Source | Model Presentation

lrshjm1d

1 Description

Consider a one-factor HJM model. If the volatility function $\sigma(t,T)$ is differentiable with respect to T, a necessary and sufficient condition for the price of any (interest-rate) derivative to be completely determined by a two-state Markov process $\chi(.) = (r(.), \phi(.))$ is that the following condition holds :

$$\sigma(t,T) = \eta(t)\exp\left(-\int_t^T \kappa(x)dx\right)$$

where η is an adapted process and κ is a deterministic (integrable) function. In such a case, the second component of the process χ is defined by

$$\phi(t) = \int_0^t \sigma(s,t)^2 ds$$

Accordingly, zero-coupon-bond prices are explicitly given by

$$P(t,T) = \frac{P(0,T)}{P(0,t)}\exp\left(-\frac{1}{2}\Lambda^2(t,T)\phi(t) + \Lambda(t,T)[f(0,t) - r(t)]\right)$$

where

$$\Lambda(t,T) = \int_t^T \exp\left(-\int_t^u \kappa(x)dx\right)du$$

Under the Ritchken and Sankarasubramanian class of volatilities, the process χ, and hence the instantaneous short-rate r, evolve according to

$$d\chi(t) = \begin{pmatrix} dr(t) \\ d\phi(t) \end{pmatrix} = \begin{pmatrix} \mu(r,t)dt + \eta(t)dW(t) \\ [\eta^2(t) - 2\kappa(t)\phi(t)]\,dt \end{pmatrix} \tag{1}$$

with

$$\mu(r,t) = \kappa(t)[f(0,t) - r(t)] + \phi(t) + \frac{\partial}{\partial t}f(0,t)$$

2 Code Implementation

```
#ifndef _LiRitchkenSankarasubramanian1D_H
#define _LiRitchkenSankarasubramanian1D_H

#include "optype.h"
#include "var.h"
#include "enums.h"

#define TYPEMOD LRSHJM1D

/*1D Li Ritchken Sankarasubramanian World*/
typedef struct TYPEMOD{
  VAR T;
  VAR flat_flag;
  VAR Sigma;
  VAR Kappa;
  VAR Rho;
  VAR Lambda;
} TYPEMOD;

extern double MOD(GetYield)(TYPEMOD *pt);

#endif
```