

Comparing the performance of market-based and accounting-based bankruptcy prediction models [☆]

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Abstract

Recently developed corporate bankruptcy prediction models adopt a contingent claims valuation approach. However, despite their theoretical appeal, tests of their performance compared with traditional simple accounting-ratio-based approaches are limited in the literature. We find the two approaches capture different aspects of bankruptcy risk, and while there is little difference in their predictive ability in the UK, the *z*-score approach leads to significantly greater bank profitability in conditions of differential decision error costs and competitive pricing regime.

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1. Introduction

There is renewed interest in credit risk assessment, inter alia, driven by the requirements of Basle II and explosive growth in the credit derivatives market.¹ This, and the concern about the lack of theoretical underpinning of traditional accounting-ratio-based models such as the Altman

(1968) *z*-score, has led to the application of the contingent claims valuation methodology for predicting corporate failure with the KMV model now extensively employed by banks and financial institutions. However, empirical tests of the relative power of the two approaches are lacking in the literature. The only published study, that of Hillegeist et al. (2004), is deficient in comparing the market-based approach with the Altman (1968) and Ohlson (1980) accounting-ratio-based models which are known to suffer from high misclassification rates (e.g. Begley et al., 1996). It also does not take into account differential error misclassification costs and the economic benefits of using different credit risk assessment approaches. In any case, a more valid comparison would be with the commercially available Zeta® (Altman et al., 1977) model which has far superior performance (e.g. Altman, 1993, pp. 219–220).

Under Basel II, banks are allowed to use internal ratings-based approaches to set capital charges with respect to the credit risks of their portfolios. Hence, research in this area assumes greater significance because a poor credit risk model could lead to sub-optimal capital allocation.

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¹ This interest is also demonstrated by the wide range of papers in the special issue on ‘Credit ratings and the proposed new BIS guidelines on capital adequacy for bank credit assets’ in the *Journal of Banking and Finance* (Altman (Ed.), 2001).

Accounting-ratio-based models are typically built by searching through a large number of accounting ratios with the ratio weightings estimated on a sample of failed and non-failed firms. Since the ratios and their weightings are derived from sample analysis, such models are likely to be sample specific. Mensah (1984) finds that the distribution of accounting ratios changes over time, and hence recommends that such models be redeveloped periodically. In addition, the very nature of the accounting statements on which these models are based casts doubt on their validity: (i) accounting statements present past performance of a firm and may or may not be informative in predicting the future, (ii) conservatism and historical cost accounting mean that the true asset values may be very different from the recorded book values, (iii) accounting numbers are subject to manipulation by management, and in addition, (iv) Hillegeist et al. (2004) argue that since the accounting statements are prepared on a going-concern basis, they are, by design, of limited utility in predicting bankruptcy.

Market-based models using the Black and Scholes (1973) and Merton (1974) contingent claims approach provide a more appealing alternative and there have been several recent papers using this approach for assessing the likelihood of corporate failure (e.g., Bharath and Shumway, 2004; Hillegeist et al., 2004; Reisz and Perlich, 2004; Vassalou and Xing, 2004; Campbell et al., 2006). Such a methodological approach counters most of the above criticisms of accounting-ratio-based models: (i) it provides a sound theoretical model for firm bankruptcy, (ii) in efficient markets, stock prices will reflect all the information contained in accounting statements and will also contain information not in the accounting statements, (iii) market variables are unlikely to be influenced by firm accounting policies, (iv) market prices reflect future expected cash-flows, and hence should be more appropriate for prediction purposes, and (v) the output of such models is not time or sample dependent.

However, the Merton model is a structural model and operationalizing it requires a number of assumptions. For instance, as Saunders and Allen (2002, pp. 58–61) point out, the underlying theoretical model requires the assumption of normality of stock returns. It also does not distinguish between different types of debt and assumes that the firm only has a single zero coupon loan. In addition, it requires measures of asset value and volatility which are unobservable. It is therefore not surprising that the empirical evidence on the performance of market-based models is mixed. Kealhofer (2003) and Oderda et al. (2003) find that such models outperform credit ratings, and in their empirical comparisons Hillegeist et al. (2004) suggest their derived model carries more information about the probability of bankruptcy than poorly performing accounting-ratio-based models. On the other hand, Campbell et al. (2006) find such market-based models have little forecasting power after controlling for other variables. Similarly, Reisz and Perlich (2004) find that Altman's (1968) *z*-score does a slightly better job at failure prediction

over a 1-year period than both their KMV-type and computationally much more intensive down-and-out barrier option models, though their market-based models are better over longer horizons (3–10 years).

This paper compares the performance of the well-known and widely used UK-based *z*-score model of Taffler (1984) originally published in a special issue of this journal on international credit risk models against carefully developed market-based models over a 17-year period from 1985 to 2001 using receiver operating characteristic (ROC) curves and information content tests. Importantly, we use the framework of Stein (2005) and Blöchliger and Leippold (2006a), and extend the analysis to compare the market shares, revenues and profitability of banks employing these competing models taking into consideration differential error misclassification costs. Using a sample of middle-market borrowers, Stein (2005), in a largely theoretical paper, demonstrates that small differences in model power can lead to significant economic impact for the user. In contrast, we use the mixed regime framework of Blöchliger and Leippold (2006a), and apply this to all UK-listed firms over a 17-year period. We also introduce a specific risk-based performance measure based on the Foundation Approach under Basel II. As Caouette et al. (1998, p. 148) point out:

“Ultimately, however, the real issue is how well the models work and to what extent their use contributes to improved financial performance of the institution. A conceptual model that does not perform has no advantage over a statistical model that does.”

The main conclusions of this study are: (i) while the *z*-score model is marginally more accurate, the difference is statistically not significant, (ii) in a competitive loan market, a bank using the *z*-score approach would realize significantly higher risk-adjusted revenues, profits, return on capital employed, and return on risk-adjusted capital than a bank employing the comparative market-based credit risk assessment approach, and (iii) relative information content tests find that both the *z*-score and market-based approaches yield estimates that carry significant information about failure, but neither method subsumes the other.

Our results demonstrate that traditional accounting-ratio-based bankruptcy risk models are, in fact, not inferior to KMV-type option-based models for credit risk assessment purposes, and dominate in terms of potential bank profitability when differential error misclassification costs and loan prices are taken into account. The apparent superiority of the market-based model approach claimed by Hillegeist et al. (2004) reflects the poor performance of their comparator models, not a particularly strong performance by their option-pricing model.

The paper proceeds as follows: the next section describes data sources and different models used, and Section 3 presents the evaluation metrics adopted. Results are reported in Section 4 and conclusions drawn in Section 5.

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