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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:

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

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 alphas;
    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