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Real option, debt maturity and equity default swaps under negotiation☆

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ABSTRACT

We consider an investment option, of which the sunk cost is financed by entering into a fee-for-guarantee swap (FGS) or equity-for-guarantee swap (EGS). Debt has a finite maturity and guarantee costs depend on negotiation. We explicitly derive guarantee costs and the pricing and timing of the option. Under negotiation, borrowers get partial option value depending on his bargaining power and insurers gain the remaining value. We discover that EGSs are better than FGSs in borrowers' view. Guarantee costs generally increase with funding gaps and investment thresholds decrease with debt maturities. The option value decreases first and then increases with debt maturity.

1. Introduction

It is well known that small- and medium-sized enterprises (SMEs) play a vital role in promoting economic growth but many of them have experienced financing constraints. To overcome the constraints, some guarantee companies or insurers in China develop two new types of financial products: one is equity-for-guarantee swap (EGS); the other is fee-for-guarantee swap (FGS). They are agreements among banks/lenders, insurers and SMEs/borrowers, where banks lend at a given interest rate to SMEs and once SMEs default on the loans, insurers instead of borrowers must pay all the outstanding interests and principals to the banks. In return for insurers, the SMEs must allocate a fraction of their equity (loans) to insurers under EGSs (FGSs). The fraction is called guarantee cost. In China, according to a report from Xinhuanet on May 15, 2014, the added amount of loans guaranteed arrives at 2.39 trillion RMB yuan, increasing by 14.5% relative to the last year.

Unfortunately, almost all the guarantee costs are determined without a quantitative standard. To overcome the shortcoming, Yang and Zhang (2013, 2015); Xiang and Yang (2015); Wang et al. (2015), and Luo et al. (2016) develop several formal models. However, all these papers assume the guarantee market is sufficiently competitive and insurers earn zero net profit entering into the swaps. As a matter of fact, the guarantee market is not so competitive and in many cases, it is impossible

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for an entrepreneur to invest in a project if he does not get a guarantee. Therefore, we argue that insurers should obtain a fraction of the value of the option to invest and the fraction depends on their bargaining power index. In addition, all the papers consider perpetual debt but actually most debt has a finite maturity. Taking the two items into account, we borrow a Nash bargaining game model developed by Luce and Raffia (1957) and present a new method to determine the guarantee costs of FGSs and EGSs. This game model is widely used to consider a similar debt renegotiation problem, see e.g., Fan and Sundaresan (2000), Demougin and Helm (2006) and Shibata and Tian (2010).

Our paper is related with a long line of research on real options originating from Myers (1977). Recently, many papers employ the real options approach to investigate the interaction between financing and investment, such as Hackbarth and Mauer (2012) and Hori and Osano (2014).

Following Yang and Zhang (2015), FGSs and EGSs are new type of equity default swaps (EDSs), which are designed to deliver a protection payment to the EDS buyer at the time of the triggering event defined as the stock price decline below a pre-specified lower triggering barrier level. In exchange, the EDS buyer makes periodic premium payments at time intervals at the equity default swap rate up to the triggering event or the final maturity, whichever comes first, see Mendoza-Arriaga and Linetsky (2011) among others.

We consider a firm with no assets in place but an investment option. There is a funding gap for the investment, which is bridged by entering into EGSs or FGSs. We explicitly derive guarantee costs, endogenous default trigger levels, the pricing and timing of the option to invest in a project. Thanks to the static bargaining theory, our model explains that under negotiation, borrowers get a fraction of the value of the option to invest, which depends on their bargaining power index, and insurers obtain the remaining value instead of nothing assumed in the existing literature. We discover that EGSs are better than FGSs to increase borrower's benefits since they harvest the maximum tax shields. The guarantee cost decreases linearly with the bargaining power index. The longer the debt maturity, the higher the guarantee cost. The guarantee cost generally increases with the funding gap but it may conversely decrease as well. Investment thresholds globally decrease with debt maturity and EGSs induce earlier investment than FGSs. The option value decreases first and then increases with debt maturity.

The structure of the paper is as follows. Section 2 introduces the model. Section 3 derives the pricing of corporate securities and guarantee cost. Section 4 addresses the pricing and timing of the option to invest under negotiation. Section 5 provides numerical results. Section 6 concludes. Some proofs are relegated to the Appendixes.

2. The model

Following Song and Yang (2016) among others, we consider an SME who has no assets in place but an option to invest in a single project by paying a fixed investment cost I. The investment is irreversible but delayable. Time is continuous, and indexed by $t \in [0, \infty)$. After investment, the cash flow X generated by the project, is invariant to changes in capital structure and governed by the following geometric Brownian motion:

$$dX_t = \mu X_t dt + \sigma X_t dZ_t, \quad X_0 \text{ given},$$

where μ is the risk-adjusted expected growth rate, $\sigma > 0$ is the volatility rate and Z is a standard Brownian motion defined on the probability space $(\Omega, \mathcal{F}, \mathbb{P})$. We assume that $\mu < r$ for convergence (otherwise the project value is infinite), where $r > 0$ is the constant risk-free interest rate.

We assume the firm has a funding gap P for the real investment which is bridged by entering into a three-party agreement (EGS or FGS) with a bank and an insurer. Under the agreement, the bank lends a loan at a given interest rate to the firm and gets constant coupon payment c from the firm until default. Once the firm defaults, the insurer gets the salvage value of the firm and instead of the firm pays all the outstanding interest and principal to the bank. Under an EGS (FGS), in return for the insurer, the firm allocates a fraction of equity (loan) to the insurer at the very starting time. We call the fraction guarantee cost.

Following Jeon and Nishihara (2015), we adopt stationary debt structure with finite maturity. Namely, the firm issues debt with principal P, pays a coupon c constantly, and rolls over a fraction m of the total debt. The average maturity of the debt is therefore $1/m$ if bankruptcy is neglected, and the debt structure is completely characterized by a tuple (c, m, P). We assume debt is issued at par and its coupon rate is determined by maximizing the firm value.

Should the firm go default on its debt, the value of the firm's future cash flow is assigned to the insurer but a fraction, denoted by α, of the value of the future cash flow will lost due to bankruptcy costs, where $0 \leq \alpha \leq 1$ is constant and called bankruptcy loss rate.

Similar to Goldstein et al. (2001), we assume a simple tax structure that includes corporate and personal taxes, where interest payments are taxed at a personal rate τ_i, effective dividends are taxed at τ_d, and corporate profits are taxed at τ_c, with full loss offset provisions. Clearly $\tau_f \equiv 1 - (1 - \tau_c)(1 - \tau_d) > 0$ represents the corporate effective tax rate.

3. Pricing of corporate securities and guarantee cost

In this section, we assume investment is already undertaken. We first derive the prices of corporate securities and then we compute the guarantee cost for EGSs and FGSs respectively. Doing so, in contrast to the literature, we present a model of negotiation between insurers and borrowers.