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A sequential pricing framework for corporate securities: The case of rating-trigger step-up/-down bonds

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ABSTRACT

We develop a sequential pricing framework in a continuous time cash flow model allowing for repeated valuation of different cash flow claims. One claim is valued until a prespecified boundary is hit, which is subsequently used as the new valuation starting point for the next claim. This highly flexible pricing framework is applied to the pricing of rating-trigger step-up/-down corporate bonds, the coupon payments of which depend on the issuing company's credit rating. We present a simple closed-form pricing solution for this type of bonds including both a step-up and step-down threshold, as well as a lower default boundary.

1. Introduction

This paper develops a sequential pricing framework which allows for the valuation of rating-trigger step-up/-down bonds with a closed-form pricing formula. These bonds are characterized by bond holders being compensated for deteriorations in the issuing company's credit quality. More specifically, the coupon of a rating-trigger step-up/-down bond will increase by some predetermined amount of basis points if the credit rating falls below a prespecified threshold. If the credit rating improves later on, the coupon decreases to the initial level.

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Rating-trigger step-up/-down bonds can either be valued with a structural approach in the vein of Merton (1974), Leland (1994), and Goldstein et al. (2001), or with a reduced form approach using rating transition probabilities (i.e., the model of Jarrow et al., 1997). The latter approach, represented by Lando and Mortensen (2004) or Houweling et al. (2004), uses historical rating transitions and develops empirical pricing models for rating-trigger step-up/-down bonds. Pricing models within the structural approach are developed by Koziol and Lawrenz (2010) and Manso et al. (2010). Koziol and Lawrenz (2010) derive a closed-form pricing solution for rating-trigger step-up/-down bonds with an endogenously determined optimal default threshold.[1] Similarly, Manso et al. (2010) develop pricing models for performance-sensitive debt that have (i) a linear pricing schedule (i.e., coupons are adjusted continuously based on the change of a certain performance index) or (ii) a rating-based schedule. The latter allows for I different credit-ratings based coupon adjustments, with the lowest credit rating as the default threshold.[2]

The structural models have some distinctive shortcomings with regard to the valuation of performance sensitive bonds. Koziol and Lawrenz' (2010) model only allows for a single step-up, but does not incorporate a step-down trigger. The rating model of Manso et al. (2010) features an (almost) continuous change in the level of coupon payments. In their model, the probability of a rating change reversal in the next time instant is close to 50% at any threshold. However, empirical observations show that ratings are rather stable and only change occasionally. Our goal is thus to design a tractable pricing framework to circumvent the above-mentioned shortcomings.[3]

Therefore, we develop a sequential pricing framework in a continuous time cash flow model setting with a perpetual bond and focus on the valuation of rating-trigger step-up/-down bonds as one possible application. The basic idea of sequential pricing is to value the cash flow of a claim until a prespecified cash flow boundary is hit. The cash flow is subsequently valued using this boundary as a new starting point until the next distinctive boundary is hit. Applying the value additivity principle allows for the calculation of the overall cash flow's present value over an infinite time interval.

Fig. 1 shows the basic idea underlying our valuation approach. The development of a cash flow process contains (i) a lower threshold triggering higher coupon payments (i.e., x_L), (ii) a threshold where the coupon rate is readjusted to its initial level (i.e., x_U), and (iii) a threshold where the company eventually defaults on its debt (i.e., x_D). This framework can thus be used to value rating-trigger step-up/-down bonds since the decrease of a company's cash flow to a certain low level (i.e., x_L) would lead to a downgrade by rating agencies. On the other hand, if the cash flow improves again and is substantially higher (i.e., x_U) than at the level of the rating downgrade, the company's credit quality would be upgraded again. In Fig. 1, the coupon payment is adjusted upwards at t_1 since the cash flow threshold x_L is hit. Then, at t_2, the process hits the step-down threshold x_U, where coupon payments are lowered back to the initial level. Starting over at x_U, the cash flow level hits the lower threshold x_L again at time t_3 and coupon payments are subsequently increased. Finally, at time t_4, the cash flow level hits the default threshold x_D and will be ultimately stopped. Coupon payments thus fluctuate between the lower coupon level (i.e., c) and the higher coupon level (i.e., $c + \delta$) as long as the default threshold is not reached.

In addition, Fig. 2 provides a generalized illustration showing all possible paths for the single step-up/-down model up to the fourth stopping time. Note that potential cash flow paths develop in a repetitive manner and we will make use of this feature in our pricing model. More specifically, when

[1] This step-up/-down feature might create incentives for firms (i) to prevent a downgrade of their credit rating and (ii) to improve the credit rating again in case of a downgrading. Koziol and Lawrenz (2010) show that single step-up trigger bonds are useful to mitigate asset substitution and related asymmetric information problems.

[2] Manso et al. (2010) show that issuing performance sensitive debt (PSD) is not efficient since straight debt c.p. allows for a higher debt capacity. They argue that PSD may serve as a screening device to resolve informational asymmetries, compensating inefficiencies.

[3] Note that the reduced-form pricing model of Houweling et al. (2004), which applies the risk-neutral valuation framework of Jarrow et al. (1997) to price rating-sensitive bonds, allows for step-up as well as step-down coupon changes. The authors use three different valuation methods (i.e. risk-neutral valuation based on Jarrow et al. (1997), valuation using historical rating transition probabilities and valuation of step-up/-down bonds as plain vanilla bonds). The authors find that especially rating-trigger step-up/-down bonds with only one coupon step (i.e., the coupon can only increase once by a certain amount, but not twice) seem to be priced by the market with the risk-neutral valuation model of Jarrow et al. (1997).