Master of Science

Pricing of Structured Products

Laboratory Session
Pricing and hedging a portfolio of corporate bonds

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Outline

The problem

- We have built the term structure of spot rates
- We would like to price different types of corporate bonds
- Using a swap, we would like to hedge the portfolio exposure to parallel shift in the term structure
- Home Project: Repeat with a different portfolio and hedge also against changes in the slope of the term structure.
- We take market information from the cap volatility curve and from the term structure of credit spreads.

The Portfolio Composition

- Fixed Coupon Bond (ISIN IT0001301776).
- Floating Rate Note (ISIN XS0115565821).
- Bonds containing Digitals (ISIN IT0001385050).
- Bonds containing Digitals (ISIN IT0001207064).
- The hedging instrument is a swap

Tools from Excel: calendar functions

YearFrac(start_date; end_date; basis)

Returns the year fraction representing the number of whole days between start_date and end_date

	d_e	25/10/1996	27/01/1998	
	d_t	31/12/1996	01/02/1999	
Day Count	Basis			
30/360	0	0.183333333	1.011111111	=Yearfrac(E4,E5,C7)
ACT/ACT	1	0.183060109	1.013698630	=Yearfrac(E4,E5,C8)
ACT/360	2	0.186111111	1.027777778	=Yearfrac(E4,E5,C9)
ACT/365	3	0.183561644	1.013698630	=Yearfrac(E4,E5,C10)
30/360	4	0.180555556	1.011111111	=Yearfrac(E4,E5,C11)

Couppcd(Settlement,Maturity,Frequency,Basis)
Coupncd(Settlement,Maturity,Frequency,Basis)
Coupdaybs(Settlement,Maturity,Frequency,Basis)
Coupdays(Settlement,Maturity,Frequency,Basis)

Return the:
1. *the coupon date before the settlement date*
2. *the coupon date successive to the settlement date*
3. *the number of days from the beginning of the coupon period to the settlement date*
4. *the number of days in the coupon period containing the settlement date*

Maturity	01/02/2006	
Trade Date	28/10/2003	
Value Date	31/10/2003	
Frequency	2	number of coupons in the year
Basis	1	day count convention
Payment Date of last coupon	01/08/2003	=Couppcd(E27,E25,E28,E29)
Payment Date of next coupon	01/02/2004	=Coupncd(E27,E25,E28,E29)
Annual coupon	2.75	
Days since last coupon	91	=Coupdaybs(E27,E25,E28,E29)
Days in the coupon period	184	=Coupdays(E27,E25,E28,E29)
Accrued Interest	0.68003	=(E32/2)*E33/(E34)

Coupnum(Settlement,Maturity,Frequency,Basis)

Returns the number of coupons between the settlement date and the maturity

Value Date	31/10/2003	
Maturity	01/02/2006	
Frequency	2	number of coupons in the year
Basis	1	day count convention
Number of coupons	5	number of coupons up to maturity

Tools from VBA: pricing functions

Nelson Siegel VBA functions

Function **NelsonSiegelFwd(beta0 As Double, beta1 As Double, beta2 As Double, kappa As Double, tau As Double) As Double**
compute the instantaneous forward rate in NS

Function **NelsonSiegelSpot(beta0 As Double, beta1 As Double, beta2 As Double, kappa As Double, tau As Double) As Double**
compute the instantaneous spot rate in NS

Function **NelsonSiegelPrice(beta0 As Double, beta1 As Double, beta2 As Double, kappa As Double, tau As Double) As Double**
computes the discount factor in NS

Function **NelsonSiegelSimpleSpot(beta0 As Double, beta1 As Double, beta2 As Double, kappa As Double, tau As Double, tenor As Double) As Double**
computes the simple spot rate in NS

Function **NelsonSiegelSimpleFwd(beta0 As Double, beta1 As Double, beta2 As Double, kappa As Double, tau As Double, tenor As Double) As Double**
computes the simple forward rate in NS

Black VBA functions

Function **UndiscountedBlackDigitalAN(phi As Integer, dFwdrate As Double, dCaprate As Double, dVolat As Double, dOptionMaturity As Double) As Doubl**
computes the price of Asset-or-Nothing option (phi=1: call, phi=-1: put)

Function **UndiscountedBlackDigitalCN(phi As Integer, dFwdrate As Double, dCaprate As Double, dVolat As Double, dOptionMaturity As Double) As Doubl**
computes the price of Asset-or-Nothing option (phi=1: call, phi=-1: put)

Function **UndiscountedBlackCaplet(phi As Integer, dFwdrate, dCaprate As Double, dVolat As Double, dOptionMaturity As Double, dtenor) As Double**
computes the price of a caplet/floorlet (phi=1: caplet, phi=-1: floorlet)

The Nelson Siegel Curve

The Nelson-Siegel Discount function

- The spot rate is obtained by integrating the eq. above over the time to maturity τ :

$$R(t,t+\tau)=\frac{\int_0^\tau f(t,u)\,u}{\tau}=\beta_0+\left(\beta_1+\frac{\beta_2}{k}\right)\frac{1-\exp(-\tau k)}{\tau k}-\frac{\beta_2}{k}\exp(-\tau k).$$

β_0	4.70%
β_1	3.10%
β_2	7.34%
κ	0.07

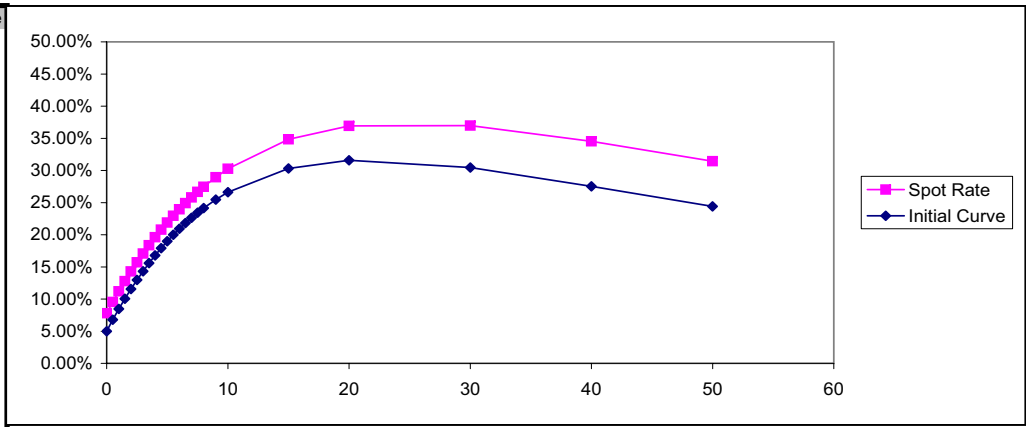
- β_0 specifies the long rate to which the fwd rate horizontally asymptotically,
- β_1 is the weight attached to the short term component (spread spread short/long-term),
- β_2 is the weight attached to the medium term component,
- k measures the point of the beginning of decay:

R(t,t+s) = β_0+β1 as s->0

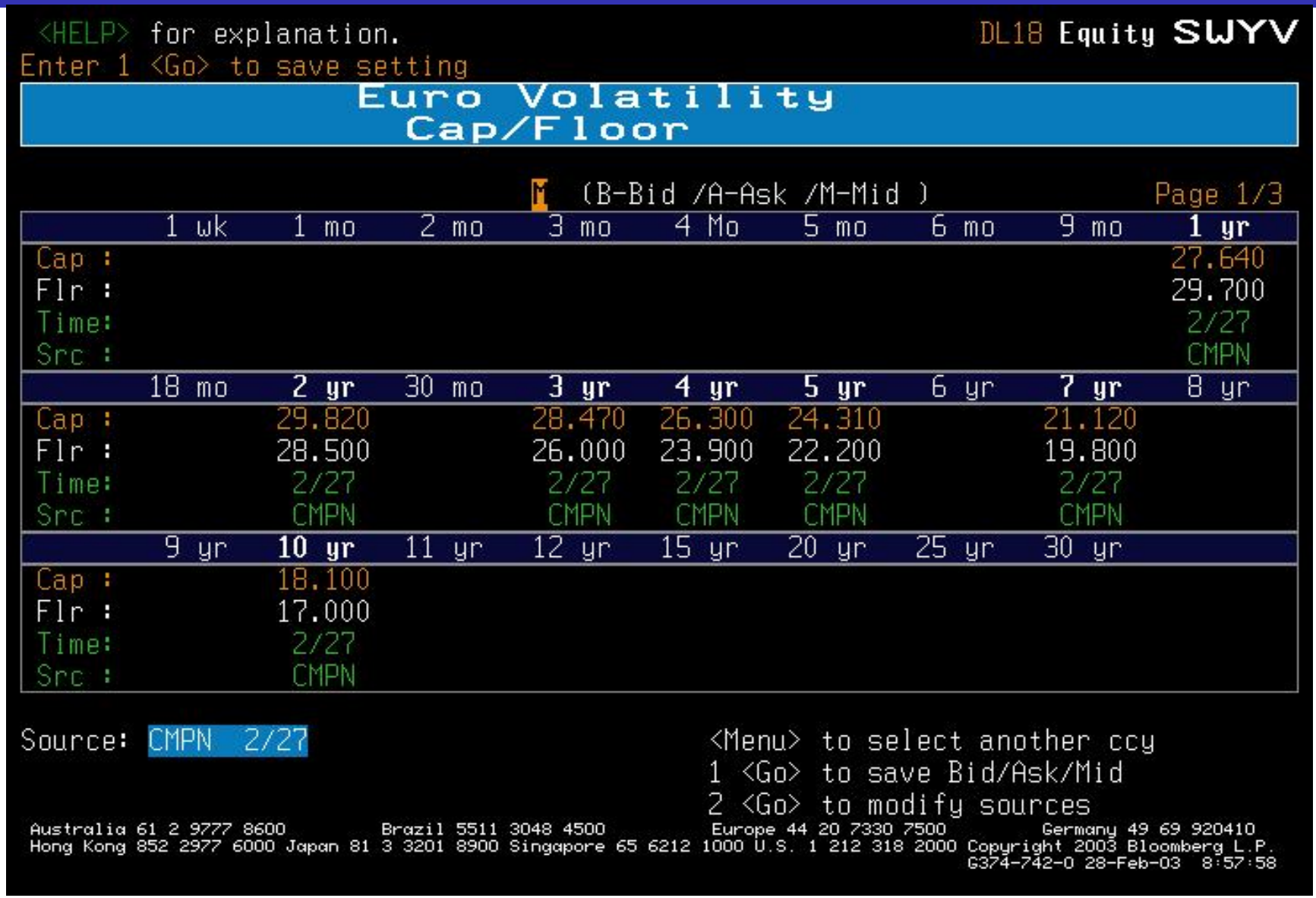
R(t,t+s) = β_0 as s->+inf

b0=2.5%, b1=2.5%, b2=7.5%, k=0.08

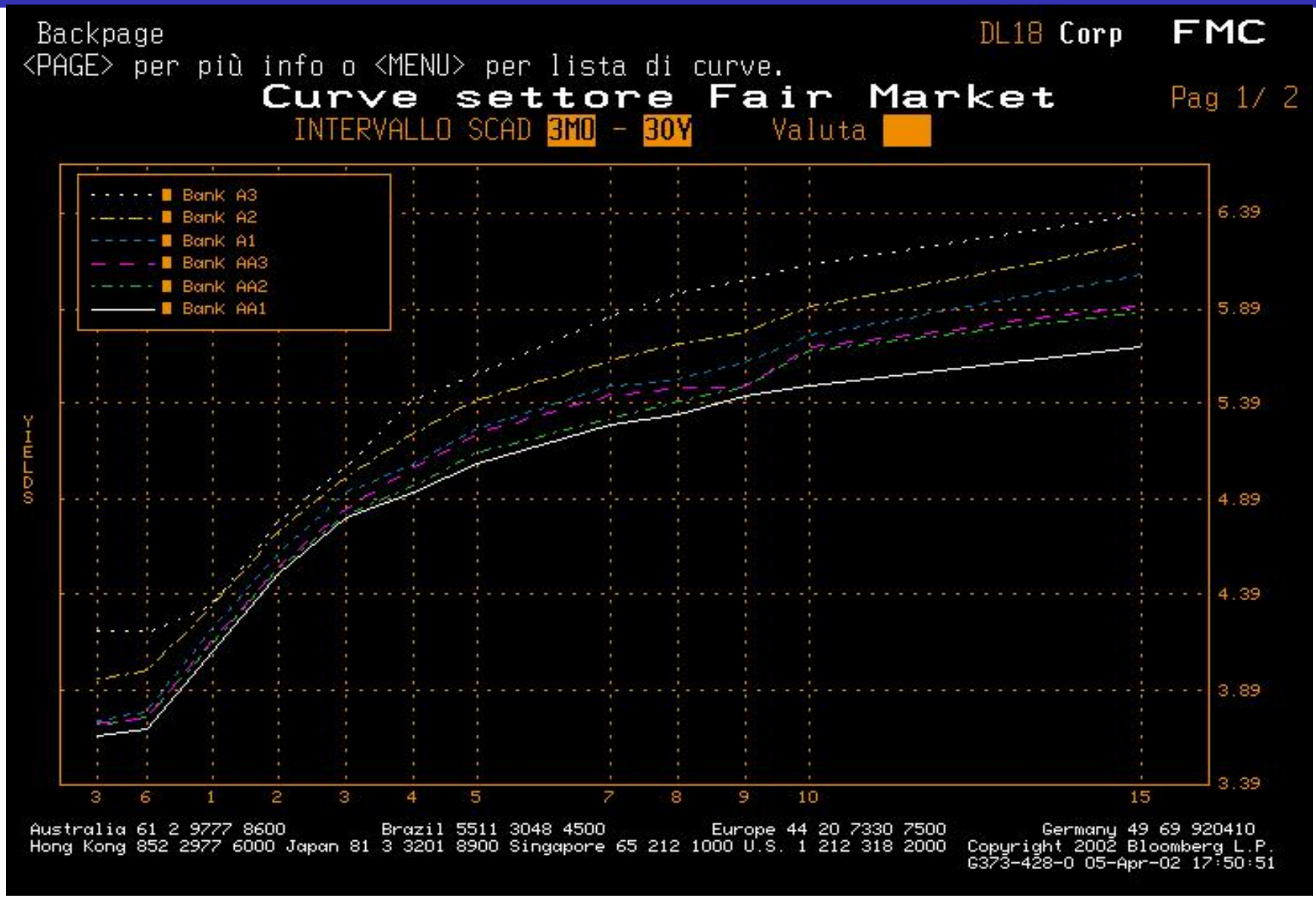
maturity	Initial Curve	Spot Rate
0	5.00%	7.80%
0.5	6.78%	9.54%
1	8.46%	11.20%
1.5	10.05%	12.78%
2	11.56%	14.28%
2.5	12.98%	15.72%
3	14.32%	17.08%
3.5	15.59%	18.38%
4	16.79%	19.61%
4.5	17.92%	20.78%
5	18.99%	21.90%
5.5	19.99%	22.95%
6	20.93%	23.96%
6.5	21.82%	24.91%
7	22.65%	25.81%
7.5	23.43%	26.66%
8	24.16%	27.47%
9	25.48%	28.95%
10	26.63%	30.27%
15	30.31%	34.84%
20	31.58%	36.94%
30	30.46%	36.97%
40	27.53%	34.54%
50	24.40%	31.45%



The Term Structure of Volatilities



Credit Spreads



Credit Spreads

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Curve settore Fair Market Pag 2/ 2

Curva	889 +	890 +	891 +	892 +	893 +	894 +
Nome	€ Bank AA1	€ Bank AA2	€ Bank AA3	€ Bank A1	€ Bank A2	€ Bank A3
3ms	3.64	3.70	3.71	3.72	3.94	4.20
6ms	3.67	3.74	3.74	3.78	3.99	4.18
1an	4.08	4.14	4.15	4.20	4.33	4.35
2an	4.49	4.52	4.53	4.61	4.71	4.77
3an	4.79	4.80	4.84	4.92	5.01	5.05
4an	4.91	4.94	5.05	5.08	5.22	5.42
5an	5.06	5.13	5.22	5.25	5.41	5.54
7an	5.27	5.31	5.42	5.47	5.61	5.84
8an	5.33	5.39	5.46	5.52	5.70	5.97
9an	5.42	5.48	5.49	5.61	5.76	6.03
10an	5.47	5.66	5.69	5.75	5.88	6.12
15an	5.69	5.87	5.90	6.06	6.23	6.39
20an						
25an						
30an						

Freq: 2
+ = curva varia in giornata con la curva benchmark

Banca Mediocredito SPA (ISIN IT0001301776)

	A	B	C	D	E	F	G	H	I	J
1	**Banca Mediocredito SPA**	**Caution: do not move Nominal from cell B5 and Clean Price from cell B19**								
2	ISIN IT0001301776		**FIXED RATE BOND**							
3			INPUT							
4	**Features:**			**Parameters:**						
5	Nominal	100								
6	Maturity	29-gen-09		Rating	Bank Aaa3					
7	Trade date	**28-feb-03**	6	Credit Spread	0.90%	<- flat				
8	Settlement date (2 days later)	04-mar-03								
9	Time to maturity	5.908								
10	# payments per year	1								
11	Day-count convention	1	act/act							
12	Last coupon date	29-gen-03								
13	Time from last coupon payment	0.093								
14	Fixed rate Coupon	4.25%								
15										
16										
17	**Gros Price**	**98.0294**								
18	**Accrued Interest**	**0.3959**								
19	**Clean Price**	**97.6335**								
20										
21	Coupon Dates	day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor $\alpha(T(i-1),T(i))$	Time	Risky Discount Factor	Simple Forward Rate	Fwd Fwd Vol $\sigma(F(t,T(i-1),T(i)))$	Expected Coupon	Discount Factor x Expected Coupon
22	29-gen-03	4	29-gen-03							
23	29-gen-04	5	29-gen-04	**1.0000000**	0.906849	0.963251	not relevant	not relevant	0.04250000	0.0409382
24	29-gen-05	7	31-gen-05	1.006839945	1.913321	0.920928	not relevant	not relevant	0.04279070	0.0394071
25	29-gen-06	1	30-gen-06	0.997260274	2.910335	0.879108	not relevant	not relevant	0.04238356	0.0372597
26	29-gen-07	2	29-gen-07	0.997260274	3.907448	0.838285	not relevant	not relevant	0.04238356	0.0355295
27	29-gen-08	3	29-gen-08	1	4.905109	0.798866	not relevant	not relevant	0.04250000	0.0339518
28	29-gen-09	5	29-gen-09	1	5.907704	0.760870		not relevant	1.04250000	0.7932074

Pricing Banca Mediocredito SPA (ISIN IT0001301776)

	A	B	C	D	E	F	G	H	I	J
1	**Banca Mediocredito SPA**	**Caution: do not move Nominal from cell B5 and Clean Price from cell B19**								
2	ISIN IT0001301776		**FIXED RATE BOND**							
3			INPUT							
4	**Features:**			**Parameters:**						
5	Nominal	100								
6	Maturity	29-gen-09		Rating		Bank Aaa3				
7	Trade date	26-feb-03	6	Credit Spread		0.90%	<- flat			
8	Settlement date (2 days later)	04-mar-03								
9	Time to maturity	5.908								
10	# payments per year	1								
11	Day-count convention	1	act/act							
12	Last coupon date	29-gen-03								
13	Time from last coupon payment	0.093								
14	Fixed rate Coupon	4.25%								
15										
16										
17	Gross Price	98.0294								
18	Accrued Interest	0.3959								
19	Clean Price	97.6335								
20										
21	Coupon Dates	day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor $\alpha(T(i-1),T(i))$	Time	Risky Discount Factor	Simple Forward Rate	Fwd Fwd Vol $\sigma(F(t,T(i-1),T(i)))$	Expected Coupon	Discount Factor x Expected Coupon
22	29-gen-03	4	29-gen-03							
23	29-gen-04	5	29-gen-04	1.0000000	0.906849	0.963251	not relevant	not relevant	0.04250000	0.0409382
24	29-gen-05	7	31-gen-05	1.006839945	1.913321	0.920928	not relevant	not relevant	0.04279070	0.0394071
25	29-gen-06	1	30-gen-06	0.997260274	2.910335	0.879108	not relevant	not relevant	0.04238356	0.0372597
26	29-gen-07	2	29-gen-07	0.997260274	3.907448	0.838295	not relevant	not relevant	0.04238356	0.0355295
27	29-gen-08	3	29-gen-08	1	4.905109	0.798866	not relevant	not relevant	0.04250000	0.0339518
28	29-gen-09	5	29-gen-09	1	5.907704	0.760870		not relevant	1.04250000	0.7932074

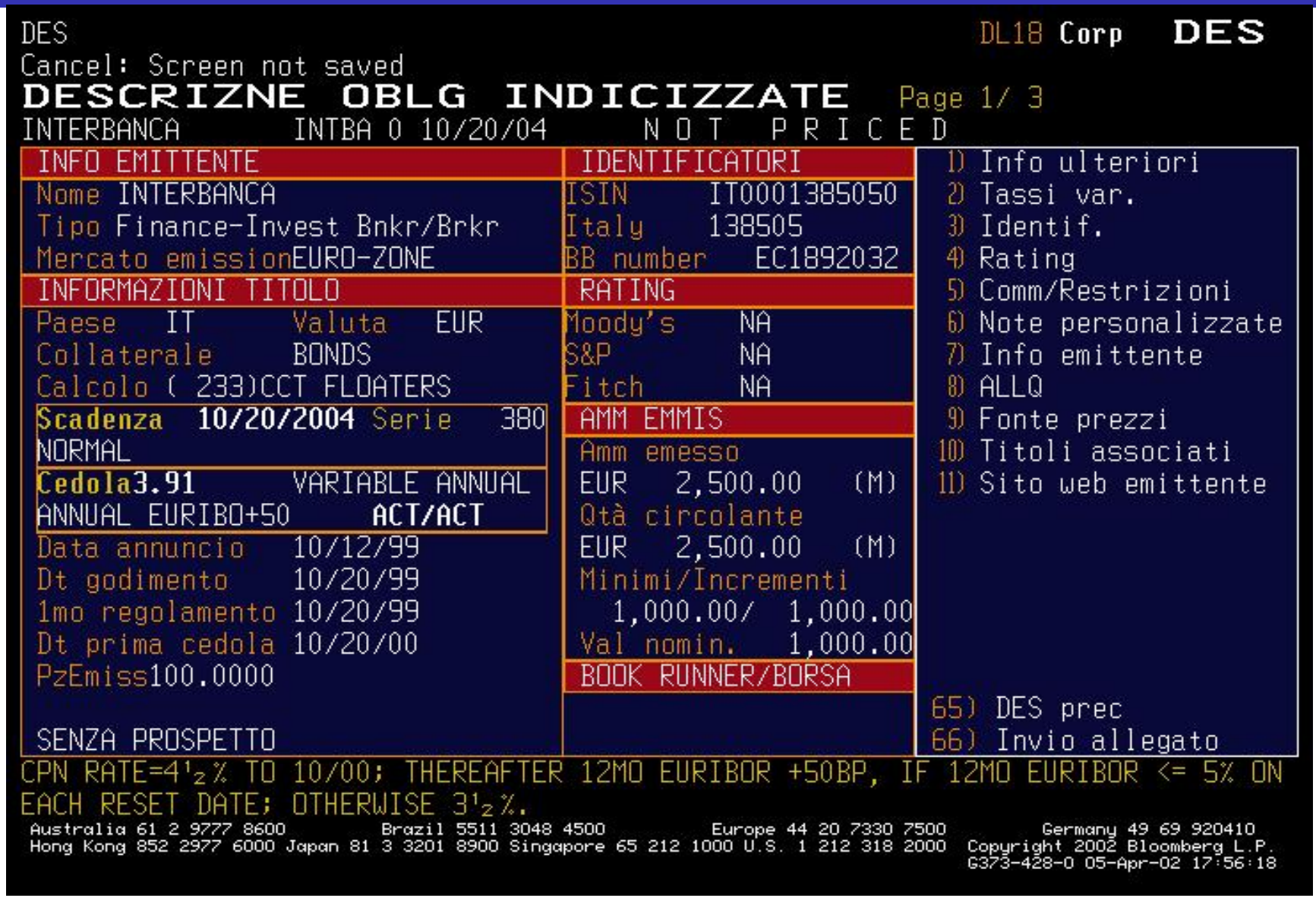
Banca popolare di Lodi (ISIN XS0115565821)

Pricing Banca popolare di Lodi (ISIN XS0115565821)

	A	B	C	D	E	F	G	H	I	J
1	**Banca popolare di Lodi**	**Caution: do not move Nominal from cell B5 and Clean Price from cell B19**								
2	ISIN XS0115565821		**PLAIN FRN**					**VBA functions:**		
3			INPUT					Function NelsonSiegelSimpleFwd(beta0 As Double, _		
4	**Features:**			**Parameters:**				beta1 As Double, _		
5	Nominal	100		Rating	bank A3			beta2 As Double, _		
6	Maturity	04-ago-05		Credit Spread	0.72%	<- flat		kappa As Double, _		
7	Trade date	28-feb-03	6	Spread	0.28%			T1 As Double, _		
8	Settlement date (2 days later)	04-mar-03						T2 As Double, _		
9	Time to maturity	2.420						tenor As Double) As Double		
10	# payments per year	4								
11	Day-count convention	2	act/360							
12	Last coupon date	04-feb-03								
13	Time from last coupon payment	0.077	0.283966667	**Valuation Method**						
14	First coupon	3.651%		We assume that the simple forward rate F(t,T(i-1),T(i)) is a martingale under the T(i) measure						
15	Cpn = 3moEuribor + 28BP			Therefore the expected value of the floating coupon at time T(i) under this measure is given by:						
16				F(0, T(i-1), T(i)) + 28BP						
17	**Gross Price**	99.3282		where F(0, T(i-1), T(i))=1/(T(i)-T(i-1)) * [P(0,T(i-1))-P(0,T(i))]/P(0,T(i))						
18	**Accrued Interest**	0.2840		Remark: the coupon that will be payed in may 2003 is already known						
19	**Clean Price**	99.0443		since the last coupon payment date and is equal to 0.03651						
20										

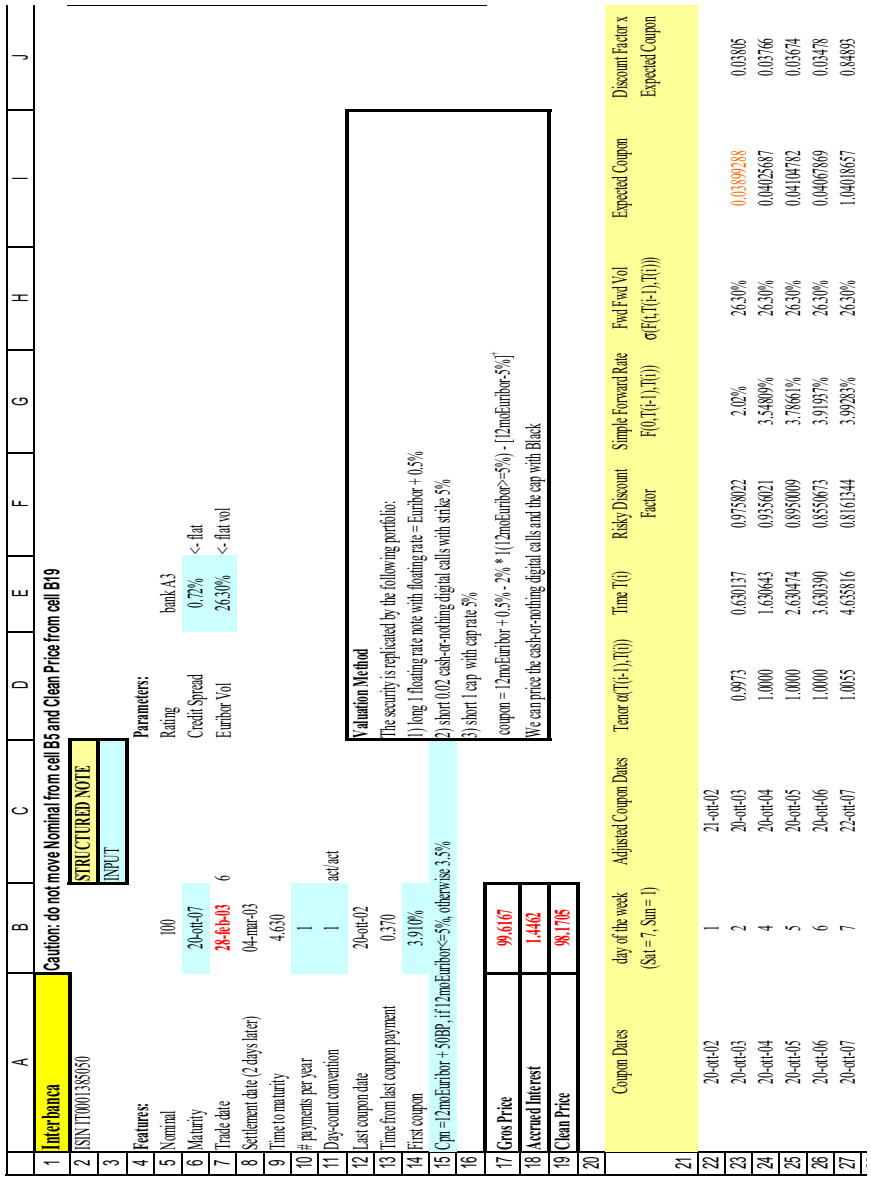
21	Coupon Dates	day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor α(T(i-1),T(i))	Time T(i)	Risky Discount Factor	Simple Forward Rate	Fwd Fwd Vol σ(F(t,T(i-1),T(i)))	Expected Coupon	Discount Factor x Expected Coupon
22	04-feb-03	3	04-feb-03							
23	04-mag-03	1	05-mag-03	0.2500000	0.169863	0.99361786			0.009128	0.00907
24	04-ago-03	2	04-ago-03	0.2527778	0.419178	0.98404957	3.130212%	not relevant	0.008620	0.00848
25	04-nov-03	3	04-nov-03	0.2555556	0.671233	0.97418217	3.246805%	not relevant	0.009013	0.00878
26	04-feb-04	4	04-feb-04	0.2555556	0.923288	0.96416753	3.347550%	not relevant	0.009270	0.00894
27	04-mag-04	3	04-mag-04	0.2500000	1.168263	0.95433184	3.410374%	not relevant	0.009226	0.00880
28	04-ago-04	4	04-ago-04	0.2555556	1.419973	0.94415446	3.501850%	not relevant	0.009665	0.00912
29	04-nov-04	5	04-nov-04	0.2555556	1.671683	0.93393386	3.565998%	not relevant	0.009829	0.00918
30	04-feb-05	6	04-feb-05	0.2555556	1.924270	0.92365917	3.633932%	not relevant	0.010002	0.00924
31	04-mag-05	4	04-mag-05	0.2472222	2.167883	0.91375180	3.669186%	not relevant	0.009763	0.00892
32	04-ago-05	5	04-ago-05	0.2555556	2.419708	0.90353003	3.710016%	not relevant	1.010197	0.91274

Interbanca (ISIN IT0001385050)



Rating Interbanca (B.ca Pop. Antoniana)

Pricing Interbanca (ISIN IT0001385050)



	A	B	C	D	E	F	G	H	I	J
1	**Interbanca**	**Caution: do not move Nominal from cell B5 and Clean Price from cell B19**								
2	ISIN IT0001385050		STRUCTURED NOTE							
3			INPUT							
4	**Features:**			**Parameters:**						
5	Nominal	100		Rating	bank A3					
6	Maturity	20-oct-07		Credit Spread	0.72%	<- flat				
7	Trade date	28-feb-03	6	Euribor Vol	26.30%	<- flat vol				
8	Settlement date (2 days later)	04-mar-03								
9	Time to maturity	4.630								
10	# payments per year	1								
11	Day-count convention	1	act/act							
12	Last coupon date	20-oct-02								
13	Time from last coupon payment	0.370								
14	First coupon	3.910%								
15	Cpn = 12moEuribor + 50BP, if 12moEuribor<=5%, otherwise 3.5%									
16										
17	**Gross Price**	99.6167								
18	**Accrued Interest**	1.4462								
19	**Clean Price**	98.1705								
20										
21	Coupon Dates	day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor ot(T(i-1),T(i))	Time T(i)	Risky Discount Factor	Simple Forward Rate F(0,T(i-1),T(i))	Fwd Fwd Vol σ(F(t,T(i-1),T(i)))	Expected Coupon	Discount Factor x Expected Coupon
22	20-oct-02	1	21-oct-02							
23	20-oct-03	2	20-oct-03	0.9973	0.630137	0.97538022	2.02%	26.30%	0.038899288	0.03805
24	20-oct-04	4	20-oct-04	1.0000	1.630643	0.93560221	3.54809%	26.30%	0.040256687	0.03766
25	20-oct-05	5	20-oct-05	1.0000	2.630474	0.89500009	3.78661%	26.30%	0.041047782	0.03674
26	20-oct-06	6	20-oct-06	1.0000	3.630390	0.85506673	3.91937%	26.30%	0.040678869	0.03478
27	20-oct-07	7	22-oct-07	1.0055	4.635816	0.81613344	3.99283%	26.30%	1.040186657	0.84893

Valuation Method

The security is replicated by the following portfolio:

1) long 1 floating rate note with floating rate = Euribor + 0.5%

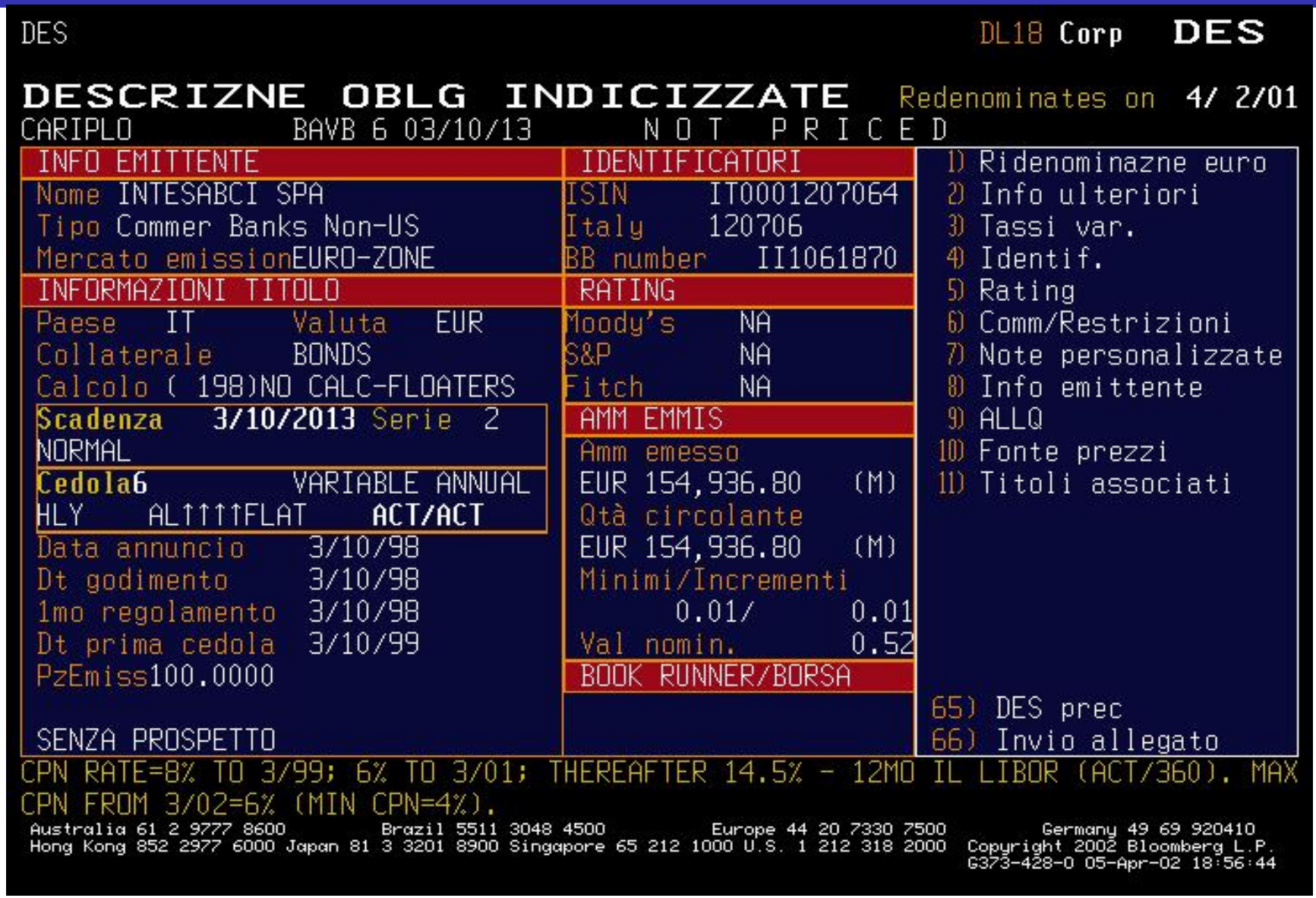
2) short 0.02 cash-or-nothing digital calls with strike 5%

3) short 1 cap with cap rate 5%

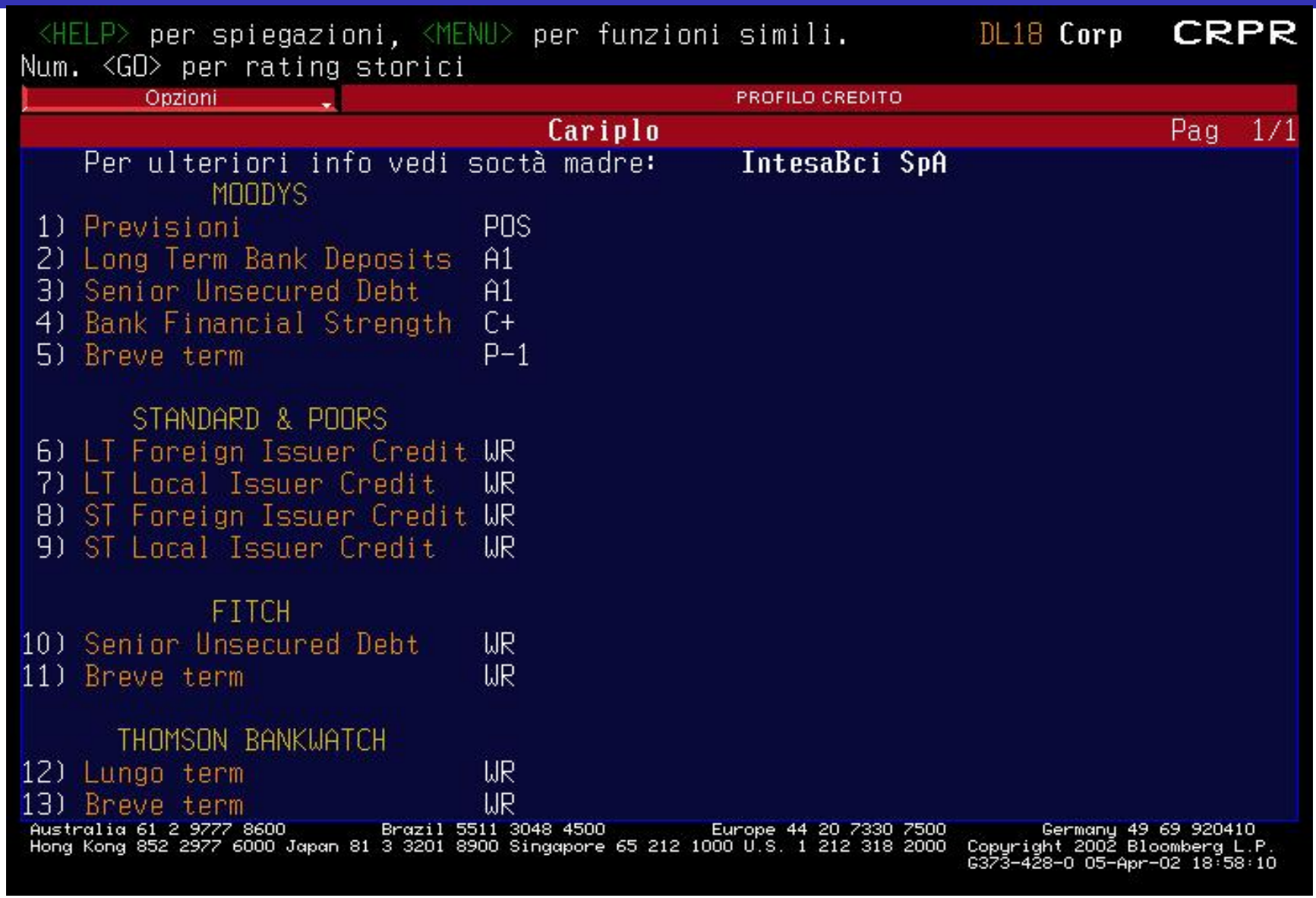
coupon = 12moEuribor + 0.5% - 2% * 1{12moEuribor>=5%} - [12moEuribor-5%]$^+$

We can price the cash-or-nothing digital calls and the cap with Black

Cariplo IntesaBCI (ISIN IT0001207064)



Rating Cariplo IntesaBCI



Pricing Cariplo IntesaBCI (ISIN IT0001207064)

	A	B	C	D	E	F	G	H	I	J
1	**Cariplo IntesaBCI**	**Caution: do not move Nominal from cell B5 and Clean Price from cell B19**								
2	ISIN IT0001207064		**REVERSE FLOATER**							
3			INPUT							
4	**Features:**			**Parameters**						
5	Nominal	100		Rating	Bank A1					
6	Maturity	10-mar-08		Credit Spread	0.42%	<- flat				
7	Trade date	**28-feb-03**	6	Euribor Vol	24.31%	<- flat vol				
8	Settlement date (2 days later)	04-mar-03								
9	Time to maturity	5.0173								
10	# payments per year	1								
11	Day-count convention	1	act/ACT							
12	Last coupon date	10-mar-02		**Valuation method**						
13	Time from last coupon payment	0.984		The security is replicated by the following portfolio:						
14	First coupon	6.000%		1) long 1 cap with strike 10.5%						
15	Cpn = 14.5%-12moLibor, max cpn = 6%, min cpn = 4%			2) short 1 cap with strike 8.5%						
16				3) long a coupon bond with fixed rate 6%						
17	**Gros Price**	**113.948**		coupon = $(12\text{moLibor}-10.5\%)^{+} - (12\text{moLibor}-8.5\%)^{+}+6\%$						
18	**Accrued Interest**	**5.901**		We can price the 2 caps with Black						
19	**Clean Price**	**108.047**								
20										

21	Coupon Dates	day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor $\alpha(T(i-1),T(i))$	Time	Risky Discount Factor	Simple Forward Rate $F(0,T(i-1),T(i))$	Fwd Fwd Vol $\sigma(F(t,T(i-1),T(i)))$	Expected Coupon	Discount Factor x Expected Coupon
22	10-mar-02	1	11-mar-02							
23	10-mar-03	2	10-mar-03	0.9972603	0.016438	0.999	not relevant	not relevant	0.05983561644	0.05980194
24	10-mar-04	4	10-mar-04	1.0000000	1.017784	0.963	0.03314	24.31%	0.06000000000	0.05779923
25	10-mar-05	5	10-mar-05	1.0000000	2.017336	0.925	0.03655	24.31%	0.05999902426	0.05552652
26	10-mar-06	6	10-mar-06	1.0000000	3.017112	0.887	0.03847	24.31%	0.05993913410	0.05319227
27	10-mar-07	7	12-mar-07	1.0054795	4.022453	0.850	0.03953	24.31%	0.06008904897	0.05107066
28	10-mar-08	2	10-mar-08	0.9945355	5.017336	0.814	0.04012	24.31%	1.05921144081	0.86208960

Hedging Instrument: a swap

IRS	Caution: do not move Nominal from cell B5 and Clean Price from cell B19	
ISIN XYZ	SWAP	
Features:		
Swap type (payer=1, receiver=-1)	-1	
Nominal	100	
Trade date	28-feb-03	6
Settlement date (2 bussness days)	04-mar-03	3
Inception	07-ott-02	2
Maturity	07-ott-10	5
Swap rate	4.00%	
Floating leg: # payments per year	1	
Floating leg: basis	2	
Last coupon date floating leg	07-ott-02	
Time from last floating payment	0.405	
First floating payment	2.12%	
	0.8598%	
Gros Price	2.682	
Accrued Interest	0.762	
Clean Price	1.920	

Floating Leg	0.2522
Fixed Leg	0.2790
Swap	0.0268

Fixed leg: # payments per year	2
Fixed leg: basis	1
Last coupon date fixed leg	07-ott-02
Time from last coupon payment	0.4055
First fixed payment	4.00%

FLOATING LEG	
$P(t_0, T_1)$	0.98
$P(t, T_1)$	0.98
$P(t, T_n)$	0.75
Floating leg	0.2522

Valuation Method
Payer IRS: Value = Floating Leg - Fixed Leg
Receiver IRS: Value = Fixed Leg -Floating Leg

INPUT	

$$\text{accrued interest} = \text{interest due in full period} \times \frac{\text{number of days since last coupon date}}{\text{number of days in period between coupon payments}}.$$

Hedging Instrument: the floating leg

FLOATING LEG

Payment Dates	Day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor a(T(i-1),T(i))	Time T(i)	Discount Factor P(0, T(i))	Simple Forward Rate F(0,T(i-1),T(i))	Expected Floating Payment	Discounted Expected Floating Payment
04-mar-03	3	04-mar-03		0.0000				
07-ott-03	3	07-ott-03	1.0139	0.5945	0.9814		0.02150	0.02110
07-ott-04	5	07-ott-04	1.0167	1.5951	0.9479	0.03479	0.03537	0.03352
07-ott-05	6	07-ott-05	1.0139	2.5949	0.9133	0.03728	0.03780	0.03453
07-ott-06	7	07-ott-06	1.0139	3.5948	0.8789	0.03862	0.03916	0.03442
07-ott-07	1	08-ott-07	1.0167	4.5975	0.8451	0.03936	0.04002	0.03382
07-ott-08	3	07-ott-08	1.0139	5.5949	0.8124	0.03966	0.04021	0.03267
07-ott-09	4	07-ott-09	1.0139	6.5948	0.7808	0.03998	0.04054	0.03165
07-ott-10	5	07-ott-10	1.0139	7.5948	0.7503	0.04010	0.04066	0.03051
							PV(floating Leg)	**0.25221**

Hedging Instrument: the fixed leg

FIXED LEG

Payment Dates	day of the week (Sat = 7, Sun = 1)	Adjusted Coupon Dates	Tenor a(T(i-1),T(i))	Time T(i)	Discount Factor P(0, T(i))	Payment	Discount Factor x Payment
04-mar-03	3	04-mar-03		0.0000			
07-apr-03	2	07-apr-03	0.4986	0.0932	0.9972	0.01995	0.01989
07-ott-03	3	07-ott-03	0.5014	0.5945	0.9814	0.02005	0.01968
07-apr-04	4	07-apr-04	0.5000	1.0944	0.9649	0.02000	0.01930
07-ott-04	5	07-ott-04	0.5000	1.5951	0.9479	0.02000	0.01896
07-apr-05	5	07-apr-05	0.4986	2.0940	0.9307	0.01995	0.01856
07-ott-05	6	07-ott-05	0.5014	2.5949	0.9133	0.02005	0.01832
07-apr-06	6	07-apr-06	0.4986	3.0938	0.8961	0.01995	0.01787
07-ott-06	7	07-ott-06	0.5014	3.5948	0.8789	0.02005	0.01763
07-apr-07	7	07-apr-07	0.4986	4.0936	0.8620	0.01995	0.01719
07-ott-07	1	08-ott-07	0.5041	4.5975	0.8451	0.02016	0.01704
07-apr-08	2	07-apr-08	0.4973	5.0940	0.8287	0.01989	0.01648
07-ott-08	3	07-ott-08	0.5000	5.5949	0.8124	0.02000	0.01625
07-apr-09	3	07-apr-09	0.4986	6.0939	0.7965	0.01995	0.01589
07-ott-09	4	07-ott-09	0.5014	6.5948	0.7808	0.02005	0.01566
07-apr-10	4	07-apr-10	0.4986	7.0938	0.7654	0.01995	0.01527
07-ott-10	5	07-ott-10	0.5014	7.5948	0.7503	0.02005	0.01505
						PV(fixed Leg)	**0.27903**

Compute Sensitivities

SENSITIVITY ANALYSIS WITH RESPECT TO PARALLEL SHIFTS IN THE TS

FULL EVALUTION

	INPUT
	UPDATE BY MACRO GET_DV01

Nelson Siegel parameters	
Trade date	28-feb-03
beta0	0.0400
beta1	-0.0100
beta2	0.0000
kappa	0.6000
current spot rate	3.00%

Starting sheet	7 <- hedging instrument
Nb_products	4

ΔR	0.01%	
R-ΔR	3.99%	-ΔR
R+ΔR	4.01%	+ΔR

GET_DV01

Clear

MACRO GET_DV01:
We have 1 hedging instrument and N porfolio's securities
1) Given current TS R = R(beta0), writes clean prices V(R) in spreadsheet 'PORTFOLIO', from cell B19 of pricing spreadsheets
2) Set R = R-dR and writes clean prices V(R-dR) in spreadsheet 'PORTFOLIO', from cell B19 of pricing spreadsheets
3) Set R = R+dR and writes clean prices V(R+dR) in spreadsheet 'PORTFOLIO', from cell B19 of pricing spreadsheets

Sometimes, the DV01 is comput
derivative by the following incre

$$DV01 = -\frac{B(y^* +$$

Remark: all nominals are set by default at 100 in the subsequent spredsheets

HEDGING INSTRUMENT

N.	FACE VALUE	NOMINAL	PRICE	VALUE	V(y-Δy)	V(y+Δy)	DV01	BPV
1	1,000,000	100	1.920169763	19,202	1.980	1.858	0.06118365	611.836483
					=-(H24-G24)/(10000*2*C13)			=(I24/D24)*C24

Porfolio Value (Clean Value)	20,155,448	=SOMMA(F31:F34)
Portfolio bpv	5,983.678	=MATR.SOMMA.PRODOTTO(I31:I34;C31:C34)/100

PORTFOLIO

N.	FACE VALUE	NOMINAL	PRICE	VALUE	V(y-Δy)	V(y+Δy)	DV01	BPV
1	5,000,000	100	97.634	4,881,677	97.6837	97.5794	0.052123	2,606.129
2	5,000,000	100	99.258	4,962,911	99.2596	99.2564	0.001610	80.495
3	5,000,000	100	98.171	4,908,525	98.1859	98.1531	0.016384	819.213
4	5,000,000	100	108.047	5,402,335	108.0941	107.9950	0.049557	2,477.842
				=C34/D34*E34		=-(H34-G34)/(10000*2*C13)		=(I34/D34)*C34

Set Up the hedging strategy

HEDGING STRATEGY

Recompose the portfolio

n1 * PV + n2* SV = V+SV

n1 * BPV1 + n2* BPV2 = 0

Build the linear system

PV	SV	n1	=	PV+SV
BPV1	BPV2	n2		0

Legend

PV: portfolio value — SV: swap value

BPV1: portfolio BPV — BPV2: swap bpv

Build the linear system

20,155,448	19,202	n1	=	20,174,649
5,984	612	n2		0

Solution

n1	1.010366349	=SE(D43=0;"";MATR.PRODOTTO(MATR.INVERSA(D42:E43);I42:I43))
n2	-9.881246643	=SE(D43=0;"";MATR.PRODOTTO(MATR.INVERSA(D42:E43);I42:I43))

Portfolio Analysis

	No hedge	Hedge
n1 (bond)	1	1.0104
n2 (swap)	1	-9.8812
Value	20,174,649	20,174,649
Shift up	20,167,773	20,174,513
Shift up	20,179,740	20,174,513
DV01	-5,984	0.00
BPV	-0.60	0.00

Set Up the hedging strategy against different term structure movements

beta0	Swap	Bond1	Bond2	Bond3	Bond4	Portfolio
0.04	1.9202	97.6335	99.2582	98.1705	108.0467	
0.0401	1.8590	97.5814	99.2566	98.1541	107.9971	
0.0399	1.9814	97.6857	99.2598	98.1869	108.0963	
Derivative	-611.8504	-521.2366	-16.0989	-163.8174	-495.5772	
DV01	0.0612	0.0521	0.0016	0.0164	0.0496	5983.651291
hedge ratio	97796	to hedge only against parallel shifts				

beta1	Swap	Bond1	Bond2	Bond3	Bond4	Portfolio
-0.01	1.920169763	97.63353217	99.25821661	98.17050706	108.0466953	
-0.010001	1.920278408	97.63368374	99.25823215	98.17057771	108.046859	
-0.009999	1.920061119	97.63338059	99.25820106	98.1704364	108.0465315	
Derivative	1.0864	1.5158	0.1555	0.7065	1.6379	
DV01	-0.0001	-0.0002	0.0000	-0.0001	-0.0002	-20.07807834
hedge ratio	184806	to hedge only against slope shifts				very small sensitivity to slope chan

beta2	Swap	Bond1	Bond2	Bond3	Bond4	Portfolio
0	1.920169763	97.63353217	99.25821661	98.17050706	108.0466953	
0.0001	1.897689945	97.61196842	99.25811702	98.16429257	108.0246165	
-0.0001	1.942655567	97.65510094	99.25831619	98.17670134	108.068777	
Derivative	-224.8281	-215.6626	-0.9958	-62.0439	-220.8022	
DV01	0.0225	0.0216	0.0001	0.0062	0.0221	2497.522368
hedge ratio	111086	to hedge only against curvature shifts				

New Bloomberg data: swdf

<HELP> for explanation. EquitySWDF

1) Save 2) Refresh 3

Euro Standard

Short End — Cash Rates	Start	End
	1 Bd	6 MO

Term	Bid	Ask
1 Bd	2.89600	2.89600
1 WK	2.69700	2.69700
1 MO	3.22900	3.22900
2 MO	3.46700	3.46700
3 MO	3.56300	3.56300
4 MO	3.58900	3.58900
5 MO	3.60100	3.60100
6 MO	3.62400	3.62400
7 MO	3.64100	3.64100
8 MO	3.65500	3.65500

ACT/360

Middle — Spot FRAs	Start	End
☒ Spot FRAs	6 MO	18 MO

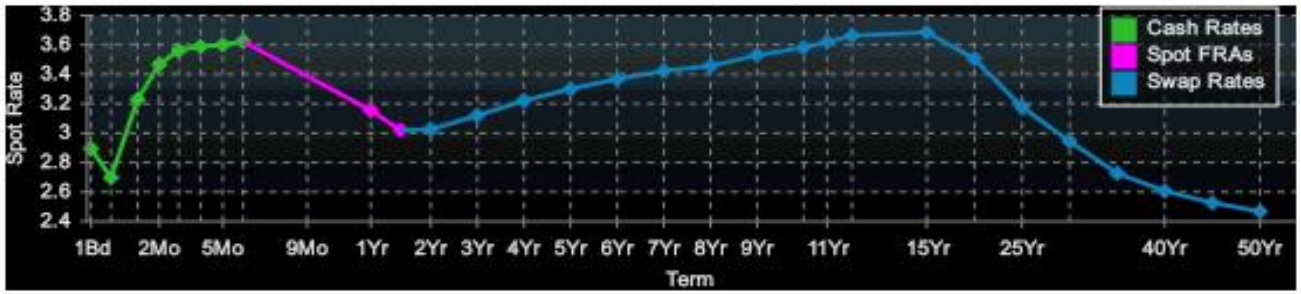
Term	Bid	Ask
FRA 4X10	2.6530	2.6530
FRA 5X11	2.5490	2.5490
FRA 6X12	2.5530	2.5720
FRA 7X13	2.5890	2.6390
FRA 8X14	2.5910	2.6410
FRA 9X15	2.5930	2.6430
FRA 10X16	2.6250	2.6750
FRA 11X17	2.6880	2.7300
FRA 12X18	2.7100	2.7540
FRA 18X24	2.9090	2.9590

ACT/360 Contributor CMPN

Long End — Swap Rates	Start	End
	2 YR	50 YR

Term	Bid	Ask
1 YR	3.1200	3.1545
18 MO	3.0210	3.0400
2 YR	3.0270	3.0270
3 YR	3.1180	3.1180
4 YR	3.2150	3.2150
5 YR	3.2900	3.2903
6 YR	3.3540	3.3540
7 YR	3.4050	3.4060
8 YR	3.4370	3.4510
9 YR	3.5020	3.5033

30U/360, A Contributor CMPN



* Illiquid contracts are not used in curve building.

20) Configuration 21) Stripped Curve 22) Forward Analysis 23) Curve Horizon 24) Real Time Rates

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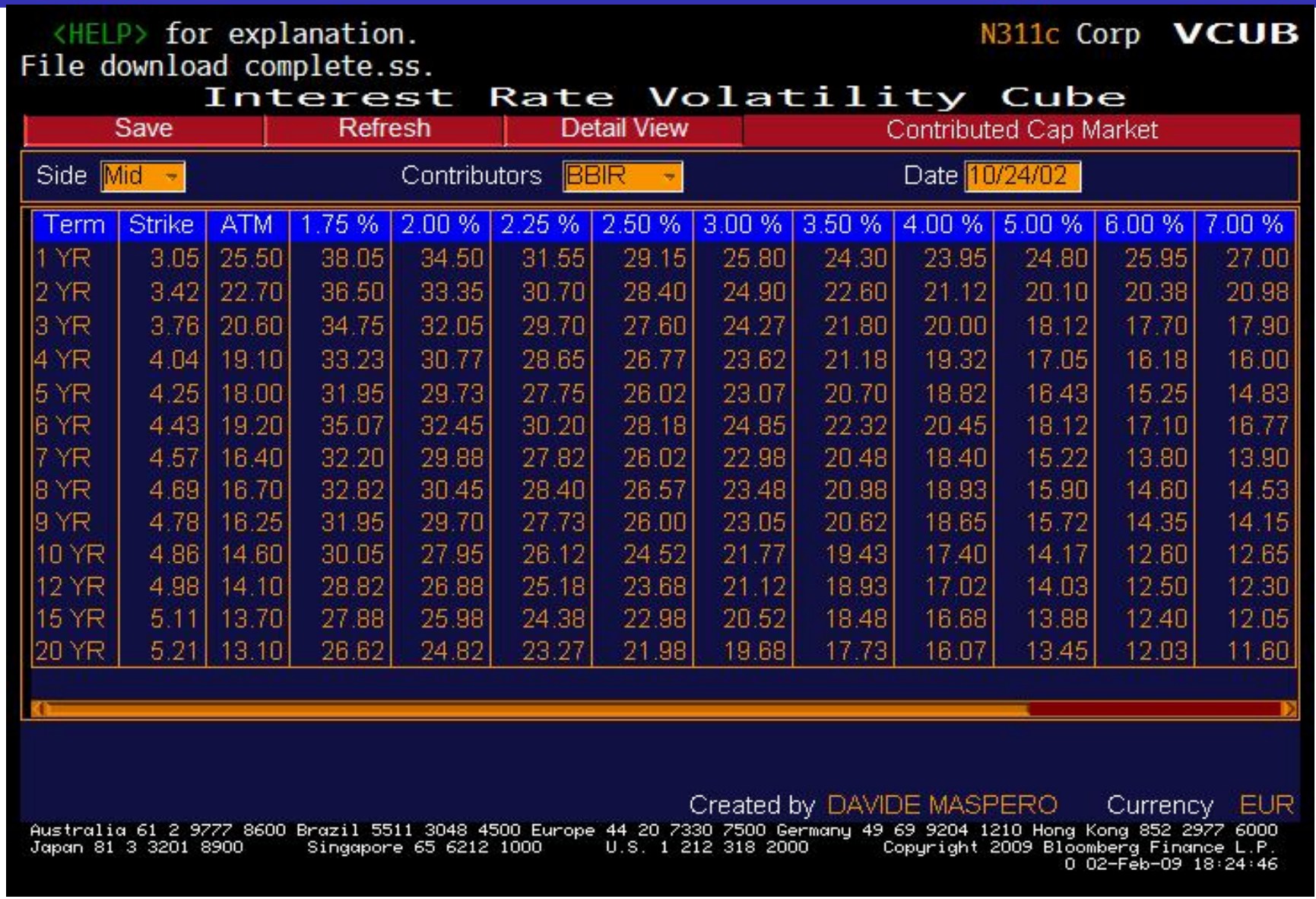
New Bloomberg data: vcub



<HELP> for explanation. N311c Corp VCUB

File download complete.ss.

Interest Rate Volatility Cube

Save | Refresh | Detail View | Contributed Cap Market

Side Mid Contributors BBIR Date 10/24/02

Term	Strike	ATM	1.75 %	2.00 %	2.25 %	2.50 %	3.00 %	3.50 %	4.00 %	5.00 %	6.00 %	7.00 %
1 YR	3.05	25.50	38.05	34.50	31.55	29.15	25.80	24.30	23.95	24.80	25.95	27.00
2 YR	3.42	22.70	36.50	33.35	30.70	28.40	24.90	22.60	21.12	20.10	20.38	20.98
3 YR	3.76	20.60	34.75	32.05	29.70	27.60	24.27	21.80	20.00	18.12	17.70	17.90
4 YR	4.04	19.10	33.23	30.77	28.65	26.77	23.62	21.18	19.32	17.05	16.18	16.00
5 YR	4.25	18.00	31.95	29.73	27.75	26.02	23.07	20.70	18.82	16.43	15.25	14.83
6 YR	4.43	19.20	35.07	32.45	30.20	28.18	24.85	22.32	20.45	18.12	17.10	16.77
7 YR	4.57	16.40	32.20	29.88	27.82	26.02	22.98	20.48	18.40	15.22	13.80	13.90
8 YR	4.69	16.70	32.82	30.45	28.40	26.57	23.48	20.98	18.93	15.90	14.60	14.53
9 YR	4.78	16.25	31.95	29.70	27.73	26.00	23.05	20.62	18.65	15.72	14.35	14.15
10 YR	4.86	14.60	30.05	27.95	26.12	24.52	21.77	19.43	17.40	14.17	12.60	12.65
12 YR	4.98	14.10	28.82	26.88	25.18	23.68	21.12	18.93	17.02	14.03	12.50	12.30
15 YR	5.11	13.70	27.88	25.98	24.38	22.98	20.52	18.48	16.68	13.88	12.40	12.05
20 YR	5.21	13.10	26.62	24.82	23.27	21.98	19.68	17.73	16.07	13.45	12.03	11.60

Created by DAVIDE MASPERO Currency EUR

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New Bloomberg data: cds

UCIM CDS EUR SR Curve
99<GO> to save current selections

Index DES

Pricing Source CMAN

Page 1/3 CDS Switch Historical Analysis

Region, Sector | Europe | Banks

Ref Names UniCredit SpA

Currency EUR Debt Type Senior

Buy-Sell

Historical CDS Switch Spreads

Strategy	Today	1 Day	1 Wk	1 Mo	3 Mo	6 Mo	1 Yr	1Yr Hi	1Yr Lo
1) 1-3	9.3	9.3	6.7	6.2	21.6	9.1	7.3	47.8	6.2
2) 1-5	12.9	12.9	9.3	8.7	33.3	17.2	14.6	71.2	8.7
3) 3-5	3.6	3.6	2.6	2.5	11.7	8.1	7.3	29.2	2.5
4) 3-7	4.9	4.9	3.7	0.5	14.3	10.3	11.3	35.3	0.5
5) 3-10	5.9	5.9	4.4	-2.5	14.9	9.9	12.5	42.7	-2.7
6) 5-7	1.3	1.3	1.1	-2.0	2.6	2.2	4.0	11.5	-3.3
7) 5-10	2.3	2.3	1.8	-5.0	3.2	1.8	5.2	23.0	-9.7
8) 7-10	1.0	1.0	0.7	-3.0	0.6	-0.4	1.2	11.5	-9.9

Curr CDS Spreads

Maturity	(bps)
6 Mo	*133.0
1 Yr	133.0
2 Yr	138.4
3 Yr	142.3
4 Yr	144.5
5 Yr	145.9
7 Yr	147.2
10 Yr	148.2

* interpolated

Buy 5 Yr/Sell 7 Yr

Method Equal Notional Switch Spread(bps) 1.3

	Security	Curr Spread	Notional	SprdDV01
Buy	5 Yr CDS	145.9	10.00MM	-4,443.8
Sell	7 Yr CDS	147.2	10.00MM	5,868.3

Further Analysis

10) HS Historical Price Spread
11) HGCS CDS Switch Analysis

30) Spreads(CDSH) 40) Term Structure(CDHT) 50) Switch(CHSA) 60) Sector(GCDS)

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Arrivederci