A Structural Analysis of Credit Risk With Risky Collateral: A Methodology for Haircut Determination

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Abstract

Although many credit risk pricing models exist in the academic literature, very little attention has been paid to the impact of risky collateral on credit risk. It is nonetheless well known that practitioners often mitigate credit risk with collateral, using so–called haircuts for collateral level determination. The presence of collateral has a complex effect that can not be analysed simply with existing models. We analyse the value of credit risk when there is collateral in a range of different situations, including dual–default in a simple setting, stochastic collateral, stochastic bond collateral with stochastic interest rates, continuous and discrete marking–to–market and margin calls. The models confirm many practical intuitions, such as the impact on the haircut level required of the risks of the collateral asset and of the underlying asset to the forward as well as the impact of their correlation. Moreover, the model supports the intuition that the frequency of marking–to–market and collateral are substitutes. The models also stress the possibly unexpected magnitude of these factors. More importantly, they give actual solutions to determining the value of the credit risk depending on the haircut chosen and the frequency of marking–to–markets, results not presented before in the literature. The models are also a good basis to understand the portfolio effect of collateral management. Finally, they illustrate how differences in prices may arise from pure differences of credit risk management, as illustrated here in the case of futures and forwards.

(J.E.L.: G13).

R. W. Anderson– S. M. Sundaresan (1996), "The Design and Valuation of Debt Contracts", *Review of Financial Studies*, **9**, pp. 37–68.

Web of Science® ↗ | Google Scholar ↗

D. K. Benjamin (1978), "The Use of Collateral to Enforce Debt Contracts", *Economic Inquiry*, **16**(3), pp. 333–59, July.

Web of Science® ↗ | Google Scholar ↗

H. Bester, (1994), "The Role of Collateral in a Model of Debt Renegotiation", *Journal of Money, Credit & Banking*, **26**(1), pp. 72–86, February.

Web of Science® ↗ | Google Scholar ↗

M. Broadie– P. Glasserman– S. Kou (1997), "A Continuity Correction For Discrete Barrier Options", *Mathematical Finance*, **7**(4), pp. 325–49, October.

Web of Science® ↗ | Google Scholar ↗

D. Cossin– H. Pirotte (1997), "Swap Credit Risk: An Empirical Investigation on Transaction Data", *Journal of Banking & Finance*, **21**(10), pp. 1351–73, October.

Web of Science® ↗ | Google Scholar ↗

D. Cossin– H. Pirotte (1998), "How Well Do Classical Credit Risk Models Fit Swap Transaction Data?", *European Financial Management Journal*, **4**(1), March, pp. 65–78.

Google Scholar ↗

G. R. Duffee (1995a), "On Measuring Credit Risks of Derivative Instruments", Working Paper, Federal Reserve Board, February.

Google Scholar ↗

D. Duffie– K. J. Singleton (1997), "An Econometric Model of the Term Structure of Interest–Rate Swap Yields", *Journal of Finance*, **52**(4), pp. 1287–321, September.

Web of Science® ↗ | **Google Scholar** ↗

V. G. France– H. L. Baer– J. T. Moser (1996), "Opportunity Cost and Prudentiality: An Analysis of Futures Clearinghouse Behavior", OFOR Working Paper 96–01.

Google Scholar ↗

H. Geman– N. El Karoui– J. C. Rochet (1995), "Changes of Numeraire, Changes of Probability Measure and Pricing of Options", *Journal of Applied Probability*, **32**, pp. 443–58

Web of Science® ↗ | **Google Scholar** ↗

J. M. Harrison– S. R. Pliska (1981), "Martingales and Stochastic Integrals in the Theory of Continuous Trading", *Stochastic Process. Appl.*, **11**, pp. 215–60.

Web of Science® ↗ | **Google Scholar** ↗

J. M. Harrison– S. R. Pliska (1983), "A Stochastic Calculus Model of Continuous Trading: Complete Markets", *Stochastic Process. Appl.*, **15**, pp. 313–16.

Google Scholar ↗

B. Iben– R. Brotherton–Ratcliffe (1994), "Credit Loss Distributions and Required Capital for Derivatives Portfolios", *Journal of Fixed Income*, June.

Google Scholar ↗

Th. Iben– R. Litterman (1991), "Corporate Bond Valuation and the Term Structure of Credit Spreads", *Journal of Portfolio Management*, Spring,.

Google Scholar ↗

Web of Science® ↗ | Google Scholar ↗

N. Kunitomo– M. Ikeda (1992), "Pricing Options With Curved Boundaries", *Mathematical Finance*, **2**(4), pp. 275–98, October.

Google Scholar ↗

H. Leland– K. Toft (1996), "Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads", *Journal of Finance*, **51**, pp. 987–1019.

Web of Science® ↗ | Google Scholar ↗

F. Longstaff– E. Schwartz (1995), "A Simple Approach to Valuing Risky Fixed and Floating Rate Debt", *Journal of Finance*, **50**(3), July.

Google Scholar ↗

F. Longstaff– E. Schwartz (1995), "Valuing Credit Derivatives", *Journal of Fixed Income*, June, pp. 6–12.

Google Scholar ↗

D. J. Lucas– J. Lonski (1992), "Changes in Corporate Credit Quality 1970–1990", *Journal of Fixed Income*, March.

Google Scholar ↗

W. Margrabe (1978), "The Value of an Option to Exchange One Asset for Another", *Journal of Finance*, **33**, March, pp. 177–87.

Web of Science® ↗ | Google Scholar ↗

P. Mella–Barral– W. Perraudin (1997), "Strategic Debt Service", *Journal of Finance*, **52**(2), June, pp. 531–56.

Web of Science® ↗ | Google Scholar ↗

Google Scholar

D. C. Shimko– N. Tejuna– D. Von Deventer (1993) "The Pricing of Risky Debt When Interest Rates are Stochastic", *The Journal of Fixed Income*, September, pp. 58–65.

Google Scholar

E. H. Sorensen– Th. F. Bollier (1994), "Pricing Swap Default Risk", *Financial Analysts Journal*, May–June, pp. 23–33.

Google Scholar

R. Stulz– H. Johnson (1985), "An Analysis of Secured Debt", *Journal of Financial Economics*, **14**, pp. 501–21.

Web of Science® | Google Scholar

P. G. Zhang (1998), "Exotic Options", World Scientific.

Google Scholar

Citing Literature

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