

A Consistent Stochastic Model of the Term Structure of Interest Rates for Multiple Tenors

Martino Grasselli¹, M. Alfeus², E. Schlogl³

¹ Padova University, Italy & Devinci Research Center, France

^{2,3} University of Technology Sydney

Explicitly taking into account the risk incurred when borrowing at a shorter tenor versus lending at a longer tenor (“roll-over risk”), we construct a stochastic model framework for the term structure of interest rates in which a frequency basis (i.e. a spread applied to one leg of a swap to exchange one floating interest rate for another of a different tenor in the same currency) arises endogenously. This roll-over risk consists of two components, a credit risk component due to the possibility of being downgraded and thus facing a higher credit spread when attempting to roll over short-term borrowing, and a component reflecting the (systemic) possibility of being unable to roll over short-term borrowing at the reference rate (e.g., LIBOR) due to an absence of liquidity in the market. The modelling framework is of “reduced form” in the sense that (similar to the credit risk literature) the *source* of credit risk is not modelled (nor is the source of liquidity risk). However, the framework has more structure than the literature seeking to simply model a different term structure of interest rates for each tenor frequency, since relationships between rates for all tenor frequencies are established based on the modelled roll-over risk. We proceed to consider a specific case within this framework, where the dynamics of interest rate and roll-over risk are driven by a multifactor affine process, show how such model can be calibrated to market data, and used for relative pricing of interest rate derivatives, including bespoke tenor frequencies not liquidly traded in the market.