THE IMPACT OF DEFAULT RISK ON THE BASU MEASURE OF ACCOUNTING CONSERVATISM

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The Impact of Default Risk on the Basu Measure of Accounting Conservatism

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Abstract

We show, analytically and empirically, that there is a positive correlation between default risk and the Basu measure of conservatism: the higher the default risk, the higher the bias in the Basu measure. We use the insight provided by our analysis to construct an improved version of the Basu measure, the Default-Adjusted-Basu (DAB) measure. The DAB measure adjusts for the effects of default risk on the Basu measure. Using Distance-to-Default as a measure of default risk, we contend that the DAB measure can substantially reduce the bias caused by default risk, and hence is a more robust measure of accounting conservatism than the standard Basu measure. We demonstrate that once one adjusts for the distance-to-default, the Basu conservatism coefficient is no longer positively correlated with leverage.

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1 Introduction[1]

Basu (1997) introduced the first, and currently the most popular, empirical measure of accounting conservatism, commonly known as the 'Basu measure', or the asymmetric timeliness of earnings coefficient. Since Basu's influential paper, a substantial and growing literature has emerged applying the Basu measure to examine accounting conservatism in a variety of theoretical contexts.

However, the validity and characteristics of the Basu measure have received limited attention in the literature. Dietrich et al. (2007), Givoly et al. (2007), Ryan (2006) and others have examined the validity of the Basu measure and highlighted a number of weaknesses in the Basu measure. Dietrich et al. (2007), for example, find that the Basu measure is biased upward because of what they call the sample-variance-ratio bias and the sample-truncation bias. Givoly et al. (2007) empirically test the validity of the Basu measure, and discover that the measure can demonstrate neither the power to distinguish conservative firms from aggressive ones nor the stability expected in a time-series context. These recent studies have cast doubt on the validity of the Basu (1997) measure and motivate us to further examine its validity from a default risk perspective.

This paper has the following three related objectives:

First, we extend the recent critical appraisal of the Basu measure by investigating the relationship between the Basu measure and a firm's default risk. Using Merton's (1974) call-option pricing model of equity, we show that the Basu measure is a biased measure of the degree of accounting conservatism. We show, analytically and empirically, that there is a positive correlation between default risk and the Basu measure of conservatism: the higher the default risk, the higher the bias in the Basu measure. In general, default risk means

the uncertainty around a firm's ability to repay its debt when it falls due. In this paper, we use Distance-to-Default (DD) to measure default risk. DD is an inverse measure of default risk and we estimate DD using Vassalou and Xing's (2004) option-pricing-based iterative algorithm.

Second, we use the insight provided by our analysis of the Basu measure to construct an improved version of the Basu measure. We call the new measure the Default-Adjusted-Basu (DAB) measure, because it adjusts for the effects of default risk on the Basu measure. We contend that the DAB measure can substantially reduce the bias caused by default risk, and hence is a more robust measure of accounting conservatism than the standard Basu measure.

Third, we demonstrate that once one adjusts for the distance-to-default, the Basu conservatism coefficient is no longer correlated with leverage. This finding makes a clear and substantive contribution by questioning some of the empirical justification of the conservatism literature. In particular, we find that leverage and the actual degree of accounting conservatism may not be positively correlated: instead, the positive correlation previously observed in the literature may result from leverage controlling the extent of upward-bias in the original Basu measure. Hence, we conclude that leverage is not a determinant of accounting conservatism as currently measured but is simply a control for bias in the Basu measure of accounting conservatism.

Our analysis of the Basu measure bears a close relationship to the analysis of the earnings response coefficient (ERC) by Dhaliwal et al. (1991), who analytically show that there is a negative association between a firm's ERC and its default risk. Dhaliwal et al.'s finding implies that there should also be a positive association between the Basu regression coefficients and default risk, because the Basu regression is essentially a reversed ERC regression. This positive association between the Basu coefficients and default risk is further analyzed in this paper. Another similarity between this paper and Dhaliwal et al. (1991) is that both papers use the contingent claims methodology of Black and Scholes (1973) and Merton (1974).

However, our paper goes beyond Dhaliwal et al. The finding in the current paper obtained from the DAB measure has significant implications for how researchers should interpret the fact that the original Basu measure is positively correlated with leverage. We find that the DAB measure is not positively correlated with leverage.

Before proceeding to the main analysis, we briefly introduce the Basu measure itself. In its most common form, the Basu (1997) measure is based on a cross-sectional, dummy-variable regression of accounting earnings on stock returns, as follows:

$$\frac{NI_{it}}{E_{i,t-1}} = \alpha_0 + \alpha_1 DR_{it} + \beta_0 R_{it} + \beta_1 R_{it} DR_{it} + \epsilon_{it} \tag{1}$$

where

NI_{it}:   Net Income for firm i year t.

$E_{i,t-1}$:   Opening market value of total equity for firm i year t.

R_{it}:   Buy-and-hold *percentage* rate of return on equity for firm i year t. By definition, $R_{it} \equiv R_{it}^E / E_{i,t-1}$, where R_{it}^E is the buy-and-hold *dollar* return on equity and E_{it} is total *dollar* value of equity.

DR_{it}:   Dummy variable that is equal to 1 if the return on equity for firm i year t is negative, and equal to 0 if the return on equity for firm i year t is non-negative.

The regression model above, known as the Basu model, regresses accounting earnings ($NI_{it}/E_{i,t-1}$) on stock returns ($R_{it}^E/E_{i,t-1}$) separately for 'good-news' and 'bad-news' firms. A firm-year is deemed a 'good-news' one if the return on its stock return is positive or zero, and a firm-year is deemed a 'bad-news' one if its stock return is negative. By using the dummy variable, DR_{it}, the Basu model allows the slope coefficients to differ between the good-news and bad-news groups (β_0 and $\beta_0 + \beta_1$, for good- and bad-news coefficients respectively). The difference between the bad- and good-news coefficients, β_1, is the *Basu asymmetric timeliness*

coefficient ('ATC'), which measures the degree of conservatism in the sample of firms.

The Basu (1997) model above is logically equivalent to regressing positive stock return on earnings and then negative return on earnings separately – one is for the good-news timeliness coefficient and the other for the bad-news timeliness coefficient, as shown in Equation 2 below. While we use the more popular piece-wise regression version of the Basu model (i.e. Equation 1) in the empirical tests, we follow Dietrich et al.'s approach (2007) and use the version in Equation 2 (i.e. having two separate regressions) in the theoretical discussions for the convenience of simpler theoretical proofs. However, the end results are always the same no matter which version of the Basu model is used.

$$\frac{NI_{it}}{E_{it-1}} = \alpha + \beta \frac{R^E_{it}}{E_{it-1}} + \mu_{it} \text{ where } \beta = \begin{cases} \beta_0, & \forall\, R^E_{it} \geq 0 \\ \beta_2, & \forall\, R^E_{it} < 0 \\ \beta_1 & = \beta_2 - \beta_0 \end{cases} \tag{2}$$

The rest of this paper proceeds as follows: Section 2 analytically examines how default risk impacts on the Basu measure, and develops the Default-Adjusted-Basu (DAB) measure of accounting conservatism. Section 3 discusses the sample data and the proxies used in the empirical tests. Section 4 reports the main empirical results with respect to both the original Basu measure and the DAB measure. Section 5 reports the results of the robustness tests. Section 6 discusses the implications of this paper for the accounting literature and, finally, the paper presents in Section 7 a summary of our conclusions.

2 The link between the Basu measure and default risk

In this section, we analytically derive the relationship between default-risk and the Basu measure of conservatism. In section 2.1, we develop a simple analytical model to demonstrate that the Basu measure is confounded by default risk. In section 2.2, we propose the Default-

Adjusted-Basu (DAB) measure and show that the DAB measure is not affected by default risk.

2.1 A simple analytical model

Here we use a simple analytical model to demonstrate that default risk can create a confounding bias in the Basu asymmetric timeliness coefficient (ATC) measure of accounting conservatism. To keep the exposition simple, our model has only one firm in a single period setting and a tax-free world. All investors, whether debt or equity, are assumed to be risk neutral.[2] Also for simplicity, we assume that the risk-free rate of interest is zero, implying that the investors' intertemporal elasticity of substitution is one. However the assumption of zero risk free rate does not rule out the existence of risk-premiums in the bond market. In addition, it is also assumed that the capital market is both complete and efficient, and the product market is characterized by perfect competition. The perfect competition condition guarantees that there will be no *ex ante* abnormal returns to be made by investing in this firm. At the start of the single period, date t_0, the firm has a debt in the form of a zero coupon bond with face value D which is the amount that must be repaid at the end of the period, date t_1. At the terminal date t_1, the firm generates a random terminal cash flow $\widetilde{x} \in X$, which has a certain statistical distribution $f(x) > 0$ for all $x \in X$.[3] The expected value of $\tilde{x}$ is μ, and the standard deviation of $\tilde{x}$ is σ.

Because a rational investor would not agree *ex ante* to take on a negative NPV project, we must impose the regularity condition that the expected value of the cash flow is greater than the face value of debt, thus, $\mu > D$. In other words, the regularity condition guarantees

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[2]There is however no difficulty in generalizing the analytical result to a risk-averse world, which can be achieved by simply using risk-neutral probabilities instead of real probabilities for the random cash flow $\tilde{x}$.

[3](1) In this general discussion of the analytical model, we abstract from the specific forms of distribution of cash flow $\tilde{x}$ in order to obtain the most general possible result. Later in the computer simulations in Section 2.2, we demonstrate this general result by using two specific distributions of $\tilde{x}$: the uniform distribution and the lognormal distribution. (2) To avoid the negative cash flow situation which is inconsistent with limited corporate liability, the set X consists only of non-negative numbers.

that the *ex ante* value of equity, which is the value of equity on date t_0, is strictly positive, thus avoiding the case of negative NPV.

Given the structure developed above, we can now derive the behavior of the value of the firm's equity (i.e, stock price). Because the capital market is fully efficient, the available information regarding the distribution of $\tilde{x}$ is fully and accurately reflected in the stock price at date t_0 *ex ante*. First, we follow the well-known Merton (1974) model of equity and characterize equity as a call option written on the underlying cash flow of the firm, with the maturity value of the debt D as the exercise price. Thus, the value of equity at date t_0 can be given by the following formula (Merton, 1974):

$$E_0 = \mathbb{E}\left[\max\left(\tilde{x} - D, \ 0\right)\right] \tag{3}$$

At date t_1, the information about the actual realization of $\tilde{x}$ becomes available, the cash flow $\tilde{x}$ is realized and thus uncertainty no longer exists. The value of equity adjusts accordingly and becomes

$$\tilde{E}_1 = \max\left(\tilde{x} - D, \ 0\right) \tag{4}$$

Using the value of equity at the beginning and the end of the period, the firm's rate of return on equity, $\tilde{R}$, can be calculated according to the following formula

$$\tilde{R} = \frac{\tilde{E}_1 - E_0}{E_0} = \frac{\max\left(\tilde{x} - D, \ 0\right) - E_0}{E_0} \tag{5}$$

In this tax-free world, the Modigliani and Miller (1958) capital structure theory must hold for this firm: (1) the present value of the firm is simply the expected value of cash flow, μ; (2) the present value of equity is E_0; and (3) the present value of debt is $B = \mu - E_0$. The behavior of the values of equity and debt as a function of the terminal cash flow $\tilde{x}$ is illustrated in Figure 1. The graph in Figure 1 shows that when the firm makes less cash

Figure 1: Illustration of the terminal value of debt and equity as functions of terminal cash flow
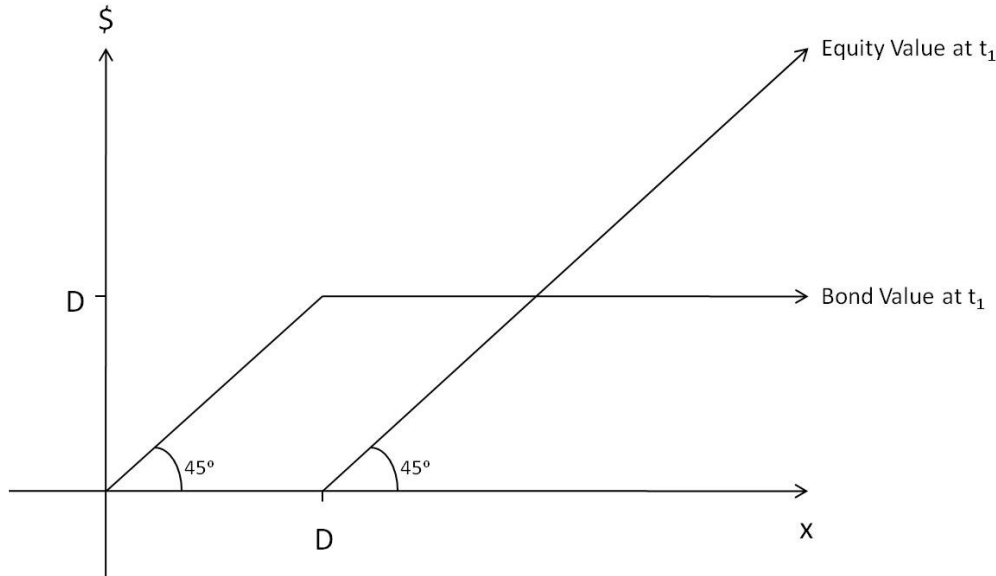
flow than the face value of debt D, the debt-holders will receive all of the cash flow and the equity-holder nothing; when the firm's cash flow is exactly D or greater, the debt-holder will receive exactly the amount D, and the equity-holder the surplus of the cash flow over D.

From Equation 3, we have $E_0 = \mathbb{E}\left[\max\left(\tilde{x} - D,\ 0\right)\right]$, and we know that $\max\left(\tilde{x} - D,\ 0\right)$ is a convex function of $\tilde{x}$. *Jensen's inequality* implies that $\mathbb{E}\left[\max\left(\tilde{x} - D,\ 0\right)\right] \geq \max\left(\mathbb{E}\left[\tilde{x}\right] - D,\ 0\right)$. The right-hand side of the inequality can be simplified to $\mu - D$, because $\mu > D$ which is one of our assumptions. We have just proved that $E_0 \geq \mu - D$. In economic terms, this result can be interpreted as stating that equity-holders must pay more to purchase the firm's stock than simply the expected value of the firm minus the face value of the debt. This is because the equity-holders' payoff function is convex, which results from limited liability. For example, when cash flow x is lower than a particular value that correspond to the maturity value of debt, equity-holders will not longer suffer any greater loss than their original investment and will not be liable to reimburse debtholders for their loss. Conversely, the debt-holders pay less than the maturity value D, since they must be compensated for default risk.

The face value of debt, D, directly determines the capital structure and thus is the main

determinant of the firm's default risk. A high D signifies that the firm is more heavily debt-financed, whereas a low D means that the firm is more equity-financed. At the same time, the higher the level of debt D, the higher is the default risk of the firm, as the same underlying cash flow $\tilde{x}$ will now have to pay off a greater amount of debt before equityholders can be paid a return.

Now consider how the accounting system reports earnings conditional on receiving the cash flow information $\tilde{x}$. When information about the realization of $\tilde{x}$ becomes available at date t_1, earnings e are announced. But since the accounting system is biased by accounting conservatism, e is not generally equal to the actual cash flow x. In particular, an asymmetry exists in earnings, as good news and bad news are handled differently by a conservative accounting system. If the actual cash flow x is greater than the expected value μ, i.e. $x > \mu$, then there is good news; conversely if $x < \mu$, then there is bad news. More specifically, under conservatism, earnings are reported in the following manner:

$$e = \mu + k\,(x - \mu) - i \tag{6}$$

where

$$k = \begin{cases} k_0 & \text{if } x \geq \mu \\ k_2 & \text{if } x < \mu \end{cases}$$

and i is the accrued implicit interest expense that the firm recognizes. Even though the debt has a zero coupon rate, the implicit interest expense is recognized in earnings. The interest expense is determined by the difference between the maturity value of debt at date t_0 and the purchase price of the debt at date t_1, that is $i = D - D_0$. Also notice that for a maturity value of debt D, the interest expense is non-stochastic as both D and D_0 are known at date t_0.

Using Basu's terminology, k_0 is the good news timeliness of earnings, whereas k_2 is bad

news timeliness of earnings. The degree of accounting conservatism is naturally defined as

$$k_1 \equiv k_2 - k_0 \tag{7}$$

The parameters k_0, k_1 and k_2 are not observable but can be estimated by running the Basu regression in Equation 1 or Equation 2 above. The solution of estimating these three parameters proposed by Basu (1997) is naturally to run the Basu regression in Equation 1 or Equation 2, both of which yield identical results. The resulting Basu asymmetric timeliness of earnings coefficient ("ATC"), β_1, measures the degree of conservatism, k_1, calculated as follows:

$$\begin{aligned} \text{ATC} &\equiv \beta_2 - \beta_0 \tag{8} \\ &= \frac{\text{cov}\left(\tilde{R},\ \tilde{e}/E_0 \mid \tilde{R} < 0\right)}{\text{var}\left(\tilde{R} \mid \tilde{R} < 0\right)} - \frac{\text{cov}\left(\tilde{R},\ \tilde{e}/E_0 \mid \tilde{R} \geq 0\right)}{\text{var}\left(\tilde{R} \mid \tilde{R} \geq 0\right)} \tag{9} \end{aligned}$$

In the equation above, the stock return $\tilde{R}$ is a random variable which can be viewed as many independent realizations of stock return generated by the corresponding realizations of cash flow $\tilde{x}$. This can be thought of as the same firm engaging in many repeated independent single period games like this, or as many independent firms with identical return distributions and with their cash realizations ocurring at the same time.

The Basu ATC depends on stock returns, R, as a proxy for the underlying cash flow news x, but they are not the same thing. Equation 5 shows that R is a function not only of cash flow x but also of debt D, which is a determinant of default risk. The debt factor is also carried over into the Basu ATC calculation, and is thus the source of the confounding bias in the ATC. It is conceivable that if D changes, the stock return R will also change, which in turn impacts on the value of the ATC. In other words, the Basu ATC is a function of both k_1 and D rather than just k_1 alone.

In order to analyze the precise relationship between the Basu measure, ATC, and the level of debt D, we must first substitute for R and e in Equation 8 in terms of their definitions and simplify the resulting expression:

$$
\text{ATC} = \frac{\text{cov}\left(\tilde{R},\ \frac{\tilde{e}}{E_0}\mid \tilde{R} < 0\right)}{\text{var}\left(\tilde{R}\mid \tilde{R} < 0\right)} - \frac{\text{cov}\left(\tilde{R},\ \frac{\tilde{e}}{E_0}\mid \tilde{R} \geq 0\right)}{\text{var}\left(\tilde{R}\mid \tilde{R} \geq 0\right)} \tag{10}
$$

$$
= \frac{\text{cov}\left(\frac{\tilde{E}_1 - E_0}{E_0},\ \frac{\mu + k_2(\tilde{x}-\mu)-i}{E_0}\mid \tilde{x} < \mu\right)}{\text{var}\left(\frac{\tilde{E}_1 - E_0}{E_0}\mid \tilde{x} < \mu\right)} - \frac{\text{cov}\left(\frac{\tilde{E}_1 - E_0}{E_0},\ \frac{\mu + k_0(\tilde{x}-\mu)-i}{E_0}\mid \tilde{x} \geq \mu\right)}{\text{var}\left(\frac{\tilde{E}_1 - E_0}{E_0}\mid \tilde{x} \geq \mu\right)} \tag{11}
$$

$$
= \frac{\text{cov}\left(\tilde{E}_1,\ k_2\tilde{x}\mid \tilde{x} < \mu\right)}{\text{var}\left(\tilde{E}_1\mid \tilde{x} < \mu\right)} - \frac{\text{cov}\left(\tilde{E}_1,\ k_0\tilde{x}\mid \tilde{x} \geq \mu\right)}{\text{var}\left(\tilde{E}_1\mid \tilde{x} \geq \mu\right)} \tag{12}
$$

$$
= k_2\frac{\text{cov}\left(\tilde{E}_1,\ \tilde{x}\mid \tilde{x} < \mu\right)}{\text{var}\left(\tilde{E}_1\mid \tilde{x} < \mu\right)} - k_0\frac{\text{cov}\left(\tilde{E}_1,\ \tilde{x}\mid \tilde{x} \geq \mu\right)}{\text{var}\left(\tilde{E}_1\mid \tilde{x} \geq \mu\right)} \tag{13}
$$

The first quotient in the above equation is the bad news timeliness coefficient and the second is the good news timeliness coefficient. The entire equation is the Basu asymmetric timeliness of earnings coefficient, which is the bad news timeliness coefficient minus the good news timeliness coefficient. Both $\tilde{R}$ and $\tilde{E}_1$ are random variables here because they are unknown when considered at date t_0. (If they were known, then there would be no uncertainty and thus no need to run regressions for estimation.) It is clear that in the second quotient, where $\tilde{x} > \mu$, the value of equity $\tilde{E}_1$, which is the greater of $\tilde{x} - D$ and zero, is simply $\tilde{x} - D$, because $x > \mu$ and $\mu > D$. Thus, by substituting $\tilde{x}$ for $\tilde{E}$, the Basu good news timeliness coefficient becomes:

$$
\beta_0 = k_0\frac{\text{cov}\left(\tilde{E}_1,\ \tilde{x}\mid \tilde{x} \geq \mu\right)}{\text{var}\left(\tilde{E}_1\mid \tilde{x} \geq \mu\right)} = k_0\frac{\text{var}\left(\tilde{x}\mid \tilde{x} \geq \mu\right)}{\text{var}\left(\tilde{x}\mid \tilde{x} \geq \mu\right)} = k_0
$$

Thus, we have shown that the Basu regression produces an unbiased estimate for the good news timeliness of earnings, i.e. $\beta_0 = k_0$. However, this does not hold for the Basu bad news

timeliness of earnings, β_2. We provide in the Appendix an indicative proof that, given our assumptions that $\mu > 0$ and $f(x) > 0$, it follows that $\beta_2 > k_2$. That is, the Basu bad news timeliness coefficient, β_2, is always biased upwards relative to the real degree of bad news timeliness of earings, k_2. Because the bad news coefficient, β_2, is upwards biased while the good news coefficient β_0 is unbiased, it follows that the Basu ATC, which is the difference between these two coefficients, is also upwards biased. This result is formally stated in Propositon 1 below.

Proposition 1. *A firm's asymmetric timeliness coefficient (ATC) is upwards biased, if the firm has debt financing.*

We next examine how the Basu ATC varies with the level of default risk in the firm. We adopt as our measure of default risk Merton's (1974) well-known 'distance-to-default' construct (abbr. DD) defined as:

$$DD = \frac{\ln(A_t/D) + (\alpha - \sigma^2/2)t}{\sigma\sqrt{t}} \tag{14}$$

where DD is the distance to default of a firm at time t for a specific forecasting period into the future, t; A_t is the gross value of the firm at time t, which is the sum of the value of equity and the value of debt; D is the maturity value of debt as we have defined earlier; α is the firm's expected rate of growth; σ is the firm's assets volatility; and t is the time until maturity which counts downwards.

DD measures the difference (in standard deviations) between the value of a firm's total assets and the maturity value of its debt. DD is a negative measure of default risk: the lower DD, the higher the default risk.

It is common practice to calculate the distance-to-default for 1 year ahead, as is in our simple one period model, hence $t = 1$ (Crosbie and Bohn, 2003; Vassalou and Xing, 2004). In our simple model the formula for DD thus reduces to:

$$DD = \frac{\ln(\mu/D) - \sigma^2/2}{\sigma} \tag{15}$$

as (i) the value of assets A at date t_0 is equal to the expected value of terminal cash flow, μ, and (ii) the *ex ante* growth rate is zero.

Since both μ and σ are fixed by the underlying probability distribution of $\tilde{x}$, the only source of variation in DD must come from the face value of debt D. In fact, the ratio μ/D has a very intuitive economic meaning: it is the Assets-to-Debt ratio of a firm at time t, which indicates the firm's financial leverage. When the firms take on more debt as a proportion of their total assets, the Asset-to-Debt ratio decreases, which leads to a decrease in DD. That is, as the firm's DD decreases, its default risk increases accordingly. This is formulated as Proposition 2, below, which connects the Basu ATC with distance-to-default.[4] The intuition for this proposition is also discussed below.

Proposition 2. *The bias in the Basu asymmetric timeliness coefficient (ATC) increases as the distance to default (DD) of the firm decreases (i.e. the default risk of the firm increases).*

The bias in the Basu measure analyzed in this paper departs from the model by Hayn (1995) at the following two major points: First, the focus of our model is the Basu regression model, which is essentially a reverse ERC model, whereas Hayn's (1995) focus is on an ordinary ERC. Second, our model emphasizes the role of debt, whereas Hayn's model emphasizes the effect of abandonment options. Debt and abandonment options are conceptually as well as practically different, as a firm may still have the abandonment option even though it has zero debt. Such a difference is especially significant, because our analysis has direct

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[4] Since it is $D > 0$ that produces the upward bias in the Basu ATC, it is obvious that the magnitude of the bias is increasing in D. A proof of this result, based on mathematical induction, is available on request from the corresponding author.

implications for the large literature on the relation between debt financing and accounting conservatism.

The above analytical propositions have been obtained without assuming any specific statistical distribution of the terminal cash flow $\tilde{x}$. In the Appendix, we illustrate these propositions using two computer simulations that are each based on specific statistical distributions of $\tilde{x}$. One simulation is based on the uniform distribution and the other on the lognormal distribution.

2.2 A *Default-Adjusted-Basu* (DAB) measure of accounting conservatism

Given the demonstrated bias in the standard Basu (1997) measure of conditional conservatism, we propose a new measure of accounting conservatism. This new measure is a modification of the standard Basu measure. The aim is to propose a measure of 'conditional' conservatism, which not only preserves the basic features of the original Basu (1997) measure, but is unbiased with respect to default risk. This new measure of conservatism, which we call the *Default-Adjusted-Basu (or "DAB")* measure, is estimated by fitting the following regression model:

$$\frac{OI_{it}}{A_{it-1}} = a_0 + a_1 DAR_{it} + b_0 R_{it}^A + b_1 R_{it}^A DAR_{it} + \epsilon_{it} \tag{16}$$

where OI_{it}, operating income, is estimated by adding Pre-tax Interest Expense back to Net Income (i.e. $OI_{it} = NI_{it} + INT_{it}$).[5] The value of the firm, A_{it}, which is the total of the firm's value of debt and value of equity, is estimated by Vassalou and Xing's (2004) iterative algorithm (see Section 4 below).

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[5]In an unreported robustness test, we find that the results of the DAB measure are not sensitive to whether we add back *After-tax Interest Expenses* or *Pre-tax Interest Expenses* to *Net Income*, as both methods produce very similar results.

R_{it}^A is the percentage return on assets for firm i year t. In our analytical model, R_{it}^A is equivalent to $(\tilde{x} - \mu)/\mu$, the actual terminal cash flow minus the expected terminal cash flow. Empirically, R_{it}^A is calculated as:

$$R_t^A = \frac{A_t - A_{t-1} - CFF_t}{A_{t-1}} \tag{17}$$

where CFF_{it} is the net cash flow from financing activities for firm i in year t, which is positive for net cash inflows, and negative for net cash outflows. The term CFF_{it} is there to control for the firm's capital financing transactions during the fiscal year. This term does not occur in the analytical model because we make the simplifying assumption that the firm does not conduct any capital financing transactions.

Lastly, the dummy variable, DAR_{it}, controls for good-news and bad-news. It is set equal to 1, if $R_{it}^A < 0$; and is set equal to 0, if $R_{it}^A \geq 0$. Hence, it is clear that the DAB measure in Equation 16 has the same underlying structure as the standard Basu (1997) regression model, but it utilizes different proxies for accounting earnings and economic 'news'. The DAB measure of accounting conservatism is b_1, in contrast to the standard Basu measure β_1. In the Appendix we show that $\hat{b}_1$ is an *unbiased* measure of accounting conservatism and we formulate the result as Proposition 3.

Proposition 3. The Default-Adjusted-Basu (DAB) measureof conservatism, which is b_1 estimated in Equation 16, is an unbiased measure of accounting conservatism.

3 Proxies and data

3.1 The Vassalou and Xing (2004) iterative method

In this paper, we employ Vassalou and Xing's (2004) iterative method to calculate firms' distance-to-default (DD) and firm value (A).[6] Vassalou and Xing (2004) offer a robust iterative algorithm for calibrating the volatility (σ) and the daily values (A) of the firm, which has the Merton (1974) model as its conceptual underpinning. This method is a relatively new technique of calculating default risk and has shown considerable power in predicting firms' default probabilities (Crosbie and Bohn, 2003). Bushman and Williams (2009) have recently employed a similar approach to measuring the default risk in banks, an approach first used by Ronn and Verma (1986). Although the approach taken by Ronn and Verma (1986) and Bushman and Williams (2009) is similar to the Vassalou and Xing (2004) method, it differs from Vassalou and Xing's (2004) method as it is not iterative.[7] The iterative procedure has a significant advantage over the non-iterative procedure, because variability in actual market leverage is too great for the simpler approach to yield a reliable estimate of asset volatility σ_1.

Vassalou and Xing's (2004) iterative estimation method consists of the following steps: (1) Use daily stock prices over the 12 months prior to the desired balance date to form an initial estimate of the volatility of equity – σ_E. (2) Use the initial value, σ_E, to derive an initial estimate of asset volatility, σ, by $\sigma = \frac{E}{E+BVD}\sigma_E$. (3) Use the new σ to solve the Black-Scholes-Merton equity-pricing equation for the value of A_t in each of the trading days

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[6]We especially thank Robert M. Bushman for suggesting Vassalou and Xing's (2004) iterative method of estimating distance-to-default.

[7]Crosbie and Bohn (2003, pp. 16-17) point out that the iterative procedure adopted in the academic literature by Vassalou and Xing was already being applied in practice by Moody's *KMV*.

over a 12 months period, as follows:[8]

$$E_t = A_t N(d_1) - De^{-rt} N(d_2) \tag{18}$$

where

$$
\begin{aligned}
d_1 &= \frac{\ln(A_t/D) + (r + \sigma^2/2)t}{\sigma\sqrt{t}}; \\
d_2 &= d_1 - \sigma\sqrt{t}
\end{aligned}
$$

(4) Obtain a new σ from the newly estimated daily values of A_t. This new σ is then used as the input to the Black-Scholes-Merton equity-pricing equation in the next iteration. (5) Repeat Steps 3 and 4, until the values of σ from two consecutive iterations converge, specifically, where the difference between two consecutive σ is less than 10^{-3}. In the actual computations of this Vassalou and Xing algorithm on our sample data, most of the sample firm-years converge quickly, usually within 2 to 3 iterations.

In this study, this iterative procedure is conducted once each year for every firm with a December fiscal year-end.[9] To be consistent with Vassalou and Xing (2004), the time until debt repayment or refinancing, t, is set at 1 year for all firms. The firm's *steady growth rate* α, which is also its *weighted average cost of capital ("WACC")*, is calculated according to the Capital Asset Pricing Model (CAPM), as $\alpha = r + \beta_A RiskPremium$.[10] We first estimate the equity beta for each firm-year using prior *monthly* returns for up to 60 months, ending in December of the year of estimation. In the case that there are less than 24 months of stock return data available, we estimate the equity beta based on *daily* stock returns in the year of

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[8]On average, there are 251 trading days per year.

[9]We remove all firms that do not have their fiscal year-ends in December.

[10]We do not follow Vassalou and Xing's (2004) choice of the current year's *realized* assets growth rate as the firm's *expected* steady growth rate, because the *expected* rate is usually different from the *realized* rate. Many firms have negative *realized* growth rates, but not many firms would have negative *expected* growth rates.

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estimation itself. Once the equity betas (β_E) are estimated, we then convert them into asset betas (β_A) by Hamada's formula (ignoring income tax): $\beta_A = \frac{E}{E+BVD}\beta_E$ (Hamada, 1972). After that, we can easily calculate the WACC for each firm-year using the estimated β_A and the appropriate market risk premium and risk-free rates. Based on Dimson et al. (2009), we set the risk premium of the U.S. market at 5%. The risk-free rate, r, is the average rate of 3-Month U.S. Treasury Bills in the relevant year. The default point, D, is approximated by the firm's total book liabilities reported, BVD, at every year-end, from the Compustat database. Finally, DD is calculated for each firm year by using Equation 14 with the estimated values of α and σ as well as the known values of D, r .

3.2   Sample and descriptive statistics

The raw sample consists of all non-financial firms listed on NYSE, AMEX, and NASDAQ (national and OTC) exchanges from 1999 to 2006, excluding ADR firms. In order to simplify the computations of the Vassalou and Xing (2004) algorithm, we select only those firms that have a December fiscal year-end. To reduce the effects of outliers, as in standard practice, we trim the top and bottom 1% of the following variables[11]: R_{it}, EPS_{it}/P_{it-1}, ACC_{it}/TA_{it-1}, CFO_{it}/TA_{it-1}, OI_{it}/A_{it-1}, and two estimated variables DD_{it} and R_{it}^A. In addition, we delete those observations with a missing value in any of the key variables, and those observations with a zero or negative Market-to-Book (MTB) ratio. Since the Vassalou and Xing (2004) algorithm requires 12 months of uninterrupted daily stock price data, we also delete those firm-years that do not meet this requirement. The raw sample contains 14,167 firm-year observations, and after the trimming process, the final sample consists of 12,531 firm-years, spanning 8 calendar years from 1999 to 2006 inclusive.

Table 1 provides the descriptive statistics of the final sample. All scale-related variables,

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[11]In unreported sensitivity tests, we obtained similar results by alternatively trimming 0.5% and 2% from the top and bottom of the range of each variable.

Table 1: Descriptive statistics

		mean	median	min	max	st. dev.
A	($'million)	4,303	593	1	244,500	13,420
ACC	($'million)	4	0	-8,409	15,080	276
CFO	($'million)	229	18	-4,447	24,110	832
DD		4.28	4.05	-1.44	12.73	2.82
BVA	($'million)	2,608	294	0	250,800	8,955
BVD	($'million)	1,635	111	0	205,700	6,192
EPS	($)	0.07	0.29	-400.00	212.20	8.53
EPS/P		-0.01	0.03	-0.90	0.33	0.14
LEV		0.75	0.39	0.00	26.70	1.14
MTB		3.49	2.20	0.12	86.77	4.97
MVE (or E)	($'million)	2,600	344	0	116,800	8,184
NI	($'million)	89	5	-27,450	13,530	553
OI	($'million)	136	9	-27,110	14,530	621
P	($)	19	12	0	2375	50
R		0.18	0.06	-0.82	4.11	0.65
R^A		0.10	0.03	-0.93	7.49	0.50
VOL (or σ)		0.46	0.35	0.03	4.37	0.36

A_{it}: value of (of the assets of) the firm, calculated using the Vassalou & Xing (2004) method; ACC: operating accrual according to Ball & Shivakumar's (2005) balance sheet method; CFO: cash-flow from operating activities; DD: distance-to-default estimated with the Vassalou & Xing (2004) iterative procedure; BVA: total book value of assets; BVD: total book value of current and long-term liabilities; EPS: basic earnings per share before extra-ordinary items; EPS/P: earnings per share divided by opening share price; LEV: financial leverage, calculated as the sum of short- and long-term debt divided by the closing market value of equity; MTB: closing market value of equity divided by closing net book value; MVE: closing market value of equity, also denoted as E in the analytical section; NI: net income including extra-ordinary items; OI_{it}/A_{it-1}: operating income (net income + interest expense) divided by A_{it-1}; P: opening share price; R: buy-and-hold rate of return of equity stocks; R_{it}^A: return on the value of the firm, calculated as $R_{it}^A = (A_{it} - A_{it} + CFF_{it})/A_{it-1}$, where CFF_{it} is the net cash-flow from financing activities; VOL (σ): assets volatility of the firm, i.e. volatility of the value of the firm, calculated using the Vassalou & Xing (2004) method, measured in units of standard deviations of assets returns.

Table 2: Correlation Table

	A	ACC	CFO	DD	BVA	BVD	EPS/P	LEV	MTB	MVE	NI	OI	R	R^A	VOL
A	1	0.02	0.84	0.15	0.88	0.84	0.09	0.06	0.06	0.87	0.48	0.6	-0.04	-0.05	-0.17
ACC	0.1	1	-0.02	0.02	0.03	0.02	0.03	0	0.01	0.01	0.19	0.17	0	0	-0.01
CFO	0.72	0.02	1	0.17	0.87	0.84	0.14	0.06	0	0.76	0.63	0.73	-0.01	-0.01	-0.2
DD	0.32	0.1	0.33	1	0.13	0.1	0.3	-0.33	0.05	0.24	0.19	0.19	0.38	0.39	-0.43
BVA	0.92	0.1	0.81	0.3	1	0.98	0.11	0.13	-0.03	0.72	0.48	0.63	-0.02	-0.03	-0.21
BVD	0.88	0.09	0.79	0.22	0.97	1	0.1	0.16	-0.02	0.64	0.46	0.61	-0.02	-0.03	-0.21
EPS/P	0.22	0.17	0.52	0.33	0.36	0.36	1	-0.07	0.01	0.12	0.19	0.19	0.11	0.09	-0.42
LEV	0.2	-0.02	0.31	-0.37	0.39	0.53	0.17	1	-0.17	-0.03	-0.02	0.04	-0.13	-0.15	-0.25
MTB	0.24	0.07	0	0.15	0	-0.03	-0.07	-0.47	1	0.09	0.03	0.02	-0.09	-0.08	0.17
MVE	0.93	0.11	0.75	0.49	0.91	0.85	0.32	0.04	0.26	1	0.54	0.62	0.02	0.02	-0.18
NI	0.51	0.2	0.74	0.41	0.58	0.56	0.76	0.13	0.1	0.59	1	0.97	0.02	0.02	-0.14
OI	0.61	0.18	0.81	0.37	0.7	0.69	0.71	0.27	0.06	0.66	0.94	1	0.01	0.01	-0.18
R	-0.01	0.04	0.16	0.55	0.1	0.1	0.32	-0.12	-0.19	0.2	0.22	0.21	1	0.92	-0.02
R^A	-0.03	0.02	0.16	0.54	0.08	0.08	0.3	-0.16	-0.17	0.19	0.21	0.2	0.95	1	0
VOL	-0.53	-0.09	-0.64	-0.42	-0.7	-0.75	-0.46	-0.56	0.22	-0.53	-0.52	-0.61	-0.15	-0.13	1

Note: Pearson correlations are above the main diagonal, and Spearman rank-correlations are below the main diagonal.

such as Operating Accruals (ACC), Book Value of Assets (BVA), Cash Flows from Operating Activities (CFO), Market Value of Equity (MVE) and Total of Current and Long-term Liabilities (BVD), vary significantly across firms, because of the varying sizes of the firms. The mean (median) of EPS_{it}/P_{it-1} is -1% (3%). The mean (median) of stock returns, R, is 18% (6%). This is consistent with the existence of a "fat-tail" in the distribution of stock returns. Several variables, such as DD, VOL (i.e. σ), and A, are calculated using the Vassalou and Xing (2004) method, as described earlier. Table 1 shows that the mean DD is 4.28 (in units of standard deviations), and the median is 4.05. Similarly, asset volatility, VOL (which, in our earlier notation used in the Merton model, is σ), has a mean of 46% (annualized), and a median of 35% (annualized). The mean (median) rate of return on assets, R_{it}^A, is 10% (3%), which is significantly lower than that of the return on equity (R), as expected.

The correlation table is reported in Table 2 and shows no unexpectedly high or low correlation coefficients. As expected, all size variables, such as MVE, BVA, NI and A, are all positively correlated with each other. The percentage return on equity, R_{it}, is highly positively correlated with the percentage return on assets, R_{it}^A, as illustrated by a Pearson correlation of 0.92 and a Spearman rank-correlation of 0.95, as expected.

4   Main empirical results

4.1   Results for the standard Basu measure

If default risk does indeed induce an upward bias in the Basu measure, as determined in *Proposition 1*, then one should empirically observe that the Basu measure, β_1, increases with the level of default risk in the sample firms. This forms the first aspect of our empirical testing. To test this prediction, we follow the augmented regression approach commonly applied in the relevant literature (e.g. LaFond and Watts, 2008; Roychowdhury and Watts,

2007; Ahmed and Duellman, 2007; Lara et al., 2009a). In particular, we estimate the following Basu regression augmented by DD:

$$
\begin{aligned}
\frac{EPS_{it}}{P_{i,t-1}} = & \ \alpha_0 + \alpha_1 DR_{it} + \alpha_2 DD_{it} + \beta_0 R_{it} + \beta_1 R_{it} \cdot DR_{it} \qquad (19) \\
& + \gamma_0 R_{it} \cdot DD_{it} + \gamma_1 R_{it} \cdot DR_{it} \cdot DD_{it} + \epsilon_{it}
\end{aligned}
$$

In equation 19, we test whether γ_1, which is the coefficient on the interaction between default risk and the Basu ATC, has the desired sign. Since *Proposition 1* predicts that DD is *negatively* correlated with the Basu ATC, we expect γ_1 to be (statistically) significantly *less* than zero.[12]

Table 3 presents the results of the regression of our sample data. First, we estimate the standard Basu model (in Column A), and the result shows that the standard Basu measure, β_1, is 0.210 and is significant at the 1% level. The estimated value of β_1 is consistent with the values reported in prior research (Basu, 1997; Ball et al., 2000; Bushman and Piotroski, 2006; Pope and Walker, 1999). The good-news timeliness ($\beta_0 = -0.022$) is significantly negative at the 1% level, which is also consistent with the prior studies for U.S. firms in roughly the same sample period (e.g. Bushman and Piotroski, 2006; Zhang, 2008).

The results of testing the main proposition that β_1 increases in the degree of default risk are reported in Columns B and C of Table 3. The regression in Column B augments the standard Basu regression model with distance-to-default (DD). The coefficient, γ_1, on the interaction term, $DD \cdot DR \cdot R$, is -0.011, and is (statistically) significant at the 1% level, indicating that default risk is positively associated with the Basu asymmetric timeliness coefficient. Since DD is an inverse measure of default, this finding is consistent with our theoretical prediction that default risk and the bias in the Basu measure are positively correlated.

---

[12]Note that DD is a negative proxy for default risk. Thus, if the Basu ATC is negatively correlated with DD, then it is positively correlated with default risk.

Table 3: The association between the Basu measure of conservatism and distance-to-default (DD)

Independent Variables	(A) Standard Basu Measure		(B) Effects of DD on Basu Measure		(C) Effects of DDRANK on Basu	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Intercept	0.027	*12.40* ***	-0.029	*-4.43* ***	-0.050	*-6.07* ***
DR	-0.009	*-2.53* **	0.011	*1.18*	0.029	*2.66* ***
R	-0.022	*-5.70* ***	-0.035	*-3.17* ***	-0.039	*-2.86* ***
*DR*R*	0.210	*22.05* ***	0.182	*10.13* ***	0.190	*8.94* ***
DD			0.010	*10.56* ***		
*DD*DR*			-0.003	*-2.03* **		
*DD*R*			0.002	*1.44*		
*DD*DR*R*			-0.011	*-2.52* **		
DDRANK					0.121	*11.01* ***
*DDRANK*DR*					-0.055	*-3.45* ***
*DDRANK*R*					0.025	*1.35*
*DDRANK*DR*R*					-0.091	*-2.19* **
Adj. R_sq.		7.95%		11.10%		11.60%
F-stat		362 ***		225 ***		235 ***

DR is 0 if $R \geq 0$ and 1 otherwise. R: arithmetic rate of stock return; DD: distance-to-default estimated with Vassalou & Xing's (2004) iterative method; $DDRANK$: percentile of DD. The dependent variable is EPS_{it}/P_{it-1} . Significance levels: *10%, **5%, ***1%. All t-statistics are White-adjusted.

Table 4: The association between the Default-Adjusted-Basu (DAB) measure and distance-to-default (DD)

Independent Variables	(A) DAB Measure		(B) Effects of DD on DAB Measure		(C) Effects of DDRANK on DAB Measure	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Intercept	0.034	*38.40* ***	0.011	*4.51* ***	0.003	*1.08*
DAR	-0.010	*-7.00* ***	0.003	*0.50*	0.010	*2.34* **
R^A	-0.019	*-10.00* ***	-0.024	*-3.62* ***	-0.026	*-3.81* ***
*DAR * R^A*	0.129	*30.20* ***	0.118	*13.56* ***	0.119	*12.48* ***
DD			0.004	*11.55* ***		
*DD * DAR*			-0.002	*-2.80* **		
*DD * R^A*			0.001	*0.75*		
*DD * DAR * R^A*			0.002	*1.04*		
DDRANK					0.048	*11.20* ***
*DDRANK * DAR*					-0.025	*-3.95* **
*DDRANK * R^A*					0.008	*0.87*
*DDRANK * DAR * R^A*					0.021	*1.06*
Adj. R_sq.	12.50%		14.40%		14.60%	
F-stat	596.0 ***		301.0 ***		307.0 ***	

The dependent variable of all 3 models is OI_{it}/A_{it-1}. DAR_{it} is 0 if $R_{it}^A \geq 0$ and 1 otherwise. R_{it}^A: the rate of return on assets of the firm; DD: distance-to-default estimated with Vassalou & Xing's (2004) iterative method; $DDRANK$: percentile of DD. Significance levels: *10%, **5%, ***1%. All t-statistics are White-adjusted.

In order to control for any potential non-linearity in the relationship between DD and the Basu measure, the regression in Column C augments the Basu model with the percentile ranking of distance-to-default $DDRANK$. The resulting coefficient on the interaction term, $DDRANK \cdot DR \cdot R$, is -0.091, which is statistically significant at the 5% level. This result further supports *Proposition 1*.

4.2 Results for the DAB measure

In Section 3 above, we constructed the DAB measure of accounting conservatism, as in Equation 16, and developed the prediction that the DAB measure should exhibit little or no correlation with distance-to-default DD. We test this prediction by conducting the following augmented regression:

$$
\frac{OI_{it}}{A_{it-1}} = a_0 + a_1 DAR_{it} + a_2 DD_{it} + b_0 R_{it}^A + b_1 R_{it}^A \cdot DAR_{it} \qquad (20)
$$
$$
+ c_0 R_{it}^A \cdot DD_{it} + c_1 R_{it}^A \cdot DAR_{it} \cdot DD_{it} + \epsilon_{it}
$$

In light of our analytical results, we make the following empirical predictions:

1. $b_0 < \beta_1$: *The DAB measure produces a lower measure of the degree of accounting conservatism than does the Basu measure, because the DAB measure is unbiased whereas the Basu measure is upward-biased.*

2. $c_1 = 0$: *The DAB measure is not associated with the distance-to-default of sample firms, because it is unbiased.*

Table 4 presents the results of testing the DAB measure. First, the results reported in Column A for the DAB regression model show that the value of the asymmetric timeliness coefficient ($b_1 = 0.129$ in Table 4) is 34% lower than the standard Basu ATC ($\beta_1 = 0.210$ in Table 3). This difference between β_1 and b_1 is significant at the 1% level (the t-statistic is

7.80).[13] This suggests that there is an upward bias in the standard Basu measure. Second, the results in Columns B and C of Table 4 for the two augmented regressions with DD and $DDRANK$ respectively show that c_1, the interaction coefficient between conservatism and DD or $DDRANK$, is not significantly different from zero in either regression. This is also consistent with our theoretical prediction and thus lends direct support to the validity of the DAB model. Therefore, our test results provide strong empirical evidence that the DAB measure is more robust to default risk than is the standard Basu (1997) measure and that the Basu (1997) measure systematically overestimates the degree of accounting conservatism in samples where firms are under various degrees of financial distress.[14]

Finally, we wish to emphasize that the magnitude as well as the direction of the bias in the Basu ATC is as economically significant and prevalent as it is statistically. Default risk is a matter of degree and exists to some degree in almost all firms, as demonstrated by the varying degree of distance-to-default that we find in our dataset. In other words, default risk is not binary (i.e. default risk, no default risk), since as long as a firm has debt, it has default risk. Therefore, while few firms in the stock market are on either end of the scale – having either extremely high default risk or extremely low default risk – and the majority of the firms carry a moderate, but non-zero, degree of default risk. Another implication of this bias in the Basu measure is that it tends to confound the empirical research that investigates the relationship between accounting conservatism and leverage, which is another proxy for default risk. The last issue will be further discussed in Section 6 of this paper.

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[13]This t statistic is derived from the formula: $t = (\beta_1 - b_1)/\sqrt{SE(\beta_1)^2 + SE(b_1)^2}$.

[14]Given the computational complexity of the Vassalou and Xing procedure for measuring DD and the significant data requirement, we also estimated the DAB measure by the simple method of substituting the book value of debt for the market value of debt in the calculation of A_{it}. The resulting estimate of conservatism was much the same as obtained from the standard Basu regression. This result indicates that the simplified measure is not an adequate substitute for the Vassalou and Xing (2004) based approach. Nevertheless, the result is useful because it supports there being a default-risk related bias in the Basu measure. The simplified DAB measure ignores changes in the value of debt, which can be quite large when the firm has high risk of default. As a consequence, the total return of the firm, as measured by the simplified method, understates the true extent of the firm's return when the firm's default risk is high. The DAB regression coefficients would thus overstate the firm's true degree of accounting conservatism. We are indebted to an anonymous referee for this perspective on the result of the simplified approach.

5 Robustness tests

5.1 Controlling for the potential identification issue

In the previous section, the empirical evidence showed that there is a positive correlation between default risk and the Basu measure of conservatism. However, simply finding this correlation is not a sufficient condition for the existence of *bias* in the Basu measure, because the real degree of accounting conservatism could also have increased when default risk increases. Therefore, we face an identification problem: *Is the increase in the Basu measure when default risk increases the result of upward bias, or an increase in the actual degree of conservatism, or both?*

In the analytical section, we showed how default risk impacts on β_1 via its impact on D, while holding the true degree of accounting conservatism k_1 constant. But the debt-contracting theory of conservatism has argued that k_1 might increase as a result of increased risk-shifting to debt-holders from equity-holders under high default risks (Beatty et al., 2008; Watts, 2003; Zhang, 2008). If this theory holds, then the Basu measure of conservatism, β_1, will also increase as a result of the increases in k_1, even when there are no biases present in the Basu measure itself. Therefore, it is important to control for the changes in the real degree of conservatism, k_1, in our tests.

To do that, we use the Asymmetric Accrual to Cashflow (AACF) measure of conservatism developed by Ball and Shivakumar (2005) as the control variable for the actual degree of conservatism. The AACF measure regresses the firm's operating accruals on its operating cashflows in the same time period, as follows:

$$ACC_{it} = \beta_0 + \beta_1 DCFO_{it} + \beta_2 CFO_{it} + \beta_3 DCFO_{it} \cdot CFO_{it} + \epsilon_{it} \tag{21}$$

where

- ACC_{it}: Accruals measured as: ΔInventory $+$ ΔDebtors $+$ ΔOther current assets - ΔCreditors - ΔOther current liabilities - Depreciation, all deflated by beginning total book assets.

- $DCFO_{it}$: Dummy variable that is set to 0 if $CFO_{it} \geq 0$, and is set to 1 if $CFO_{it} < 0$.

- CFO_{it}: Cash-flow for period t, deflated by beginning total book assets.

- β_3: the AACF measure of accounting conservatism.

Table 5 reports the results for the estimation of Ball and Shivakumar's (2005) AACF measure (Equation 21). The regression reported in Column A is the standard AACF model. Consistent with Ball and Shivakumar (2005), the standard AACF model shows a negative good-news timeliness coefficient (-0.105), and a positive asymmetric timeliness coefficient (0.148). Both coefficients are significant at the 1% level.

The regressions reported in Column B and Column C of Table 5 augment the AACF model with DD and $DDRANK$ respectively. In the regression reported in Column B, γ_1 is 0.007 which is not significant. The regression in Column C produces a similar result. The results reported in Columns B and C thus show that the AACF measure of conservatism is not associated with the default risk of the firm.

The regression results in Table 5 are in sharp contrast with the earlier results in Table 3. In Table 3, the Basu measure is highly negatively correlated with DD, suggesting that the Basu measure is positively correlated with default risk. But in Table 5, the AACF measure of conservatism shows no correlation with DD at all. Thus, our robustness test suggests that the increase in the Basu measure as default risk increases is likely the consequence of the increasingly higher upward bias rather than changes in the actual degrees of accounting conservatism.

Table 5: Robustness Test: Ball & Shivakumar's (2005) AACF measure of conservatism and Distance-to-Default (DD)

Independent Variables	(A) AACF measure of conservatism		(B) Effects of DD on AACF measure		(C) Effects of DDRANK on AACF measure	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Intercept	0.018	*15.31****	0.010	*4.50****	0.008	*3.17****
DCFO	0.011	*4.31****	0.008	*1.87**	0.007	*1.38*
CFO	-0.105	*-11.66****	-0.150	*-7.89****	-0.164	*-7.09****
DCFO*CFO	0.148	*12.35****	0.154	*6.49****	0.158	*5.57****
DD			0.002	*5.65****		
DD*DCFO			0.001	*1.26*		
DD*CFO			0.004	*1.40*		
DD*DCFO*CFO			0.007	*1.53*		
DDRANK					0.023	*5.42****
DDRANK*DCFO					0.013	*1.35*
DDRANK*CFO					0.061	*1.78**
DDRANK*DCFO*CFO					0.052	*1.14*
Adj. R_sq.	2.36%		3.55%		3.64%	
F-stat	102 ***		67 ***		69 ***	

$DCFO_{it}$ is 0 if $CFO_{it} \geq 0$, and 1 otherwise. CFO: operating cashflow divided by opening total book value of assets (BVA). DD: distance-to-default estimated with Vassalou & Xing's (2004) iterative method; $DDRANK$: percentile of DD. Dependent variable in all 3 models is operating accrual divided by opening total assets – ACC_{it}/BVA_{it-1}. [For representational convenience, the denominator, BVA, is not shown in the table.] Significance levels: *10%, **5%, ***1%. All t-statistics are White-adjusted.

Figure 2: Box-plot of distance-to-default (DD) – "normal firm-years" vs. "outliers"
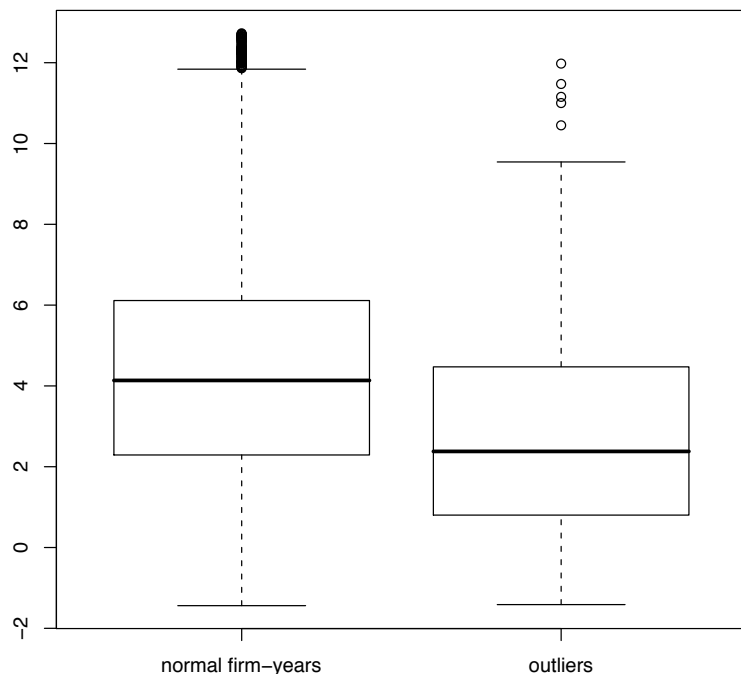
5.2 Characteristics of "outliers"

Our second robustness test is of a different character to the other empirical tests conducted in the paper. While the other tests examine certain *a priori* theoretical predictions, the current test begins with no *a priori* theory at all – instead we let the dataset reveal its patterns and characteristics. This is done by detecting the "outliers" of the sample data based on a pure statistical technique, Cook's distance, which we introduce below.

In regression analysis, "outliers" are relative to the regression model itself. Fox (1997) contends that if a regression model has omitted some important (and correlated) explanatory variables, the data will likely show "outliers". In a strict sense, they are not "outliers" at all; rather, they are merely observations with special characteristics that the existing regression model fails to explain.

The main regression model in this paper is the standard Basu (1997) model. To identify "outliers", we first separately estimate the Basu model year-by-year from 1999 to 2006 inclu-

sive.[15] Then, we calculate the Cook's distance (CD) for each firm-year observation. Using the cut-off recommended by Fox (1997), we label any firm-year with $CD > df/(n - df - 1)$ as an "outlier" (df is the degrees of freedom, n is the number of observations). After classifying firms into "normal" firms and "outliers", we compare the levels of distance-to-default (DD) between these two groups of firms. Figure 2 graphically depicts this comparison. An analysis of variance (ANOVA) shows that the "outliers" have lower DD than the "normal" firms. The average DD in "normal" firms is 4.374. In contrast the average DD in "outliers" is 2.775. The difference is statistically significant at the 1% level. In summary, this analysis of "outliers" suggests that firms with high default risk possess quite different characteristics from firms with low default risk, and it appears that the standard Basu model fails to capture that difference. Thus, in an indirect way, this analysis corroborates the argument that default risk is an omitted variable in the Basu measure.

6 Implication: Is leverage really a determinant of accounting conservatism?

Khan and Watts (2009), Watts (2003), LaFond and Roychowdhury (2008) and Lara et al. (2009b) argue that leverage is an important determinant of accounting conservatism. In particular, those studies claim that there exists a higher debt-contracting demand for accounting conservatism from firms with higher leverage ratios. They argue that the demand for higher degrees of conservatism arises from the fact that there is a more severe agency conflict between shareholders and debtholders in highly leveraged firms. In such firms, a variety of forms of opportunistic behaviors on the part of the shareholders could occur at the expense of the debtholders, such as excessive dividends and/or asset substitutions. As

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[15]This robustness test does not include the trimmed data, because the purpose of this test is to show that "outliers" still exist in the Basu model even after extreme values have been trimmed way, and to understand the characteristics of these "outliers".

a response to these agency problems, the debtholders tend to demand a greater degree of accounting conservatism from the firm in order to protect themselves, because higher degrees of conservatism can benefit the debtholders by (1) timelier defaults of debt covenants, and (2) constraining opportunistic behaviors on the part of the managers and shareholders (Khan and Watts, 2009).

Table 6: Leverage vs. Measures of Conservatism

(A) Basu measure interacted with Leverage		(B) DAB measure interacted with Leverage		(C) AACF measure interacted with Leverage	
Dependent Variable EPS/P		**Dependent Variable** OI/A		**Dependent Variable** ACC	
Intercept	0.025 (8.08)***	**Intercept**	0.029 (25.52)***	**Intercept**	0.022 (14.3)***
R	-0.022 (-4.56)***	**R^A**	-0.021 (-9.29)***	**CFO**	-0.09 (-7.82)***
DR	-0.009 (-1.93)*	**DAR**	-0.01 (-5.41)***	**DCFO**	0.005 (1.63)
LEV	0.003 (0.6)	**LEV**	0.003 (3.01)***	**LEV**	0.000 (0.32)
DR*R	0.179 (15.5)***	**R^A*DAR**	0.124 (25.55)***	**CFO*DCFO**	0.140 (9.73)***
DR*LEV	-0.001 (-0.09)	**R^A*LEV**	0.026 (4.56)***	**CFO*LEV**	-0.081 (-4.73)***
R*LEV	-0.001 (-0.13)	**DAR*LEV**	0.001 (0.88)	**DCFO*LEV**	-0.001 (-0.59)
DR*R*LEV	0.032 (2.38)**	**R^A*DAR*LEV**	-0.021 (-3.32)***	**CFO*DCFO*LEV**	-0.002 (-0.06)
Adj. R-sq.	8.49%	**Adj. R-sq.**	13.22%	**Adj. R-sq.**	3.54%

The prior literature often justifies the above theoretical proposition based on the empirical finding that there is a positive correlation between financial leverage and the Basu measure of accounting conservatism (e.g. Khan and Watts, 2009; LaFond and Watts, 2008; LaFond

and Roychowdhury, 2008; Ahmed and Duellman, 2007; Lara et al., 2009b). However, a firm's leverage ratio is also closely related to its default risk (and thus its distance-to-default), and therefore, the positive correlation between the Basu measure and the leverage ratio can also be explained by the existence of an upward bias in the standard Basu measure: the bias tends to increase as the firm has higher default risks, which is closely associated with the firm's leverage ratio. In other words, leverage is found to be positively associated with the Basu measure, not because the real degree of conservatism has increased with leverage, but because leverage causes an upwards bias in the Basu measure.

In Table 6, we conduct some empirical tests in order to test the effect of leverage on all three different measures of accounting conservatism that we have used in the paper - the Basu, DAB and AACF measures. Similar to Khan and Watts (2009), we calculate leverage as the sum of short- and long-term debt divided by the closing market value of equity. When the firm is more financial distressed, its market value of equity tends to be lower compared to the size of its debt, resulting in a higher leverage ratio.

In Column A of Table 6, we interact the Basu measure with leverage, and the regression coefficient on $DR * R * LEV$ indicates the impact of leverage on the Basu measure. Consistent with prior research, Column A shows that this interaction coefficient is 0.032 and is statistically significant at the 5% level, suggesting that leverage and the Basu (1997) measure are indeed positively correlated.

Moving to Column B of Table 6, where we interact LEV with our Default-Adjusted-Basu (DAB) measure, the interacting coefficient on $R^A * DAR * LEV$ is now -0.021, which is negative and statistically significant at the 1% level. This result means that the degree of conservatism is not positively correlated with leverage when the bias in the Basu measure is corrected for.[16]

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[16]The fact that the interaction effect observed is negative seems to suggest that as a firm gets more leveraged up, the agency problem between debtholders and equityholders may actually induce the firm to adopt an even lower degree of conservatism, thereby allowing the equityholders to extract an even greater amount of wealth from the debtholders. However, a thorough investigation of this topic is outside the scope of this

To further increase the robustness of our result, we conduct an augmented AACF regression with LEV as an additional variable, as shown in Column C of Table 6. The interaction effect between LEV and the AACF measure of conservatism is indicated by the coefficient on $CFO * DCFO * LEV$, which is -0.002 and is not statistically significant. Thus, the result of this AACF test concurs with our previous two tests in that LEV may not be positively correlated with the actual degree of accounting conservatism, and that the observed positive correlation between LEV and the Basu measure of conservatism is likely the consequence of a bias caused by default-risk.

While AACF controls for conservatism, we find that the DAB measure is superior to AACF because, first, AACF uses cash flow as a proxy for value shocks or 'news'. This is more noisy than stock returns, or better, asset returns. Hence, the DAB measure retains the advantage of the Basu model but avoids its biases. Second, many studies on conservatism and leverage have been undertaken using the Basu measure, not AACF. It is therefore more appropriate to analyze the Basu model using DAB rather than AACF.

7   Conclusions

The main implication of our results for the literature concerns how researchers should explain the existing literature's finding that leverage and the Basu measure are positively associated. There are two possible explanations: one explanation is that high leverage leads to greater demands for accounting conservatism due to creditors' incentives to protect themselves when agency costs are high. Our explanation is that leverage and the actual degree of accounting conservatism may not be positively correlated: rather the observed positive correlation may simply be the result from leverage controlling for the extent of the upward bias in the original Basu measure. Our empirical evidence strongly supports this second explanation: LEV is

paper.

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probably not a real determinant of accounting conservatism, and is instead simply a *control* for the bias in the Basu (1997) measure of accounting conservatism.

Recently, Khan and Watts (2009) developed a modified Basu measure of accounting conservatism based on firm-year specific measures. In Khan and Watts' (2009) new measure of conservatism, the leverage ratio is used as one of the key instrumental variables for determining the degree of accounting conservatism for each firm-year. However, if our findings are valid, then the use of leverage in the Khan and Watts' measure of conservatism needs to be reconsidered.

In conclusion, we have analytically and empirically demonstrated that the Basu measure is, in general, *upward* biased due to the existence of default risk, and that the magnitude of this bias tends to increase with the level of default risk. We have also proposed a new measure of accounting conservatism – the *Default-Adjusted-Basu (DAB)* measure – in order to address the issue of bias in the original Basu (1997) measure. Our empirical results suggest that the DAB measure can substantially reduce or even eliminate the default-risk bias, and therefore can produce a more accurate measure of the degree of accounting conservatism.

An implication of our paper for the accounting literature is that there is a need for a reconsideration of measures of accounting conservatism in the context of higher leverage and risk of default. Our analytical and empirical results suggest that the positive association of leverage with the Basu (1997) measure may simply be a result of an increase in the default-risk bias in the Basu measure in highly-leveraged firms, which masks the true relationship between leverage and accounting conservatism. Therefore, further research is required to re-examine the relationship between accounting conservatism and leverage.

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Appendix

In this appendix, we first present indicative proofs of Propositions 1 and 3, and then provide two computer simulations as demonstrations of the effect of default risk on the Basu ATC.

Proof of Proposition 1

From Equation 13, we have

$$\beta_2 = k_2 \frac{\text{cov}\left(\tilde{E}_1, \ \tilde{x} \mid \tilde{x} < \mu\right)}{\text{var}\left(\tilde{E}_1 \mid \tilde{x} < \mu\right)}$$

Thus whether β_2 is equal to k_2 or not depends on the value of the covariance/variance term that is multiplied to it. We show below that the $\text{cov}(.)/\text{var}(.)$ term is greater than 1 and therefore β_2 is biased. First, we established earlier that:

$$\mathbb{E}\left[\max\left(\tilde{x} - D, \ 0\right)\right] \geq \mu - D \tag{22}$$

Now, using Jensen's inequality again as well as Inequality 22, we can now derive the following inequality for the numerator term. (For clarity we drop $\tilde{x} < \mu$ from the expressions, but it continues to hold.)

$$
\begin{aligned}
\text{cov}\left(\tilde{E}_1, \ \tilde{x}\right) &= \mathbb{E}\left(\tilde{E}_1 \tilde{x}\right) - \mathbb{E}\left(\tilde{E}_1\right) \mathbb{E}\left(\tilde{x}\right) \\
&= \mathbb{E}\left[\max\left(\tilde{x} - D, \ 0\right) \tilde{x}\right] - \mathbb{E}\left[\max\left(\tilde{x} - D, \ 0\right)\right] \mathbb{E}\left[\tilde{x}\right] \\
&\geq \max\left(\mathbb{E}\left(\tilde{x}^2\right) - \mathbb{E}\left(D\tilde{x}\right), \ 0\right) - (\mu - D)\mu \\
&= \mathbb{E}\left(\tilde{x}^2\right) - D\mu - \mu^2 + D\mu \\
&= \sigma^2 \tag{23}
\end{aligned}
$$

The demoninator is:

$$
\begin{aligned}
var\left(\tilde{E}_1\right) &= \mathbb{E}\left[\tilde{E}_1^2\right] - \mathbb{E}\left[\tilde{E}_1\right]^2 \\
&= \mathbb{E}\left[\left(\max\left(\tilde{x} - D, \ 0\right)\right)^2\right] - \mathbb{E}\left[\max\left(\tilde{x} - D, \ 0\right)\right]^2 \tag{24}
\end{aligned}
$$

It is easy to see intuitively that $[\max(x - D, \ 0)]^2 \leq (x - D)^2, \ \forall x \in X$. The inequality must be true, because when $x - D$ is less than zero, the left-hand side is zero, while the right-hand side term is a square of a negative number, which is positive. On the other hand, when $x - D$ is positive, both sides are the same. Thus, summing up over $x \in X$ and calculating their

expected value, we obtain

$$\mathbb{E}\left[\left(\max\left(\tilde{x}-D,\,0\right)\right)^2\right] \le \mathbb{E}\left[\left(\tilde{x}-D\right)^2\right] \tag{25}$$

Substitute Inequalities 22, 25 into Equality 24, and we get

$$
\begin{aligned}
var\left(\tilde{E}_1\right) &= \mathbb{E}\left(\tilde{E}_1^2\right) - \mathbb{E}\left(\tilde{E}_1\right)^2 \\
&= \mathbb{E}\left[\max\left(\tilde{x}-D,\,0\right)^2\right] - \mathbb{E}\left[\max\left(\tilde{x}-D,\,0\right)\right]^2 \\
&\le \mathbb{E}\left[\left(\tilde{x}-D\right)^2\right] - \left(\mu-D\right)^2 \\
&= \sigma^2
\end{aligned}
\tag{26}
$$

In short, the above inequality states that

$$var\left(\tilde{E}_1\right) \le \sigma^2 \tag{27}$$

Thus, by combing Inequalities 23 and 27, we have the following conclusion

$$\text{cov}\left(\tilde{E}_1,\,\tilde{x}\mid\tilde{x}<\mu\right) \ge \sigma^2 \ge var\left(\tilde{E}_1\mid\tilde{x}<\mu\right)$$

Thus,

$$\frac{\text{cov}\left(\tilde{E}_1,\,\tilde{x}\mid\tilde{x}<\mu\right)}{var\left(\tilde{E}_1\mid\tilde{x}<\mu\right)} \ge 1$$

that is

$$\beta_2 \ge k_2$$

and hence $\beta_1 = \beta_2 - \beta_0 \ge k_1$.[17]

Proof of Proposition 3

The following proof is simple and follows the structure of the proof of Proposition 1.

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[17]Note the sign $\ge$ can be replaced by the sign $>$, thus removing the possibility of equality all together, if the $\tilde{E}$ is a strictly convex function of μ. Pursuing this idea would take us far afield from accounting into mathematics. Therefore, we supplement the mathematical proof with two computer simulations to show that the sign is indeed $>$ and therefore the Basu ATC is indeed upwards biased.

$$b_2 = \frac{cov\left[\tilde{R}^A, \dfrac{\tilde{e}+i}{A_0} \mid \tilde{R}^A < 0\right]}{var\left[\dfrac{e+i}{A_0} \mid \tilde{R}^A < 0\right]} = \frac{cov\left[\dfrac{\tilde{x}-\mu}{\mu}, \dfrac{\mu + k_2(\tilde{x}-\mu) - i + i}{\mu} \mid \tilde{R}^A < 0\right]}{var\left[\dfrac{\mu + k_2(\tilde{x}-\mu) - i + i}{\mu} \mid \tilde{R}^A < 0\right]}$$

$$= \frac{cov\left[\tilde{x}-\mu, \ \mu + k_j(\tilde{x}-\mu) \mid \tilde{x} < \mu\right]}{var\left[\tilde{x}-\mu \mid \tilde{x} < \mu\right]} = k_2$$

Similarly,

$$b_0 = k_0$$

Thus, the DAB measure, b_1, is an unbiased estimator of accounting conservatism.

Computer Simulations

Here we provide two computer simulations to illustrate that the Basu ATC is indeed biased by the presence of debt and default risk. We use these simulations to corroborate our theoretical results. In particular, the theoretical results hold for two very well-known distributions $\tilde{x}$: (1) a uniform distribution and (2) a lognormal distribution. The simulation procedure and results are discussed below.

a) For a uniform distribution of cash flow $\tilde{x}$:

First, we set up some common parameters: for simplicity, we assume that the good news timeliness is $k_0 = 0.5$, and the bad news timeliness is $k_2 = 1$. So our ficticious firm would recognize 50% of good news in the period in which it arises, but all 100% of the bad news immediately. The degree of conservatism following this setup is $k_1 = 1 - 0.5 = 0.5$.

We first randomly generate 1000 realizations of cash flow $\tilde{x}$ based on a uniform distribution in the domain $X = [0, \ 1]$. The mean of $\tilde{x}$ is $\mu = 0.5$. It is clear that the value of the firm at date t_0 is just the expected value 0.5. Then we set the face value of debt to the initial value $D_{j=0} = 0$, which is the situation where the firm has no borrowing at all. Then, for this initial level of debt, $D_{j=0}$, we calculate the 1000 realizations for the value of equity, $\tilde{E}_1$, each of which corresponding to a particular realization of the cash flows $\tilde{x}$ generated earlier. For example, for cash flow x_i, where $i \in [1, \ 1000]$, we calculate the value of equity by $E_{1i} = \max\left[(x_i - D_j), \ 0\right]$. Based on the generated data of 1000 pairs of x_i and E_{1i}, we then conduct the *reduced form* Basu regression (Equation 13) and estimate the ATC. This result gives us the ATC corresponding to $D_{j=0} = 0$. Since, there is no debt in this situation at all, we expect to see ATC very close to the true value of conservatism, which is $k_1 = 0.5$.

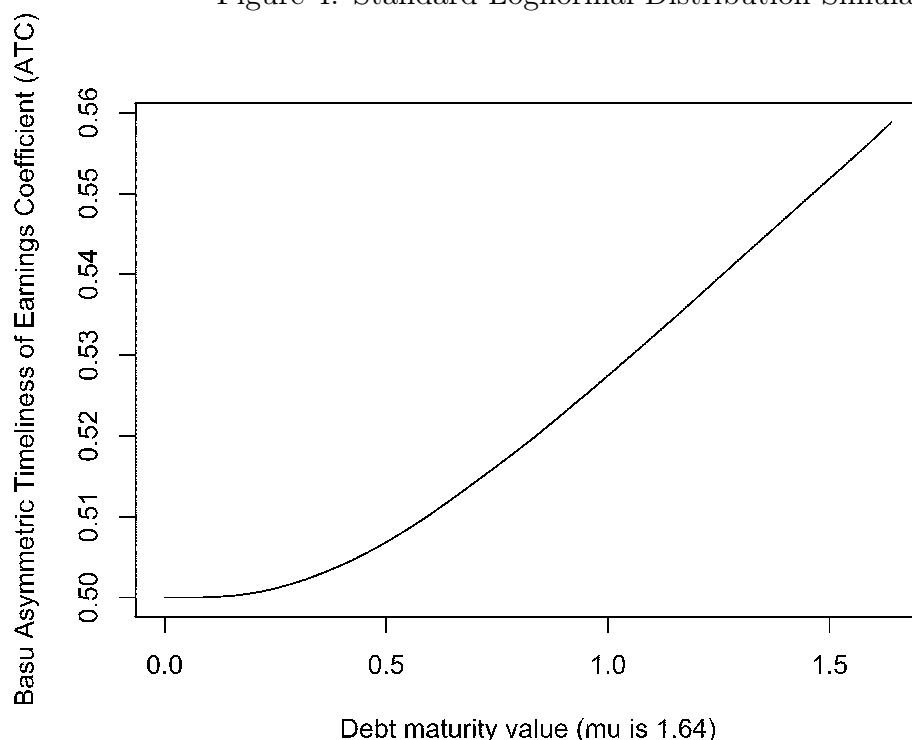Figure 3: Uniform Distribution Simulation Result
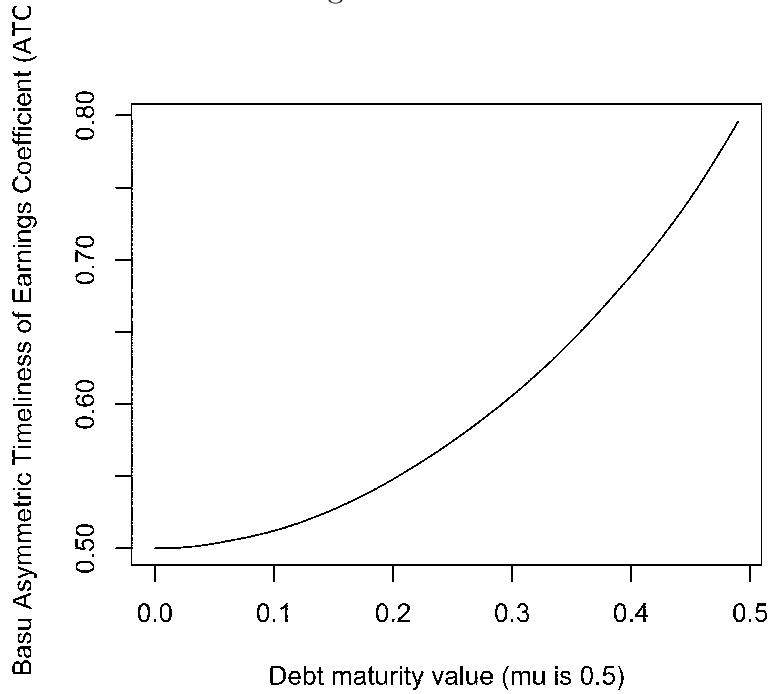
Indeed this is the case as shown in Figure 3.

Now let us see how the Basu ATC responds when we increase the value of debt, D_j, in small increments. For every increment, we increase D_j by 100th of 0.49, which is 0.0049, and we increase D_j 100 times, until the final value is $D_{100} = 0.49$ – just slightly below the expected value of the firm 0.5.[18] In each increment, we regenerate 1000 realizations of cash flows and use them to calculate the values of equity based on the rule that $E_{1i} = \max\left[(x_i - D_j),\ 0\right]$. In other words, we generate 1000 new pairs of $(x_i,\ R_i)$ for each small increment of D. Then we run the reduced form Basu regression (Equation 13) and calculate the ATC using those 1000 simulated observations. Since we run this regression 101 times from $D_0 = 0$ to $D_{100} = 0.49$, we can obtain 101 different estimates of ATC, each of which corresponds to a particular value of debt D_j.

In Figure 3, the results of these 101 Basu ATC estimates are plotted against their respective D_j. It is immediately clear that when the maturity value of debt D_j increases, the Basu ATC also increases. When debt is zero, the Basu ATC is unbiased: $\beta_1 = k_1 = 0.5$. However, as D_j increases, the Basu ATC gradually rises and eventually reaches the highest point where $D_{100} = 0.49$. This simulation clearly demonstrates that the presence of debt financing causes bias to the Basu ATC measure of conservatism, and the greater the level of debt relative to equity, the greater is the bias.

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[18]Note the regularity condition that $D < \mu$.

Figure 4: Standard Lognormal Distribution Simulation Result

b) For a lognormal distribution of cash flow $\tilde{x}$:

In the second simulation exercise, we assume that cash flow $\tilde{x}$ follows a standard lognormal distribution, i.e. $\tilde{x} \sim \ln N (0, 1)$. A lognormal distribution is far more realistic than uniform distribution and it is the usual distribution that financial researchers assume for stock prices. The expected value of cash flow according to this distribution is $\mu = exp(1/2) \approx 1.65$. The domain of cash flow is $X = (0, +\infty)$. In this case, we still choose the initial D_0 to be zero, indicating zero debt. As we did with the uniform distribution, we gradually move D_j up, each step by 100th of 1.64, that is 0.0164, for 100 steps. The highest value of D_j is therefore $D_{101} = 0.164$, which means that it satisfies the investor rationality constraint that $D < \mu$. Then we repeated the same procedure discussed above with regards to the uniform distribution to estimate the basu ATC for each value of D_j.

The results of simulating the lognormal distribution for cash flows are plotted in Figure 4. We can see that there is clearly an increasing trend in the Basu ATC as the level of leverage increases. It can also be seen that in the case of $D = 0$, which is located at the bottom-left corner of Figure 3, the ATC is exactly the true degree of conservatism that $\beta_1 = k_1 = 0.5$, but at all other values of D, the ATC is above the true degree of conservatism, which again confirms our theoretical results.