Research in International Business and Finance 24 (2010) 123–137

Contents lists available at ScienceDirect

Research in International Business and Finance

journal homepage: www.elsevier.com/locate/ribaf

Belief updating, debt pricing and financial decisions under asymmetric information

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ARTICLE INFO

Article history:
Received 17 November 2008
Accepted 9 October 2009
Available online 14 November 2009

JEL classification:
C70
G13
G32Asymmetric information
Belief updating
Capital structure
Debt valuation
Financial decisions

ABSTRACT

This paper studies debt holders' belief updating, valuation of corporate debt, and equity owners' financing decisions during financial distress under asymmetric information. This is done within a continuous-time framework, where the relevant state variable is assumed to follow an Arithmetic Brownian motion (ABM). ABM can take negative values and has very realistic feature compared with Geometric Brownian motion (GBM). Using Chapter 11 of U.S. Bankruptcy Code as a costly screening device, we can characterize which firm will choose private workouts (in the form of strategic debt service) and which will choose to file for the Chapter 11 Bankruptcy procedure (in the form of debt–equity swap) when the firm is in financial distress. Using arguments similar to equilibrium refinements, we give a clear picture of how debt holders' beliefs about the firm's types are updated according to the state variable and the firm's default behavior, and describe optimal strategies of both parties under those beliefs. We also provide an approximate solution to the debt pricing problem under asymmetric information.

1. Introduction

In this study, we show how debt holders' beliefs about firm's types are updated under asymmetric information that equity owners have better information on their firm or investment project than do

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0275-5319/$ – see front matter © 2009 Published by Elsevier B.V.
doi:10.1016/j.ribaf.2009.10.002

debt holders, and examine the impact of asymmetric information on debt valuation and equity owners' financial decisions during financial distress.

The valuation of risky debt is central to theoretical and empirical work in corporate finance. A fruitful approach is known as contingent claims analysis pioneered by Black and Scholes (1973), Merton (1974). They assume that the firm value follows a GBM. The firm has a finite maturity zero coupon bond that it will repay if its value exceeds the notional amount of the debt at debt maturity. Otherwise the firm defaults on its debt.

Since then, the literature on the valuation of corporate securities and financing decisions has substantially developed. Black and Cox (1976) extends this setup by allowing bankruptcy before debt maturity when the firm value touches a bankruptcy barrier for the first time. Further extension of the basic setup introduces capital structure changes (e.g., in Fischer et al., 1989a,b). In both papers they model the capital structure of the firm endogenously in a continuous-time setting under the assumption that equity owners optimize the value of their claim, and explain empirically observed leverage ratios and call premia of callable corporate bond. The idea of equity owners maximizing the value of their claim when levering the firm is further developed by Leland (1994), who focuses on the valuation of corporate debt and the sensitivity of debt value to certain model parameters, and derives a firm value level at which equity owners endogenously optimally trigger bankruptcy. His analysis is extended among others by Leland and Toft (1996) to relax the assumption of infinite life debt, and Leland (1998) to account for asset substitution.

Because substantial empirical evidence[1] has documented that bankruptcies are costly and bankruptcy procedures give considerable scope for opportunistic behavior by various parties involved, the traditional structural models are later developed by Anderson and Sundaresan (1996), Mella-Barral and Perraudin (1997), Fan (2000), Francois and Morellec (2004), who take into consideration strategic issues and renegotiation in the context of debt valuation and treat bankruptcy as a bargaining game.

Almost all the papers above assume that the relevant state variable is given by the (unlevered) firm value, which may permit arbitrage opportunities or other difficulties.[2] Goldstein et al. (2001) first dispenses with the assumption by considering the Earnings Before Interest and Taxes (EBIT) as the state variable, upon which all contingent claims can be valued in a consistent manner. EBIT is assumed to follow a GBM as before. Within this setting, Goldstein et al. (2001) considers the impact of the option to increase future debt levels on tax advantages, and find that both the optimal leverage ratio range and predicted credit spreads are more in line with what is observed in practice. Models that make use of the EBIT assumption, include Dangl and Zechner (2004), Ammann and Genser (2005), Hackbarth et al. (2007).

Commonly, EBIT is assumed to follow a GBM by reason of its mathematical tractability. But economically the choice of GBM is debateable because the potential negative cash flow characteristic is an important feature of most investment projects (e.g., Klumpes and Tippett, 2004; Marathe and Ryan, 2005). ABM has more realistic feature, for cash flow can become negative, which is by definition not possible with GBM. This is confirmed by Capozza and Li (1994) for real-estate net cash flows.

Absent from the papers above is the concept of information asymmetry and its impact on debt valuation and financing choices. Pioneering work in this area is due to Leland and Pyle (1977), Ross (1977), Myers (1977), Myers and Majluf (1984). One notable contribution in this direction was recently made by Duffie and Lando (2001), who essentially extends Leland and Toft (1996) to incorporate a noisy version of the asset value, i.e., the asset value plus a noise component, on the part of investors. With imperfect information about the firm's value, they show that there exists a default-arrival intensity process as in reduced-form models[3] and credit spreads remain bounded away from zero as maturity goes to zero, which remedies an important critique on structural credit risk models. Giesecke and Weber (2006) extends Duffie and Lando (2001) to consider not only incomplete information about the asset value but also imperfect information about the default barrier. In contrast to Duffie and

[1] For example, see Asquith et al. (1994), Franks and Torous (1994), Weiss (1990).

[2] See Toft and Prucyk (1997), Goldstein et al. (2001) for more details.

[3] As opposed to the structural models described above, reduced-form models model factors influencing the default event but typically (not necessarily) leave aside the question of what exactly triggers the default event. See, for example, Artzner and Delbaen (1995), Jarrow and Turnbull (1995), Jarrow et al. (1997), Duffie and Singleton (1999).