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Term Structure of Default-Free and Defaultable Securities: Theory and Empirical Evidence

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Introduction: This article provides a survey on term structure models designed for pricing fixed income securities and their derivatives. 1 The past several decades have witnessed a rapid development in the fixed-income markets. A number of new fixed-income instruments have been introduced successfully into the financial market. These include, to mention just a few, strips, debt warrants, put bonds, commercial mortgage-backed securities, payment-in-kind debentures, zero-coupon convertibles, interest rate futures and options, credit default swaps, and swaptions. The size of the fixed-income market has greatly expanded. The total value of the fixed-income assets is about two-thirds of the market value of all outstanding securities.2 From the investment perspective, it is important to understand how fixed-income securities are priced.

The term structure of interest rates plays a key role in pricing fixed income securities. Not surprisingly, a vast literature has been devoted to understanding the stochastic behavior of term structure of interest rate, the pricing mechanism of fixed-income markets, and the spread between different fixed-income securities. Past research generally focuses on: (i) modeling the term structure of interest rates and yield spreads; (ii) providing empirical evidence; and (iii) applying the theory to the pricing of fixed-income instruments and risk management. As such, our review centers on alternative models of term structure of interest rates, their tractability, empirical performance, and applications.

We begin with the basic definitions and notations in Section 1. We provide clear concepts of term structure of interest rates that are easily misunderstood. Section 2 introduces bond pricing theory within the dynamic term structure model (DTSM) framework. This framework provides a general modeling structure in which most of the popular term structure models are nested. This discussion thus helps understand the primary ingredients to categorize different DTSMs, i.e., the risk-neutral distribution of the state variables and the mapping function between these state variables and instantaneous interest rate.

Sections 3 provides a literature review of the studies on default free bonds. Several widely used continuous-time DTSMs are reviewed here, including affine, quadratic, regime switching, jump-diffusion and stochastic volatility models. We conclude this section with a discussion of empirical performance of these DTSMs, where we discuss some open issues, including the expectation puzzle, the linearity of state variables, the advantages of multifactor and nonlinear models, and their implications for pricing and risk management.

The studies of defaultable bonds are explored in section 4. We review both structural and reduced-form models, with particular attention given to the later. Several important issues in reduced form models are addressed

here, including the specification of recovery rates, default intensity, coupon payment, other factors such as liquidity and taxes, and correlated defaults. Since it is convenient to have a closed-form pricing formula, it is important to evaluate the tradeoff between analytical tractability and the model complexity. Major empirical issues are related touncovering the components of yield spreads and answering the question whether the factors are latent or observable.

Section 5 reviews the studies on two popular interest rate derivatives: interest rate swap and credit default swap. Here we present the pricing formulas of interest rate swap and credit default swap based on risk-neutral pricing theory. Other risk factors, such as counterparty risk and liquidity risk are then introduced into the pricing formula. Following this, we review important empirical work on the determinants of interest rate swap spread and credit default swap spread.

Section 6 concludes the paper by providing a summary of the literature and directions for future research. These include: (i) the economic significance of DTSM specification on pricing and risk management; (ii) the difference of interest rate dynamics in the risk neutral measure and physical measure; (iii) the decomposition of yield spreads; and (iv) the pricing of credit risk with correlated factors.

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