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A comparative study of structural models of corporate bond yields: An exploratory investigation ☆

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Abstract

This paper empirically compares a variety of firm-value-based models of contingent claims. We formulate a general model which nests versions of the models introduced by Merton (1974), Leland (1994), Anderson and Sundaresan (1996), and Mella-Barral and Perraudin (1997). We estimate these using aggregate time series data for the US corporate bond market, monthly, from August 1970 through December 1996. We find that models fit reasonably well, indicating that variations of leverage and asset volatility account for much of the time-series variations of observed corporate yields. The performance of the recently developed models which incorporate endogenous bankruptcy barriers is somewhat superior to the original Merton model. We find that the models produce default probabilties which are in line with the historical experience reported by Moodys.

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1. Introduction

In this paper we estimate structural models of corporate bond yields using monthly observations of yield indices of US investment grade corporate bonds. Following the tradition established by Merton (1974) structural models of corporate bonds treat these as contingent claims on the assets of the firm. Variations in yield are explained by variations in leverage, asset value volatility, and the riskless interest rate. Structural models of the liabilities of the firm are attractive on theoretical grounds, as they link the valuation of financial claims to economic fundamentals. Further motivation for structural models of corporate liabilities is provided by past empirical work which has found that corporate yield spreads over government bonds is related to stock market returns and macroeconomic business cycle indicators (Jaffee, 1975; Duffee, 1998).

Despite the appeal of structural models, they have proved difficult to implement successfully. One problem is that the theoretical models relate yields to fundamental determinants in a highly non-linear way. Furthermore, structural models have greater data requirements than other approaches. Past serious attempts to implement the Merton model on US corporate bonds proved disappointing (Jones et al., 1984, 1985). The models did not fit very well and tended to systematically underestimate observed yields when plausible values of asset volatility were employed. Nevertheless, simple structural models have been the basis of a number of tools used by practitioners in the evaluation of credit-risky instruments.

The alternative approach of practitioners has been to infer fair yields from market yields of other traded instruments that are comparable with respect to rating and maturity. In the simplest application this gives rise to "matrix pricing" where the yield of a given issue is derived from a set of yields of traded benchmarks using ad hoc rules for interpolation. Recently a number of advances have been made which give a rigorous statistical basis for inferring issue yields from market benchmarks. Important studies of these so-called "reduced form" models of corporate yields include Litterman and Iben (1991), Jarrow and Turnbull (1995) and Duffie and Singleton (1997, 1996). This approach introduces a variety of flexible functional forms giving the conditional probability of default. The results have been encouraging, and these reduced form models are useful in some practical applications. However, there are important limitations to this approach.

A first issue is the abundance of possible functional forms which may be calibrated to a given set of benchmarks but which can imply significantly