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."
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.


▶ Duffie and Lando (1997): Incomplete information about 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.
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.