

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 $\chi(\cdot) = (r(\cdot), \phi(\cdot))$ 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

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

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);
extern char *MOD(GetCurve)(TYPEMOD *pt);

#endif
```