Source | Model Presentation

bharchiarella1d

1 Description

Bhar-Chiarella model [1] is a single factor HJM model with a forwardrate volatility function depending upon a function of time to maturity, the instantaneous spot rate of interest and a forward rate to a fixed maturity. :

$$\sigma(t,T,r(t),f(t,\tau)) = g(r(t),f(t,\tau))e^{-\lambda(T-t)}, 0 \leq t \leq \tau \leq T. \quad (1)$$

The stochastics dynamic of the forward rate is:

$$f(t,T) = f(0,T) + \int_0^t \sigma(u,T,.) \int_u^T \sigma(u,s,.)dsdu + \int_0^t \sigma(u,T,.)dW_u.$$

and spot interest rate $r(t) = f(t,t)$. In our implementation we test the forward volatility

$$\sigma(t,T,r(t),f(t,\tau)) = [\alpha_0 + \alpha_r r(t) + \alpha_f f(t,\tau)]^\gamma e^{-\lambda(T-t)},$$

with $\alpha_0, \alpha_r, \alpha_f \geq 0$ and $0 < \gamma < 1$. and

$$f(0,t) = \beta_0 + \beta_1(1 - e^{-\eta t})$$

2 Code Implementation

```
#ifndef _BharChiarella1D_H
#define _BharChiarella1D_H

#include "optype.h"
#include "var.h"
#include "error_msg.h"

#define TYPEMOD BharChiarella1D
```

```
/*1D Bhar Chairella World*/
typedef struct TYPEMOD
{
  VAR T;
  VAR alpha0;
  VAR alphar;
  VAR alphaf;
  VAR gamm;
  VAR tau;
  VAR lambda;
  VAR beta0;
  VAR beta1;
  VAR eta;
} TYPEMOD;

#endif
```

References

[1] R.Bahr C.Chiarella N.El-Hassan X.Zheng. The reduction of forward rate volatility hjm models to markovian form: pricing european bond options. *Journal of Computational Finance*, 3-3:47–72, 2000. 1