Growth options, macroeconomic conditions, and the cross section of credit risk ☆

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ABSTRACT

This paper develops a structural equilibrium model with intertemporal macroeconomic risk, incorporating the fact that firms are heterogeneous in their asset composition. Compared with firms that are mainly composed of invested assets, firms with growth options have higher costs of debt because they are more volatile and have a greater tendency to default during recession when marginal utility is high and recovery rates are low. Our model matches empirical facts regarding credit spreads, default probabilities, leverage ratios, equity premiums, and investment clustering. Importantly, it also makes predictions about the cross section of all these features.

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1. Introduction

This paper examines the impact of corporate growth options on credit spreads, equity premiums, firm value, and financial policy choices in the presence of time-varying macroeconomic conditions.

The motivation for our study derives from the empirical fact that credit risk, leverage, and equity risk premiums exhibit important cross-sectional variation. First, Davydenko and Strebulaev (2007) show that, controlling for standard credit risk factors, proxies of growth options are all positively and significantly related to credit spreads. Similarly, Molina (2005) finds that firms with a higher ratio of fixed assets to total assets have lower bond yield spreads and higher ratings. Second, firms with more

growth options typically have lower leverage (see, e.g., Smith and Watts, 1992; Fama and French, 2002; Frank and Goyal, 2009). Third, value firms earn higher equity returns than growth firms (see, e.g., Fama and French, 1992). Strikingly, none of these cross-sectional properties can be explained by existing structural models of default. The reason is that these models consider firms with only invested assets, but they ignore the fact that growth opportunities constitute an essential element of asset values and that firms are heterogeneous in their asset composition.[1]

We provide a model that matches these cross-sectional properties of credit risk, leverage, and equity risk premiums. In particular, we explicitly incorporate expansion options of firms into a structural model of default with macroeconomic risk. We show that heterogeneity in the composition of assets helps explain cross-sectional variation of credit spreads and leverage. Moreover, allowing firms to be heterogeneous with respect to the importance of growth options in the values of their assets explains the aggregate credit spread puzzle, not only qualitatively, but also quantitatively. Importantly, the puzzle is solved while fitting historically reported asset volatilities and default rates for realistic debt maturities. At the same time, the model matches the average equity premium and explains a significant portion of the cross section of equity risk (the value premium). It also generates a countercyclical value premium, as observed in the data. Finally, our model is consistent with aggregate and cross-sectional features of default clustering, investment spikes and busts, and recovery rates.

For our analysis, we develop a structural-equilibrium framework in the spirit of Bhamra, Kuehn, and Strebulaev (2010b). Thus, we embed a pure structural model of financial decisions into a consumption-based asset pricing model with a representative agent. Our model simultaneously incorporates both intertemporal macroeconomic risk (building on work by Hackbarth, Miao, and Morellec, 2006; Bhamra, Kuehn, and Strebulaev, 2010c; Chen, 2010), which has been shown to be important for explaining credit spreads and leverage, as well as expansion options. Macroeconomic shocks to the growth rate and volatility of earnings, as well as to the growth rate and volatility of consumption, arise due to switches between two states of the economy: boom and recession. The changes in the state of the economy are modeled via a Markov chain, a standard tool to model regime switches. The representative agent has the continuous time analog of Epstein-Zin-Weil preferences (Epstein and Zin, 1989; Weil, 1990; Duffie and Epstein, 1992b). Therefore, how he prices claims depends on both his risk aversion and his elasticity of intertemporal substitution. Via the market

price of consumption determined by the agent's preferences, we are able to link unobservable risk-neutral probabilities used in the structural model to historical probabilities. This modeling approach allows us to study endogenously the effect of macroeconomic risk on credit spreads and optimal financing decisions.

We allow firms to have expansion options. These options are converted into invested assets when the underlying earnings process exceeds the investment boundary. We pinpoint the isolated effect of a firm's asset composition on credit risk and leverage by assuming, in the main analysis, that the exercise price of the growth option is financed through the sale of some assets in place, i.e., without additional funds being injected into the company. We also study equity financing later in the paper. Default occurs when earnings are below the default threshold in a given regime. Shareholders maximize the value of equity by simultaneously choosing the optimal default and expansion option exercise policies. The capital structure is determined by trading off tax benefits of debt against default costs to maximize the ex ante value of equity, i.e., the value of the firm.

The first result the model yields is that, like in other macroeconomic models, default boundaries are countercyclical, i.e., shareholders default earlier in recession than in boom. Thus, default is more likely during recession, which, together with countercyclical marginal utilities and default costs, raises the costs of debt for all firms compared with a benchmark model without business cycle risk.

The central new feature of our model is that the asset composition alone matters significantly for the costs of debt. Two forces lead to the cross-sectional prediction that debt is particularly costly for firms with a high portion of expansion options in their assets' values. First, because options represent levered claims, firms with valuable growth options are more sensitive to the underlying earnings process than firms that consist of only invested assets. The volatility of the underlying earnings process would, consequently, underestimate the true default risk of growth firms. While the literature discusses this basic idea within equity-financed firms (Berk, Green, and Naik, 1999; Carlson, Fisher, and Giammarino, 2006), little is known about its impact on debt prices. Our structural model allows us to jointly analyze a firm's expansion policy and financial leverage. We show that the combination of these factors is critical for a full exploration of the quantitative implications of the riskiness of growth options on credit spreads.

The second driving force is that option values are more sensitive to macroeconomic regime changes than are assets in place. This higher sensitivity is, to some extent, another consequence of the idea that options represent levered claims. Importantly, an additional effect derives from the fact that the optimal exercise boundary of growth options increases in recession and decreases in boom. Intuitively, it is optimal to defer the exercise of an expansion option when the economy switches to recession, i.e., to wait for better times. Because the moneyness of growth options is regime-dependent, and because options represent levered claims, the continuation value

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[1] Recent research focuses on the credit spread puzzle, i.e., the fact that standard structural models of default significantly underestimate credit spreads for corporate debt (see, e.g., Elton, Gruber, Agrawal, and Mann, 2001; Huang and Huang, 2002). Several papers present significant progress in solving this puzzle (see, e.g., Bhamra, Kuehn, and Strebulaev, 2010a–c; Chen, 2010; Chen, Collin-Dufresne, and Goldstein, 2009; Gomes and Schmid, 2010a). However, none of these papers addresses the cross section of credit risk.