



A comparison of Merton's option pricing model of corporate debt valuation to the use of book values

Allan C. Eberhart*

The McDonough School of Business, Georgetown University, Washington, DC 20057, USA

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Abstract

Many studies use the book value of debt as a proxy for its market value because most corporate debt does not trade. I call this practice the book value of debt (BVD) approximation, and it appears to be justified by the observation that the average market value of debt is close to its book value. Many corporate bonds, however, trade at values significantly different from their book values, and consequently the BVD approximation can create important biases. I compare the accuracy of the BVD approximation to Merton's option pricing (OPT) model of corporate debt valuation, and find consistent evidence that the Merton model provides more accurate estimates. I also show that this model is an easily estimated alternative to the BVD approximation. In short, the BVD approximation not only creates significant biases, but it is also an unnecessary simplification.

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1. Introduction

Nearly all firms have debt outstanding and most of it does not trade. This dearth of trading creates a problem for many researchers because they need market values of debt for their empirical tests. A common solution to this problem is to use the book value of debt as a proxy for its market value. I call this solution the book value of debt (BVD) approximation, and it appears to be justified by the observation that the average market price of debt is close to its book value.

* Tel.: +1-202-687-4584.

E-mail address: eberhara@georgetown.edu (A.C. Eberhart).

As Sweeney et al. (1997) report, however, many corporate bonds trade at values significantly different from their book values and the consequences of these differences can be notable. For example, previous studies documenting the existence of a diversification discount use the BVD approximation (e.g., Berger and Ofek (1995))¹. Mansi and Reeb (2002) reexamine the existence of this discount by analyzing a sample of firms with publicly traded debt. Their sample selection permits them to use the market value of debt instead of the BVD approximation. They find that diversification does destroy shareholder wealth but it increases bondholder wealth by an approximately equal amount because it decreases default risk. They conclude that there is no destruction of (total) firm value (i.e., the sum of the firm's market value of equity and debt) associated with diversification. What appears to be a diversification discount is actually a wealth transfer from shareholders to bondholders, and the BVD approximation prevents previous studies from observing this wealth transfer effect.²

In short, there is extensive evidence that the BVD approximation can create important biases and yet its widespread use ignores this evidence. These results are even more notable when one considers that the kinds of firms with traded debt (i.e., large, well-established firms) are the least likely to have large differences between their book and market values of debt. In other words, previous studies documenting the bias created by the BVD approximation most likely understate the extent of the bias because their samples are limited to firms with traded debt.

Notwithstanding these problems, the BVD approximation might be viewed as a necessary simplification because it permits researchers to conduct large sample tests (requiring debt values) without having to go through a cumbersome and involved valuation of each firm's debt. There is, however, an alternative to the BVD approximation that can be estimated easily using standard data available in Compustat and the Center for Research in Security Prices (CRSP) files: Merton's (1974) option pricing (OPT) model of corporate debt valuation (also called a structural bond valuation model). Despite the long history of this model, I am unaware of any previous study that conducts a comprehensive comparison of this model to the BVD approximation. One of the main contributions of this paper to the literature is to make such a comparison using two primary series of tests.

My two test series differ mainly in their estimation of the underlying firm value and return volatility, two important inputs to the Merton model that are not directly observable for most firms because most corporate debt does not trade. My first series of tests use exogenous estimates of firm values and return volatilities. The advantage of these tests is that I can compare the *stock* value estimates implied by the Merton model, and by the BVD approximation, to actual stock prices. So, I am not limited to examining the small percentage of firms with traded debt (around 10 percent of firms with traded stocks have traded bonds). With these tests, I subtract the Merton OPT model estimate of the firm's

¹ The diversification discount is measured as the percentage difference between a diversified firm's total value and the sum of imputed values for its segments as stand-alone entities. The diversified firm's total value is defined as the sum of its market value of equity and book value of its debt (i.e., the BVD approximation). The BVD approximation is also used to estimate the imputed values of the firm's segments.

² Many other studies (using market value of debt data) report evidence of significant wealth transfers from shareholders to bondholders (e.g., Eberhart and Siddique, 2002) and from bondholders to shareholders (e.g., Warga and Welch, 1993).

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