

# **Structural Models: An Overview**

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# The Merton Model

- ▶ The central distinguishing point of “structural models” is the view of debt, equity, and other claims issued by a firm as contingent claims on the firm’s asset value.
- ▶ There is an obvious appeal to viewing and pricing debt in this way.
- ▶ However, Merton’s original model contained several restrictive assumptions:
  - Simple debt structure.
  - Default possible only at debt maturity.
  - No liquidation costs; indeed, model does not distinguish between bankruptcy/liquidation/transfer of control.
  - No renegotiation; Absolute Priority holds in the event of default.
  - Constant interest rates.
  - Default never a “surprise.”

## The Merton Model (Cont'd)

- ▶ Early empirical tests too were not encouraging:
  - Jones, Mason, Rosenfeld (1984): Predicted prices are, on average, 4.50% too high. Errors largest for speculative-grade firms.
  - Ogden (1987): The Merton model underpredicts by 104 basis points on average.
  
- ▶ The combination of restrictive theoretical assumptions and empirical shortcomings spawned an enormous theoretical literature generalizing the original model.
  
- ▶ More recently, an empirical literature has also grown testing many of the proposed theoretical approaches.

## Advances on the Theoretical Front . . .

- ▶ Black and Cox (1976): Default before maturity.
- ▶ Geske (1977): Coupon and other more complex debt structures.
- ▶ Leland (1994), Leland & Toft (1996): Endogenous default boundary.
- ▶ Longstaff and Schwartz (1995): Stochastic interest rates.
- ▶ Anderson & Sundaresan (1996), Mella-Barral & Perraudin (1997): Strategic debt-service, endogenizes violation of APR.
- ▶ Duffie and Lando (1997): Incomplete information about the firm value process.
- ▶ Zhou (2001): Jumps in the firm-value process.
- ▶ Many others.

## But the Empirical Evidence Remains Mixed

- ▶ Eom, Helwege, and Huang (2004): Compare five models empirically. Find that predicted spreads from some models are certainly too low, but for some other models:
  - Predicted spreads from others are too *high*. Moreover, dispersion is huge.
  - Severely overstate credit risk of firms with high leverage or volatility, yet underpredict spreads from safer bonds.
  
- ▶ But Huang and Huang (2003) undertake a calibration approach based on historical data. Find that
  - Credit risk accounts for only a small fraction of observed corporate yield spreads for investment grade bonds, but accounts for a larger share of high-yield bond spreads.
  - Different structural models predict fairly similar yield spreads.
  
- ▶ This is the context of our first paper, Ericsson, Reneby, and Wang.

# Distance-to-Default

- ▶ One concept coming from the structural model approach that has become popular is *distance-to-default*: the normalized distance (measured in standard deviations) of a firm's asset value from its default threshold.
- ▶ Distance-to-default plays a central role in calculating the EDF in the Moody's KMV model.
- ▶ It has also become widely used in the finance literature as an ordinal measure of credit-worthiness in (e.g., Vassalou and Xing (2003), Sundaram and Yermack (2006)).
- ▶ The second paper in this session, Bharath and Shumway, looks at the question: how important is it to compute the distance-to-default using the Merton model, rather than use a “naive” approach?

## In Summary . . .

- ▶ Structural models offer an intellectually appealing approach to modeling credit risk.
- ▶ But empirically such models do not appear to be able to match observed yield spreads on corporate bonds.
- ▶ This may have less to do with shortcomings of structural models than with our view of yield spreads as arising primarily from credit risk.
- ▶ Thus, a better understanding of the composition and drivers of yield spreads may help gauge the value of structural models better.