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The term structure of credit spreads with jump risk

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Abstract

Default risk analysis is important for valuing corporate bonds, swaps, and credit derivatives and plays a critical role in managing the credit risk of bank loan portfolios. This paper offers a theory to explain the observed empirical regularities on default probabilities, recovery rates, and credit spreads. It incorporates jump risk into the default process. With the jump risk, a firm can default instantaneously because of a sudden drop in its value. As a result, a credit model with the jump risk is able to match the size of credit spreads on corporate bonds and can generate various shapes of yield spread curves and marginal default rate curves, including upward-sloping, downward-sloping, flat, and hump-shaped, even if the firm is currently in a good financial standing. The model also links recovery rates to the firm value at default so that the variation in recovery rates is endogenously generated and the correlation between recovery rates and credit ratings before default reported in Altman [J. Finance 44 (1989) 909] can be justified.

JEL classification: G12; G13; G33

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1. The term structure of credit spreads with jump risk

There are two basic approaches to modeling corporate default risks. The structural approach, pioneered by Black and Scholes (1973) and Merton (1974) and extended by Black and Cox (1976), Longstaff and Schwartz (1995), Leland (1998), Zhou (2001), and others, explicitly models the evolution of the firm value. A firm defaults when its market value falls below certain exogenously given threshold level or the value of its debt. One critical common assumption of the Merton–Black–Cox–Longstaff–Schwartz approach is that the evolution of firm value follows a diffusion process. Under a diffusion process, because a sudden drop in the firm value is impossible, firms never default by surprise. Thus, the large credit spreads of corporate bonds, especially those with short maturities, are unexplained in the context (see, e.g., Jones et al., 1984; Sarig and Warga, 1989; Fons, 1994).

The reduced-form approach, adopted by Duffie and Singleton (1999), Jarrow et al. (1997), Madan and Unal (1994), and others, does not consider the relation between default and the firm value in an explicit (or structural) way. It treats default as an unpredictable Poisson event. It is not clear from this approach what the link is between the structure of a firm's assets and liabilities and the firm's default risk. For example, since the hazard rate of default in the reduced-form approach is modeled as an exogenous process, it is unknown what economic mechanism is behind the default process. Therefore, even though the reduced-form approach generates the rich dynamics of the term structure of credit spreads, it provides few theoretical insights on the causes of these dynamics. Moreover, according to Duffie (1999), the parameters of the reduced-firm models are unstable when the models are applied to fit observed yield spreads.

The main objective of this paper is to build a model that possesses the advantages of both the reduced-from approach and the traditional diffusion approach. That is, on one hand, the new model should be flexible to capture both short-term and long-term yield spreads and default rates; on the other hand, the new model should also provide sufficient conceptual insights on the economic mechanism of default risk. To fulfill this objective, the paper develops a structural approach to valuing risky debt by modeling the evolution of firm value as a jump-diffusion process. The jump-diffusion model has many nice features, including:

- The jump-diffusion model is consistent with the fact that bond prices often drop in a surprising manner at or around the time of default (Beneish and Press, 1995; Duffie and Lando, 1997). Duffie and Lando (1997) attribute this phenomenon to incomplete accounting information. That is, around the time of default, substantial accounting information about the issuer will be revealed to the market. Because of a jump in market information, bond prices jump accordingly. The jump caused by incomplete information is just