

[Help](#)

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#include "cirpp1d_std.h"

#ifdef PremiaCurrentVersion && PremiaCurrentVersion < (2007+2) //The "#els
static int CHK_OPT(CF_ZCCallBondEuro)(void *Opt, void *Mod)
{
    return NONACTIVE;
}
int CALC(CF_ZCCallBondEuro)(void *Opt, void *Mod, PricingMethod *Met)
{
    return AVAILABLE_IN_FULL_PREMIA;
}
#else

/*Shift function of the CIR++ model*/
static double shift(double a, double b, double sigma, double f0_s, double s)
{
    /* the shift rate of the cir++ model for x(0)=0 */
    double c;

    c = sqrt(a * a + 2 * sigma * sigma);

    return (f0_s - 2 * a * b * (exp(s * c) - 1) / (2 * c + (a + c) * (exp(s * c) - 1)));
}

static double A(double time, double a, double b, double sigma)
{
    double h = sqrt(SQR(a) + 2.*SQR(sigma));
    return pow(h * exp(0.5 * (a + h) * (time))) / (h + 0.5 * (a + h) * (exp(h * (time)) - 1.));
}

static double B(double time, double a, double b, double sigma)
{
    double h = sqrt(SQR(a) + 2.*SQR(sigma));
    return (exp(h * (time)) - 1.) / (h + 0.5 * (a + h) * (exp(h * (time)) - 1.));
}

/*Zero Coupon Bond*/
static double zcbond(double rcc, double a, double b, double sigma, double t, double
{

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if (t == 0)
{
    return BondPrice(T, ZCMarket);
}
else
{
    double h, A, B, At, AT, shift, c;
    double f0_t, P0_t, P0_T, P0_t_plus, P0_t_minus;

    P0_t = BondPrice(t, ZCMarket);
    P0_T = BondPrice(T, ZCMarket);

    /*Computation of Forward rate*/
    P0_t_plus = BondPrice(t * (1. + INC), ZCMarket);
    P0_t_minus = BondPrice(t * (1. - INC), ZCMarket);
    f0_t = -(log(P0_t_plus) - log(P0_t_minus)) / (2.*t * INC);

    /*A,B coefficient*/
    h = sqrt(SQR(a) + 2.*SQR(sigma));
    B = 2.*(exp(h * (T - t)) - 1.) / (2.*h + (a + h) * (exp(h * (T - t)) - 1.));
    A = pow(h * exp(0.5 * (a + h) * (T - t)) / (h + 0.5 * (a + h) * (exp(h * (T - t)) - 1.));
    At = pow(h * exp(0.5 * (a + h) * (t)) / (h + 0.5 * (a + h) * (exp(h * (t)) - 1.));
    AT = pow(h * exp(0.5 * (a + h) * (T)) / (h + 0.5 * (a + h) * (exp(h * (T)) - 1.));

    c = sqrt(a * a + 2 * sigma * sigma);

    shift = (f0_t - 2 * a * b * (exp(t * c) - 1) / (2 * c + (a + c) * (exp(t * c) - 1)));

    A = A * (P0_T * At) / (AT * P0_t) * exp(B * shift);

    /*Price*/
    return A * exp(-B * rcc);
}
}

/*Call Option*/
static int zbc_cirpp1d(int flat_flag, double a, double b, double t, double sigma)
{
    double K;
    double PtS, PtT, ATS, BTS;
    double f0_t;

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double p1, p2, p3, k1, k2, k3, psi, phi, rb;
double h;

ZCMarketData ZCMarket;

/* Flag to decide to read or not ZC bond datas in "initialyields.dat" */
/* If P(0,T) not read then P(0,T)=exp(-r0*T) */
if (flat_flag == 0)
{
    ZCMarket.FlatOrMarket = 0;
    ZCMarket.Rate = rcc;
}

else
{
    ZCMarket.FlatOrMarket = 1;
    ZCMarket.filename = curve;
    ReadMarketData(&ZCMarket);

    if (T > GET(ZCMarket.tm, ZCMarket.Nvalue - 1))
    {
        printf("\ nError : time bigger than the last time value entered in ini
        exit(EXIT_FAILURE);
    }
}

/*Computation of Forward rate*/
h = sqrt(SQR(a) + 2.*SQR(sigma));

if (t - 0.5 * INC > 0)
{
    f0_t = (log(BondPrice(t - 0.5 * INC, &ZCMarket)) - log(BondPrice(t + 0.5 *
}
else
{
    f0_t = -log(BondPrice(INC, &ZCMarket)) / INC;
}
K = p->Par[0].Val.V_DOUBLE;

PtT = zcbond(rcc, a, b, sigma, t, T, &ZCMarket);
PtS = zcbond(rcc, a, b, sigma, t, S, &ZCMarket);

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BTS = B(S - T, a, b, sigma);
ATS = A(S - T, a, b, sigma);

/*X^2 parameters*/
rb = (log(ATS / K) + log(A(T, a, b, sigma) * BondPrice(S, &ZCMarket)) - log(A(
if (rb < 0)
{
    rb = 0;
}
phi = 2.*h / (SQR(sigma) * (exp(h * (T - t)) - 1.));
psi = (a + h) / SQR(sigma);

p1 = 2.*rb * (phi + psi + BTS);
p2 = 4.*a * b / SQR(sigma);
p3 = 2.*SQR(phi) * (rcc - shift(a, b, sigma, f0_t, t)) * exp(h * (T - t)) / (p

k1 = 2.*rb * (phi + psi);
k2 = p2;
k3 = 2.*SQR(phi) * (rcc - shift(a, b, sigma, f0_t, t)) * exp(h * (T - t)) / (p

/*Price of Call*/
*price = PtS * pnl_cdfchi2n(p1, p2, p3) - K * PtT * pnl_cdfchi2n(k1, k2, k3);

*delta = pnl_cdfchi2n(p1, p2, p3);

return OK;
}

int CALC(CF_ZCCallBondEuro)(void *Opt, void *Mod, PricingMethod *Met)
{
    TYPEOPT *ptOpt = (TYPEOPT *)Opt;
    TYPEMOD *ptMod = (TYPEMOD *)Mod;

    return zbc_cirpp1d(ptMod->flat_flag.Val.V_INT, ptMod->a.Val.V_DOUBLE, ptMod->b
        ptMod->Sigma.Val.V_PDOUBLE, MOD(GetYield)(ptMod),
        MOD(GetCurve)(ptMod), ptOpt->BMaturity.Val.V_DATE,
        ptOpt->OMaturity.Val.V_DATE, ptOpt->PayOff.Val.V_NUMFUNC_1,
        &(Met->Res[1].Val.V_DOUBLE));
}

```

```
static int CHK_OPT(CF_ZCCallBondEuro)(void *Opt, void *Mod)
{
    return strcmp(((Option *)Opt)->Name, "ZeroCouponCallBondEuro");
}
#endif //PremiaCurrentVersion
```

```
static int MET(Init)(PricingMethod *Met, Option *Opt)
{
    if (Met->init == 0)
    {
        Met->init = 1;
    }

    return OK;
}
```

```
PricingMethod MET(CF_ZCCallBondEuro) =
{
    "CF_Cirpp1d_ZBCallEuro",
    {" " , PREMIA_NULLTYPE, {0}, FORBID}},
    CALC(CF_ZCCallBondEuro),
    {"Price", DOUBLE, {100}, FORBID}, {"Delta", DOUBLE, {100}, FORBID} , {" " , PR
    CHK_OPT(CF_ZCCallBondEuro),
    CHK_ok,
    MET(Init)
} ;
```