This paper demonstrates how the LIBOR Market Model of Brace et al. (Math Financ 7(2):127–147, 1997) and Miltersen et al. (J Financ 52(1):409–430, 1997) may be extended in a way that not only takes into account sudden market shocks without long-term effects, but also allows for structural breaks and changes in the overall economic climate. This is achieved by substituting the simple diffusion process of the original LIBOR Market model by a Markov-switching jump diffusion. Since interest rates of different maturities are modeled under different (forward) measures, we investigate the effects of changes between measures on all relevant quantities. Using the Fourier pricing technique, we derive pricing formula for the most important interest rate derivatives, caps/caplets, and calibrate the model to real data.