Leverage and the Value Premium*

Hitesh Doshi   Kris Jacobs   Praveen Kumar   Ramon Rabinovich

University of Houston

October 20, 2015

*We would like to thank Yakov Amihud, Rob Engle, Jan Ericsson, David Lesmond, Sheri Tice, Celim Yildizhan and seminar participants at Tulane University and the Society for Financial Econometrics Meeting for helpful comments. Please send correspondence to Kris Jacobs, C.T. Bauer College of Business, 334 Melcher Hall, University of Houston, Houston, TX 77204-6021, USA; Telephone: (713) 743-2826; E-mail: kjacobs@bauer.uh.edu.

Abstract

Does cross-sectional variation in financial leverage help explain the well-known size and book-to-market (BTM) anomalies? Identifying the impact of leverage on cross-sectional variation in stock returns is challenging because the relation between leverage and stock returns in the data is highly nonlinear. To resolve this identification problem, we use structural credit risk models such as Merton (1974) to adjust stock returns for leverage and compute returns on unlevered equity. If cross-sectional differences in leverage are the underlying cause of the asset pricing anomalies, these anomalies should disappear for unlevered equity returns. While the size effect still holds in the cross-section of unlevered equity returns, the value premium disappears, and this finding is very robust to variations in the empirical design. Regressions and simple sorts also confirm our results, but it is critical to take into account that leverage affects positive and negative unlevered equity returns differently, as suggested by structural credit risk models. Firm characteristics provide an economic explanation of our results: The highest BTM firms are high leverage but low asset risk firms with low returns on unlevered equity.

Keywords: leverage; value premium; unlevered equity returns.

JEL classification codes: G12

1 Introduction

The size discount (Banz, 1981; Fama and French, 1992) and the value premium (Rosenberg, Reid, and Lanstein, 1985; Fama and French, 1992) are two of the most important anomalies in cross-sectional asset pricing.[1] After controlling for systematic risk through unconditional betas, stocks of firms with smaller market capitalization and higher ratios of book value of equity to market value of equity (BTM) yield higher average returns.[2] The importance of these anomalies stems from their empirical robustness, having been confirmed for different sample periods, stock markets, and other security markets (Chan, Hamao, and Lakonishok, 1991; Fama and French, 1998, 2012; Asness, Moskowitz, and Pedersen, 2013). But while there is consensus on the existence of these anomalies, there is much less agreement on their economic interpretation. The literature provides a variety of possible explanations that range from interpreting the return premia as a rational reward for risk (Zhang, 2005; Petkova and Zhang, 2005) to the view that they reflect some form of irrational investor behavior (Porta, Lakonishok, Shleifer, and Vishny, 1997; Chan, Karceski, and Lakonishok, 2003).

In this paper, we investigate the hypothesis that these anomalies reflect cross-sectional differences in financial leverage. Identifying the effects of leverage on observed stock returns is challenging because, in the data, the relation between leverage and stock returns is nonlinear, and highly so for low volatility stocks. Hence, existing approaches may not be able to fully capture the impact of leverage on the cross-section of expected returns. Here, we adopt a different approach. We use returns on levered firms to obtain unlevered returns on equity, and subsequently run the cross-sectional tests on the unlevered equity returns. If cross-sectional differences in leverage are the underlying cause of the asset pricing anomalies, then *these anomalies should disappear for unlevered equity returns.* Specifically, we adjust stock returns

[1] While the cross-sectional literature contains many anomalies, the size, book-to-market, and momentum effects are widely perceived to be the most important ones. We do not address momentum in this paper. On momentum, see Jegadeesh and Titman (1993), Asness, Moskowitz, and Pedersen (2013) and the references therein.

[2] Like most of the literature, we focus on book-to-market as an indicator of value stocks. Basu (1983) instead uses the earnings-to-price ratio, which is another proxy of the value effect.

for leverage by computing unlevered equity returns using the structural credit risk models of Merton (1974) and Leland and Toft (1996). It is well known that these models allow the value of equity and risky debt to be computed by using standard option techniques.

Our main finding is that the value premium disappears in the cross-section of unlevered equity returns. However, the size discount remains for unlevered equity returns, and the market beta is insignificant when we control for size. These results are robust: they hold when we compute portfolio returns on unlevered equity by size and book-to-market quintiles, using the same twenty-five portfolios that exhibit the anomalies for stock returns (Fama and French, 1992), and also when we use cross-sectional Fama-MacBeth regressions. The results are also robust to using different structural credit risk models and various variations in the empirical design.

We confirm empirically that our results are due to the well-known fact that high BTM firms tend to be highly levered firms. Further analysis of firm characteristics provides additional economic insights. We find that the positive relation between leverage and BTM arises because high BTM firms tend to be low growth option firms with relatively low capital expenditures (CAPEX). The observed positive relation between high BTM and high leverage is thus consistent with Myers' (1977) prediction of a negative relation between leverage and growth opportunities, which has been empirically confirmed in the literature (e.g., Rajan and Zingales, 1995). Consequently, the highest BTM firms tend to have relatively low unlevered equity returns, as derived from structural credit risk models. It is also not surprising that the high BTM firms, which have relatively low growth options, have low unlevered equity volatility. This is relevant for another important finding in the cross-sectional literature. The well-known negative relation of stock (or levered equity) returns and volatility (Ang et al., 2006) disappears for unlevered equity returns.

The analysis of firm characteristics thus clarifies why high BTM firms have relatively low unlevered equity returns but high (levered) stock returns, consistent with the observed value premium. On the other hand, the relation between size and firm characteristics such as CAPEX is complex. The lack of a robust relation between leverage, size, and other firm characteristics is consistent with our findings that the size effect remains for unlevered equity returns.

We conclude that delevering equity returns using the Merton model strongly suggests that leverage may help explain the book-to-market anomaly. This raises the question why the importance of leverage for the book-to-market anomaly has not been uncovered in existing work. Specifically, several studies have investigated the importance of leverage for (levered) stock returns using a regression approach. We argue that existing regression approaches fail to fully uncover the importance of leverage for the cross-section of stock returns because of specification biases. A structural credit risk model such as Merton (1974) captures the intuition that the impact of leverage on stock returns depends on whether the unlevered equity return is positive or negative. If the unlevered return is positive, leverage will increase the levered return, and the first-order leverage term will be estimated with a positive sign, but if the unlevered return is negative, higher leverage will show up with a negative sign. If we ignore this and regress the resulting sample of negative and positive levered returns on leverage, the resulting estimates will not be informative regarding the role of leverage. We empirically confirm the importance of this argument. Our regression results are also consistent with the analysis of unlevered equity returns: leverage helps explain the value premium but not the size effect. We show that the same argument is also critically important when analyzing the impact of leverage on the cross-section of stock returns using sorts.

Our results build on an extensive existing empirical literature. A number of studies in the literature directly or indirectly suggest a role for financial leverage in explaining the cross-sectional dispersion in expected stock returns. Bhandari (1988) finds a positive relation between leverage and average stock returns. Fama and French (1992) acknowledge that size, BTM, and leverage are essentially different ways to scale stock prices in deducing information on risk and expected return, and hence all three should help explain the cross-sectional variation in expected stock returns. However, their analysis leads them to conclude that "the combination of size and book-to-market equity seems to absorb the role of leverage" (Fama and French, 1992, page 428).[3] That is, size and BTM subsume not only beta (or systematic market) risk, but also leverage and presumably financial distress risk.[4]

Our work is also related to an expanding literature that studies the impact of real options on the computation of the cost of capital and the choice of factor model. The underlying logic there is similar to our analysis in the sense that even if the CAPM generates the returns on assets in place, book-to-market matters because it proxies for the firm's risk relative to its asset base (Da, Guo, and Jagannathan 2012). Trigeorgis and Lambertides (2013) study how growth options interact with financial flexibility and leverage to determine the cross-section of returns.

The two papers most closely related to our analysis are Vassalou and Xing (2004) and Choi (2013).[5] Vassalou and Xing (2004) analyze stock returns for firms with different default probabilities implied by Merton's (1974) model. They find that the size and book-to-market effects only exist in segments of the market with high default risk. Their focus is on default risk whereas ours is primarily on leverage. They conclude that the size effect is a default effect, and that default risk is also intimately related to the book-to-market characteristics of the firm. In contrast, we find that leverage explains the differential stock returns of firms with different book-to-market ratios, but that it cannot explain the size effect.[6] Thus, our analysis suggests that leverage has effects on stock returns beyond those captured by cross-sectional variation in default risk. Choi (2013) explicitly distinguishes between the risk on levered and unlevered equity and recognizes that this distinction affects the existing empirics. However, his analysis is more closely related to the literature on the conditional CAPM, because he focuses on the link between leverage and business cycle risk, the resulting

[3] Controlling for size, Fama and French (1992) find a weak negative relationship between book leverage and expected returns.

[4] In a related vein, Chan and Chen (1991) argue that the size effect appears to be driven by small firms in financial distress, while Fama and French (1995) highlight the depressed earnings of high BTM firms.

[5] Penman, Richardson, and Tuna (2007) decompose book-to-price in enterprise book-to-price and a leverage component.

[6] See Berk (1995) for an explanation of the size effect.

time variation in betas, and the consequences for tests of the CAPM. Our focus is entirely on the cross-section and on the unconditional average unlevered and levered returns for firms with different characteristics. To the best of our knowledge, our paper is the first to map the universe of stock returns into unlevered equity returns using structural models, and to conduct asset pricing tests on the resulting cross-section to identify the role of leverage in a convenient and methodologically appealing fashion. We also demonstrate that this evidence is consistent with the results of leverage regressions, provided we take into account that leverage affects positive and negative unlevered returns differently.

The remainder of the paper is structured as follows. In Section 2 we discuss how the Merton (1974) model can be used to infer unlevered equity returns. Section 3 confirms the existence of the size and BTM anomalies for our sample of (levered) stock returns. Section 4 investigates the size and BTM anomalies in the cross section of unlevered equity returns, and also presents evidence on regressions, leverage sorts, and the implications for factor models. Section 5 further discusses the cross section of unlevered equity returns by analyzing firm characteristics. Section 6 discusses the implications of our findings for the relation between volatility and the cross-section of returns, Section 7 conducts an extensive robustness analysis, and Section 8 concludes.

2 Inferring Unlevered Equity Returns from Equity Returns on Levered Firms

In this section, we utilize Merton's (1974) framework to infer unlevered equity returns from equity returns on levered firms. Equity holders in this model have the option to pay back the face value of the debt at maturity. They will exercise the option if the value of the firm's assets exceeds the value of the debt. This insight makes it possible to value the firm's equity, and by extension its risky debt, using standard option pricing techniques. While we use the classical Merton (1974) model for expositional convenience, our results are robust to using other structural models, such as the Leland and Toft (1996) model. Please note that the terminology we use is somewhat different from the terminology usually used in the context of the Merton model. We refer to levered and unlevered equity returns to clarify that we use the model to filter out the effects of leverage. Studies that use the Merton model usually use the term "equity" to refer to the equity on the levered firm and refer to the unlevered equity as "firm assets" or "the value of the firm". Henceforth, we will denote the value of the levered equity by E and the unlevered equity by V.

The unlevered equity (or the value of the firm) follows a geometric Brownian motion:

$$\frac{dV}{V} = \mu_V dt + \sigma_V dW_t$$

where V is the value of the unlevered equity, μ_V is the expected return on the equity of the unlevered firm, σ_V is the volatility of the firms' unlevered equity, and dW_t is a standard Wiener process. The firm issues only one type of debt with face value F and maturity T. Given these assumptions, the levered equity of the firm is a call option on the unlevered firm with strike price equal to the face value of debt and time to expiration equal to the debt maturity. The value of the firm's levered equity E is obtained using the standard Black-Scholes-Merton pricing model:

$$\begin{aligned} E &= VN(d_1) - Fe^{-rT}N(d_2), \\ d_1 &= \frac{\ln\frac{V}{F} + \left(r + \frac{1}{2}\sigma_V^2\right)T}{\sigma_V\sqrt{T}}, \\ d_2 &= d_1 - \sigma_V\sqrt{T} \end{aligned} \tag{1}$$

We use the model to adjust equity returns for leverage, thus obtaining equity returns for the unlevered firm.[7] Subsequently, we conduct cross-sectional asset pricing tests on the

[7] The purpose of the Merton (1974) paper is the valuation of risky debt, but the model can also be used to study various other security returns in levered firms. Campello, Chen, and Zhang (2008) use the model to infer the expected returns on the firm's equity from the prices, yields, and expected returns on risky corporate bonds. Friewald, Wagner, and Zechner (2014) use the model to study the relationship between

unlevered equity returns. This is an intuitively appealing test of asset pricing models such as the CAPM, which are formulated in terms of the returns of unlevered firms. To understand the nature of the leverage adjustment, the following result from Merton (1974, equation (20)) is essential. The instantaneous expected excess return on levered equity $\mu_E - r$ and the instantaneous expected excess return on unlevered equity $\mu_V - r$ are related through the option's elasticity with respect to the value of the unlevered equity:

$$\mu_E - r = (\mu_V - r)\left[\frac{\partial E}{\partial V}\frac{V}{E}\right] \tag{2}$$

Here, r is the riskfree rate; $\partial E/\partial V$ is the call option delta; and, therefore, $\partial E/\partial V > 0$.

We now use Equation (2) to provide intuition for the relation between the expected return on levered equity and unlevered equity. Merton (1974) focuses almost exclusively on the valuation of risky debt, and does not provide much evidence on expected levered equity returns; however, Figure 9 in Merton studies expected levered equity returns as a function of the market debt/equity ratio. Panel A in Figure 1 illustrates this relation for three different values of the volatility of unlevered firm equity σ_V. On the horizontal axis, we have the ratio between the market value of the debt D and the market value of the firm's equity E. We assume that the yearly expected return on the unlevered firm equity μ_V is 6%. The risk-free rate is assumed to be 3%, and the initial value of the unlevered firm is assumed to be 100. Given the 6% expected return on unlevered equity, the expected value of the unlevered firm after one month is equal to 100.5. We compute the initial levered equity value and the levered equity value after one month for different face values of debt and different values of unlevered equity volatility. On the vertical axis, we have the expected excess return on the levered firm's equity $\mu_E - r$, which is concave in the D/E ratio.

Note that the intuition from Equation (2) captured by Panel A of Figure 1 is identical to the intuition we obtain using the formula for the weighted cost of capital. Defining the

firms' credit risk premia and equity returns.

value of the firm's assets V as $V = E + D$, we have

$$r_V = r_E \frac{E}{V} + r_D \frac{D}{V} \tag{3}$$

where r_V is the required return on the firm's assets, r_E is the required return on equity, and r_D is the required return on debt. Rearranging, we get an expression for the return on levered equity as a function of $\frac{V}{E}$:

$$r_E = (r_V - r_D \frac{D}{V}) \frac{V}{E} \tag{4}$$

Taking expectations and substituting the required return on debt in the Merton model

$$\mu_D - r = (\mu_V - r) \left[\frac{\partial D}{\partial V} \frac{V}{D} \right] \tag{5}$$

into Equation (4), it can be shown that Equation (4) is equivalent to Equation (2) in the Merton (1974) model.

For our purposes, it is also useful to consider Panel B of Figure 1, which graphs expected excess equity returns as a function of leverage $D/(D+E)$, which by definition is bounded between zero and one. The difference between levered and unlevered equity returns increases with leverage, as expected. Moreover, at high levels of leverage, the relationship between leverage and expected levered equity returns becomes highly convex for realistic values of the volatility of unlevered firm equity σ_V. When adjusting firms' equity returns for leverage, it is important to take these nonlinearities into account. This may be especially relevant to understanding the returns of firms with high book-to-market ratios, because we will show below that these firms typically have higher leverage ratios.

Finally, note that when the firm's unlevered equity return is negative, leverage once again amplifies this effect, but this now means that levered returns become more negative and thus *decline*. In other words, the sign of the effect of leverage on levered returns depends on the sign of the unlevered equity returns. This is illustrated in Panel C of Figure 1. We discuss this issue in more detail below.

We compute monthly unlevered equity returns by solving for the value of the unlevered firm and unlevered equity volatility at the end of every month t. Using Ito's lemma, levered equity volatility depends on unlevered equity volatility and the value of the unlevered firm as follows:

$$\sigma_E = \sigma_V \frac{dE}{dV}\frac{V}{E} \tag{6}$$

We can then infer the value of the unlevered firm and unlevered equity volatility at time t by using equations (1) and (6). These two equations depend on the levered firm's equity value, levered equity volatility, the face value of debt, debt maturity, the risk-free rate, the value of the unlevered firm, and unlevered equity volatility. All of these quantities except the value and volatility of unlevered equity are observable. We observe the face value of the debt, as well as the equity value of the levered firm, as the number of shares outstanding multiplied by the price. We measure the equity volatility of the levered firm using the annualized standard deviation of the past year's daily returns. We therefore have two equations, (1) and (6), in two unknowns, and we can solve these two equations to infer the value of the unlevered firm and the volatility of unlevered equity at the end of every month t.[8] We then compute the monthly return on unlevered equity using V_t and V_{t+1}.

In the next section we describe the data and verify that the size and BTM stock return anomalies hold for our sample. Note that we often use the terminology "stock returns" to refer to the levered equity returns. This is done only in order to be consistent with the empirical asset pricing literature.

[8] Solving for the value of the unlevered equity and unlevered equity volatility using two equations in two unknowns is the simplest approach. More sophisticated estimation methods are available, see for instance Duan (1994) and Duffie, Saita, and Wang (2007).

3 Data and Anomalies in Stock Returns

We obtain stock returns and the number of shares outstanding for all firms from the Center for Research in Security Prices. The risk-free rate is obtained from Kenneth French's website. The estimation of the value of the unlevered firm using the firm's levered equity and levered equity volatility requires information on the face value of debt. We obtain quarterly data on the firm's debt and liabilities from Compustat. Compustat debt data are available from 1971, so our sample period is from 1971 to 2012. In our benchmark implementation, we follow Eom, Helwege, and Huang (2004), who measure the firm's debt as total liabilities. For the cross-section of firms in our sample, it is not possible to compute the exact debt maturity. Thus, we specify the maturity of the debt equal to 3.38 years, which is the average maturity of debt obtained in Stohs and Mauer (1996) using a much smaller sample. In robustness tests in Section 7, we provide results for alternative definitions of firm debt and debt maturity.

While our computation of the value of the unlevered firm using the two-equations-in-two-unknowns approach is the most direct one, we have to perform this computation at each time t for all the firms in the sample, which is time-consuming. We, therefore, compute the value of the unlevered firm once a month, and subsequently compute monthly returns on unlevered equity. This implementation also makes comparison with the available literature on cross-sectional stock returns easier, because most of these studies use monthly returns.

Before embarking on our empirical analysis, we first verify that the size and BTM anomalies hold in our sample when we use (levered) stock returns. Panel A of Table 1 shows the stock returns for twenty-five size- and book-to-market portfolios, computed according to Fama and French (1993). Consistent with the available literature, small firms and high book-to-market firms have higher stock returns in our sample. The average risk-free rate in our sample is 0.43% per month. Hence, the excess returns for the twenty-five size- and book-to-market portfolios are similar to the excess returns in Fama and French (1993), even though Fama and French report on a very different sample period. Panel A also shows the differences between the fifth and first size quintiles, conditional on book-to-market, and the differences between the fifth and the first book-to-market quintiles, conditional on size. We also report the t-statistics for these differences. The differences between the fifth and the first book-to-market quintiles are positive and economically large in all five cases. They are statistically significant in three of the five cases.

Portfolio double sorts by characteristics, as shown in Panel A of Table 1, are intuitively appealing, but a more formal regression approach is also useful. We follow Fama and French (1992) and consider how size and book-to-market affect the cross-section of stock returns when they are considered as firm characteristics.[9] The results are shown in Panel B of Table 1. We use as regressors the firm's market beta, the logarithm of the firm's market capitalization $ln(ME)$, the logarithm of book value over market value $ln(BE/ME)$, the logarithm of assets over market value $ln(A/ME)$, and the logarithm of assets over book value $ln(A/BE)$. The results confirm the two main stylized facts of interest for our sample: Regardless of the other regressors, the coefficient on $ln(ME)$ is significantly negative, confirming the size effect, whereas the coefficient on $ln(BE/ME)$ is significantly positive, confirming the BTM effect.

In sum, despite using a very different sample from Fama and French (1992, 1993), we confirm the statistical and economic significance of the size discount and the value premium in the cross-section of stock returns. We now turn to our analysis.

4 Size and Book-to-Market Effects in Unlevered Equity Returns

This section contains our main empirical results. We first present average returns on unlevered equity using double sorts on size and book-to-market. Subsequently, we assess the role of the size and book-to-market characteristics in determining the cross-section of unlevered

[9] See also Daniel and Titman (1997) on the importance of size and book-to-market as characteristics.

equity returns. We investigate the impact of leverage on return regressions and portfolio sorts and study the sample of zero leverage firms. Finally, we docuemnt the implications for factor models.

4.1 The Cross-Section of Unlevered Equity Returns

Our most important empirical results are shown in Tables 2 and 3. The structure of Table 2 is the same as that of Panel A of Table 1. In Table 2 however, we use the unlevered equity returns obtained using the Merton (1974) model instead of the (levered) stock returns. The face value of debt in the Merton model is assumed to be equal to the total liabilities and the maturity of debt is assumed to be 3.38 years. We present the average value-weighted returns for each of the size and book-to-market portfolios, where the weights are determined by the market value of the stock. Size 1 and BTM 1 indicates the lowest size and book-to-market portfolios respectively. Size 5 and BTM 5 indicates the highest size and book-to-market portfolios. Note that the firms in each of the twenty-five cells are exactly the same ones as in Panel A of Table 1.

The results are striking. The pattern of returns on unlevered equity as a function of BTM is markedly different from the pattern for levered stock returns shown in Panel A of Table 1. In contrast to the monotone positive relation between stock returns and BTM — that constitutes the value premium — the relation between unlevered equity returns and BTM is complex and non-monotone. In particular, for Size 2 through Size 4 quintiles, the relation of unlevered equity returns to BTM is best described as a cubic function, where returns first fall, then rise, and fall again for the highest BTM (BTM 5) quintile. Indeed, for this middle 20%–80% firm size groups, the *highest* BTM quintile has the *lowest* average return on unlevered equity. Meanwhile, for the smallest size quintile (Size 1), the relation is also described by a cubic function, but here the returns first rise, then fall, and rise for the highest BTM group. Finally, for the largest size group (Size 5), the relation is quadratic, with the returns first rising and then declining in BTM.

Given the complex and polynomial relation between unlevered equity returns and BTM across all size groups, it is not surprising that the difference between the return on the highest and lowest BTM quintiles is not statistically significant for any size group. This is in striking contrast to stock returns, where the difference between the return on the highest and lowest BTM quintiles is positive and statistically and economically significant for Size 1 through Size 3. Thus, we conclude that de-levering returns through a widely-used structural credit risk model (Merton, 1974) eliminates the positive BTM effect.

However, the size effect observed for stock returns appears to survive adjustments for leverage. We find that the difference between the return on the highest and lowest size quintiles is negative in all BTM groups, and highly statistically significant for the largest BTM quintile, as is the case for stock returns (cf. Panel A of Table 1). Note that for BTM 1, the size effect is positive for stock returns (but not statistically significant), which is opposite of the overall negative size effect. For BTM 1 in Table 2, the difference between the average unlevered equity returns of the highest and lowest size groups is negative, but also statistically insignificant.

4.2 Regressions on Characteristics

Table 3 presents the results of an analysis that repeats the regressions in Panel B of Table 1 for unlevered equity returns. The coefficient on BTM is not statistically significant, and it switches sign in one specification. Thus, correcting for leverage effectively eliminates the BTM effect. Meanwhile, the size effect is negative and statistically significant.[10] Consider the last row of Table 3: the size coefficient has the same magnitude as in the corresponding specification in Panel B of Table 1, but with a higher t-statistic. Note that these findings are consistent with our results in Table 2.

Also note that the regressions with unlevered equity returns in Table 3 yield a positive

[10]Note that the regressions in Tables 1 and 3 capture the size effect better than the portfolio sorts in Tables 1 and 2.

coefficient on market beta, compared to a negative coefficient when we use stock returns (in Panel B of Table 1). When market beta enters by itself in the first row of Table 3, the estimate is statistically significant. However, when we introduce size as a regressor, the coefficient on market beta is positive, but it is no longer statistically significant. Thus, adjustment for leverage does not alter the fact that systematic market risk has an insignificant influence on the cross-sectional variation in returns when we control for size and BTM.

To summarize, the results in Tables 2 and 3 show that the value premium disappears when we adjust stock returns for leverage using the classical structural credit risk model of Merton (1974). The size discount still holds however when we adjust stock returns for leverage. Below, we show that this result is robust to the use of alternative structural credit risk models, such as the Leland and Toft (1996) model.

These results suggest that cross-sectional differences in leverage are the underlying cause of the value premium, but not the size discount. If this is indeed the case, then we should find confirming evidence when we study cross-sectional variation in leverage. Table 4 presents the average leverage, defined as the ratio of total liabilities to the sum of total liabilities and the market value of equity, for each of the 25 size and BTM portfolios. The results indicate a strong positive relation between BTM and leverage. Indeed, it is striking that leverage increases with book-to-market in every size quintile, and that this increase is also monotonic within each size quintile. Moreover, the difference between the average leverage of BTM 5 and BTM 1 quintiles is highly statistically significant for each size group. This analysis supports the main intuition of our study, namely that the positive BTM effect on stock returns is due to an underlying positive relation of BTM and leverage, given that stock returns and financial leverage are positively related (e.g., Bhandari, 1988). In contrast, the relation between size and leverage is much less pronounced, which is consistent with the foregoing result that adjusting for leverage does not eliminate the size effect.

4.3 Leverage Regressions

Delevering equity returns using the Merton model strongly suggests that leverage may help explain the book-to-market anomaly. This raises the question why the importance of leverage for the book-to-market anomaly has not been uncovered in existing work. Several studies have investigated the importance of leverage for (levered) stock returns using a regression approach, and they have explicitly considered if leverage can capture the book-to-market anomaly.[11] We now present evidence suggesting that existing regression approaches fail to fully uncover the importance of leverage for the cross-section of stock returns because of specification biases.

We analyze the role of leverage in return regressions with the Merton (1974) model, or any other structural model, in mind. Consider again the mechanics of the model captured by Figure 1, which raises two important issues. First, the relation between leverage and returns is likely to be (highly) nonlinear. Any return regression that includes leverage as a regressor will therefore need to specify higher-order functions of leverage. It is well-known that it is challenging to precisely estimate such nonlinear relationships, especially if higher-order polynomials are required.[12]

A second, perhaps even more important, potential problem is that the role of leverage differs dependent on whether the unlevered equity return is positive or negative. This is evident from Panels B and C of Figure 1. If the firm's unlevered return is positive, leverage will increase the levered return, and the first-order leverage term will be estimated with a positive coefficient, but if the unlevered equity return is negative, higher leverage will show up with a negative coefficient. If we ignore this and regress the resulting sample of negative and positive levered returns on leverage, the resulting estimates will not be informative regarding the role of leverage.

We explore these issues in Tables 5 and 6. In order to construct the cleanest possible

[11] See for instance Bhandari (1988), Fama and French (1992), and George and Hwang (2010).

[12] See for instance Smith (1918) and Magee (1998).

experiment, Table 5 uses return data simulated using the Merton model. The values of the model parameters used in the simulations are $V_0 = 100$, $r = 3\%$, and $T = 3.38$ years. The volatility σ_V is chosen to be uniformly distributed between 10% and 150%. The drift μ_V is chosen to be uniformly distributed between -6% and 6%. The leverage, defined as the ratio of debt to asset value, is chosen to be uniformly distributed between 0 and 1. We simulate 10,000 monthly equity returns using these parameters and regress the simulated returns on leverage and higher order terms of leverage. $1_{Ret>0}$ ($1_{Ret<0}$) is a dummy variable, which is equal to one when the equity return is positive (negative).

The advantage of using simulated data is that we can keep the analysis simple because we do not have to consider additional explanatory variables, such as size. The data are generated using the Merton model, and we therefore know that leverage should be significant in these regressions. However, the first three rows of Table 5 clearly indicate that this is not what we find, regardless of whether or not higher order terms in leverage are included. The point estimates of the leverage terms are not statistically significant and the R-squares of the regressions are very small.

In rows 4-6 of Table 5, we address the different role of leverage in case of positive and negative unlevered equity returns. We do this by simply interacting the leverage terms with a dummy that depends on the sign of the returns. The first dummy takes on a value of one if returns are positive and the second dummy takes on a value of one if returns are negative As expected, this dramatically affects the results. All the leverage terms are statistically significant and the R-square of the regressions is approximately 60%. The linear term in leverage is always estimated with a positive sign, as expected.

In summary, the regressions based on simulated data in Table 5 suggest that existing work may have failed to properly account for the role of leverage in the cross-section of returns, by ignoring the different impact of leverage on positive and negative unlevered returns. We report on polynomials in leverage of up to order three, but we have also investigated higher order terms up to order five, and the results are robust.

In Table 6, we perform a similar exercise using historical data. In this case it is of course not sufficient to simply regress on polynomials of leverage. We include other firm characteristics, because on the one hand we want to investigate how correctly accounting for leverage affects existing anomalies, and on the other hand we believe that we can only meaningfully analyze the role of leverage once we condition on some well-known empirical facts. We therefore include size, book-to-market, and the firm's beta in some of the regressions. Rows 1-3 exclusively regress on leverage. Rows 4-6 also include size, book-to-market, and the firm's beta in the regression. Rows 7-12 repeat the regressions from rows 1-6, but now the leverage terms are interacted with dummies that depend on the sign of returns, exactly as in Table 5.

The results are very convincing. In rows 1-3, the leverage terms are statistically significant. The problems with the leverage regressions surface in rows 4-6, when the stock's beta and other characteristics are added to the regressions. Many of the leverage terms are not statistically significant, and the estimated signs change with the polynomial order. When we include the interactions with the dummies in rows 7-12, the results change dramatically. All leverage terms are highly statistically significant and the signs are very robust to alternative specifications. The first-order leverage term is always estimated with a positive sign, as expected. Interestingly, the size effect remains, and in fact it is even more statistically significant. However, the book-to-market effect is clearly impacted by taking leverage into consideration. Book-to-market is estimated with a negative sign in rows 10-12, and the estimates are not always statistically significant.

In summary, we conclude that leverage regressions confirm our analysis using unlevered equity returns.

4.4 Zero Leverage Firms

Table 7 provides additional evidence on the role of leverage in explaining the book-to-market anomaly, by focusing on zero-leverage firms. The analysis of zero-leverage firms faces two challenges. First, the resulting sample is very small and therefore any relationship is likely to be imprecisely estimated. Second, as argued forcefully by Strebulaev and Yang (2013), there is an endogeneity issue because zero leverage firms in the data are a self-selected group of firms that have chosen to have no leverage. This may bias inference.

Table 7 presents results for two different book-to-market sorts. In Panel A, we use the same breakpoints used in Table 1, which are consistent with Fama and French (1992). The problem with these breakpoints is that the number of firms in some of the cells is very small or sometimes even zero. In our calculation we only use the portfolio returns in a given month if at least 15 firms are in the cell at that point in time. The results in Panel A indicate that the long-short return is very small, five basis points per month, and statistically insignificant. Note also that the pattern of returns as a function of book-to-market is not monotonic.

To avoid dropping cells, in Panel B we use breakpoints that are based on the zero-leverage firms only. This guarantees that we have sufficient firms in each cell at each point in time. In Panel B, we find a return spread of 39 basis points but it is statistically insignificant. Even more importantly, the pattern of returns as a function of book-to-market is again not monotonic.[13] However, we have to be cautious when interpreting the evidence in Table 7, because the dataset is simply not sufficiently large.

4.5 Sorting on Leverage

Rather than using leverage in regressions, as in Section 4.3, we can study the impact of leverage using sorting procedures. Table 8 presents the average value-weighted returns in 27 triple-sorted portfolios based on size, book-to-market, and leverage. We use terciles to minimize problems with small samples, but nevertheless some cells are blank because for these portfolios we have insufficient data to compute average returns.[14] Panel A presents

[13] Interestingly, the univariate pattern of returns as a function of book-to-market looks similar to the pattern for unlevered returns which we will analyze in Table 11 below.

[14] Some cells are empty in certain months. To compute the average portfolio returns for a given cell, we require returns to be available for 400 out of the 492 months.

the average returns for the nine size and book-to-market portfolios with low leverage. Panel B presents the average returns for the nine size and book-to-market portfolios with medium leverage, and Panel C for high leverage.

In columns 2 to 4 of each panel, we compute the value-weighted returns in each portfolio using all firms in our sample. In columns 5 to 7, we compute the value-weighted returns in each portfolio using firms with only negative returns. In columns 8 to 10, we compute the value-weighted returns in each portfolio using firms with only positive returns.

The results in columns 2 to 4 correspond to running regressions without accounting for the differential impact of leverage on positive and negative unlevered equity returns. For our purpose, the most important conclusion is that the book-to-market effect seems present in all three panels, i.e. irrespective of the level of leverage. However, columns 5 to 10 clearly indicate that this conclusion is due to ignoring the differential impact of leverage on positive and negative unlevered equity returns. When considering positive returns in columns 8 to 10, higher book-to-market firms have lower stock returns, regardless of firm size or leverage level. In the case of negative returns in columns 5 to 7, the book-to-market effect remains for smaller firms. Even for small firms, the pattern is not monotonic in the high leverage case in Panel C.

We conclude that overall, these portfolio sorting results confirm the results of the regressions in Table 6. When analyzing the role of leverage in explaining stock returns, it is critical to take into account the differential impact of leverage on negative and positive unlevered equity returns, consistent with the intuition from the Merton (1974) model. When taking this into account, the role of book-to-market in explaining stock returns either disappears or is greatly reduced.

4.6 Implications for Factor Models

We now investigate the implications of our findings for factor models. Panel A of Table 9 replicates the results from the time-series regressions in Table 6 in Fama and French (1993) for our 1971-2012 sample period. To facilitate the comparison with the unlevered equity returns and factors, we construct the size and book-to-market factors ourselves, following the methodology in Fama and French (1993). As is the case for the twenty-five test portfolios we construct, the correlation with the factors obtained from Ken French's website is very high.

The remarkable success of the Fama-French (1993) three factor model is due to its robustness, and Panel A confirms this. Although our sample period is completely different from the sample period in the original Fama-French (1993) study, the results are very similar to those in Fama and French (1993, Table 6). In particular, the loadings on the factors, t-statistics, and R-squares have similar magnitudes. Even more remarkably, the pattern of the R-squares as a function of size and book-to-market follows that in Fama and French (1993), with the smallest R-squares for large firms with high book-to-market. Also, the loadings for the five portfolios in the lowest book-to-market quintile are all negative, whereas the other ones are positive, again mimicking the stylized facts in Fama and French (1993). Clearly the economic forces underlying the Fama-French model are extremely robust and reliable.

Panel B of Table 9 repeats the time-series regressions using twenty-five size and book-to-market portfolios based on unlevered equity returns. The composition of these twenty-five portfolios, that is, the firms constituting them, is exactly as in Panel A, as well as Panel A of Table 1 and Table 2. Also, to obtain the factors, we use unlevered equity returns but we use the same firms used to construct the (levered) stock-based factors. The loadings of the twenty-five portfolios on the three factors are not very different in magnitude to the ones in Panel A, but the t-statistics are smaller. R-squares in Panel B are smaller across the board compared to Panel A, but especially for high book-to-market firms.[15]

Panels C and D present the results of a cross-sectional analysis of the Fama-French (1993)

[15] We note that the portfolio returns in Panel B are computed using the same weights as in Panel A, which are the weights based on the market value of levered equity. It could be argued that instead, weights based on unlevered equity should be used. It turns out that unlevered equity weights can be very different from levered equity weights, especially in the portfolios with high book-to-market and high leverage. We discuss this issue in detail in Section 7 below.

model. We use the Fama-MacBeth (1973) approach: we estimate the betas using the last five years of monthly returns and run a cross-sectional regression for the next available month. We then average the coefficients and compute t-statistics based on the time-series of coefficients. Panel C presents results for (levered) stock returns and Panel D for unlevered equity returns. The size factor enters with a positive sign and is statistically more significant for unlevered equity returns, but the HML factor changes sign and is not statistically significant. These results are consistent with the stylized facts highlighted by the sorting results and the regression results on characteristics.

5 Analysis of Firm Characteristics

The differences in leverage for size and BTM portfolios in Table 4 support the hypothesis that leverage helps to explain the book-to-market effect. Moreover, Table 2 indicates that the highest BTM firms tend to have low average returns on unlevered equity (for the 20%-80% size groups). We now further relate these cross-sectional return differences to differences in firm characteristics related to leverage and asset return risk.

Table 10 presents some salient characteristics for each of the 25 size and BTM portfolios. These characteristics are computed in December of the year prior to the portfolio formation and are presented as follows: Panel A of Table 10 presents the average capital expenditures, defined as the capital expenditure scaled by the lagged property, plant and equipment; Panel B presents the average book return on assets, defined as the net income scaled by the book value of assets; Panel C presents the average book return on equity, defined as the net income scaled by the shareholder equity; Panel D presents the average tangibility, defined as the property, plant and equipment scaled by the total book value of assets; Panel E presents the average annualized stock volatility computed using the standard deviation of past one year daily returns; and Panel F presents the average unlevered equity return volatility obtained from the Merton model with debt equal to the total liabilities maturing in $T = 3.38$ years.

There are several noteworthy aspects regarding the data presented in Table 10. High BTM firms appear to be low growth option firms with relatively low capital expenditures (CAPEX) and low unlevered equity return volatility. For all size quintiles, there is a monotone negative relation between BTM and capital expenditures, while a similar negative relation between BTM and unlevered equity return volatility exists for all size quintiles except the smallest one. The low capital expenditures are consistent with the view that in high BTM firms the substantial component of value is in assets-in-place (AIP) rather than in growth options (e.g., Dechow, Sloan, and Soliman, 2004; Cooper, Gulen, and Schill, 2008; Da, 2009). From the perspective of the real options literature, high BTM firms tend to be those that have already converted higher risk growth options to lower risk AIP (Carlson, Fisher, and Giammarino, 2004; Berk, Green, and Naik, 1999, 2004). This interpretation is consistent with the negative relation of BTM to unlevered equity return volatility.

Moreover, with the exception of the smallest firms (Size 1), the highest BTM firms also have the lowest book return on assets. In a similar vein, for the medium to large firms (Size 3 through Size 5), the highest BTM firms have the lowest book return on assets. We note that the low profitability of high BTM firms is consistent with the findings of Fama and French (1995), although our samples are quite different. Thus, it appears that for the majority of the firms (Size 2 through Size 5), the highest BTM firms are located in relatively mature industries, characterized by relatively low profitability and risk (unlevered equity return volatility). This view is also consistent with the fact that the high BTM firms tend to have high tangibility. For example, in the medium to large size firm groups (Size 3 through Size 5), firms in BTM 4 and BTM 5 groups have the highest tangibility.

Taken together, the low growth option intensity and mature business environment of the high BTM firms are consistent with the fact that they have low returns on unlevered equity.[16] Meanwhile, consistent with the corporate finance literature (e.g., Myers, 1977),

[16] However, as seen in Table 2, the relation between average unlevered equity returns and BTM is non-monotone overall.

the high tangibility and low unlevered equity return volatility of the high BTM firms helps explain their high leverage, as seen in Table 4.

On the other hand, we do not see clear patterns between size and CAPEX. While there is a negative relation between size and CAPEX for the middle three BTM quintiles, for the smallest and the largest BTM quintiles the relationship between size and CAPEX is non-monotone. Similarly, the relation between size and book profitability is complex. While large firms in the small BTM groups tend to have higher profitability, for firms in the BTM 3 through BTM 5 groups, the relation between size and book profits is not monotone.

6 Volatility and the Cross-Section of Returns

Ang et al. (2006) document, among other things, a negative cross-sectional relation between a stock's volatility and its subsequent return. Our analysis of firm characteristics suggests that the positive relation between leverage and BTM arises because of the relatively low growth option component of these firms. High BTM firms tend to be low growth option firms with relatively low capital expenditures. Not surprisingly, these high BTM firms also tend to have low unlevered equity volatility.

These findings suggests that de-levering equity returns may also affect the relation between volatility and returns. Table 11 addresses precisely this issue. While we have hitherto used the twenty-five Fama-French portfolios sorted on size and book-to-market to facilitate the interpretation of our results, when investigating the role of volatility it is more instructive to use a simple volatility sort as in Ang et al. (2006).

The third row of Table 11 replicates the results of Ang et al. (2006) using quintiles for our sample. For comparison, the first two rows present results using quintiles and a simple univariate sort based on size and book-to-market. The results confirm the robustness of the cross-sectional relationship documented by Ang et al. (2006).

The bottom three rows of Table 11 repeat the quintile results for the univariate sorts, but this time using unlevered equity returns. The last row indicates that the negative cross-sectional relation between volatility and returns does not obtain using unlevered equity returns, suggesting that this data pattern is partly due to leverage. Note that the univariate sorts in rows 4 and 5 of Table 11 confirm our conclusion that the book-to-market effect is also partly due to leverage, but that the size effect remains.

7 Robustness

In this Section we report on several robustness tests. First, we discuss results for different definitions of the firm's debt and different debt maturities. Second, we present results for a different computation of unlevered equity returns. Third, we present results for the Leland and Toft (1996) model, which has a richer structure, to investigate if our results are due to the use of the Merton (1974) model. Finally, we discuss the importance of the weights used in computing the portfolio returns.

7.1 Measuring Debt and Debt Maturity

Structural credit risk models can be implemented with relatively few assumptions, and we use the classical Merton (1974) model because it uses as few assumptions as possible. One assumption is on the definition and the maturity structure of the debt. Two approaches are used in the existing literature. Most implementations use a maturity of one or five years, and they measure the debt as the sum of the short-term debt and one-half of the long-term debt.[17] This approach is appropriate for these studies because their main focus is the computation of expected one-year or five-year default probabilities.

Our focus is different and for our analysis presented above in Tables 2 through 11, we therefore follow Eom, Helwege, and Huang (2004), who measure the firm's debt as total

[17] See Bharath and Shumway (2008), Campbell, Hilscher, and Szilagyi (2008), Crosbie and Bohn (2003), Duffie, Saita, and Wang (2007), Ericsson, Reneby and Wang (2006), and Vassalou and Xing (2004) for examples.

liabilities. For our cross-section of firms, we do not have sufficiently detailed information to compute the exact maturity of the debt for each firm. We therefore use the average maturity from Stohs and Mauer (1996), who use a much smaller sample, which allows them to compute the exact maturity structure of the firms' debt. The average maturity in their study is 3.38 years.

We now investigate the robustness of our results to alternative assumptions. Panels A and B of Table 12 report results for the Merton (1974) model using a debt maturity of one and five years respectively. In Panel A, we measure the debt as the sum of the short-term debt and one-half of the long-term debt, while in Panel B we define the debt as equal to the total liabilities. In Panel C, we present results using different debt maturities for different firms. The Compustat data do not provide us the exact maturity of the debt or liabilities, but they provide information on the debt maturing in one, two, three, four and five years. For debt maturing in two to five years, we use Compustat items DD2 to DD5. Current liabilities are our measure of debt maturing in one year. We treat the remaining liabilities as the long-term debt maturing in 10 years. Using this information, we compute the average maturity of the debt as follows:

$$T = \sum_{t=1}^{5} w_t \times t + \left(1 - \sum_{t=1}^{5} w_t\right) \times 10,$$

where w_t is the proportion of total debt maturing in t years. Note that the detailed debt information is available annually, therefore we hold the debt maturity to be same for a given fiscal year even though we use quarterly debt data as our measure of default boundary F. On average across all firms and years in our sample this gives a maturity of $T = 4.75$. The debt is defined as equal to the total liabilities in Panel C.

Finally, In Panel D, we report the results for the Merton model, defining debt as the sum of long-term and short-term debt, with maturity $T = 3.38$ years.

The results are clear. The calibration of the maturity and the definition of the debt somewhat affects the level of the unlevered equity returns, but not the cross-sectional patterns as a function of BTM. These assumptions do not impact the cross-sectional differences among firms, and our results are robust in this dimension.

7.2 Computing Unlevered Equity Returns

In our benchmark implementation we infer the value of the unlevered equity at times t and $t+1$ using equations (1) and (6), and then compute the monthly unlevered equity return using V_t and V_{t+1}. We now report on a different implementation that directly uses equation (2). At time t, we solve the model for the value of unlevered equity V_t and its volatility σ_{V_t}. We then compute ex-post (levered) stock returns over the next month as an estimate of the expected levered equity return $\mu_{E,t}$. Using the estimates V_t, σ_{V_t}, and $\mu_{E,t}$ and equation (2), we then obtain an estimate of the expected unlevered equity return μ_{V_t}.

This implementation has both advantages and disadvantages compared to the benchmark implementation. It is intuitively appealing because it uses the theoretical relationship (2) and it only requires information at one point in time. By using the ex-post stock return to estimate $\mu_{E,t}$, dividends are also taken into account in a straightforward way, while in the benchmark approach they have to be added into returns after computing V_t and V_{t+1}. A drawback of this implementation is that our sampling frequency is monthly, thus, we are effectively using monthly stock returns as an estimate of instantaneous expected returns μ_E. Hence, implicitly we are assuming that important model features, including leverage, remain constant over a one-month period.

Panel E of Table 12 shows the results of this alternative implementation. The result that higher BTM is not associated with higher returns is robust for all but the smallest size quintile. We therefore conclude that our results are not sensitive to alternative procedures for computing unlevered equity returns. Interestingly, the size effect seems to be economically and statistically stronger in Panel E of Table 12 than in Table 2.

7.3 The Leland-Toft Model

Panel F of Table 12 presents the results obtained using the Leland-Toft (1996) model instead of the Merton (1974) model. Other aspects of the implementation, such as the debt maturity and the definition of debt, are the same as in Table 2. The Leland-Toft model is a more richly parameterized and more complex model than the Merton (1974) model, allowing for an endogenous default boundary.[18] The model implementation is identical to the method used to estimate the Merton model in Tables 2 and 3, i.e. at each point in time, we solve two equations to obtain two unknowns. However, this model requires additional inputs besides the information used to estimate the Merton model. The Leland-Toft model also requires information about the tax rate, the payout ratio, and the costs of financial distress. We fix the tax rate at 20%, which is consistent with the previous literature (see e.g. Leland (1998)). We assume that the firm loses 15% of its assets in financial distress, which is within the range estimated in Andrade and Kaplan (1998). We compute the payout rate each quarter using the Compustat and CRSP data. The payout rate is defined as follows.

$$\delta = \frac{IE}{TL} \times \frac{TL}{TL \ + \ ME} + DY \times \left(1 - \frac{TL}{TL \ + \ ME}\right)$$

where IE is the interest expense obtained from Compustat, TL is the total liabilities, ME is the market value of equity, and DY is the dividend yield.

The results in Panel F indicate that the choice of model does not drive our results. Just as in Table 2, high BTM firms in Panel F of Table 12 do not have higher unlevered equity returns than low BTM firms.

[18] See for instance Black and Cox (1976), Collin-Dufresne and Goldstein (2001), Cremers, Driessen, and Maenhout (2008), Geske (1977), Kim, Ramaswamy and Sundaresan (1993), Leland (1994), and Longstaff and Schwartz (1995) for examples of other extensions of the Merton (1974) model.

7.4 Cumulative Returns

One question that comes to mind is if the effect of leverage on stock returns changes through time. In Figure 2 we answer this question by graphing the cumulative long-short return for levered and unlevered equity over the sample, starting with a $1 investment in 1971. Panel A graphs the cumulative long-short return based on book-to-market for levered equity. It is well known that the return changes through time and that this time variation is related to the business cycle.

Panel B of Figure 2 graphs the corresponding cumulative long-short unlevered return. The figure indicates that the absence of a book-to-market effect in the unlevered equity returns is not due to a small part of the sample period. But there is substantial variation in the long-short return on unlevered equity. Somewhat surprisingly, the cumulative long-short investment breaks even only because of the large return on unlevered equity during the recent recession.

7.5 Levered and Unlevered Equity Weights

Table 13 reports alternative results where the twenty-five portfolio unlevered equity returns are computed using different weights. In Tables 2 and 9, portfolio unlevered equity returns are computed using the weights used in Panel A of Table 1, which are based on (levered) stock market value. It may be preferable to use weights based on the value of unlevered equity, as some of the stock-based weights may be affected by leverage. The differences between the resulting returns should be more pronounced for those portfolios that contain firms with high leverage.

Panel A of Table 13 reports the unlevered equity returns for the twenty-five portfolios using unlevered weights. Compared to the results in Table 2, the resulting portfolio returns are significantly smaller for high book-to-market firms, and for the small firms in particular. More importantly for our purposes, the implications are that our result is strengthened.

High book-to-market firms do not offer higher returns after correcting for leverage. In fact, for three out of the five size quintiles, they offer statistically significant lower returns.

Panel B of Table 13 reports time-series regressions obtained using unlevered weights instead of the levered weights used in Table 9. Comparison with Table 9 indicates that the use of unlevered weights also affects these results. The t-statistics associated with the betas for the HML factor are much smaller in Table 13 compared with Table 9, and the R-squares are also lower, especially for high BTM portfolios.

We conclude that our results are somewhat sensitive to the choice of unlevered versus levered weights, but that using unlevered weights actually strengthens the results. We, therefore, use the levered weights in our benchmark analysis, because they yield more conservative results.

8 Summary and Conclusions

The size effect and the book-to-market (BTM) effect — the so-called value premium — are two of the most important anomalies in cross-sectional asset pricing, having been confirmed for different sample periods and markets. But while there is consensus on the existence of these anomalies, there is much less agreement on their economic interpretation. The literature provides a variety of possible explanations that range from interpreting the return premia as a rational reward for risk to the view that they reflect some form of irrational investor behavior. Some existing work conjectures that these anomalies reflect cross-sectional differences in financial leverage. However, identifying the effects of leverage on observed stock returns is challenging because, in the data, the relation between leverage and levered equity returns is nonlinear.

We adopt a novel approach to examine the role of leverage in explaining these cross-sectional stock pricing anomalies. We adjust levered equity (stock) returns for leverage by computing unlevered equity returns using the widely used structural credit risk models of Merton (1974) and Leland and Toft (1996); these models allow equity and risky debt valuation to be computed by using standard option techniques. We subsequently run the standard cross-sectional tests on the unlevered equity returns. If cross-sectional differences in leverage are the underlying cause of the asset pricing anomalies, then these anomalies should disappear for unlevered equity returns.

While our sample period (from 1971 to 2012) is very different from the one used by Fama and French (1992, 1993), we confirm the existence of the size effect and the value premium for stock returns. Our main result is that the value premium disappears in the cross-section of unlevered equity returns. The size discount exists even for unlevered equity returns. We confirm that our results are robust to the use of different structural credit risk models and empirical implementations. We also show that including leverage as a firm characteristic in regressions can capture the value premium, provided one allows for leverage to affect positive and negative unlevered returns differently, as suggested by structural credit risk models.

An analysis of firm characteristics provides an economic explanation of these results. High BTM firms tend to be low growth option firms with relatively low capital expenditures. The observed positive relation of high BTM and high leverage is thus consistent with Myers's (1977) prediction of a negative relation between leverage and growth opportunities. This also explains why high BTM firms have low unlevered equity volatility. These stylized facts also explain why the well-known negative relation between stock returns and volatility (Ang et al., 2006) disappears for unlevered equity returns.

References

[1] Andrade, G., and S. N. Kaplan, 1998, "How Costly is Financial (not Economic) Distress? Evidence from Highly Leveraged Transactions that became Distressed," *Journal of Finance*, 53, 1443-1493.

[2] Ang, A., R. Hodrick, Y. Xing, and X. Zhang, 2006, "The Cross-Section of Volatility and Expected Returns," *Journal of Finance*, 11, 259-299.

[3] Asness, C., T. Moskowitz, and L. Pedersen, 2013, "Value and Momentum Everywhere," *Journal of Finance*, 68, 929-985.

[4] Banz, R., 1981, "The Relationship Between Return and Market Value of Common Stocks," *Journal of Financial Economics*, 9, 3-18.

[5] Basu, S., 1983, "The Relationship Between Earnings Yield, Market Value, and Return for NYSE Common Stocks: Further Evidence," *Journal of Financial Economics*, 12, 129-156.

[6] Berk, J., 1995, "A Critique of Size Related Anomalies," *Review of Financial Studies*, 8, 275-286.

[7] Berk, J., R. Green, and V. Naik, 1999, "Optimal Investment, Growth Options, and Security Returns," *Journal of Finance*, 54, 1553-1607.

[8] Berk, J., R. Green, and V. Naik, 2004, "Valuation and Return Dynamics of New Ventures," *Review of Financial Studies*, 17, 1-35.

[9] Bhandari, L., 1988, "Debt/Equity Ratio and Expected Common Stock Returns: Empirical Evidence," *Journal of Finance*, 43, 507-528.

[10] Bharath, S., and T. Shumway, 2008, "Forecasting Default with the Merton Distance-to-Default Model," *Review of Financial Studies*, 21, 1339-1369.

[11] Black, F., and J. Cox, "Valuing Corporate Securities: Some Effects of Bond Indenture Provisions," *Journal of Finance*, 31, 351-367.

[12] Campbell, J., J. Hilscher, and J. Szilagyi, 2008, "In Search of Distress Risk," *Journal of Finance*, 63, 2899-2939.

[13] Campello, M., L. Chen, and L. Zhang, 2008, "Expected Returns, Yield Spreads, and Asset Pricing Tests," *Review of Financial Studies,* 21, 1297-1338.

[14] Carlson, M., A. Fisher, and R. Giammarino, 2004, "Corporate Investment and Asset Price Dynamics: Implications for the Cross-Section of Returns," *Journal of Finance*, 59, 2577-2603.

[15] Chan, K.C., and N. Chen, 1991, "Structural and Return Characteristics of Small and Large Firms," *Journal of Finance*, 46, 1467-1484.

[16] Chan, L.K., Y. Hamao, and J. Lakonishok, 1991, "Fundamentals and Stock Returns in Japan," *Journal of Finance*, 46, 1739-1764.

[17] Chan, L.K., J. Karceski, and J. Lakonishok, 2003, "The Level and Persistence of Growth Rates," *Journal of Finance*, 58, 643-684.

[18] Choi, J., 2013, "What Drives the Value Premium?: The Role of Asset Risk and Leverage," *Review of Financial Studies,* 26, 2845-2875.

[19] Cochrane, J., 2005, "Asset Pricing," Princeton University Press.

[20] Collin-Dufresne, P., and R. S. Goldstein, 2001, "Do Credit Spreads Reflect Stationary Leverage Ratios?," *Journal of Finance*, 56, 1929-1957.

[21] Cooper, M., H. Gulen, and M. Schill, 2008, "Asset Growth and the Cross-Section of Stock Returns," *Journal of Finance*, 63, 1609-1651.

[22] Cremers, M., J. Driessen, and P. Maenhout, 2008, "Explaining the Level of Credit Spreads: Option Implied Jump Risk Premia in a Firm Value Model," *Review of Financial Studies,* 21, 2209-2242.

[23] Crosbie, P., and J. Bohn, 2003, "Modeling Default Risk," Working Paper, KMV Corporation.

[24] Da, Z., 2009, "Cash Flow, Consumption Risk, and the Cross-Section of Stock Returns," *Journal of Finance*, 64, 923-956.

[25] Da, Z., R.-J. Guo, and R. Jagannathan, 2012, "CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence," *Journal of Financial Economics*, 103, 204-220.

[26] Daniel, K., and S. Titman, 1997, "Evidence on the Characteristics of Cross Sectional Variation in Stock Returns," *Journal of Finance*, 52, 1-33.

[27] Dechow, P., R. Sloan, and M. Soliman, 2004, "Implied Equity Duration: A New Measure of Equity Risk," *Review of Accounting Studies*, 9, 197-228.

[28] Duan, J., 1994, "Maximum Likelihood Estimation Using Price Data of the Derivative Contract," *Mathematical Finance*, 4, 155-167.

[29] Duffie, D., L. Saita, and K. Wang, 2007, "Multi-Period Corporate Default Prediction with Stochastic Covariates," *Journal of Financial Economics*, 83, 635-665.

[30] Eom, Y. H., J. Helwege, and J. Huang, 2004, "Structural Models of Corporate Bond Pricing: An Empirical Analysis," *Review of Financial Studies*, 17, 499-544.

[31] Ericsson, J., J. Reneby, and H. Wang, 2006, "Can Structural Models Price Default Risk? New Evidence from Bond and Credit Derivative Markets," Working Paper, McGill University.

[32] Fama, E., and M. J. MacBeth, 1973, "Risk, Return, and Equilibrium: Empirical Tests," *Journal of Political Economy*, 81, 607-636.

[33] Fama, E., and K. French, 1992, "The Cross-Section of Expected Stock Returns," *Journal of Finance*, 47, 427-465.

[34] Fama, E., and K. French, 1993, "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics*, 33, 3-56.

[35] Fama, E., and K. French, 1995, "Size and Book-to-Market Factors in Earnings and Returns," *Journal of Finance*, 50, 131-155.

[36] Fama, E., and K. French, 1998, "Value Versus Growth: The International Evidence," *Journal of Finance*, 53, 1975-1999.

[37] Fama, E., and K. French, 2012, "Size, Value, and Momentum in International Stock Returns," *Journal of Financial Economics*, 105, 457-472.

[38] Friewald, N., C. Wagner, and J. Zechner, 2014, "The Cross-Section of Credit Risk Premia and Equity Returns," forthcoming in the Journal of Finance.

[39] George, T., and C.-H. Hwang, 2010, "A Resolution of the Distress Risk and Leverage Puzzles in the Cross Section of Stock Returns," *Journal of Financial Economics*, 96, 56-79.

[40] Geske, R., 1977, "The Valuation of Corporate Liabilities as Compound Options," *Journal of Financial and Quantitative Analysis*, 12, 541-552.

[41] Jegadeesh, N., and S. Titman, 1993, "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency," *Journal of Finance*, 48, 65-91.

[42] Kim, J., K. Ramaswamy, and S. Sundaresan, 1993, "Does Default Risk in Coupons Affect the Valuation of Corporate Bonds," *Financial Management*, 22, 117-131.

[43] Leland, H., 1994, “Risky Debt, Bond Covenants and Optimal Capital Structure,” *Journal of Finance*, 49, 1213-1252.

[44] Leland, H., 1998, "Agency Costs, Risk Management, and Capital Structure," *Journal of Finance,* 53, 1213-1243.

[45] Leland, H., and K. Toft, 1996, “Optimal Capital Structure, Endogenous Bankruptcy and the Term Structure of Credit Spreads,” *Journal of Finance*, 51, 987-1019.

[46] Liew, J., and M. Vassalou, 2000, “Can Book-to-Market, Size, and Momentum Be Risk Factors that Predict Economic Growth?,” *Journal of Financial Economics*, 57, 221-245.

[47] Longstaff, F., and E. S. Schwartz, 1995, “A Simple Approach to Valuing Risky Fixed and Floating Rate Debt,” *Journal of Finance*, 50, 789-819.

[48] Magee, L., 1998, “Nonlocal Behavior in Polynomial Regressions,” *The American Statistician*, 52, 20–22.

[49] Merton, R., 1974, “On the Pricing of Corporate Debt: The Risk Structure of Interest Rates,” *Journal of Finance*, 29, 449-470.

[50] Myers, S., 1977, “Determinants of Corporate Borrowing,” *Journal of Financial Economics*, 5, 147-175.

[51] Penman, S., S. Richardson, and I. Tuna, 2007, “The Book-to-Price Effect in Stock Returns: Accounting for Leverage,” *Journal of Accounting Research*, 45, 427-467.

[52] Petkova, R., and L. Zhang, 2005, “Is Value Riskier than Growth?,” *Journal of Financial Economics*, 78, 187-202.

[53] Porta, R.L., J. Lakonishok, A. Shleifer, and R. Vishny, 1997, “Good News for Value Stocks,” *Journal of Finance*, 52, 859-874.

[54] Rajan, R., and L. Zingales, 1995, "What Do We Know About Capital Structure? Some Evidence from International Data," *Journal of Finance*, 50(5), 1421-1460.

[55] Rosenberg, B., K. Reid, and R. Lanstein, 1985, "Persuasive Evidence of Market Inefficiency," *Journal of Portfolio Management*, 11, 9-16.

[56] Smith, K., 1918, "On the Standard Deviations of Adjusted and Interpolated Values of an Observed Polynomial Function and its Constants and the Guidance They Give Towards a Proper Choice of the Distribution of the Observations," *Biometrika*, 12, 1–85.

[57] Stohs, M.H., and D. Mauer, 1996, "The Determinants of Corporate Debt Maturity Structure," *Journal of Business*, 69, 279-312.

[58] Strebulaev, I., and B. Yang, 2013, "The Mystery of Zero-Leverage Firms," *Journal of Financial Economics*, 109, 1-23.

[59] Trigeorgis, L., and N. Lambertides, 2013, "The Role of Growth Options in Explaining Stock Returns," forthcoming in the Journal of Financial and Quantitative Analysis.

[60] Vassalou, M., and Y. Xing, 2004, "Default Risk in Equity Returns", *Journal of Finance*, 59, 831-868.

[61] Zhang, L., 2005, "The Value Premium", *Journal of Finance*, 60, 67-103.

Table 1: Average Stock Returns and Regressions on Firm Characteristics

Panel A: Average Stock Returns

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1	t-stat
Size 1	0.66%	1.14%	1.24%	1.37%	1.47%	0.81%	4.20
Size 2	0.90%	1.13%	1.26%	1.30%	1.32%	0.42%	2.18
Size 3	0.91%	1.15%	1.15%	1.27%	1.42%	0.51%	2.71
Size 4	1.00%	1.00%	1.12%	1.17%	1.29%	0.28%	1.53
Size 5	0.84%	0.98%	0.93%	1.00%	1.02%	0.18%	0.93
5 - 1	0.19%	-0.16%	-0.31%	-0.37%	-0.44%		
t-stat	0.70	-0.70	-1.55	-1.82	-2.15		

Panel B: Fama-MacBeth Regressions of Stock Returns on Firm Characteristics

Market Beta	ln (ME)	ln(BE/ME)	ln(A/ME)	ln(A/BE)
0.27				
(0.896)				
	-0.18			
	(-4.265)			
-0.15	-0.19			
(-0.512)	(-4.730)			
		0.29		
		(5.154)		
			0.29	-0.31
			(4.938)	(-5.609)
-0.06	-0.16	0.16		
(-0.218)	(-3.858)	(3.170)		

Notes to Table: Panel A presents the average value-weighted stock (levered equity) returns for 25 size and book-to-market portfolios. Size 1 and BTM 1 indicate the lowest size and book-to-market portfolios respectively. Size 5 and BTM 5 indicate the highest size and book-to-market portfolios. Panel B presents the results of Fama-MacBeth cross-sectional regressions of stock returns on firm characteristics. We run the cross-sectional regression of stock returns on different firm specific characteristics for each month. The estimates reported in the table are computed as the time-series mean of the estimated coefficients. The numbers in the brackets are the Fama-MacBeth t-statistics adjusted for autocorrelation. The market beta is computed using the CAPM model as in Fama and French (1992). ME indicates market value of equity, BE indicates book value of equity, and A indicates book value of assets.

Table 2: Average Unlevered Equity Returns

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1	t-stat
Size 1	1.39%	1.43%	1.35%	1.35%	1.50%	0.11%	0.45
Size 2	1.38%	1.23%	1.36%	1.21%	1.03%	-0.35%	-1.57
Size 3	1.35%	1.34%	1.20%	1.23%	1.07%	-0.28%	-1.09
Size 4	1.20%	1.11%	1.14%	1.14%	1.06%	-0.14%	-0.89
Size 5	1.01%	1.14%	1.29%	1.23%	1.09%	0.08%	0.20
5 - 1	-0.38%	-0.28%	-0.06%	-0.13%	-0.41%		
t-stat	-1.56	-1.53	-0.26	-0.55	-3.21		

Notes to Table: This table presents the average value-weighted unlevered equity returns for 25 size and book-to-market portfolios, where the weights are determined by the market value of equity. The unlevered equity returns are computed using the unlevered firm value inferred from the Merton structural credit risk model. The face value of debt in the Merton model is assumed to be equal to the total liabilities and the maturity of debt is assumed to be 3.38 years. Size 1 and BTM 1 indicate the lowest size and book-to-market portfolios respectively. Size 5 and BTM 5 indicate the highest size and book-to-market portfolios.

Table 3: Fama-MacBeth Regressions of Unlevered Equity Returns on Firm Characteristics

Market Beta	ln (ME)	ln(BE/ME)	ln(A/ME)	ln(A/BE)
0.40				
(2.306)				
	-0.17			
	(-5.615)			
0.28	-0.15			
(1.643)	(-5.233)			
		0.04		
		(0.480)		
			0.02	-0.11
			(0.292)	(-1.321)
0.23	-0.16	-0.07		
(1.576)	(-5.303)	(-1.049)		

Notes to Table: This table presents the results of Fama-MacBeth cross-sectional regressions of unlevered equity returns on firm characteristics. We run the cross-sectional regression of unlevered equity returns on different firm-specific characteristics for each month. The estimates reported in the table are computed as the time-series mean of the estimated coefficients. The numbers in the brackets are the Fama-MacBeth t-statistics adjusted for autocorrelation. The market beta is computed using the CAPM model, where we use the unlevered equity market returns as the independent variable. ME indicates market value of equity, BE indicates book value of equity, and A indicates book value of assets.

Table 4: Average Leverage

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1	t-stat
Size 1	26.9%	36.7%	45.7%	51.9%	63.3%	36.4%	33.8
Size 2	22.6%	36.8%	49.0%	57.4%	70.0%	47.4%	47.2
Size 3	23.0%	38.5%	51.9%	61.3%	70.0%	47.0%	53.6
Size 4	23.0%	40.8%	53.5%	61.8%	72.2%	49.1%	64.1
Size 5	24.4%	44.5%	57.2%	64.1%	72.4%	48.0%	47.1
5 - 1	-2.5%	7.8%	11.5%	12.2%	9.1%		
t-stat	-2.4	9.6	15.2	12.1	7.5		

Notes to Table: This table presents the average leverage defined as the ratio of total liabilities to the sum of total liabilities and market value of equity for the 25 size and book-to-market portfolios. Size 1 and BTM 1 indicate the lowest size and book-to-market portfolios respectively. Size 5 and BTM 5 indicate the highest size and book-to-market portfolios.

Table 5: Regressions of Simulated Equity Returns on Leverage

Lev	Lev^2	Lev^3	$Lev*1_{Ret>0}$	$Lev*1_{Ret<0}$	$Lev^2*1_{Ret>0}$	$Lev^2*1_{Ret<0}$	$Lev^3*1_{Ret>0}$	$Lev^3*1_{Ret<0}$	Adj. R^2
-0.03									0.01%
(-1.26)									
-0.03	0.01								0.00%
(-0.41)	(0.08)								
-0.13	0.29	-0.21							-0.01%
(-0.7)	(0.59)	(-0.58)							
			0.93	-0.58					58%
			(59.08)	(-40.41)					
			1.28	-0.15	-0.37	-0.52			58%
			(21.24)	(-2.82)	(-4.82)	(-8.22)			
			3.56	-2.31	-9.43	6.72	7.82	-6.02	64%
			(25.58)	(-19.13)	(-23.69)	(20.85)	(25.25)	(-24.47)	

Notes to Table: This table presents the estimated coefficients and the t-statistics (in brackets) for different regressions of simulated levered equity returns on leverage. The equity returns are simulated using the Merton Model. The values of the model parameters used in the simulations are $V_0 = 100$, $r = 3\%$, and $T = 3.38$ years. The volatility σ_V is chosen to be uniformly distributed between 10% and 150%. The drift μ_V is chosen to be uniformly distributed between -6% and 6%. The leverage defined as the ratio of debt to asset value is chosen to be uniformly distributed between 0 and 1. We simulate 10,000 monthly equity returns using these parameters and regress the simulated returns on leverage and the higher order terms of leverage. $1_{Ret>0}$ ($1_{Ret<0}$) is a dummy variable which is equal to one when the equity return is positive (negative).

Table 6: Cross-Sectional Regressions of Stock Returns on Firm Characteristics

Beta	ln (ME)	ln(BE/ME)	Lev	Lev^2	Lev^3	Lev*$1_{Ret>0}$	Lev*$1_{Ret<0}$	Lev^2*$1_{Ret>0}$	Lev^2*$1_{Ret<0}$	Lev^3*$1_{Ret>0}$	Lev^3*$1_{Ret<0}$
			0.71								
			(2.99)								
			1.99	-1.41							
			(3.29)	(-2.65)							
			3.35	-4.90	2.43						
			(3.26)	(-2.53)	(1.96)						
-0.06	-0.10	0.20	-0.10								
(-0.21)	(-2.48)	(4.71)	(-0.58)								
-0.02	-0.10	0.21	1.59	-1.89							
(-0.06)	(-2.5)	(4.91)	(3.31)	(-4.19)							
-0.02	-0.10	0.22	0.90	0.00	-1.38						
(-0.06)	(-2.5)	(5.03)	(1.09)	(0.00)	(-1.16)						
						19.31	-17.93				
						(49.31)	(-46.03)				
						43.56	-41.77	-36.77	36.40		
						(45.28)	(-41.18)	(-38.78)	(38.12)		
						88.64	-81.24	-196.43	181.48	127.60	-117.13
						(52.06)	(-45.85)	(-50.18)	(46.72)	(48.58)	(-47.84)
0.54	-0.28	-0.09				18.80	-17.81				
(2.59)	(-10.4)	(-1.91)				(59.15)	(-57.26)				
0.65	-0.33	-0.05				44.94	-40.45	-39.36	35.43		
(3.44)	(-12.96)	(-1.14)				(54.21)	(-45.81)	(-45)	(39.25)		
0.60	-0.36	-0.11				89.70	-77.90	-197.72	174.95	127.10	-113.48
(3.36)	(-13.9)	(-2.21)				(61.11)	(-51.64)	(-54.77)	(50.01)	(50.69)	(-50.5)

Notes to Table: This table presents the results of Fama-MacBeth cross-sectional regressions of stock returns on different characteristics including leverage, using historical data. We run the cross-sectional regressions of stock returns on different firm-specific characteristics in each month. The estimates reported in the table are computed as the time-series mean of the estimated coefficients. The numbers in brackets are the Fama-MacBeth t-statistics. The beta is computed using the CAPM model as in Fama and French (1992). ME indicates the market value of equity, BE indicates the book value of equity, and Lev indicates leverage defined as the ratio of debt to the sum of debt and the market value of equity. $1_{Ret>0}$ ($1_{Ret<0}$) is a dummy variable which is equal to one when the stock return is positive (negative).

Table 7: Zero Leverage Firms

Panel A: Fama-French Breakpoints							
	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	BTM 5 - 1	t-stat
Mean Returns	1.25%	1.29%	1.14%	1.25%	1.30%	0.05%	0.17
Data Length (Months)	348	324	324	324	348	348	
Avg. Firms	190	92	81	81	118		
Min Firms	19	15	15	15	22		
Max Firms	434	194	135	159	327		

Panel B: Breakpoints Based on Zero Leverage Firms Only							
	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	BTM 5 - 1	t-stat
Mean Returns	0.78%	0.94%	1.33%	1.48%	1.17%	0.39%	1.38
Data Length (Months)	492	492	492	492	492	492	
Avg. Firms	97	97	96	94	93		
Min Firms	7	8	7	8	7		
Max Firms	185	183	186	185	186		

Notes to Table: This table presents the average value-weighted stock returns for five book-to-market portfolios using firms with zero leverage. BTM 1 indicates the lowest book-to-market portfolio and BTM 5 indicates the highest book-to-market portfolio. The table also reports the average returns of the long-short portfolio (BTM 5 - BTM 1) and the corresponding t-statistics. Panel A presents the average returns of the five portfolios, where the firms are assigned to each quintile based on the Fama-French book-to-market breakpoints. Panel B presents the average returns of the five portfolios, where we allow for equal numbers of zero leverage firms in each book-to-market quintile. The breakpoints for each quintile in this case are determined using only firms that have zero leverage. In both panels, we include information about the average, minimum, and maximum number of firms in each quintile over the sample period. In Panel A, for a given month we include the quintile portfolio return only if at least 15 firms are available. Both panels include information about the number of months for which we have data to compute the portfolio returns in each quintile.

Table 8: Average Stock Returns in Size, Book-to-Market, and Leverage Sorted Portfolios

Panel A: Low Leverage

	All Firms			Negative Returns Firms			Positive Returns Firms		
	BTM 1	BTM 2	BTM 3	BTM 1	BTM 2	BTM 3	BTM 1	BTM 2	BTM 3
Size 1	0.64%	1.24%	1.51%	-10.69%	-8.53%	-8.08%	11.85%	9.85%	9.76%
Size 2	1.01%	1.14%	1.31%	-8.39%	-6.94%	-6.34%	9.06%	7.84%	7.81%
Size 3	0.80%	1.25%		-5.44%			6.00%	6.99%	

Panel B: Medium Leverage

	All Firms			Negative Returns Firms			Positive Returns Firms		
	BTM 1	BTM 2	BTM 3	BTM 1	BTM 2	BTM 3	BTM 1	BTM 2	BTM 3
Size 1	0.78%	1.26%	1.50%	-10.00%	-7.90%	-7.85%	11.02%	9.13%	9.36%
Size 2	0.96%	1.23%	1.32%	-7.38%	-6.21%	-6.29%	8.06%	7.21%	7.44%
Size 3	0.90%	1.05%	1.01%	-5.31%	-4.67%	-5.22%	5.86%	5.65%	6.11%

Panel C: High Leverage

	All Firms			Negative Returns Firms			Positive Returns Firms		
	BTM 1	BTM 2	BTM 3	BTM 1	BTM 2	BTM 3	BTM 1	BTM 2	BTM 3
Size 1	1.03%	1.04%	1.31%	-10.14%	-7.58%	-8.44%	11.40%	8.45%	9.49%
Size 2	1.09%	1.06%	1.32%	-7.45%	-5.88%	-6.44%	8.37%	6.49%	7.26%
Size 3	0.99%	0.90%	1.06%	-5.49%	-4.91%	-5.37%	6.58%	5.36%	6.08%

Notes to Table: We present the average value-weighted returns in 27 portfolios sorted based on size, book-to-market, and leverage. The portfolios are constructed by performing a triple sort where we sort all firms based on size, book-to-market, and leverage into terciles. Panel A presents the average returns for the nine size and book-to-market portfolios with low leverage. Panel B presents the average returns for the nine size and book-to-market portfolios with medium leverage, and Panel C is for high leverage. In columns 2 to 4, we compute the value-weighted returns in each portfolio using all firms in our sample. In columns 5 to 7, we compute the value-weighted returns in each portfolio using firms with only negative returns. In columns 8 to 10, we compute the value-weighted returns in each portfolio using firms with only positive returns. Size 1 and BTM 1 indicate small size and low book-to-market firms respectively. Size 3 and BTM 3 indicate large size and high book-to-market firms respectively. Some cells are empty in certain months. To compute the average portfolio returns for a given cell, we require returns to be available for 400 out of the 492 months. The blank cells indicate that we have insufficient data for those portfolios to reliably compute average returns.

Table 9: Time-series and Cross-Sectional Regressions of Portfolio Returns on the Three Fama-French Factors

Time-Series Regressions

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5
Panel A: Stock Returns																				
	Market Beta					Size Beta					Book-to-Market Beta					R^2				
Size 1	1.08	0.97	0.92	0.92	0.97	1.45	1.31	1.11	1.07	1.13	-0.36	0.02	0.27	0.44	0.68	90%	94%	95%	95%	94%
	(41.03)	(54.56)	(64.18)	(65.39)	(62.76)	(38.24)	(51.38)	(53.85)	(52.91)	(50.56)	(-8.68)	(0.75)	(12.16)	(20.08)	(28.22)					
Size 2	1.11	1.01	0.95	0.97	1.07	1.06	0.95	0.81	0.82	0.92	-0.41	0.09	0.37	0.57	0.79	94%	94%	94%	95%	95%
	(62.77)	(63.29)	(68.96)	(74.87)	(75.84)	(41.35)	(41.15)	(40.90)	(44.27)	(45.22)	(-14.67)	(3.79)	(17.33)	(28.32)	(35.78)					
Size 3	1.08	1.04	0.98	0.98	1.08	0.82	0.60	0.46	0.44	0.61	-0.37	0.19	0.45	0.64	0.76	94%	91%	90%	91%	89%
	(62.32)	(60.89)	(59.90)	(62.22)	(53.91)	(33.00)	(24.31)	(19.46)	(19.40)	(21.14)	(-13.87)	(7.25)	(17.78)	(25.87)	(24.13)					
Size 4	1.08	1.07	1.04	1.01	1.12	0.44	0.26	0.23	0.28	0.24	-0.40	0.22	0.46	0.56	0.76	94%	89%	89%	89%	86%
	(72.00)	(59.91)	(58.72)	(59.16)	(51.20)	(20.24)	(9.92)	(8.87)	(11.14)	(7.53)	(-17.01)	(7.80)	(16.81)	(21.00)	(22.27)					
Size 5	0.98	0.98	0.98	0.98	1.04	-0.18	-0.17	-0.17	-0.18	-0.01	-0.36	0.08	0.30	0.60	0.83	95%	90%	86%	89%	80%
	(89.38)	(65.63)	(55.67)	(62.88)	(41.32)	(-11.42)	(-8.04)	(-6.58)	(-8.15)	(-0.14)	(-21.21)	(3.31)	(11.03)	(24.64)	(21.06)					
Panel B: Unlevered Equity Returns																				
Size 1	1.17	1.04	1.00	0.95	1.04	1.56	1.34	1.11	0.98	1.02	-0.23	0.06	0.32	0.40	0.76	84%	88%	88%	87%	76%
	(23.08)	(31.43)	(37.60)	(40.27)	(32.12)	(25.66)	(33.56)	(34.59)	(34.45)	(25.99)	(-4.09)	(1.73)	(10.54)	(15.17)	(20.71)					
Size 2	1.12	1.00	0.94	0.94	0.96	1.21	0.90	0.80	0.91	0.86	-0.37	0.06	0.32	0.58	0.67	87%	84%	81%	82%	78%
	(26.67)	(31.65)	(33.36)	(36.82)	(35.02)	(23.75)	(23.71)	(23.53)	(29.53)	(26.06)	(-7.77)	(1.58)	(10.16)	(19.98)	(21.74)					
Size 3	1.02	1.06	0.99	0.95	1.01	0.99	0.60	0.49	0.51	0.52	-0.42	0.13	0.38	0.58	0.65	87%	78%	75%	72%	71%
	(26.70)	(29.95)	(32.85)	(33.06)	(32.94)	(21.41)	(14.16)	(13.55)	(14.76)	(14.20)	(-9.83)	(3.24)	(11.18)	(17.83)	(19.07)					
Size 4	1.10	1.09	0.94	0.88	1.13	0.62	0.41	0.41	0.33	0.39	-0.37	0.21	0.35	0.44	0.83	86%	80%	74%	68%	58%
	(29.89)	(36.19)	(32.32)	(30.26)	(25.10)	(13.98)	(11.31)	(11.90)	(9.36)	(7.18)	(-8.98)	(6.23)	(10.72)	(13.62)	(16.48)					
Size 5	1.05	0.90	0.80	0.96	1.18	-0.14	-0.03	-0.40	-0.53	0.22	-0.30	0.13	0.04	0.28	1.00	90%	71%	32%	35%	59%
	(44.90)	(29.74)	(12.06)	(13.44)	(25.25)	(-4.85)	(-0.74)	(-5.09)	(-6.10)	(3.99)	(-11.36)	(3.82)	(0.56)	(3.50)	(18.88)					

Cross-Sectional Regressions

	Panel C: Stock Returns				Panel D: Unlevered Equity Returns			
Spec.	Intercept	Market	SMB	HML	Intercept	Market	SMB	HML
1	1.16%	-0.03%			1.07%	0.26%		
	(4.17)	(-0.10)			(6.53)	(1.14)		
2	1.71%	-0.71%	0.22%	0.24%	1.39%	-0.28%	0.24%	-0.02%
	(6.97)	(-2.62)	(1.48)	(1.80)	(6.54)	(-1.37)	(2.11)	(-0.15)

Notes to Table: Panel A reports the betas on the three Fama-French factors for the 25 size and book-to-market portfolios together with the corresponding t-statistics (in parentheses) and the R-squares. Panels B reports the results of the cross-sectional regressions estimated using the Fama-MacBeth procedure. The table reports the coefficient estimates (in percentages) and the corresponding t-statistics (in parentheses) for two different specifications. Both Panel A and B report the results using the stock returns and the unlevered equity returns. The value-weighted portfolio unlevered equity returns are computed using the weights based on levered equity value.

Table 10: Ex-Ante Characteristics

Panel A: Capital Expenditure

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1
Size 1	45.5%	38.3%	32.7%	29.8%	24.0%	-21.5%
Size 2	51.2%	36.0%	28.7%	24.6%	21.6%	-29.6%
Size 3	46.3%	30.9%	24.6%	21.3%	19.3%	-27.0%
Size 4	40.6%	26.8%	21.4%	18.7%	15.8%	-24.9%
Size 5	33.5%	24.5%	20.0%	17.5%	16.3%	-17.3%
5 - 1	-11.9%	-13.7%	-12.7%	-12.3%	-7.7%	

Panel B: Return on Assets

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1
Size 1	-13.4%	-0.9%	0.5%	0.1%	-2.1%	11.3%
Size 2	3.0%	5.2%	3.7%	2.7%	2.1%	-1.0%
Size 3	7.6%	5.7%	4.0%	3.0%	1.4%	-6.2%
Size 4	9.3%	5.9%	3.9%	2.5%	1.4%	-7.9%
Size 5	9.6%	5.6%	3.9%	3.1%	2.2%	-7.4%
5 - 1	23.0%	6.6%	3.4%	3.0%	4.4%	

Panel C: Return on Equity

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1
Size 1	-68.1%	-6.4%	-0.7%	-0.8%	-6.1%	62.0%
Size 2	-1.1%	10.2%	8.4%	6.8%	5.2%	6.3%
Size 3	8.8%	12.1%	9.9%	8.5%	2.0%	-6.8%
Size 4	19.9%	13.1%	10.4%	7.5%	3.3%	-16.7%
Size 5	22.1%	14.4%	11.6%	9.5%	5.9%	-16.2%
5 - 1	90.2%	20.8%	12.3%	10.3%	12.0%	

Panel D: Tangibility

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1
Size 1	25.6%	26.3%	27.0%	26.4%	27.4%	1.8%
Size 2	27.1%	29.3%	31.3%	30.4%	29.7%	2.6%
Size 3	30.0%	32.6%	35.5%	34.9%	36.2%	6.3%
Size 4	31.3%	35.8%	38.7%	40.3%	39.5%	8.2%
Size 5	32.2%	36.2%	39.7%	44.3%	43.6%	11.4%
5 - 1	6.6%	9.8%	12.7%	17.9%	16.2%	

Panel E: Stock Volatility

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1
Size 1	72.7%	62.8%	58.3%	56.5%	66.6%	-6.1%
Size 2	51.6%	43.3%	38.9%	37.8%	42.1%	-9.6%
Size 3	44.2%	37.7%	34.2%	33.5%	38.0%	-6.2%
Size 4	38.8%	33.1%	31.0%	30.9%	34.6%	-4.2%
Size 5	32.8%	29.9%	28.8%	28.0%	30.6%	-2.1%
5 - 1	-39.9%	-33.0%	-29.6%	-28.5%	-35.9%	

Panel F: Unlevered Equity Volatility

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1
Size 1	59.2%	47.6%	40.7%	36.9%	40.2%	-19.0%
Size 2	42.2%	30.2%	23.6%	20.2%	18.3%	-23.9%
Size 3	36.2%	25.6%	19.1%	16.4%	15.5%	-20.6%
Size 4	31.8%	21.8%	16.7%	14.1%	12.7%	-19.1%
Size 5	25.9%	18.1%	13.3%	11.5%	10.6%	-15.3%
5 - 1	-33.4%	-29.4%	-27.4%	-25.4%	-29.6%	

Notes to Table: This table presents the average ex-ante characteristics in each of the 25 size and book-to-market portfolios. The characteristics are computed in December of the year prior to the portfolio formation. Panel A presents the average capital expenditures defined as the capital expendiure scaled by the lagged property, plant, and equipment. Panel B presents the average return on assets, defined as the net income scaled by the book value of assets. Panel C presents the average return on equity defined as the net income scaled by the shareholder equity. Panel D presents the average tangibility defined as property, plant, and equipment scaled by the total book value of assets. Panel E presents the average annualized stock volatility computed using the standard deviation of daily returns over the past year. Panel F presents the average unlevered equity volatility obtained from the Merton model with debt equal to total liabilities and maturity T = 3.38 years.

Table 11: Average Levered and Unlevered Equity Returns in Various Portfolios

		Ptf 1	Ptf 2	Ptf 3	Ptf 4	Ptf 5	Ptf 5 - Ptf 1	t-stat
Levered Equity	BTM	0.85%	0.99%	1.00%	1.10%	1.23%	0.38%	2.31
	Size	1.21%	1.19%	1.13%	1.07%	0.88%	-0.33%	-1.63
	Volatility	0.96%	0.99%	1.01%	0.78%	0.14%	-0.82%	-2.04
Unlevered Equity	BTM	1.02%	1.13%	1.28%	1.25%	1.11%	0.09%	0.54
	Size	1.42%	1.25%	1.26%	1.13%	1.08%	-0.34%	-2.38
	Volatility	0.79%	0.93%	1.08%	1.07%	0.76%	-0.03%	-0.09

Notes to Table: This table presents the average value-weighted levered and unlevered equity returns for five book-to-market, size, and volatility portfolios, where the weights are determined by the market value of equity. The unlevered equity returns are computed using the unlevered firm value inferred from the Merton structural credit risk model. The face value of debt in the Merton model is assumed to be equal to the total liabilities and the maturity of debt is assumed to be 3.38 years. Ptf 1 indicates the lowest book-to-market, size, or volatility portfolio. Ptf 5 indicates the highest book-to-market, size, or volatility portfolio. The table also reports the average returns of the long-short portfolio (Ptf 5 - Ptf 1) and the corresponding t-statistics. The volatility portfolios are constructed by ranking stocks each month according to the stock volatility in the past one year computed using daily returns.

Table 12: Average Unlevered Equity Returns. Alternative Model Specifications

	Panel A: Merton with T = 1 year							Panel B: Merton with T = 5 years						
	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1	t-stat	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1	t-stat
Size 1	1.32%	1.39%	1.35%	1.34%	1.31%	0.00%	0.02	1.36%	1.45%	1.34%	1.37%	1.29%	-0.07%	-0.29
Size 2	1.32%	1.22%	1.30%	1.18%	1.09%	-0.23%	-1.21	1.38%	1.22%	1.37%	1.22%	1.08%	-0.30%	-1.30
Size 3	1.22%	1.18%	1.07%	1.12%	1.03%	-0.19%	-1.03	1.33%	1.35%	1.21%	1.23%	1.18%	-0.15%	-0.48
Size 4	1.12%	0.96%	0.98%	1.01%	0.84%	-0.28%	-1.44	1.20%	1.13%	1.18%	1.19%	1.07%	-0.13%	-0.82
Size 5	0.82%	0.84%	0.76%	0.78%	0.85%	0.03%	0.18	1.01%	1.17%	1.04%	1.00%	1.23%	0.23%	0.48
5 - 1	-0.50%	-0.55%	-0.59%	-0.56%	-0.46%			-0.35%	-0.28%	-0.30%	-0.37%	-0.06%		
t-stat	-2.19	-2.98	-3.83	-3.71	-3.02			-1.37	-1.45	-1.81	-2.41	-1.02		

	Panel C: Merton with Variable Debt Maturities							Panel D: Merton with T = 3.38 years and F = Total Debt						
Size 1	1.39%	1.44%	1.25%	1.30%	1.31%	-0.08%	-0.34	1.30%	1.50%	1.47%	1.45%	1.36%	0.06%	0.28
Size 2	1.27%	1.12%	1.32%	1.18%	1.03%	-0.24%	-0.96	1.39%	1.34%	1.40%	1.33%	1.20%	-0.20%	-0.98
Size 3	1.26%	1.23%	1.11%	1.21%	1.30%	0.04%	0.33	1.23%	1.35%	1.25%	1.29%	1.13%	-0.10%	-0.53
Size 4	1.12%	1.05%	1.14%	1.16%	1.13%	0.01%	0.16	1.25%	1.11%	1.16%	1.20%	0.98%	-0.27%	-1.46
Size 5	0.96%	1.09%	1.00%	0.98%	1.08%	0.12%	0.36	0.94%	1.04%	0.98%	0.95%	1.04%	0.11%	0.60
5 - 1	-0.43%	-0.34%	-0.25%	-0.32%	-0.23%			-0.36%	-0.46%	-0.49%	-0.50%	-0.31%		
t-stat	-1.69	-1.67	-1.49	-1.98	-2.26			-1.47	-2.29	-2.87	-3.05	-1.94		

	Panel E: Merton with T = 3.38 years and Returns Computed using Equation (2.2)							Panel F: Leland-Toft with T = 3.38 years						
Size 1	1.04%	1.30%	1.29%	1.40%	1.47%	0.44%	2.07	1.24%	1.38%	1.26%	1.18%	1.11%	-0.13%	-0.61
Size 2	1.07%	1.11%	1.19%	1.10%	1.10%	0.02%	0.15	1.34%	1.19%	1.20%	1.08%	0.83%	-0.51%	-2.49
Size 3	1.09%	1.18%	1.00%	1.07%	1.07%	-0.02%	-0.11	1.26%	1.26%	1.00%	0.93%	0.77%	-0.49%	-2.47
Size 4	1.05%	1.02%	1.00%	0.98%	0.94%	-0.11%	-0.77	1.09%	0.97%	0.89%	0.94%	0.64%	-0.44%	-2.40
Size 5	0.84%	0.93%	0.81%	0.83%	0.79%	-0.05%	-1.27	0.77%	0.91%	0.75%	0.67%	0.77%	0.00%	0.01
5 - 1	-0.20%	-0.37%	-0.48%	-0.57%	-0.68%			-0.47%	-0.47%	-0.51%	-0.51%	-0.34%		
t-stat	-0.77	-1.96	-3.17	-4.16	-6.31			-2.07	-2.41	-3.22	-3.77	-2.13		

Notes to Table: We present the average value-weighted unlevered equity returns in each of the 25 size and book-to-market portfolios using alternative specifications of the structural credit risk models. In each panel, the weights are determined by the market value of equity. Panel A presents the average unlevered equity returns using the Merton model with the debt defined as the sum of half the long term debt and the short term debt and assumed to mature in 1 year. Panel B uses the Merton model with the debt equal to total liabilities maturing in 5 years. Panel C uses the Merton model with the debt equal to total liabilities and maturity computed every fiscal year using firm-specific debt maturity data. Panel D uses the Merton model with debt equal to the sum of long-term and short-term debt and maturity T=3.38 years. Panel E uses the Merton model with debt equal to total liabilities and maturity T=3.38 years, but the unlevered returns are computed using equation (2.2). Panel F uses the Leland-Toft model with debt equal to total liabilities and maturity T=3.38 years.

Table 13: Unlevered Equity Returns. Alternative Portfolio Weights

Panel A: Average Unlevered Equity Returns

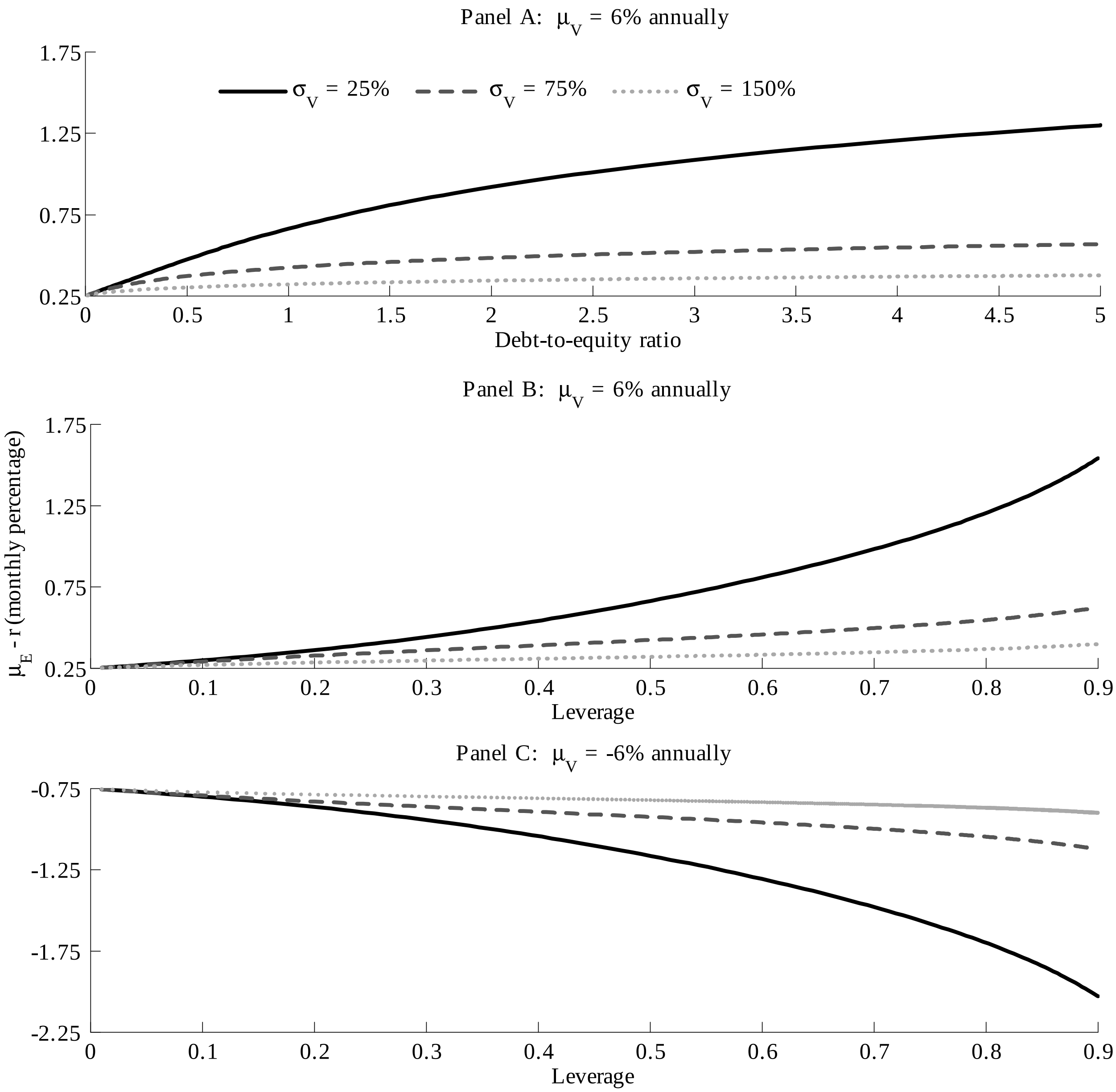
	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	5 - 1	t-stat
Size 1	1.13%	1.22%	1.02%	0.96%	0.56%	-0.57%	-2.10
Size 2	1.30%	1.09%	1.17%	0.99%	0.58%	-0.71%	-3.04
Size 3	1.27%	1.22%	1.11%	1.06%	0.77%	-0.51%	-2.03
Size 4	1.19%	1.03%	1.03%	0.93%	0.89%	-0.30%	-1.51
Size 5	1.07%	1.17%	0.97%	0.88%	0.87%	-0.20%	-1.34
5 - 1	-0.06%	-0.05%	-0.05%	-0.08%	0.31%		
t-stat	-0.18	-0.40	-0.29	-0.58	1.30		

Panel B: Time-Series Regressions of Portfolio Unlevered Equity Returns on the Three Fama-French Factors

	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5	BTM 1	BTM 2	BTM 3	BTM 4	BTM 5
			Market Beta					t-statistic		
Size 1	1.37	1.04	0.93	0.87	1.01	25.11	30.52	27.32	33.39	21.51
Size 2	1.28	0.89	0.81	0.86	0.94	28.65	25.16	21.90	30.74	28.34
Size 3	1.20	0.91	0.87	0.81	0.95	28.64	24.07	28.20	28.31	29.04
Size 4	1.13	0.93	0.82	0.87	1.15	26.78	29.10	25.79	25.82	21.14
Size 5	0.90	0.82	0.96	0.97	1.07	31.67	26.34	22.11	28.74	20.71
			Size Beta					t-statistic		
Size 1	1.76	1.20	0.91	0.74	1.09	21.21	22.97	17.46	18.74	15.23
Size 2	1.34	0.79	0.69	0.92	0.80	19.62	14.63	12.14	21.54	15.75
Size 3	1.18	0.56	0.44	0.48	0.49	18.51	9.73	9.30	10.91	9.82
Size 4	0.78	0.39	0.45	0.26	0.42	12.10	7.98	9.35	5.07	4.79
Size 5	-0.25	-0.12	-0.39	-0.13	0.13	-5.73	-2.52	-5.93	-2.49	1.55
			Book-to-Market Beta					t-statistic		
Size 1	-0.42	-0.19	0.06	0.13	0.60	-8.91	-6.60	1.89	5.67	14.86
Size 2	-0.57	-0.26	0.00	0.32	0.43	-14.87	-8.48	0.14	13.42	15.22
Size 3	-0.57	-0.20	0.07	0.21	0.41	-15.74	-6.19	2.72	8.69	14.78
Size 4	-0.57	-0.17	0.06	0.18	0.53	-15.73	-6.03	2.19	6.17	10.96
Size 5	-0.61	-0.16	0.01	0.26	0.47	-25.12	-5.92	0.22	8.65	10.27
			R^2							
Size 1	78%	80%	68%	73%	54%					
Size 2	83%	73%	57%	70%	64%					
Size 3	83%	66%	64%	63%	65%					
Size 4	79%	71%	60%	58%	51%					
Size 5	83%	66%	58%	68%	52%					

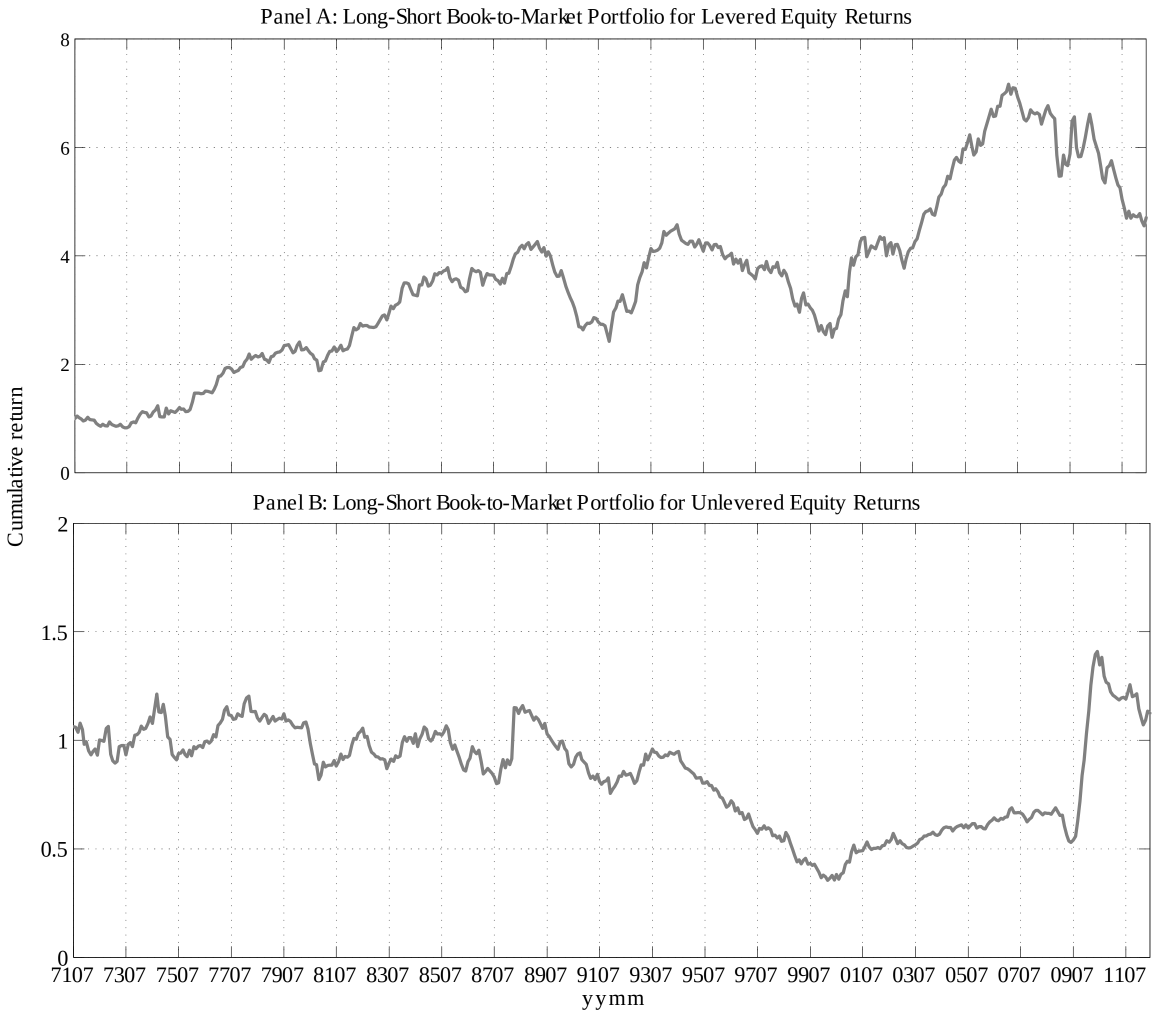
Notes to Table: Panel A presents the average value-weighted unlevered equity returns for each of the 25 portfolios. The unlevered equity returns are computed using the unlevered equity value inferred from the Merton structural credit risk model. The face value of debt in the Merton model is assumed to be equal to the total liabilities and the maturity of the debt is assumed to be 3.38 years. Panel B presents the betas associated with the three Fama-French factors for the 25 size and book-to-market portfolios. Both the dependent and the independent variables are computed using unlevered equity returns. The table also reports the t-statistics for each of the estimated betas and the regression R-squares. In both panels, the weights for computing the portfolio unlevered equity returns are determined using the market value of unlevered equity. Size 1 and BTM 1 indicate the lowest size and book-to-market portfolios respectively. Size 5 and BTM 5 indicate the highest size and book-to-market portfolios.

Figure 1: Leverage and Levered Equity Returns



Notes to Figure: We present the relation between leverage and excess equity returns generated using the Merton model. The top panel presents equity returns generated from the model for different values of the debt-to-equity ratio and unlevered equity volatilities. The middle panel presents the same equity returns but with respect to leverage defined as the ratio of debt to the sum of debt and equity. The bottom panel presents equity returns with respect to the leverage defined as the ratio of debt to the sum of debt and equity, but with $\mu_V = -6\%$ annually. The top two panels are generated using $\mu_V = 6\%$ annually. The values of the other model parameters are $V_0 = 100$, $r = 3\%$, and $T = 3.38$ years.

Figure 2: Cumulative Return of Long-Short Book-to-Market Portfolios



Notes to Figure: We present the cumulative return for the long-short book-to-market portfolios. Panel A presents the growth of one dollar initial investment made in June 1971 using levered equity. Panel B presents the growth of one dollar initial investment using unlevered equity. In both cases, we construct five book-to-market portfolios. The returns are the returns of the long-short strategy where we go long in the highest book-to-market portfolio and short in the lowest book-to-market portfolio.