonds (LI) with ratings from BBB- to BBB+, and iii) non-investment grade bonds (JK) which are rated below BBB-. With each rating category, bonds are sorted into quintile groups based on the issuers' asset growth rates evaluated in year t-1. Yield spreads is obtained from the month t-1 and change in yield spreads is the following yield spread change from year t-1 to t. We perform time-series regression and regress bond excess returns on lagged yield spreads and changes in yield spreads. The intercepts (α), the coefficient on one of four bond performance determinants (β) and associated t-statistics as well as regression R^2 are reported.

Panel A. Treasury Yield

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.005**	0.009***	0.016**	-0.000	-0.002	-0.002	0.001	0.010	0.003
	(2.03)	(2.87)	(2.39)	(-0.60)	(-1.52)	(-1.11)			
2	0.005*	0.008*	0.022**	-0.000	-0.001	-0.004	0.000	0.006	0.013
	(1.86)	(1.81)	(2.32)	(-0.23)	(-1.04)	(-1.47)			
3	0.004*	0.008**	0.018***	-0.000	-0.001	-0.004**	0.001	0.005	0.032
	(1.94)	(2.05)	(3.18)	(-0.37)	(-0.95)	(-2.45)			
4	0.005*	0.006**	0.018***	-0.001	-0.001	-0.005**	0.001	0.002	0.019
	(1.74)	(2.15)	(3.12)	(-0.58)	(-0.73)	(-2.27)			
5 (High)	0.005*	0.007**	0.013*	-0.000	-0.001	-0.003*	0.001	0.001	0.008
	(1.68)	(2.05)	(1.91)	(-0.38)	(-0.48)	(-1.80)			
All	0.005*	0.008**	0.015*	-0.000	-0.001	-0.003**	0.001	0.001	0.014
	(1.92)	(2.26)	(1.91)	(-0.72)	(-0.53)	(-2.16)			

Panel B. Δ Treasury Yield

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.003***	0.004***	0.011***	-0.040***	-0.023***	0.013	0.423	0.104	0.004
	(4.41)	(3.73)	(3.96)	(-10.31)	(-3.85)	(0.54)			
2	0.003***	0.003***	0.011***	-0.050***	-0.024***	0.017	0.544	0.085	0.010
	(4.05)	(2.86)	(3.78)	(-9.96)	(-3.37)	(1.05)			
3	0.002***	0.004***	0.005***	-0.042***	-0.030***	0.012	0.448	0.148	0.011
	(3.60)	(3.57)	(2.63)	(-9.43)	(-4.34)	(1.19)			
4	0.002***	0.003***	0.004	-0.048***	-0.033***	-0.002	0.467	0.164	0.000
	(2.97)	(2.92)	(1.50)	(-11.16)	(-4.47)	(-0.10)			
5 (High)	0.002***	0.004***	0.006**	-0.048***	-0.036***	0.011	0.390	0.243	0.006
	(2.81)	(4.09)	(2.39)	(-7.95)	(-6.48)	(0.80)			
All	0.002***	0.004***	0.006**	-0.045***	-0.030***	0.012	0.413	0.153	0.004
	(3.45)	(3.47)	(3.13)	(-8.72)	(-4.77)	(1.04)			

Panel C. Yield Spread

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	-0.000	-0.003	-0.011	0.006	0.004**	0.005*	0.073	0.069	0.169
	(-0.13)	(-0.79)	(-1.08)	(1.51)	(2.29)	(1.84)			
2	-0.004	-0.003	-0.013*	0.011	0.004**	0.005***	0.073	0.051	0.178
	(-0.73)	(-0.76)	(-1.73)	(1.47)	(1.98)	(2.69)			
3	-0.002	-0.004	0.001	0.009*	0.006**	0.001	0.065	0.070	0.078
	(-0.69)	(-0.88)	(0.27)	(1.86)	(2.06)	(1.32)			
4	0.001	-0.000	0.000	0.004	0.003	0.001	0.027	0.044	0.066
	(0.32)	(-0.01)	(0.05)	(1.02)	(1.28)	(0.48)			
5 (High)	-0.004	-0.006	-0.003	0.010	0.007***	0.002	0.063	0.091	0.055
	(-0.69)	(-1.45)	(-0.50)	(1.42)	(2.76)	(1.30)			
All	-0.003	-0.004	-0.008	0.007	0.005*	0.003	0.051	0.071	0.104
	(-0.69)	(-1.45)	(-0.50)	(1.42)	(1.89)	(1.52)			

Panel D. ΔYield Spread

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.005***	0.006***	0.010***	-0.025***	-0.035***	-0.025***	0.196	0.445	0.851
	(5.94)	(6.82)	(8.33)	(-3.92)	(-9.23)	(-9.07)			
2	0.005***	0.005***	0.010***	-0.026*	-0.037***	-0.030***	0.102	0.571	0.735
	(4.99)	(6.36)	(7.19)	(-1.71)	(-12.57)	(-7.62)			
3	0.005***	0.006***	0.007***	-0.027***	-0.037***	-0.022***	0.116	0.470	0.626
	(5.00)	(6.60)	(6.07)	(-3.43)	(-9.63)	(-10.68)			
4	0.005***	0.006***	0.007***	-0.036***	-0.035***	-0.028***	0.207	0.514	0.854
	(4.91)	(6.34)	(6.12)	(-5.42)	(-6.70)	(-10.91)			
5 (High)	0.005***	0.006***	0.007***	-0.044***	-0.039***	-0.029***	0.220	0.351	0.811
	(4.55)	(6.26)	(6.78)	(-3.77)	(-7.89)	(-15.69)			
All	0.005***	0.006***	0.008***	-0.037***	-0.038***	-0.024***	0.180	0.519	0.835
	(5.04)	(6.19)	(7.24)	(-3.77)	(-7.89)	(-15.69)			

Table 9: Explanatory Powers of Tangible-Asset-Growth Associated Factors on Yield Spread Changes

This table reports the results of time series regressions of bond portfolio yield spread changes. All sample bonds are independently sorted into three bond rating groups (HI, LI, and JK) and 5 quintiles based on issuers' asset growth rates. High investment bonds (HI) contain bonds with ratings of A- or higher. Low investment grade bonds (LI) receive ratings from BBB- to BBB+. Non-investment grade bonds (JK) are rated below BBB-. Change of yield spreads are evaluated as the value-weighted change of yield spreads of the bonds in a given subgroup. To estimate the yield spreads factor and the yield spreads change factor, sample bonds are sorted into deciles based on tangible asset growth in year t-1. The yield spread change factor is the difference of the average value-weighted yield spread changes between D10 (highest) and D1 (lowest) tangible asset growth portfolios from July of year t to June of year t+1. The table reports the alpha, loading and R^2.

	α			t(α)			β			t(β)			R^2		
	HI	LI	JK	HI	LI	JK	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	-0.034	-0.018	-0.029	-1.67	-0.90	-0.24	0.054	0.093	0.716	0.88	3.63	3.29	0.036	0.113	0.195
2	-0.033	-0.015	-0.032	-1.12	-0.63	-0.48	0.072	0.109	1.086	1.23	1.81	3.17	0.041	0.104	0.205
3	-0.033	-0.024	0.057	-1.40	-1.02	1.06	0.084	0.102	1.246	0.66	0.99	4.65	0.033	0.096	0.215
4	-0.032	-0.019	0.049	1.54	-0.65	0.58	0.095	0.267	1.380	1.58	0.70	3.13	0.037	0.093	0.191
5 (High)	-0.028	-0.036*	-0.002	-1.61	-1.78	-0.03	0.135	0.318	2.008	0.88	1.03	3.65	0.026	0.109	0.199
All	-0.032	-0.028*	0.002	-1.05	-1.16	0.33	0.086	0.178	1.287	1.09	1.24	3.28	0.033	0.105	0.206

Table 10: Cross-Sectional Regressions: Sentiment Analysis

This table reports the results of Fama-MacBeth regressions of annual bond performance. The dependent variable is annual bond performance evaluated from July of year t to June of year t+1. The full sample is split into high-sentiment and low-sentiment categories based on the issuer quality measure from Greenwood and Hanson (2013). The high-sentiment dummy variable (*Sent*) is one in which the value of the issuer quality in the quarter before the formation of portfolios is below the median value for the sample period, zero otherwise. *AG* stands for changes in total assets scaled by total assets (t-1) from Cooper, Gulen, and Schill (2008). *TG* stands for changes in tangible assets scaled by total assets (t-1) from Almeida and Campello (2007). Other independent variables are lagged variable, which are estimated prior to the formation of asset growth portfolios. Accounting variables include book leverage (*LEV*) and logarithm of total assets (*Size*). Bond characteristics variables include credit ratings (*Rating*), illiquidity (*ILQ*), duration, coupon rate, issue size (*Par*) and dummy variables for puttable and callable bonds. High investment bonds (*HI*) contain bonds with ratings of A- or higher. Low investment grade bonds (*LI*) receive ratings from BBB- to BBB+. Non-investment grade bonds (*JK*) are rated below BBB-. Newey and West (1987) t-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients.

	Full	HI	LI	JK
	(1)	(2)	(3)	(4)
$TG * Sent$	-0.023**	-0.000	-0.011*	-0.025**
	(-2.63)	(-0.42)	(-1.94)	(-2.14)
TG	-0.032***	-0.014	-0.014*	-0.109**
	(-3.77)	(-1.07)	(-2.03)	(-2.24)
$Sent$	-0.005	-0.006	0.004	0.018
	(-0.85)	(-0.88)	(0.65)	(1.25)
YS	0.008**	0.015***	0.007*	0.004
	(2.39)	(3.86)	(1.81)	(1.07)
$Size$	-0.016**	-0.010	-0.025***	-0.001
	(-2.55)	(-1.30)	(-2.95)	(-0.02)
LEV	0.023	-0.000	0.022*	0.022
	(1.62)	(-0.01)	(1.96)	(1.60)
ΔLEV	0.004*	0.000	0.001	0.009
	(1.86)	(0.20)	(0.99)	(1.55)
Rating	-0.002	0.001	-0.002	-0.003
	(-1.60)	(0.98)	(-0.64)	(-0.99)
ILQ	-0.574	0.000	-0.002	-2.884**
	(-0.87)	(0.00)	(-0.01)	(-2.37)
$Duration$	0.003***	0.002***	0.003***	0.008***
	(3.60)	(3.34)	(3.63)	(3.91)
Coupon	0.109	0.106**	0.067	0.110
	(1.72)	(2.55)	(1.46)	(0.52)
Par	0.006***	0.007***	0.007***	-0.005
	(3.74)	(4.53)	(4.14)	(-1.29)
Put	-0.016***	-0.004	-0.014	-0.045**
	(-4.89)	(-1.19)	(-1.61)	(-2.14)
Call	-0.001	-0.001	0.003	-0.001
	(-1.13)	(-1.01)	(0.77)	(-0.06)
Constant	-0.060*	-0.091***	-0.076	-0.002
	(-1.84)	(-4.41)	(-1.41)	(-0.04)
Observations	21,590	11,716	7,731	2,143
$Adj.R^2$	0.417	0.378	0.370	0.376

Table 11: Sentiment Effect on Yield Spreads and Changes in Yield Spreads

This table reports the results of Fama-MacBeth regressions of yield spreads and yield spread changes. The dependent variable of the first four columns is the bond yield spread in June of year t, evaluated as the the difference between yields of individual bonds and the yield of treasury bonds with the nearest maturities. The dependent variables of the next four columns are the yield spread changes from year t to t+1. The full sample is split into high-sentiment and low-sentiment categories based on the issuer quality from Greenwood and Hanson (2013). The high-sentiment dummy variable ($Sent$) is one in which the value of the issuer quality in the quarter before the formation of portfolios is below the median value for the sample period, zero otherwise. TG stands for changes in tangible assets scaled by total assets (t-1) from Almeida and Campello (2007). Other independent variables are lagged variable, which are estimated prior to the formation of asset growth portfolios at year t. Accounting variables include market leverage (LEV) and logarithm of total assets ($Size$). Bond characteristics variables include credit ratings ($Rating$), illiquidity (ILQ), duration, coupon rate, issue size (Par) and dummy variables for puttable and callable bonds. Newey and West (1987) t-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients.

	Yield Spreads				$\Delta YieldSpreads$			
	Full	HI	LI	JK	Full Sample	HI	LI	JK
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$TG * Sent$	-0.002*	-0.000	-0.001*	-0.002**	0.005***	0.002	0.008*	0.010**
	(-1.88)	(-0.66)	(-2.03)	(-2.65)	(3.07)	(1.36)	(1.85)	(2.45)
TG	-0.006	-0.002	-0.006	-0.006***	0.055**	0.001	0.017	0.013**
	(-1.50)	(-1.22)	(-1.48)	(-3.45)	(2.79)	(0.13)	(0.86)	(2.62)
$Sent$	0.006	0.002	0.009	0.006	-0.008	-0.003	0.024**	0.030**
	(1.33)	(1.24)	(1.32)	(1.20)	(-1.30)	(-0.45)	(2.57)	(2.29)
YS					0.014*	0.004	0.018**	0.032***
					(1.87)	(0.42)	(2.54)	(3.79)
LEV	0.015***	0.007***	0.007***	0.026***	-0.008	-0.032***	-0.001	-0.037
	(4.01)	(3.61)	(3.41)	(5.68)	(-0.38)	(-3.49)	(-0.05)	(-1.07)
ΔLEV	0.015**	0.005***	0.012***	0.011	0.007	0.010	-0.005	-0.053
	(2.78)	(2.96)	(4.25)	(1.19)	(0.16)	(0.79)	(-0.28)	(-0.56)
$Size$	-0.001*	-0.000*	-0.001***	-0.002***	-0.006	0.001	-0.002	-0.014
	(-1.89)	(-1.86)	(-4.66)	(-3.03)	(-1.34)	(1.22)	(-0.52)	(-0.87)
$Rating$	-0.003***	-0.000***	-0.003***	-0.004***	-0.006**	0.001	-0.000	-0.027*
	(-6.78)	(-4.88)	(-7.28)	(-5.53)	(2.29)	(1.46)	(-0.08)	(1.95)
ILQ	100.457***	28.178***	71.510***	143.228***	2.287*	0.772***	1.737***	3.857
	(5.34)	(3.49)	(4.61)	(5.37)	(2.03)	(4.96)	(3.42)	(1.56)
$Duration$	0.000	0.000**	0.000*	-0.000	0.001	0.000	-0.000	0.003
	(0.74)	(2.46)	(1.76)	(-0.30)	(1.09)	(0.42)	(-0.05)	(0.65)
$Coupon$	0.151***	0.091***	0.127***	0.212***	-0.531***	-0.561***	-0.365**	-1.974**
	(10.83)	(6.32)	(7.81)	(9.13)	(-3.91)	(-3.51)	(-2.64)	(-2.52)
Par	-0.001	-0.000	-0.001***	-0.002	0.006	-0.002	0.006	0.025
	(-1.16)	(-1.66)	(-3.30)	(-1.32)	(1.33)	(-0.77)	(1.30)	(1.54)
Put	0.000	-0.001***	0.001	-0.002	-0.000	0.005	-0.008	0.045
	(0.24)	(-3.38)	(1.19)	(-0.81)	(-0.04)	(1.21)	(-0.38)	(1.04)
$Call$	-0.001*	-0.000	-0.002***	0.001	-0.009	-0.005	-0.009	-0.057
	(-1.81)	(-0.02)	(-3.30)	(0.71)	(-1.67)	(-1.55)	(-0.99)	(-1.65)
Constant	0.055***	0.017***	0.074***	0.097**	-0.105	0.003	-0.022	-0.436**
	(3.36)	(3.15)	(3.93)	(2.42)	(-1.58)	(0.13)	(-0.24)	(-2.34)
Observations	17,421	9,017	6,241	2,163	17,421	9,017	6,241	2,163
$Adj.R^2$	0.709	0.488	0.476	0.687	0.280	0.148	0.237	0.371

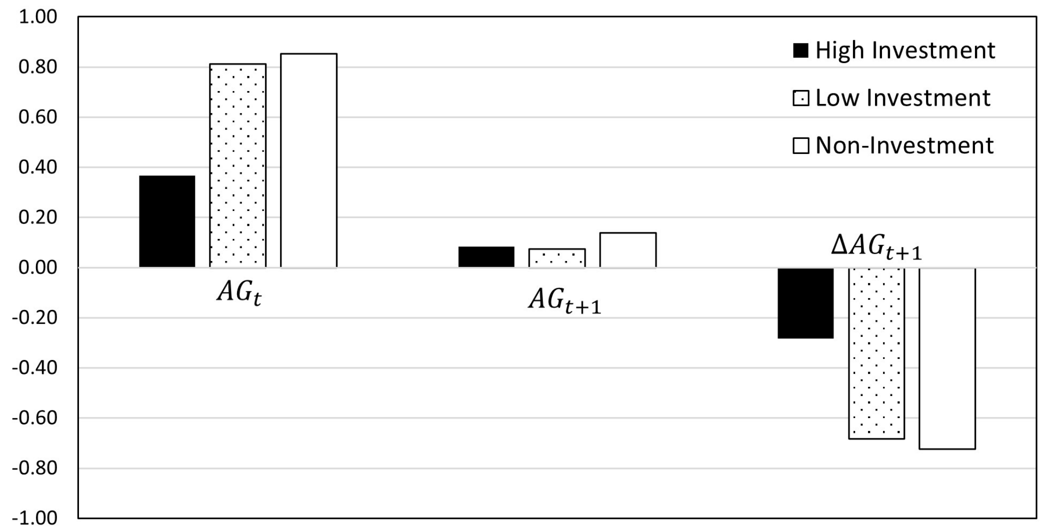
Table 12: Asset Growth and Monthly Bond Return: Controlling Bond Risk Factors

This table reports the average intercept and slope coefficients from the Fama and MacBeth (1973) cross-sectional regressions of one-month-ahead corporate bond monthly excess returns on the bond market betas, with and without control variables. The bond market betas (β^{Bond}, β^{DEF} , β^{TERM}, β^{MOM}, and β^{LIQ}) are estimated for each bond from the time-series regressions of bond excess returns on the excess bond market return and the associated bond factors (DEF, $TERM$, MOM, LIQ) using a 36-month rolling window estimation. The high-sentiment dummy variable (HS) is one in which the value of the issuer quality in the quarter before the formation of portfolios is below the median value for the sample period, zero otherwise. TG stands for changes in tangible assets scaled by total assets (t-1) from Almeida and Campello (2007). Bond characteristics include credit rating (*Rating*), illiquidity (ILQ), duration (*Duration*), and the natural logarithm of bond amount outstanding (Par). Newey and West (1987) t-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients.

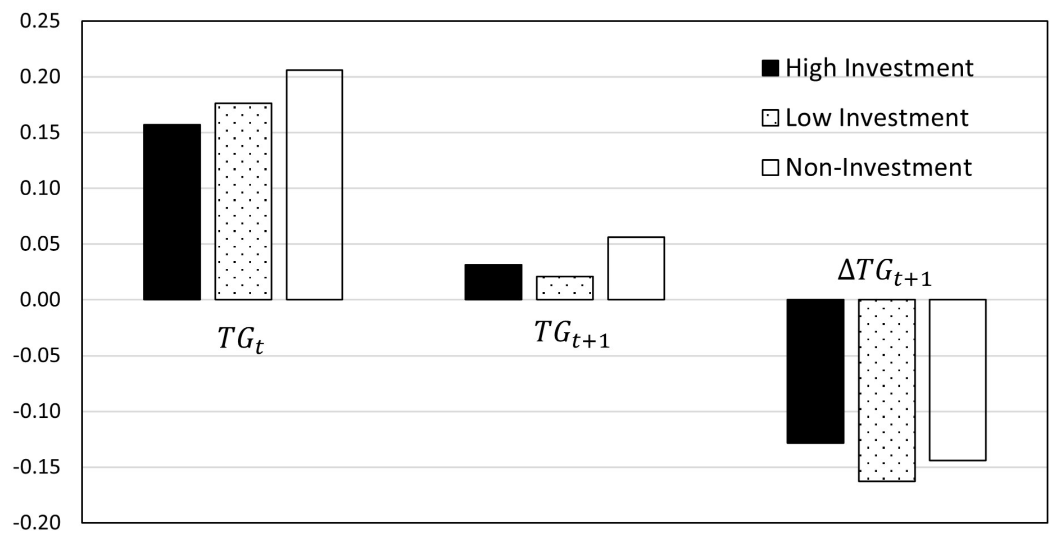
	All		HI	LI	JK
	(1)	(2)	(3)	(4)	(5)
TG	-0.0039*	-0.0025*	-0.0004	-0.0034*	-0.0059*
	(-1.84)	(-1.83)	(-0.55)	(-1.92)	(-1.85)
β^{MKT}	0.1985**	0.1132*	0.0147	0.1354*	0.1109*
	(2.56)	(1.84)	(1.92)	(2.12)	(1.90)
β^{DEF}	-0.0055	-0.0070	-0.0063	-0.0107	-0.0125*
	(-0.94)	(-1.26)	(-1.43)	(-1.63)	(-1.79)
β^{TERM}	0.0070	0.0071	0.0044	0.0054	0.0065
	(1.37)	(1.33)	(1.58)	(1.09)	(1.50)
β^{MOM}	-0.2372	-0.1892	-0.2231*	0.0892	0.1892*
	(-1.31)	(-1.50)	(-1.85)	(0.56)	(1.79)
β^{LIQ}	0.0583	0.0238	0.0436	0.0389	0.0377
	(0.75)	(0.55)	(0.62)	(0.55)	(0.77)
Rating		0.0002	0.0003	0.0003	0.0002
		(0.90)	(1.08)	(0.95)	(0.73)
ILQ		-0.0450	-0.0424	-0.0509	0.0276
		(-0.97)	(-1.22)	(-1.43)	(0.47)
Duration		0.0004*	0.0009**	0.0002*	0.0002
		(2.54)	(2.29)	(1.84)	(1.16)
Par		0.0001	0.0001	0.0001	-0.0001
		(0.48)	(0.52)	(0.76)	(-1.13)
Constant	0.0020***	-0.0012	0.0024	-0.0024	0.0012
	(2.64)	(-0.54)	(0.78)	(-0.63)	(0.69)
Observations	149,372	139,027	64,723	48,531	25,773
$Adj.R^2$	0.216	0.298	0.352	0.257	0.254

Figure 1: Differences of Asset Growth and Tangible Asset Growth between Top and Bottom Decile Groups

Panel A: Difference of Asset Growth between D10 and D1 Deciles

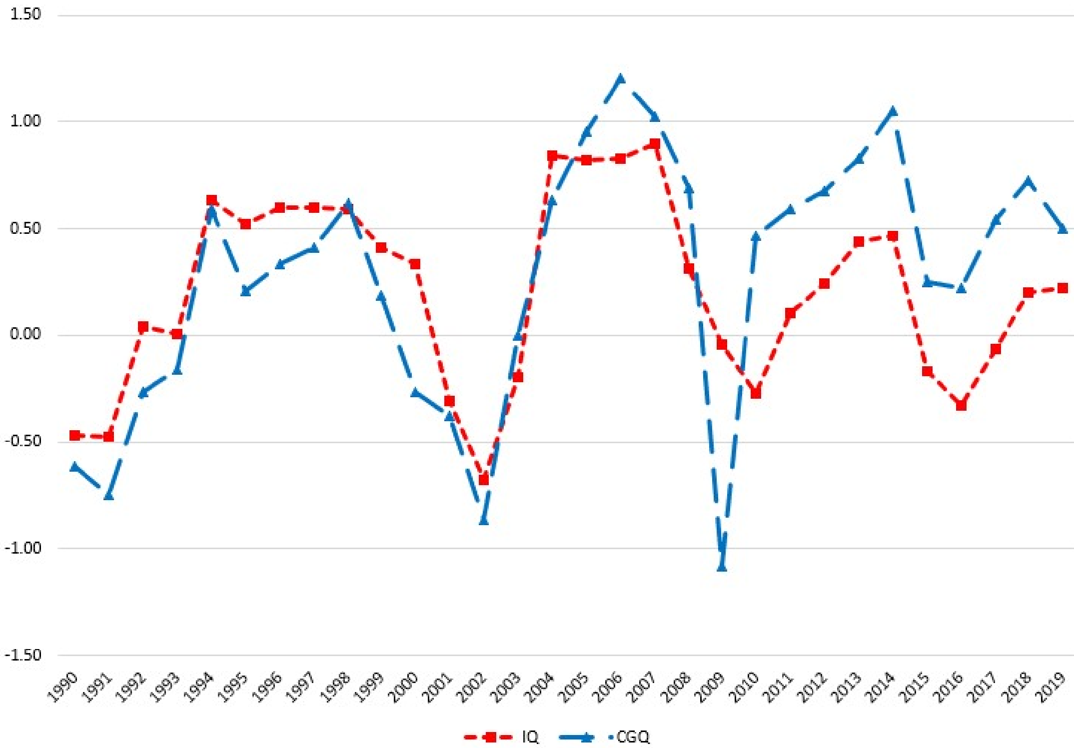


Panel B: Difference of Tangible Asset Growth between D10 and D1 Deciles



Panel A shows the differences between the top and bottom deciles sorted by the bond issuers' asset growth rates in i) the average asset growth rates in year t (portfolio formation year), ii) the average asset growth rates in year t+1, and iii) the average changes in asset growth rates from year t to year t+1. Panel B shows the differences between the top and bottom deciles sorted by the bond issuers' tangible asset growth rates in the same set of variables.

Figure 2: Issuer Quality versus Collateral Growth Quality



This graph plots the corporate bond issuer quality (IQ) and collateral growth quality (CGQ) from 1990 to 2019. Plotted as the red dash line, IQ is defined as the difference in the averages of individual issuers' EDF decile ranks between high and low debt issuers. Plotted as the blue solid line, CGQ is defined the difference in the averages of individual issuers' EDF decile ranks between high and low tangible asset growth issuers.

Internet Appendix

Table A1: Asset Growth Decomposition and Bond Return: Cross-sectional Analysis

In this table, annual bond excess returns are regressed on variables obtained from a balance sheet decomposition of asset growth. The asset decomposition defines total assets as the sum of: (1) Cash and short-term investments (Compustat #1), (2) Noncash current assets (Compustat #4 - Compustat #1), (3) Property, plant and equipment (Compustat #8), (4) Intangible assets (Compustat #33), (5) Investments (Compustat #31 + Compustat #32) and (6) Other assets (Total assets minus the above components). Variables used in the cross-sectional regressions are changes in these variables from the fiscal year ending in calendar year t-2 to the fiscal year ending in calendar year t-1 scaled by total assets in the fiscal year ending in calendar year t-2. We also control for issuer and bond lever characteristics. Issuers' accounting variables include leverage (LEV), changes in leverage (ΔLEV) and natural logarithm of total assets ($Size$). Bond characteristics variables include credit ratings ($Rating$), duration (in years), coupon rate (%), issue size (Par) and dummy variables for puttable and callable bonds. Newey and West (1987) t-statistics are reported in parentheses to denote the statistical significance of the average intercept and slope coefficients. *, ** or *** denote the significance at the 10%, 5%, or 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
CG	-0.061*					
	(-1.945)					
NCG		-0.037*				
		(-1.999)				
PPENTG			-0.058***			
			(-4.440)			
IG				-0.000		
				(-0.058)		
IVSTG					0.018	
					(1.009)	
AOG						-0.020
						(-1.594)
Control	Yes	Yes	Yes	Yes	Yes	
Observations	21,591	21,591	21,591	21,591	21,591	21,591
R-squared	0.357	0.359	0.360	0.358	0.358	0.361

Table A2: Asset Growth Decile Portfolios: Annual Bond Performance in year t+2

This table reports the annual bond performance across decile groups sorted by issuers' annual asset growth rates, AG, measured at the end of June of each year from 2002 to 2019. D1 (D10) represents the issuers' decile with the lowest (highest) asset growth rate. Panel A reports equal-weighted average annual excess returns and Panel B reports value-weighted average annual excess returns. Bond excess return is calculated as the difference between a bond's monthly return and the T-bill rate from July of year t+1 to June of year t+2. In both panels, we additionally sort bond issuers into deciles with the following bond rating groups: i) high investment bonds (HI) containing the bonds with ratings of A- or higher, ii) low investment grade bonds (LI) receiving ratings from BBB- to BBB+, and iii) junk bonds (JK) rated below BBB-. The return spreads between the highest growth (10) and the lowest growth (1) portfolios are presented at the bottom. t-stat (spread) shows the t-statistics for the high-low bond performance. *, ** or *** denotes the significance at the 10%, 5%, or 1% level, respectively.

Panel A: Equal-Weighted Portfolios

Decile	Full		HI		LI		JK	
1	2,157	5.38	1,211	3.36	779	5.04	222	7.41
2	2,188	5.11	1,147	3.77	786	4.59	191	5.90
3	2,209	4.90	1,168	3.77	774	4.64	207	11.94
4	2,216	4.10	1,187	3.66	824	5.36	206	5.34
5	2,132	4.56	1,157	3.39	739	4.40	278	12.23
6	2,166	3.84	1,220	3.69	789	4.26	163	12.42
7	2,212	3.78	1,229	3.40	792	4.38	254	6.52
8	2,210	3.99	1,208	3.80	770	4.03	206	5.64
9	2,176	4.45	1,189	3.83	785	4.84	219	10.84
10	2,163	5.33	1,143	4.08	782	4.50	204	8.66
Diff (10-1)		-0.05		0.72**		-0.54		1.25
t-stat		(-0.17)		(2.16)		(-1.43)		(0.88)

Panel B: Value-Weighted Portfolios

Decile	Full		HI		LI		JK	
1	2,157	4.59	1,211	3.23	779	4.73	222	6.42
2	2,188	5.02	1,147	4.41	786	4.80	191	5.21
3	2,209	4.77	1,168	4.46	774	5.80	207	10.68
4	2,216	4.25	1,187	3.85	824	5.16	206	4.60
5	2,132	3.95	1,157	3.51	739	4.49	278	10.67
6	2,166	4.15	1,220	4.08	789	3.67	163	9.54
7	2,212	3.80	1,229	3.68	792	3.90	254	3.11
8	2,210	4.18	1,208	4.53	770	3.79	206	4.57
9	2,176	4.37	1,189	4.22	785	5.02	219	9.67
10	2,163	4.82	1,143	4.32	782	4.18	204	7.52
Diff (10-1)		0.23		1.09***		-0.55		1.11
t-stat		(1.30)		(2.49)		(-1.56)		(0.92)

Table A3: Bond Performance Decomposition with Extended Sample from 1994-2019

This table reports the results of the decomposition of bond returns to four components including i) treasury yield, ii) the change in treasury yields, iii) yield spread between an individual bond and a treasury bond with nearest maturity, and iv) the change in yield spreads. The dependent variable is monthly bond excess return, evaluated as the difference between the monthly return of an individual bond and monthly yield of the 1-month Treasury bill. Bonds are sorted into i) high investment bonds (HI) containing bonds with ratings of A- or higher, ii) low investment grade bonds (LI) with ratings from BBB- to BBB+, and iii) non-investment grade bonds (JK) which are rated below BBB-. With each rating category, bonds are sorted into quintile groups based on the issuers' asset growth rates evaluated in year t-1. Yield spreads is obtained from the month t-1 and change in yield spreads is the following yield spread change from year t-1 to t. We perform time-series regression and regress bond excess returns on lagged yield spreads and changes in yield spreads. The sample period is from 1994 to 2019. The intercepts (α), the coefficient on one of four bond performance determinants (β) and associated t-statistics as well as regression R^2 are reported.

Panel A. Treasury Yield

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.004**	0.007***	0.013**	-0.000	-0.001	-0.001	0.001	0.005	0.002
	(2.49)	(3.27)	(2.44)	(-0.46)	(-1.32)	(-0.82)			
2	0.004**	0.005*	0.013*	-0.000	-0.000	-0.001	0.000	0.001	0.003
	(2.17)	(2.16)	(1.68)	(-0.12)	(-0.65)	(-0.88)			
3	0.004*	0.006**	0.008*	0.000	-0.001	-0.001	0.000	0.001	0.002
	(2.01)	(2.37)	(1.95)	(0.13)	(-0.69)	(-0.78)			
4	0.004*	0.004**	0.006*	0.000	-0.000	-0.001**	0.000	0.001	0.001
	(1.76)	(2.15)	(1.65)	(0.03)	(-0.48)	(-0.79)			
5 (High)	0.004*	0.006***	0.008*	-0.000	-0.001	-0.001	0.000	0.005	0.002
	(1.87)	(2.93)	(1.68)	(-0.37)	(-1.36)	(-0.83)			
All	0.004***	0.006**	0.009***	-0.000	-0.000**	-0.001*	0.000	0.002	0.002
	(4.58)	(5.70)	(4.05)	(-0.38)	(-1.99)	(-1.82)			

Panel B. Δ Treasury Yield

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.003***	0.004***	0.010***	-0.032***	-0.021***	0.004	0.342	0.109	0.001
	(5.50)	(5.15)	(5.13)	(-9.89)	(-4.72)	(0.28)			
2	0.003***	0.004***	0.008***	-0.042***	-0.020***	0.011	0.468	0.085	0.004
	(5.12)	(4.19)	(3.63)	(-10.84)	(-4.44)	(0.81)			
3	0.003***	0.004***	0.005***	-0.034***	-0.024***	0.008	0.391	0.125	0.007
	(5.48)	(4.50)	(3.80)	(-10.06)	(-5.21)	(1.15)			
4	0.003***	0.003***	0.004*	-0.037***	-0.026***	-0.002	0.373	0.157	0.000
	(4.53)	(3.80)	(1.93)	(-10.45)	(-5.80)	(-0.13)			
5 (High)	0.003***	0.003***	0.05**	-0.037***	-0.028***	0.000	0.323	0.173	0.000
	(4.06)	(4.23)	(2.69)	(-8.42)	(-5.94)	(0.80)			
All	0.003***	0.004***	0.006**	-0.036***	-0.024***	0.004	0.375	0.128	0.001
	(10.90)	(9.78)	(7.56)	(-21.75)	(-11.68)	(0.75)			

Panel C. Yield Spread

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.000	-0.003	-0.007	0.004	0.004***	0.003**	0.032	0.087	0.124
	(0.02)	(-1.42)	(-1.04)	(1.12)	(2.97)	(2.04)			
2	-0.000	-0.002	-0.015***	0.005	0.004**	0.005***	0.016	0.045	0.153
	(-0.06)	(-0.86)	(-2.79)	(0.81)	(2.03)	(3.70)			
3	0.000	-0.002	-0.000	0.004	0.004**	0.001**	0.022	0.048	0.028
	(0.00)	(-0.77)	(-0.18)	(122)	(2.10)	(2.22)			
4	0.001	0.001	0.004	0.002	0.002	-0.000	0.010	0.014	0.000
	(0.60)	(0.20)	(0.82)	(0.80)	(0.85)	(-0.08)			
5 (High)	-0.001	-0.002	-0.004	0.005	0.004**	0.002	0.025	0.036	0.041
	(-0.25)	(-0.79)	(-0.73)	(1.08)	(2.03)	(1.42)			
All	0.000	-0.002	-0.003	0.004**	0.004**	0.002***	0.019	0.043	0.045
	(0.22)	(-1.40)	(-1.09)	(2.19)	(4.20)	(2.89)			

Panel D. ΔYield Spread

	α			β			R^2		
AG	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	0.004***	0.004***	0.009***	-0.021***	-0.030***	-0.017***	0.156	0.366	0.610
	(5.86)	(6.66)	(7.04)	(-3.85)	(-8.10)	(-6.31)			
2	0.004***	0.004***	0.008***	-0.019*	-0.032***	-0.024***	0.047	0.458	0.582
	(4.86)	(6.40)	(5.26)	(-1.95)	(-10.97)	(-5.23)			
3	0.004***	0.005***	0.005***	-0.017***	-0.011***	-0.014***	0.059	0.142	0.405
	(5.37)	(6.03)	(4.69)	(-2.78)	(-2.10)	(-3.18)			
4	0.004***	0.004***	0.006***	-0.027***	-0.029***	-0.022***	0.153	0.404	0.681
	(5.02)	(5.94)	(5.92)	(-4.24)	(-6.71)	(-7.31)			
5 (High)	0.004***	0.005***	0.007***	-0.029***	-0.031***	-0.019***	0.137	0.321	0.553
	(4.52)	(6.21)	(6.12)	(-3.33)	(-7.89)	(-5.07)			
All	0.004***	0.004***	0.007***	-0.023***	-0.022***	-0.019***	0.108	0.277	0.566
	(11.33)	(14.02)	(12.21)	(-7.14)	(-4.01)	(-10.73)			

Table A4: Explanatory Powers of Tangible-Asset-Growth Associated Factors on Yield Spread Change with Extended Sample Period from 1994-2019

This table reports the results of time series regressions of bond portfolio yield spread changes. All sample bonds are independently sorted into three bond rating groups (HI, LI, and JK) and 5 quintiles based on issuers' asset growth rates. High investment bonds (HI) contain bonds with ratings of A- or higher. Low investment grade bonds (LI) receive ratings from BBB- to BBB+. Non-investment grade bonds (JK) are rated below BBB-. Change of yield spreads are evaluated as the value-weighted change of yield spreads of the bonds in a given subgroup. To estimate the yield spreads factor and the yield spreads change factor, sample bonds are sorted into deciles based on tangible asset growth in year t-1. The yield spread change factor is the difference of the average value-weighted yield spread changes between D10 (highest) and D1 (lowest) tangible asset growth portfolios from July of year t to June of year t+1. The table reports the alpha, loading and R^2.

	α			t(α)			β			t(β)			R^2		
	HI	LI	JK	HI	LI	JK	HI	LI	JK	HI	LI	JK	HI	LI	JK
1 (Low)	-0.031	-0.015	-0.024	-1.61	-0.75	-0.13	0.047	0.087	0.695	0.72	3.32	3.04	0.0327	0.105	0.172
2	-0.031	-0.012	-0.025	-1.01	-0.52	-0.32	0.063	0.099	1.032	1.14	1.88	3.21	0.034	0.089	0.195
3	-0.026	-0.021	0.046	-1.34	-1.34	1.56	0.076	0.087	1.205	0.54	0.76	4.12	0.025	0.076	0.201
4	-0.026	-0.014	0.043	1.51	-0.65	0.51	0.087	0.243	1.337	1.45	0.56	2.98	0.026	0.087	0.185
5 (High)	-0.022	-0.031*	-0.001	-1.56	-1.65	-0.01	0.126	0.301	1.984	0.81	1.01	3.33	0.021	0.101	0.178
All	-0.029	-0.021*	0.001	-1.01	-1.03	0.28	0.075	0.171	1.243	1.01	1.15	3.03	0.025	0.089	0.199