Journal of Banking & Finance 58 (2015) 112–130

Contents lists available at ScienceDirect

Journal of Banking & Finance

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

A structural model with Explicit Distress ☆

Ricardo Correia [a,*], Javier Población [b]

[a] Department of Business Administration, Universidad Carlos III, Spain
[b] D.G.A. Supervisión – Banco de España, Spain

ARTICLE INFO

Article history:
Received 12 March 2014
Accepted 28 March 2015
Available online 18 April 2015

JEL classification:
G12
G13
G32
G33

Keywords:
Structural models
Financial distress
Optimal capital structure

ABSTRACT

We construct a model for valuing firms and corporate securities incorporating economic and financial distress. The inclusion of financial distress costs is able to explain the low debt/zero debt puzzle and to clarify the relation between earnings and financial leverage. With standard parameter values, this model generates more realistic estimates of leverage ratios, credit spreads and recovery rates relative to a standard model of direct costs of bankruptcy. It clarifies the relation between optimal leverage and debt capacity and addresses different structural model problems such as underestimating (overestimating) spreads on safe (risky) bonds and relying on unrealistic high estimates for direct costs of bankruptcy.

1. Introduction

The analysis of the capital structure of firms has long evolved since Modigliani and Miller (1958) developed the irrelevance proposition. Later work on the role of tax benefits (e.g., Modigliani and Miller, 1963) and bankruptcy costs (e.g., Robichek and Myers, 1965) established the trade-off theory of capital structure as the dominant paradigm explaining optimal capital structure as the amount of leverage that balances the marginal benefits and marginal costs associated with debt financing. Although Robichek and Myers (1965) refer to 'disadvantages of leverage', the direct costs of bankruptcy took the dominant role within the overall deadweight costs of debt, and bankruptcy costs represent the most common aspect of theoretical models of capital structure.[1]

One family of models that took prominence within the theoretical analysis of financing determinants builds on the developments of Fisher (1959) and estimates the price and returns of corporate securities as functions of firm-specific financial and economic characteristics. This approach is commonly known as structural modeling, and the first structural models date back more than thirty years (e.g., Merton, 1974, Black and Cox, 1976 and Geske, 1977, 1979). Despite their increasing complexity and sophistication, these models tend to rely on unrealistically high estimates of bankruptcy costs to generate realistic estimates for optimal leverage and credit spreads (see Miller, 1977).[2]

An important stream of literature that developed later built on the assumption that default marks the onset of distress, and it focused on an analysis of the downstream events that follow default.

☆ We are grateful to Michael Brennan, Juan Ignacio Peña, Alex Cukierman, Florina Silaghi, seminar participants at Universidade Católica Portuguesa (CRP), Faculdade de Economia do Porto and at the 2013 FMA European Conference for comments on earlier versions of this article. This work was supported by Ministerio de Ciencia e Innovación (Proyecto – MCI ECO2009-12551), by Junta de Castilla-La Mancha (grant PEII11-0031-6939) and by Ministerio de Ciencia e Innovación (Proyecto – MCI ECO2011-28134).

* Corresponding author at: Universidad Carlos III de Madrid, C./Madrid 126, 28903 Getafe (Madrid), Spain. Tel.: +34 91 624 95 73; fax.: +34 91 624 96 07.
E-mail address: josericardo.vazantunes@uc3m.com (R. Correia).

[1] A different deadweight cost of debt that was later addressed was the agency cost of debt, which was analyzed in terms of risk shifting incentives in Leland (1998), underinvestment incentives in Mauer and Ott (2000) and overinvestment incentives in Mauer and Sarkar (2005).

[2] An early empirical analysis of the size of bankruptcy costs in Warner (1977) estimated that these costs represent 5.3 % of firm value at the moment of filing the bankruptcy petition and 1% 7 years before bankruptcy.

http://dx.doi.org/10.1016/j.jbankfin.2015.03.011
0378-4266/

This literature led to a thorough analysis of a common resolution of distress through debt renegotiation where we find important contributions in Anderson and Sundaresan (1996), Anderson et al. (1996), Mella-Barral and Perraudin (1997), Mella-Barral (1999), Hege and Mella-Barral (2000), Hege and Mella-Barral (2005) and more recently Bruche and Naqvi (2010) among many others.[3]

Possibly as a consequence of such important developments, the theoretical literature paid little attention to the events that precede default, although several common definitions of distress do not imply the occurrence of default (e.g., see Bodie and Merton, 2000 and Brealey et al., 2008), and many empirical papers proxy distress through different events that precede default (e.g., Franks and Torous, 1994 and Opler and Titman, 1994). Similar arguments regarding the importance of the events preceding default can be found in Couderc and Renault (2005), who argue that the vast majority of defaults do not arise suddenly but represent the conclusion of a long process. During the process leading to default, firms display obvious signs of distress, such as abnormal patterns in credit line usage and in cash inflows and limit violations (Norden and Weber, 2010), and several public announcements emerge reporting, for example, declines in earnings and dividend cuts (Dahiya et al., 2003).

A second consequence of developments in debt renegotiation was the disregard of the so-called indirect costs of bankruptcy in terms of their impact on the value of firms and corporate securities and on the financing decisions of firms.[4] Although Haugen and Senbet (1978) claim that the truly significant deadweight costs are associated with liquidation and that indirect costs should be insignificant as long as the different stakeholders of the firm behave rationally, empirical evidence on indirect costs confirms their significance and shows that they are even more important than direct costs (e.g., Altman, 1984).

This paper explores the role of the (so-called) indirect costs of bankruptcy by constructing a cash-flow-based model of the firm that incorporates operational leverage and distress. We claim that the indirect costs should be defined more accurately as costs of distress because, as Brealey et al. (2008) argue, it is not the event of bankruptcy that generates costs of financial distress, but the costs of financial distress that eventually lead the firm to bankruptcy. We assume that the onset of distress precedes default and is triggered when the operational cash flows generated by the firm are insufficient to (i) cover the appropriate reinvestments required to maintain production capacity and (ii) pay its coupons. The firm experiences economic distress when the cash flow shortfall is triggered by the need to realize productive reinvestments and financial distress when the cash flow shortfall is triggered by the obligations of the firm to pay its coupons. The inclusion of distress is shown to significantly affect the value of the firm and its corporate securities, optimal leverage, debt capacity and credit spreads.

This paper makes various contributions to the existing literature by addressing several problems of classical structural models. First and most importantly, through the introduction of operational costs of distress, our paper is able to reconcile the trade off theory of capital structure with two important empirical regularities: the negative relation between earnings growth and financial leverage ratios (see Toy et al., 1974; Rajan and Zingales, 1995) and the low debt/zero debt puzzle regarding the inexplicable conservatism in the use of debt financing for a large number of financially healthy firms (see Graham, 2000; Strebulaev and Yang, 2013). Second, through the coexistence of positive and negative effects associated with financial distress, and for reasonable parameter values, our distress model is able to generate better estimates of credit spreads for high and low leverage ratios, thus addressing a well known problem of structural models. Structural models are known to overstate the spread predictions for high leverage ratios while understating the same predictions for lower leverage ratios as discussed in Jones et al. (1983) and Eom et al. (2004). The coexistence of the positive and negative effects of financial distress also clarifies the relation between optimal financial leverage and debt capacity. Finally, by considering an additional deadweight cost of debt, our distress model also contributes to the credit spread puzzle, generating better predictions for optimal leverage and credit spreads without needing to rely on unrealistically high direct costs of bankruptcy. In their empirical analyses Jones et al. (1983, 1984) and Ogden (1987) showed how structural models tend to generate unrealistically high estimates for leverage ratios and unrealistically low predictions to debt spreads, and this finding has been called the credit spread puzzle (Huang and Huang, 2012). Recently we have witnessed important developments regarding the credit spread puzzle, its existence has even been questioned and the difference in spreads is in some cases attributed to biases in the statistical approaches used to test the structural models (e.g. Feldhütter and Schaefer, 2014). Different structural approaches have been previously followed to address the credit spread puzzle, many of which we have cited previously. More recent contributions relate to exploring the influence of macroeconomic factors directly related to the events of default clustering (e.g. Hackbarth et al., 2006 and Hess and Immenkötter, 2011) and liquidity aspects (He and Milbradt, 2014). Bhamra et al. (2010) address the theoretical and empirical aspects in a model with macroeconomic factors and a dynamic financing strategy and computing average credit spreads and actual default probabilities for a cross-section of firms Bhamra et al. (2010) also address the statistical biases.

This work is possibly closer to that of Mella-Barral and Perraudin (1997), Basak and Shapiro (2005) and François and Morellec (2004) in terms of modeling what we define as costs of financial distress. Important differences between this paper and Mella-Barral and Perraudin (1997) and François and Morellec (2004) concern the onset and resolution of distress. In our case, distress is triggered by cash-flow shortfalls, and the resolution of distress occurs with default. In Mella-Barral and Perraudin (1997) and François and Morellec (2004), distress is triggered by default, and therefore, the distress costs generated in both models never overlap with ours. Regarding the resolution of distress, we simply consider bankruptcy, whereas Mella-Barral and Perraudin (1997) focus on analyzing debt restructurings and François and Morellec (2004) consider alternative resolutions such as debt restructurings, formal bankruptcy and liquidations. There are many important differences between this paper and Basak and Shapiro (2005). First, we work in continuous time and assume that the dynamics of cash flows are exogenously determined. Basak and Shapiro (2005) work in discrete time, and their asset dynamics are endogenously determined. In addition, we mainly focus on different aspects of leverage decisions, while Basak and Shapiro (2005) ignore determinants of corporate borrowing, instead focusing on default and investment decisions and deviations from absolute priority rules that are significantly affected by an asset composition that includes intangible assets.

The remainder of this paper is structured as follows. Section 2 describes the benchmark and distress models, Section 3 presents the analyses of our results in terms of firm and security values,

[3] Other important contributions to the field of structure modeling addressed other aspects such as deviations from absolute priority rules (Leland, 1994; Longstaff and Schwartz, 1995), debt maturity (Leland and Toft, 1996), dynamic capital structures (Goldstein et al., 2001; Ju et al., 2005), and different dynamics for the state variable, such as the inclusion of jump components (Delianedis and Geske, 2001; Cremers et al., 2008) or the addition of alternative risk sources such as stochastic interest rates (Ronn and Verma, 1986; Kim et al., 1993; Longstaff and Schwartz, 1995).

[4] Mella-Barral and Perraudin (1997) and François and Morellec (2004) consider the indirect costs of bankruptcy generated after default. However, as Altman (1984), Basak and Shapiro (2005) and Glover (2011) note, these costs are incurred by firms even if they never end up defaulting on their obligations.