New Tax-efficient, Option-based Compensation Packages
Part II: Investment Protection

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Abstract. Interpreted as a boundary condition for call options the simple identity

$$P + \max(S - [X + P], 0) = \max(S - X, P)$$

S: share price, e.g., RUKN

X: exercise price

P: "investment protection", $P > 0$

means that the price of a "protected" European call option (right-hand side of the identity) equals the sum of the price of a discount bond and the price of an ordinary European call option with a strike price that is increased by the amount of the "investment protection". Using Swiss Re stock (RUKN) as an example we show here how the above simple identity and a little bit of financial engineering can be used to design ***new tax-efficient, option-based compensation packages*** with the following properties:

(a) these instruments (***European compound calls with investment protection***) are the next simplest alternative to the standard American forward-start call type compensation schemes;

(b) the option strike can be set at psychologically acceptable levels (RUKN is a high-value stock);

(c) the option premium (i.e., the tax-effective initial investment into the package) can be significantly reduced;

(d) the overall risk exposure is not increased;

(e) the initial investment (option premium) is protected if "things go wrong" during the initial time period (3.5 years in the example considered here) in which the compensation package cannot be exercised for tax reasons.

Part II: Investment Protection shows how the initial (tax-effective) investment into a European compound call option -based compensation package can be protected (property (e) above) without loosing properties (a) - (d).

Keywords. Option-based compensation package, investment protection, European compound call option with investment protection.

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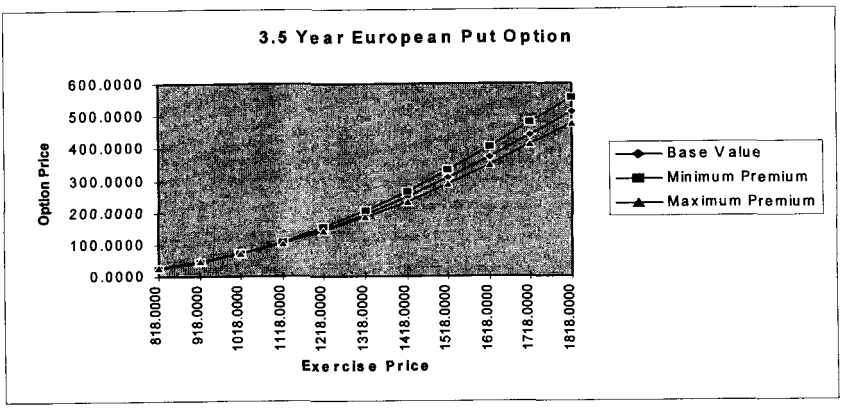
3. Hedge Strategies

European Put Options. A traditional compensation package would normally contain shares of Swiss Re registered stock (RUKN, again Swiss Re stock is just used as an example in order to present our ideas in more concrete terms), usually at some discount to the current market value of CHF 1218.00 (as of 18 October 1995). The value of these shares could then be maintained at a certain level with a conventional put option hedge strategy. We first consider European put options[1] with maturities of 3.5, 4 and 5 years:

3.5 Year European Put Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	24.9902	22.1605	27.7342
918.0000	44.4457	41.9541	46.9075
1018.0000	71.2283	70.2875	72.4649
1118.0000	105.4999	107.4427	104.4799
1218.0000	147.0240	153.1080	142.7507
1318.0000	195.2918	206.5678	186.8887
1418.0000	249.6391	266.8908	236.3947
1518.0000	309.3378	333.0752	290.7202
1618.0000	373.6604	404.1480	349.3088
1718.0000	441.9205	479.2228	411.6262
1818.0000	513.4961	557.5266	477.1749
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%



Recall from ***Part I: Compound Option Structures*** that 3.5 years is the initial time period during which the stock cannot be sold for tax reasons (and that 5 years is the maturity horizon of the standard "Mitarbeiter-Option"). Any hedge would therefore have to have a horizon of

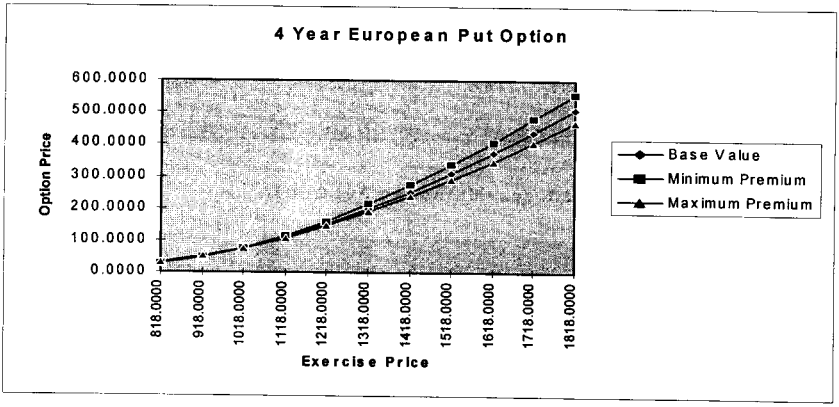
[1] The price of a European put option is

$$p(t) = Xe^{-r(T-t)}N\left[-d_2(t)\right] - S(t)e^{-y(T-t)}N\left[-d_1(t)\right].$$

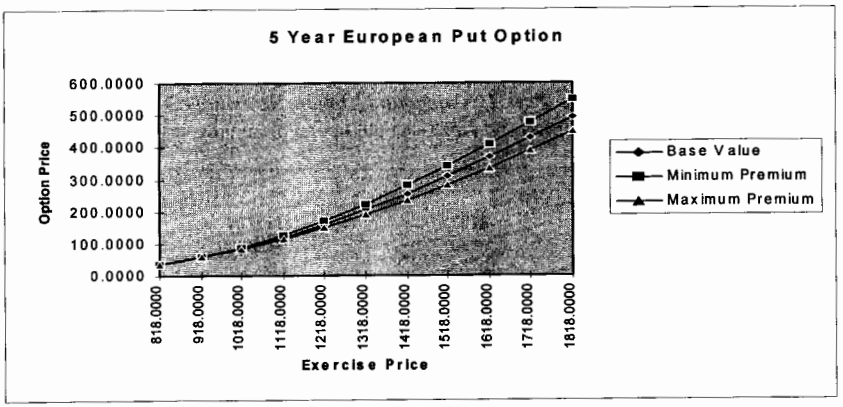
For more details, see ***Part I: Compound Option Structures***. For American put options the AM Basic Lattice Model can be used. The option value function and the sensitivities can be calculated in the same way as for American call options (although of course with different boundary conditions).

at least 3.5 years. 5 year hedge strategies on the other hand provide a benchmark for standard "Mitarbeiter-Options" with "investment protection", see further below.

4 Year European Put Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	28.9709	26.5263	31.3250
918.0000	49.4643	47.8319	51.1612
1018.0000	76.8711	77.2884	76.9589
1118.0000	111.2255	114.9876	108.7043
1218.0000	152.2484	160.5491	146.1703
1318.0000	199.4547	213.2866	188.9894
1418.0000	252.2472	272.3587	236.7143
1518.0000	309.9850	336.8809	288.8647
1618.0000	372.0343	405.9991	344.9577
1718.0000	437.7963	478.9339	404.5307
1818.0000	506.7259	554.9999	467.1522
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%

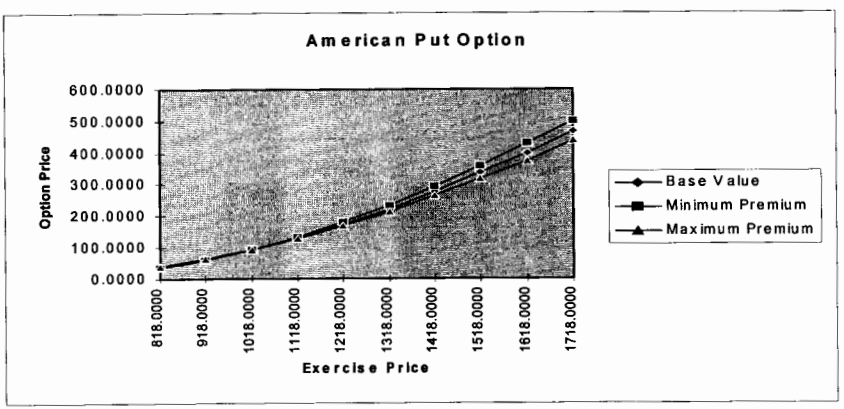


5 Year European Put Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	36.0092	34.7226	37.3020
918.0000	57.9188	58.3220	57.8796
1018.0000	86.0123	89.3492	83.6971
1118.0000	120.1746	127.6661	114.6428
1218.0000	160.0896	172.8269	150.4712
1318.0000	205.3181	224.2039	190.8541
1418.0000	255.3606	281.0876	235.4209
1518.0000	309.6999	342.7583	283.7867
1618.0000	367.8314	408.5293	335.5717
1718.0000	429.2809	477.7736	390.4127
1818.0000	493.6138	549.9347	447.9717
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%



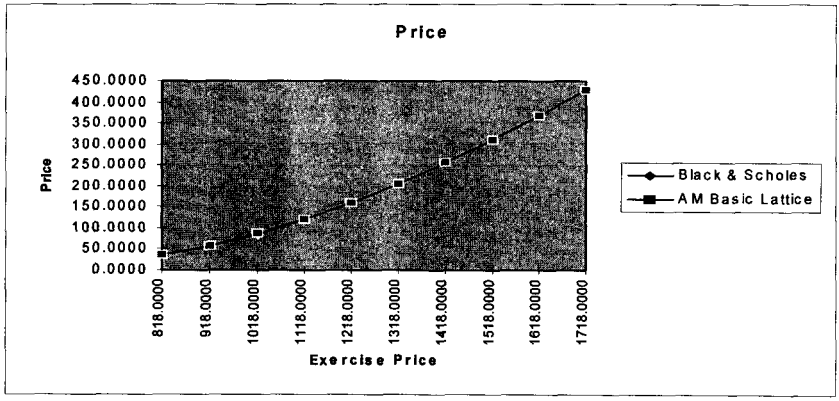
American Forward-start Puts. A much more flexible hedge strategy for the above traditional compensation package would however use a 5 year maturity American put option starting in 3.5 years time (American forward-start put):

American Put Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	38.2510	36.1022	41.5875
918.0000	62.1550	60.7824	64.2312
1018.0000	93.0396	93.3089	93.5110
1118.0000	130.3237	133.2530	128.7592
1218.0000	172.7147	179.6374	168.0635
1318.0000	222.9265	234.6608	214.5477
1418.0000	277.1883	294.5792	263.8414
1518.0000	336.4636	358.7299	319.0528
1618.0000	399.6799	428.8905	376.1329
1718.0000	466.6146	500.8250	438.5567
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%



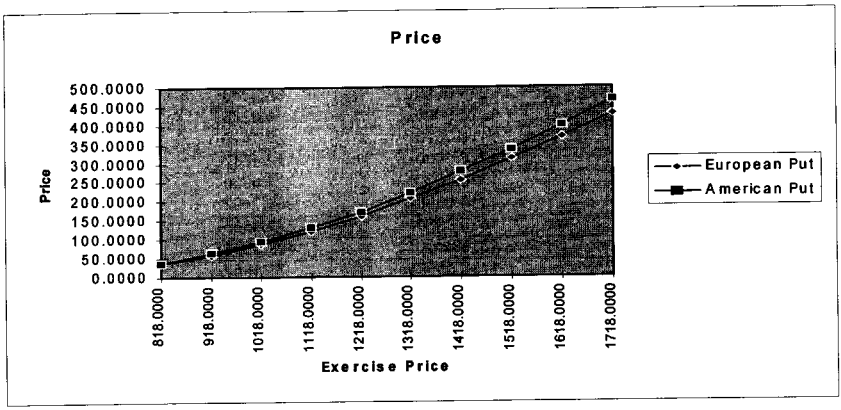
Note that in all relevant scenarios (where our original terminology "minimum premium scenario" and "maximum premium scenario" for the above put options of course now reverses its meaning) both the simple Black & Scholes model and the AM Basic Lattice Model (for more details, see ***Part I: Compound Option Structures***) again provide very accurate estimates of the European and American put option premiums, respectively:

Price			
	Exercise Price	Black & Scholes	AM Basic Lattice
	818.0000	36.0092	35.8596
	918.0000	57.9188	58.1496
Base Value:	1018.0000	86.0123	86.8322
volatility = 22.5%	1118.0000	120.1746	121.0935
dividend yield = 2%	1218.0000	160.0896	159.5795
interest rate = 4%	1318.0000	205.3181	206.4519
	1418.0000	255.3606	255.7794
	1518.0000	309.6999	310.6560
	1618.0000	367.8314	368.2372
	1718.0000	429.2809	430.2680



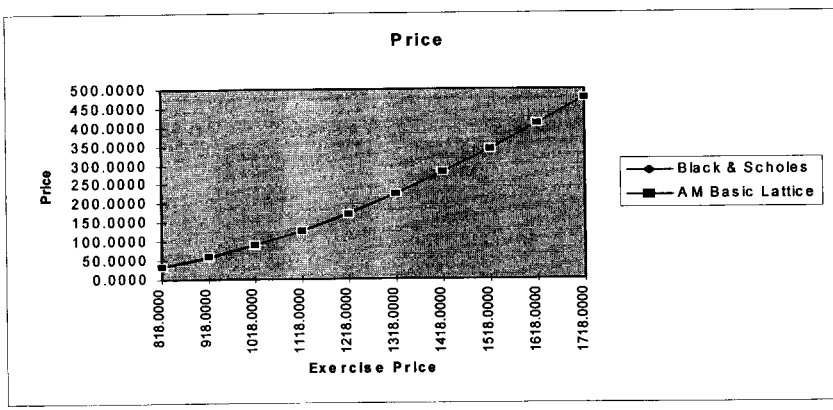
However, unlike before, in the case of the put options considered here there is a significant difference between the American and European option values for the higher exercise prices. This means that for these strikes the additional flexibility of early exercise between 3.5 years and 5 years from the purchase date of the American put option has significant value in the market scenarios likely to prevail during the time period of the above hedge.

Price			
	Exercise Price	European Put	American Put
	818.0000	35.8596	38.2510
	918.0000	58.1496	62.1550
Base Value:	1018.0000	86.8322	93.0396
volatility = 22.5%	1118.0000	121.0935	130.3237
dividend yield = 2%	1218.0000	159.5795	172.7147
interest rate = 4%	1318.0000	206.4519	222.9265
	1418.0000	255.7794	277.1883
	1518.0000	310.6560	336.4636
	1618.0000	368.2372	399.6799
	1718.0000	430.2680	466.6146

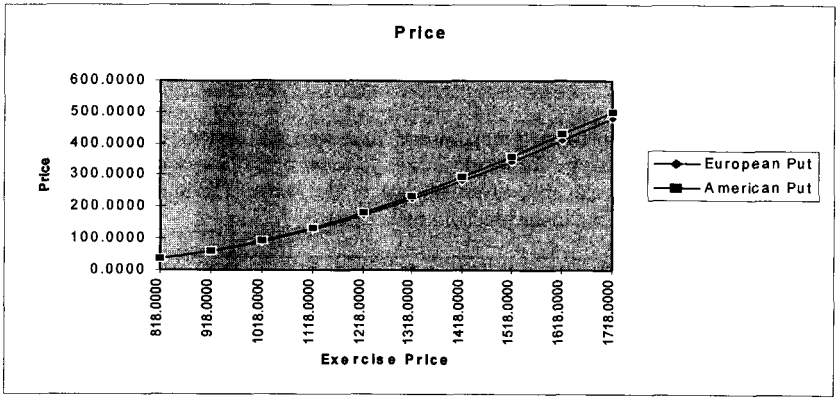


This pricing difference between European and American put options could therefore, in general, be used as a measure for the downside potential of the Swiss Re registered share value between the start and the expiration date of the hedge. Obviously, this downside potential is largest in the maximum premium case.

Price			
	Exercise Price	Black & Scholes	AM Basic Lattice
	818.0000	34.7226	35.0606
	918.0000	58.3220	58.8343
Minimum Premium:	1018.0000	89.3492	90.0283
volatility = 20%	1118.0000	127.6661	128.1499
dividend yield = 2.4%	1218.0000	172.8269	172.1642
interest rate = 3%	1318.0000	224.2039	224.8996
	1418.0000	281.0876	281.7492
	1518.0000	342.7583	342.5896
	1618.0000	408.5293	409.3011
	1718.0000	477.7736	477.1952

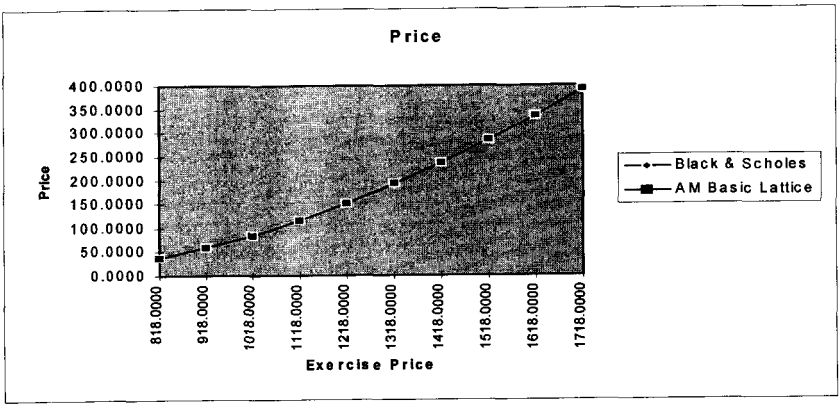


Price			
	Exercise Price	European Put	American Put
	818.0000	35.0606	36.1022
	918.0000	58.8343	60.7824
Minimum Premium:	1018.0000	90.0283	93.3089
volatility = 20%	1118.0000	128.1499	133.2530
dividend yield = 2.4%	1218.0000	172.1642	179.6374
interest rate = 3%	1318.0000	224.8996	234.6608
	1418.0000	281.7492	294.5792
	1518.0000	342.5896	358.7299
	1618.0000	409.3011	428.8905
	1718.0000	477.1952	500.8250

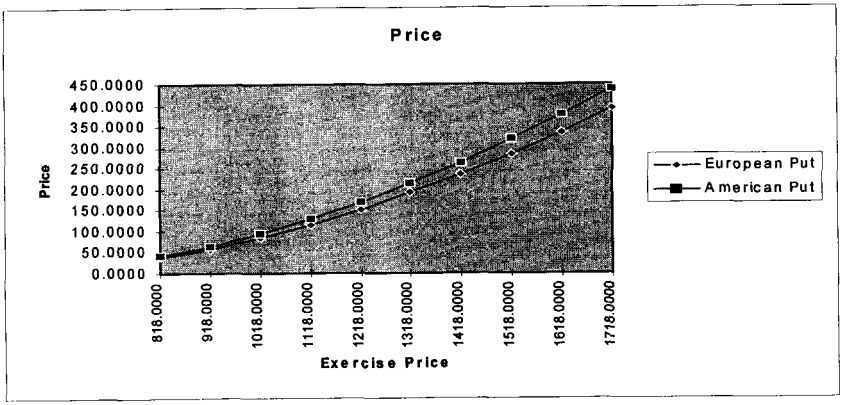


In the minimum premium scenario above the 5 year maturity European put hedge is a good approximation of the corresponding American forward-start put hedge (start period in 3.5 years, 5 year maturity horizon) for the strikes around the Swiss Re registered share's current market price of CHF 1218.00. This is not true in the other scenarios. Therefore, if the downside potential in the market value of the Swiss Re registered share (RUKN) is to be exploited, then the American forward-start put option should be purchased instead of the European put option (but this really goes beyond the basic hedging ideas considered here).

Price			
	Exercise Price	Black & Scholes	AM Basic Lattice
	818.0000	37.3020	37.8225
	918.0000	57.8796	57.8870
Maximum Premium:	1018.0000	83.6971	84.4395
volatility = 25%	1118.0000	114.6428	115.9249
dividend yield = 1.6%	1218.0000	150.4712	150.1607
interest rate = 5%	1318.0000	190.8541	192.3832
	1418.0000	235.4209	235.3997
	1518.0000	283.7867	285.3972
	1618.0000	335.5717	335.3948
	1718.0000	390.4127	391.8319



Price			
	Exercise Price	European Put	American Put
	818.0000	37.8225	41.5875
	918.0000	57.8870	64.2312
Maximum Premium:	1018.0000	84.4395	93.5110
volatility = 25%	1118.0000	115.9249	128.7592
dividend yield = 1.6%	1218.0000	150.1607	168.0635
interest rate = 5%	1318.0000	192.3832	214.5477
	1418.0000	235.3997	263.8414
	1518.0000	285.3972	319.0528
	1618.0000	335.3948	376.1329
	1718.0000	391.8319	438.5567



4. Investment Protection

Investment Protecting European Put. In the case where Swiss Re compensation packages also contain long-dated "Mitarbeiter-Options" in one or another form, because of their relatively high market value (see ***Part I: Compound Option Structures***), the issue of protecting the initial investment in such options arises. Recall the standard American forward-start call type "Mitarbeiter-Option"

American Call Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	471.6676	420.7499	526.1541
918.0000	411.0477	356.2238	467.9785
1018.0000	357.1319	299.5792	416.4205
1118.0000	309.0213	250.2711	369.8777
1218.0000	265.2864	207.2170	326.1366
1318.0000	230.0401	173.0631	290.4157
1418.0000	197.3261	143.2443	255.5095
1518.0000	170.2104	117.5981	227.5985
1618.0000	145.8353	97.8945	199.6965
1718.0000	125.9338	79.4943	178.2402
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%

(with 5 years to maturity, starting 3.5 years from now). Naturally, the above put hedges can be applied for this purpose as well. One only needs to buy one 3.5 year maturity European put with an exercise or strike price set according to the (scenario-dependent) schedules

European Put Option			
	Strike Underlying	Exercise Price	Option Price
	818.0000	1360.5469	217.7135
	918.0000	1390.8174	234.3056
Base Value:	1018.0000	1428.7994	255.8416
volatility = 22.5%	1118.0000	1473.4591	282.1336
dividend yield = 2%	1218.0000	1523.1520	312.5448
interest rate = 4%	1318.0000	1582.6090	350.4116
	1418.0000	1644.9790	391.7156
	1518.0000	1713.7886	438.9748
	1618.0000	1785.7506	490.0862
	1718.0000	1862.8583	546.5327

European Put Option			
	Strike Underlying	Exercise Price	Option Price
	818.0000	1285.3314	188.3005
	918.0000	1313.6616	204.0990
Minimum Premium:	1018.0000	1350.7458	225.6137
volatility = 20%	1118.0000	1395.9788	253.0685
dividend yield = 2.4%	1218.0000	1448.1581	286.2792
interest rate = 3%	1318.0000	1510.2230	327.7407
	1418.0000	1577.1030	374.5497
	1518.0000	1648.6175	426.7470
	1618.0000	1726.7325	485.9423
	1718.0000	1806.2951	548.2166

European Put Option			
	Strike Underlying	Exercise Price	Option Price
	818.0000	1444.7791	250.4933
	918.0000	1475.4776	267.0667
Maximum Premium:	1018.0000	1514.0594	288.4951
volatility = 25%	1118.0000	1558.6154	314.0329
dividend yield = 1.6%	1218.0000	1606.5090	342.3770
interest rate = 5%	1318.0000	1663.9566	377.5158
	1418.0000	1722.3747	414.4296
	1518.0000	1789.1259	457.9438
	1618.0000	1855.8877	502.7591
	1718.0000	1930.3279	554.1010

or, in general, according to the formula

$$EPS = ACS + e^{3.5r} ACP$$

r	Swiss risk - free interest rate
EPS	European put (hedge) strike
ACS	American forward - start call (underlying) strike
ACP	American forward - start call (underlying) price

in oder to protect the initial investment in the American forward-start call option under all market circumstances prevailing during the initial 3.5 year time period in which this option cannot be exercised. Investment protection thereafter is not necessary since exercise of the American call option is then possible and the option holder can freely act according to his/her individual risk appetite. Note that the above outlined way of setting the European put strike accounts for interest (at the prevailing Swiss risk-free rate) on the initial investment.

American Call Option with Investment Protection. Investment protection with the above outlined European put strategy is the cheapest possible hedge for the underlying American forward-start call option. Any other hedge with traded securities would not perform as well and because of the short-term nature of these hedging instruments also be more expensive. The question now is, whether the same investment protection could be achieved at a still lower price. ***One way of doing this would be to build the investment protection property into the American forward-start call option itself***[2]. This means that the modified American call option would at least pay the initial investment (plus interest as above) after 3.5 years if "things went wrong" during this initial time period in which it cannot be exercised, while preserving the leverage of an ordinary American call option thereafter. As above, investment protection after 3.5 years (period 42) is not necessary because the option holder can then freely exercise according to his/her individual preferences for risk. In the base value case the relevant characteristics of this built-in investment protection mechanism for the American forward-start call option are:

Price		
Exercise Price	Ordinary Call	Protected Call
818.0000	471.6676	643.8323
918.0000	411.0477	573.8679
1018.0000	357.1319	509.5810
1118.0000	309.0213	451.6187
1218.0000	265.2864	397.2898
1318.0000	230.0401	350.6229
1418.0000	197.3261	306.5901
1518.0000	170.2104	268.3005
1618.0000	145.8353	233.2376
1718.0000	125.9338	204.1941

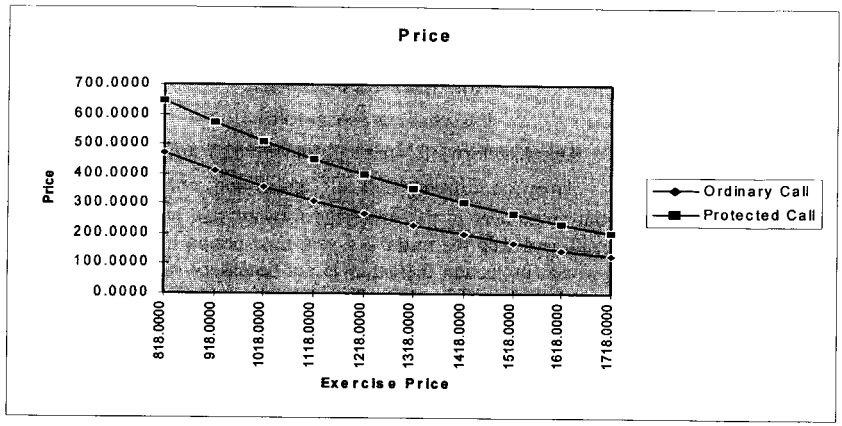
[2] A 5 year maturity American call option starting 3.5 years from now is characterized by the boundary conditions

$$L(t,S) = \max(S - X, 0), \; 3.5 \le t \le 5$$
$$F(S) = \max(S - X, 0).$$

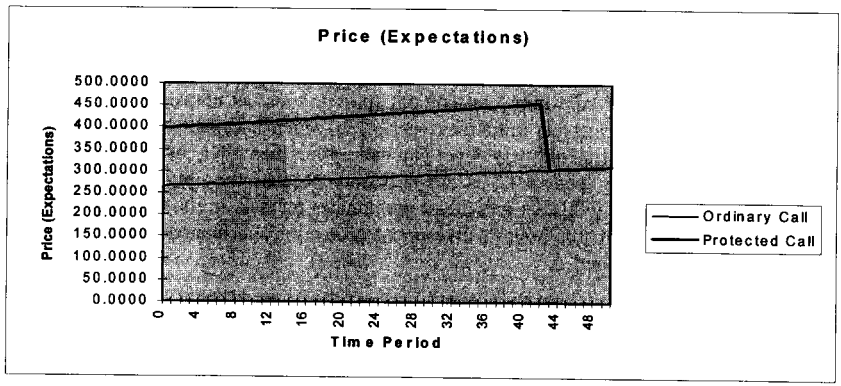
A corresponding protected (by an amount $P > 0$) call has the slightly more complicated characterization

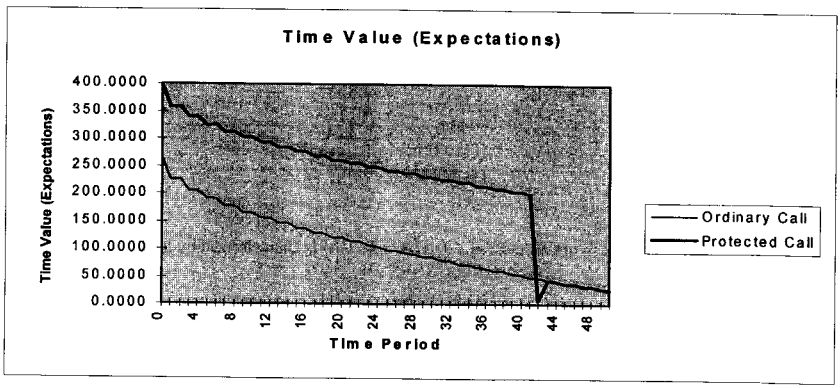
$$L(3.5,S) = \max(S - X, P)$$
$$L(t,S) = \max(S - X, 0), \; 3.5 < t \le 5$$
$$F(S) = \max(S - X, 0).$$

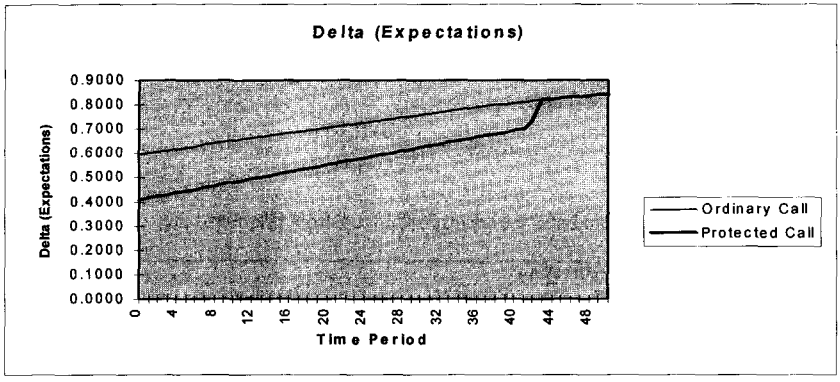
For more details, see ***Part I: Compound Option Structures***.

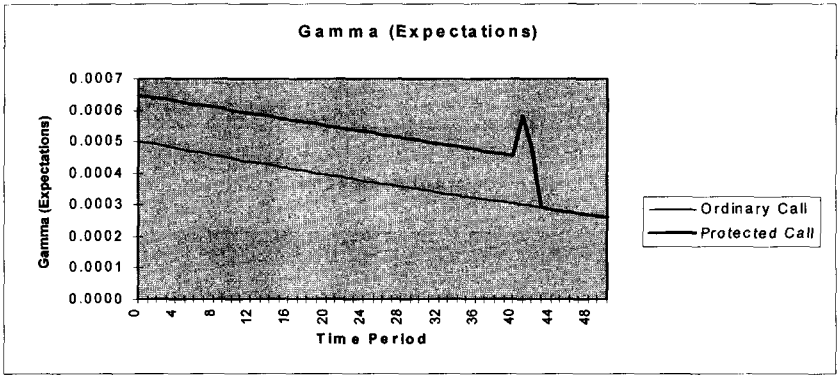


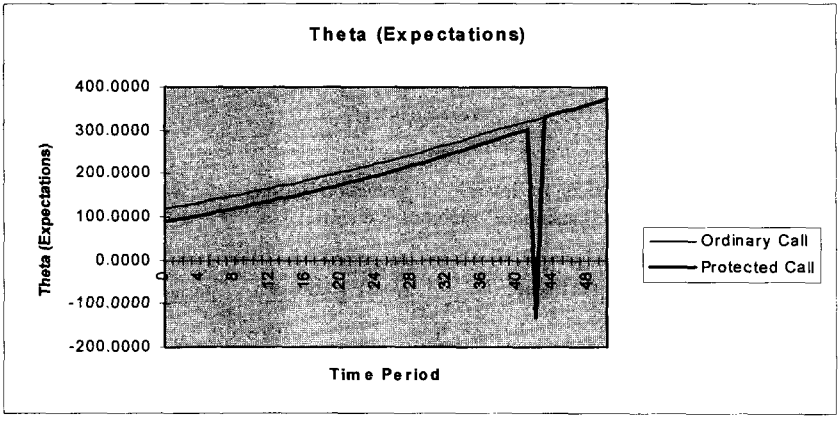
Example - Strike at CHF 1218.00:











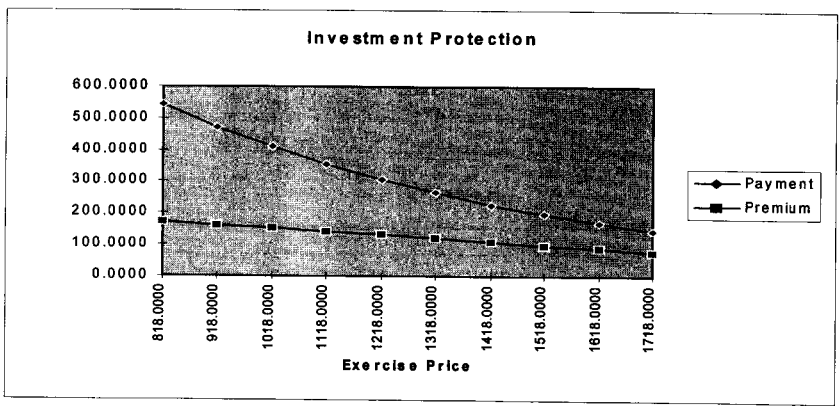
Note that the first order risk exposure (delta, theta) of the protected call is smaller than the corresponding exposure of the ordinary call. In the case of the second order risk exposure (gamma) we have the opposite situation. The same holds for the other scenarios (i.e., the

minimum and maximum premium cases). Recall from ***Part I: Compound Option Structures*** that the sensitivities delta, gamma and theta are stochastic quantities: conditionally expected rates of change of the option value with respect to changes in the price of the Swiss Re registered share (RUKN) and time, e.g.,

$$\delta(t,S) = E_{tS}\left[\frac{\Delta v(t,S)}{\Delta S(t)}\right].$$

The actual protection offered and the corresponding up-front premiums are

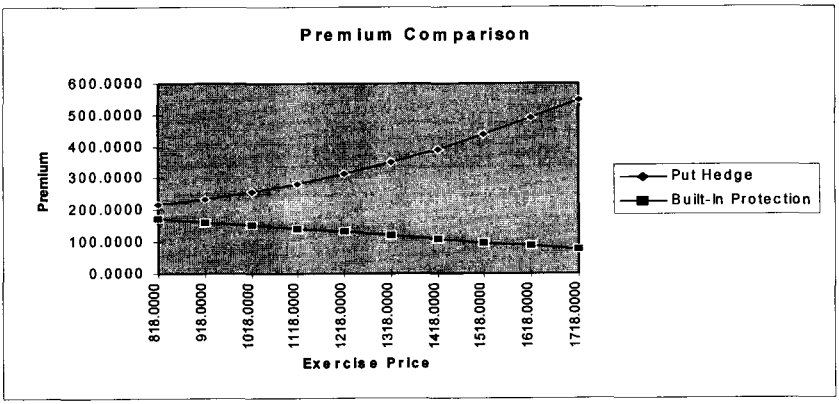
Investment Protection		
Exercise Price	Payment	Premium
818.0000	542.5469	172.1647
918.0000	472.8174	162.8201
1018.0000	410.7994	152.4491
1118.0000	355.4591	142.5974
1218.0000	305.1520	132.0034
1318.0000	264.6090	120.5828
1418.0000	226.9790	109.2641
1518.0000	195.7886	98.0901
1618.0000	167.7506	87.4022
1718.0000	144.8583	78.2603

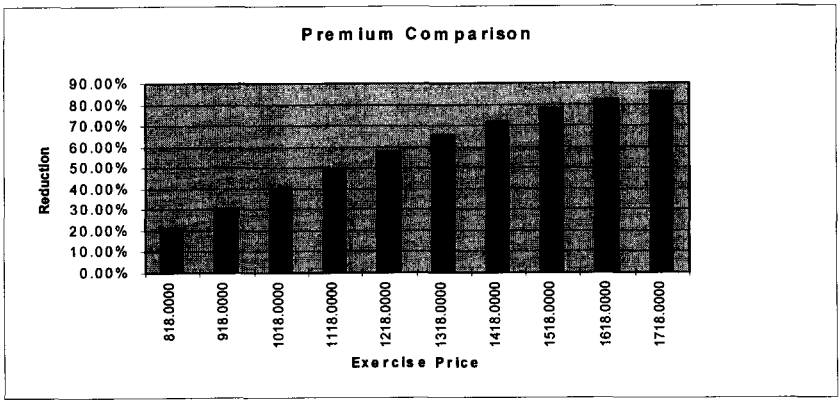


which means that by building the investment protection into the American forward-start call itself we have achieved an "insurance" premium reduction of:

Premium Comparison		Premium	
Exercise Price	Put Hedge	Built-In Protection	Reduction
818.0000	217.7135	172.1647	20.92%
918.0000	234.3056	162.8201	30.51%
1018.0000	255.8416	152.4491	40.41%
1118.0000	282.1336	142.5974	49.46%
1218.0000	312.5448	132.0034	57.76%
1318.0000	350.4116	120.5828	65.59%
1418.0000	391.7156	109.2641	72.11%
1518.0000	438.9748	98.0901	77.65%
1618.0000	490.0862	87.4022	82.17%
1718.0000	546.5327	78.2603	85.68%

Note the premium reduction of almost 60% at a strike of CHF 1218.00 and the fact that the "insurance" premium for the built-in investment protection mechanism decreases with increasing exercise prices.





In the minimum premium case we have similarly:

Price		
Exercise Price	Ordinary Call	Protected Call
818.0000	420.7499	572.8016
918.0000	356.2238	498.7270
1018.0000	299.5792	430.4981
1118.0000	250.2711	368.3359
1218.0000	207.2170	313.4917
1318.0000	173.0631	267.5286
1418.0000	143.2443	226.2267
1518.0000	117.5981	189.4079
1618.0000	97.8945	159.7517
1718.0000	79.4943	132.1452

Investment Protection		
Exercise Price	Payment	Premium
818.0000	467.3314	152.0517
918.0000	395.6616	142.5031
1018.0000	332.7458	130.9189
1118.0000	277.9788	118.0648
1218.0000	230.1581	106.2747
1318.0000	192.2230	94.4655
1418.0000	159.1030	82.9824
1518.0000	130.6175	71.8098
1618.0000	108.7325	61.8572
1718.0000	88.2951	52.6509

Premium Comparison		Premium	
Exercise Price	Put Hedge	Built-In Protection	Reduction
818.0000	188.3005	152.0517	19.25%
918.0000	204.0990	142.5031	30.18%
1018.0000	225.6137	130.9189	41.97%
1118.0000	253.0685	118.0648	53.35%
1218.0000	286.2792	106.2747	62.88%
1318.0000	327.7407	94.4655	71.18%
1418.0000	374.5497	82.9824	77.84%
1518.0000	426.7470	71.8098	83.17%
1618.0000	485.9423	61.8572	87.27%
1718.0000	548.2166	52.6509	90.40%

Finally, in the maximum premium case the corresponding characteristics of the American forward-start call option with built-in investment protection are:

Price		
Exercise Price	Ordinary Call	Protected Call
818.0000	526.1541	719.6255
918.0000	467.9785	654.7781
1018.0000	416.4205	594.8212
1118.0000	369.8777	538.8397
1218.0000	326.1366	485.0842
1318.0000	290.4157	438.3354
1418.0000	255.5095	392.4130
1518.0000	227.5985	353.4746
1618.0000	199.6965	314.9211
1718.0000	178.2402	284.6280

Investment Protection		
Exercise Price	Payment	Premium
818.0000	626.7791	193.4714
918.0000	557.4776	186.7996
1018.0000	496.0594	178.4007
1118.0000	440.6154	168.9621
1218.0000	388.5090	158.9476
1318.0000	345.9566	147.9198
1418.0000	304.3747	136.9035
1518.0000	271.1259	125.8761
1618.0000	237.8877	115.2246
1718.0000	212.3279	106.3878

Premium Comparison		Premium	
Exercise Price	Put Hedge	Built-In Protection	Reduction
818.0000	250.4933	193.4714	22.76%
918.0000	267.0667	186.7996	30.06%
1018.0000	288.4951	178.4007	38.16%
1118.0000	314.0329	168.9621	46.20%
1218.0000	342.3770	158.9476	53.58%
1318.0000	377.5158	147.9198	60.82%
1418.0000	414.4296	136.9035	66.97%
1518.0000	457.9438	125.8761	72.51%
1618.0000	502.7591	115.2246	77.08%
1718.0000	554.1010	106.3878	80.80%

The striking fact about the American forward-start call with investment protection however is that it can be argued that its "real" price is only the "insurance" premium since the ordinary call part of the option value is paid back with interest after 3.5 years upon the option holder's choice to exercise (compare this "real" price with the price of a 3.5 year maturity European call option with the same exercise price):

Price			
Exercise Price	Ordinary Call	Protected Call	3.5 Y European Call
818.0000	471.6676	172.1647	449.5187
918.0000	411.0477	162.8201	382.0431
1018.0000	357.1319	152.4491	321.8947
1118.0000	309.0213	142.5974	269.2352
1218.0000	265.2864	132.0034	223.8283
1318.0000	230.0401	120.5828	185.1650
1418.0000	197.3261	109.2641	152.5812
1518.0000	170.2104	98.0901	125.3488
1618.0000	145.8353	87.4022	102.7404
1718.0000	125.9338	78.2603	84.0695
Base Value:	volatility = 22.5%	dividend yield = 2%	interest rate = 4%

N.B.: The relevant payoff pattern in period 42 (3.5 years) is

$$\text{American Protected Call} \qquad \text{European Call Option}$$
$$\max[SP - EP, PA] \qquad \max[SP - EP, 0]$$

SP stock price EP exercise price PA payment amount

if the option holder chooses to exercise the American protected call.

Price			
Exercise Price	Ordinary Call	Protected Call	3.5 Y European Call
818.0000	420.7499	152.0517	405.5558
918.0000	356.2238	142.5031	335.3206
1018.0000	299.5792	130.9189	273.6252
1118.0000	250.2711	118.0648	220.7517
1218.0000	207.2170	106.2747	176.3883
1318.0000	173.0631	94.4655	139.8193
1418.0000	143.2443	82.9824	110.1135
1518.0000	117.5981	71.8098	86.2692
1618.0000	97.8945	61.8572	67.3132
1718.0000	79.4943	52.6509	52.3593
Minimum Premium:	volatility = 20%	dividend yield = 2.4%	interest rate = 3%

Price			
Exercise Price	Ordinary Call	Protected Call	3.5 Y European Call
818.0000	526.1541	193.4714	492.7468
918.0000	467.9785	186.7996	427.9802
1018.0000	416.4205	178.4007	369.5976
1118.0000	369.8777	168.9621	317.6726
1218.0000	326.1366	158.9476	272.0035
1318.0000	290.4157	147.9198	232.2015
1418.0000	255.5095	136.9035	197.7676
1518.0000	227.5985	125.8761	168.1531
1618.0000	199.6965	115.2246	142.8018
1718.0000	178.2402	106.3878	121.1792
Maximum Premium:	volatility = 25%	dividend yield = 1.6%	interest rate = 5%

European Call Compound Option with Investment Protection. We showed in ***Part I: Compound Option Structures*** that a 3.5 year European call (compound) option

European Call (Compound) Option			
	Strike Underlying	Exercise Price	Option Price
	818.0000	542.5469	172.1647
	918.0000	472.8174	162.8202
Base Value:	1018.0000	410.7994	152.4491
volatility = 22.5%	1118.0000	355.4591	142.5974
dividend yield = 2%	1218.0000	305.1520	132.0034
interest rate = 4%	1318.0000	264.6090	120.5828
	1418.0000	226.9790	109.2641
	1518.0000	195.7886	98.0901
	1618.0000	167.7506	87.4022
	1718.0000	144.8583	78.2604

European Call (Compound) Option			
	Strike Underlying	Exercise Price	Option Price
	818.0000	467.3314	152.0517
	918.0000	395.6616	142.5031
Minimum Premium:	1018.0000	332.7458	130.9189
volatility = 20%	1118.0000	277.9788	118.0648
dividend yield = 2.4%	1218.0000	230.1581	106.2747
interest rate = 3%	1318.0000	192.2230	94.4655
	1418.0000	159.1030	82.9824
	1518.0000	130.6175	71.8098
	1618.0000	108.7325	61.8572
	1718.0000	88.2951	52.6509

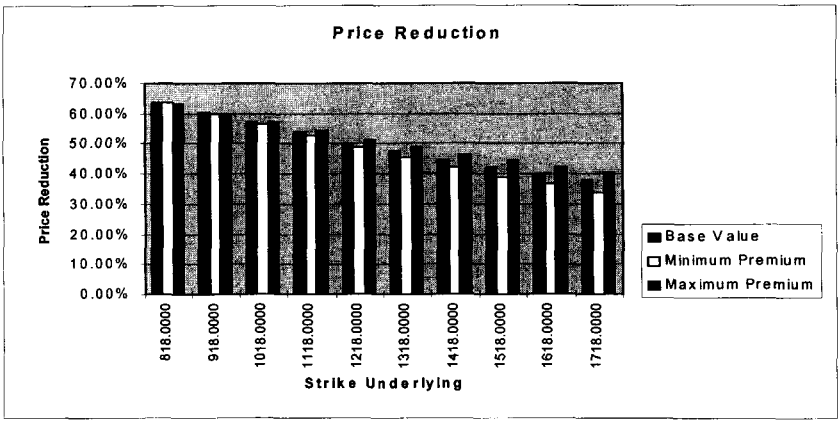
European Call (Compound) Option			
	Strike Underlying	Exercise Price	Option Price
	818.0000	626.7791	193.4714
	918.0000	557.4776	186.7996
Maximum Premium:	1018.0000	496.0594	178.4007
volatility = 25%	1118.0000	440.6540	168.9514
dividend yield = 1.6%	1218.0000	388.5090	158.9476
interest rate = 5%	1318.0000	345.9566	147.9197
	1418.0000	304.3747	136.9035
	1518.0000	271.1259	125.8761
	1618.0000	237.8877	115.2246
	1718.0000	212.3279	106.3878

on the basic 5 year maturity American forward-start call option

American Call Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	471.6676	420.7499	526.1541
918.0000	411.0477	356.2238	467.9785
1018.0000	357.1319	299.5792	416.4205
1118.0000	309.0213	250.2711	369.8777
1218.0000	265.2864	207.2170	326.1366
1318.0000	230.0401	173.0631	290.4157
1418.0000	197.3261	143.2443	255.5095
1518.0000	170.2104	117.5981	227.5985
1618.0000	145.8353	97.8945	199.6965
1718.0000	125.9338	79.4943	178.2402
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%

(standard "Mitarbeiter-Option" starting in 3.5 years time) with the exercise price set equal to the expected value of this underlying American call option in 3.5 years time reduces the price payable for a "Mitarbeiter-Option" in the following way:

Price Reduction			
Strike Underlying	Base Value	Minimum Premium	Maximum Premium
818.0000	63.50%	63.86%	63.23%
918.0000	60.39%	60.00%	60.08%
1018.0000	57.31%	56.30%	57.16%
1118.0000	53.86%	52.83%	54.32%
1218.0000	50.24%	48.71%	51.26%
1318.0000	47.58%	45.42%	49.07%
1418.0000	44.63%	42.07%	46.42%
1518.0000	42.37%	38.94%	44.69%
1618.0000	40.07%	36.81%	42.30%
1718.0000	37.86%	33.77%	40.31%
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%



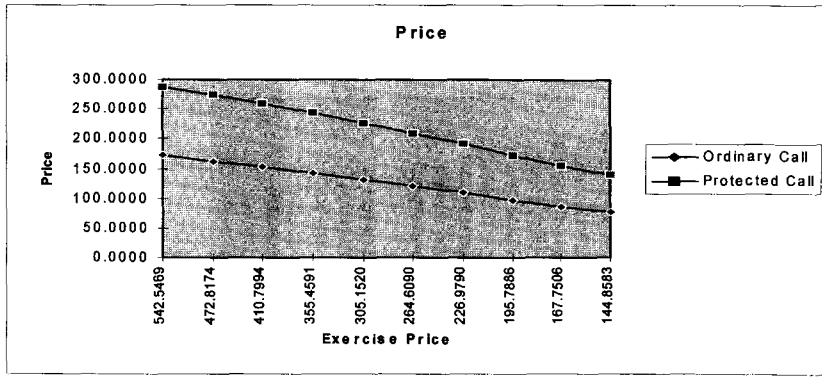
Note the 50% reduction at a strike of CHF 1218.00 (i.e., the current value of RUKN as of 18 October 1995). Of course, a potential holder of such a compound "Mitarbeiter-Option" structure can increase (decrease) the associated leverage by setting its strike above (below) the American call value expectation according to his/her individual preferences for risk. Setting the European call exercise price above (below) the underlying American call value expectation decreases (increases) the compound "Mitarbeiter-Option" price. In fact, in ***Part III: A Note on the Implementation*** we shall set the European call strike price below the expected value of the underlying (fully protected) American forward-start call option in 3.5 years time in such a way that the associated pay-off to the option holder (employee) is still significant. This compound "Mitarbeiter-Option" structure can now be re-engineered in a way similar to the American call option with investment protection above. The resulting European call (compound) option with investment protection would then at least pay the initial investment (plus interest at the Swiss risk-free rate) at maturity if "things went wrong" during this 3.5 year time period, while however preserving the leverage of an ordinary European call option. The relevant payoff pattern in period 42 (3.5 years) is

$$\max[AC - EP, PA]$$

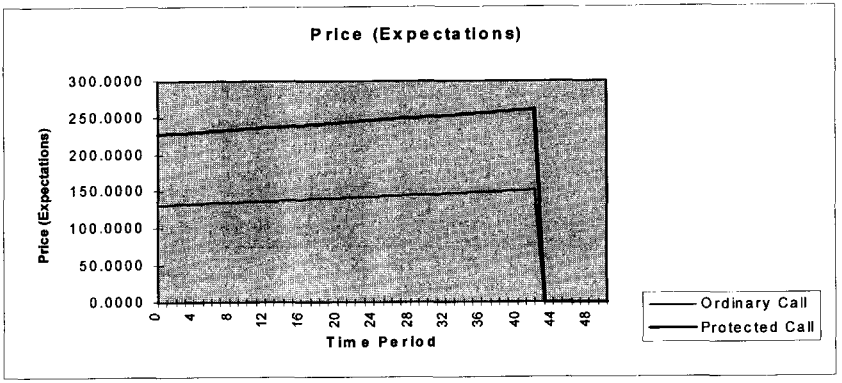
AC American call value EP exercise price PA payment amount

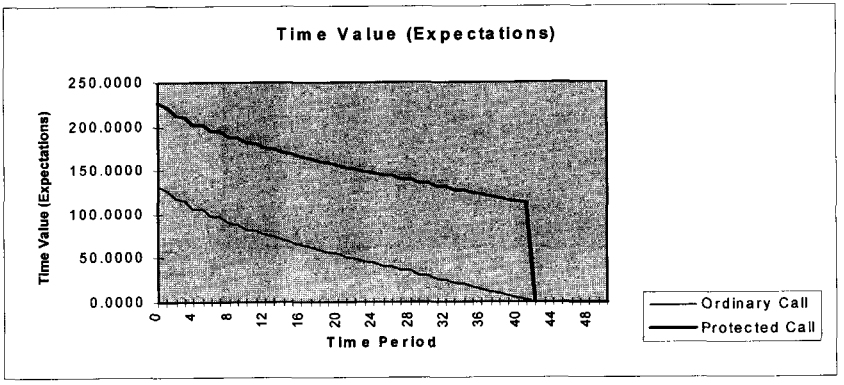
and the resulting options investment characteristics are in the base value case:

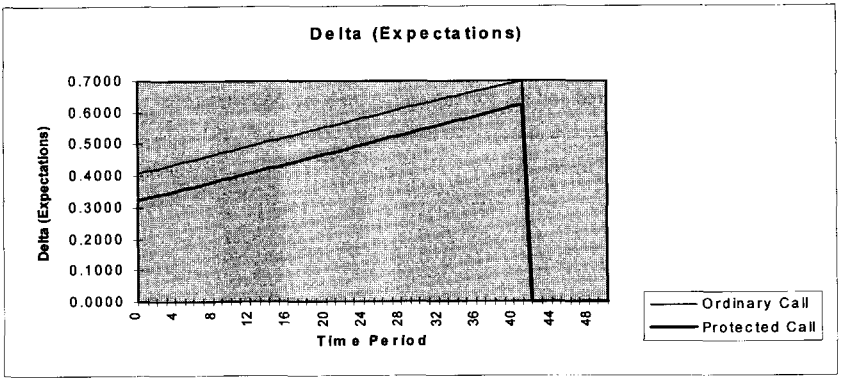
Price			
Strike Underlying	Exercise Price	Ordinary Call	Protected Call
818.0000	542.5469	172.1647	288.0318
918.0000	472.8174	162.8202	274.2386
1018.0000	410.7994	152.4491	258.6656
1118.0000	355.4591	142.5974	243.6570
1218.0000	305.1520	132.0034	227.4302
1318.0000	264.6090	120.5828	209.5456
1418.0000	226.9790	109.2641	191.6715
1518.0000	195.7886	98.0901	173.6605
1618.0000	167.7506	87.4022	156.2246
1718.0000	144.8583	78.2604	140.2992

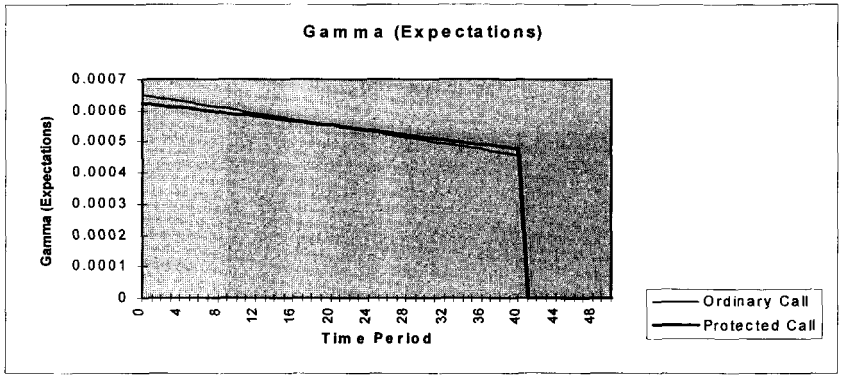


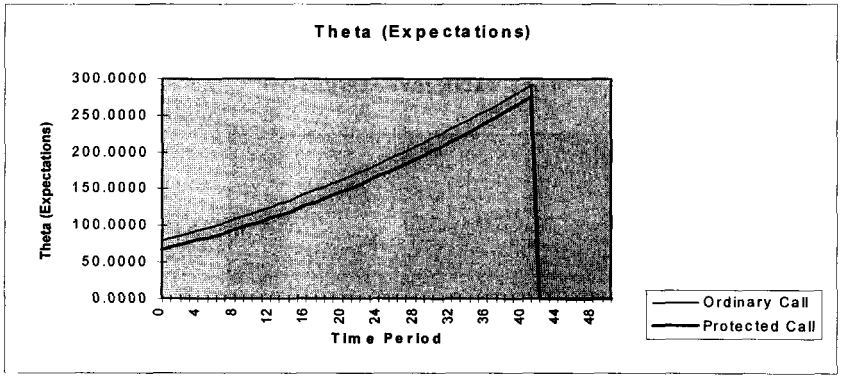
Example - Strikes at CHF 1218.00 / 305.15:







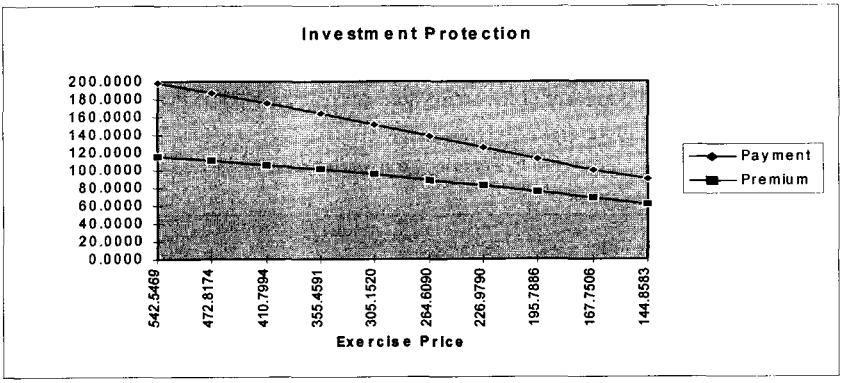




Note that in terms of the options risk dynamics (as expressed by the stochastic sensitivities delta, gamma and theta) the protected European call (compound) option has a very favourable profile. This is also true in the other scenarios and corresponds to the situation above where we built an investment protection capability into a standard "Mitarbeiter-Option".

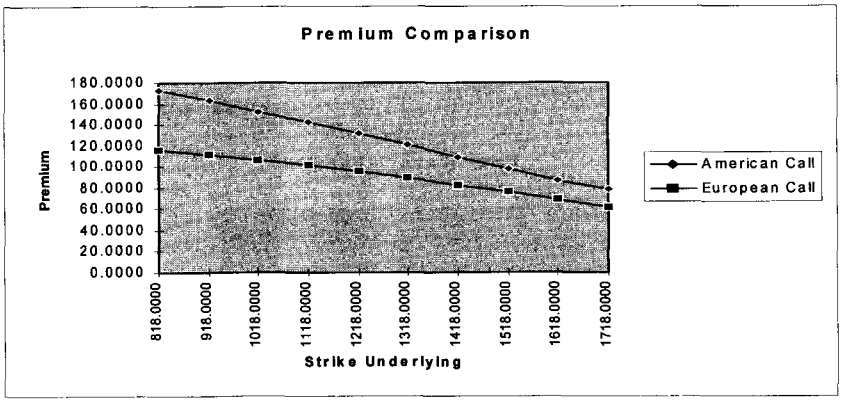
The actual protection offered and the corresponding up-front premiums are

Investment Protection			
Strike Underlying	Exercise Price	Payment	Premium
818.0000	542.5469	198.0366	115.8671
918.0000	472.8174	187.2878	111.4184
1018.0000	410.7994	175.3582	106.2165
1118.0000	355.4591	164.0260	101.0596
1218.0000	305.1520	151.8400	95.4268
1318.0000	264.6090	138.7033	88.9628
1418.0000	226.9790	125.6836	82.4074
1518.0000	195.7886	112.8305	75.5704
1618.0000	167.7506	100.5365	68.8224
1718.0000	144.8583	90.0208	62.0388



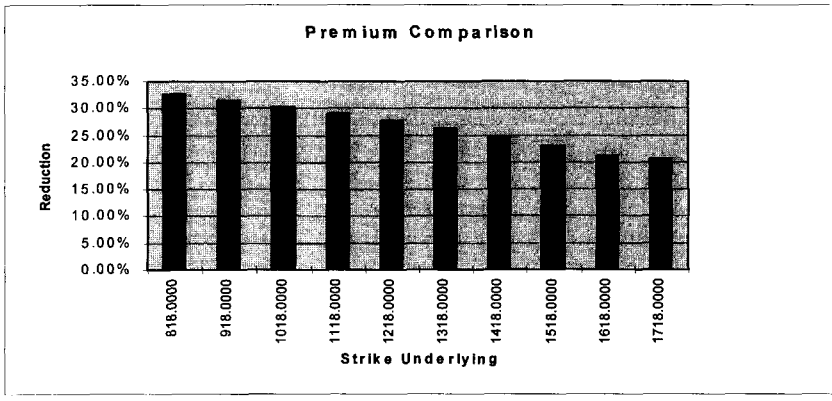
which means that by building the investment protection into the European call (compound) option instead of into the underlying American forward-start call option itself we have achieved a further "insurance" premium reduction of:

Premium Comparison		Premium	
Strike Underlying	American Call	European Call	Reduction
818.0000	172.1647	115.8671	32.70%
918.0000	162.8201	111.4184	31.57%
1018.0000	152.4491	106.2165	30.33%
1118.0000	142.5974	101.0596	29.13%
1218.0000	132.0034	95.4268	27.71%
1318.0000	120.5828	88.9628	26.22%
1418.0000	109.2641	82.4074	24.58%
1518.0000	98.0901	75.5704	22.96%
1618.0000	87.4022	68.8224	21.26%
1718.0000	78.2603	62.0388	20.73%



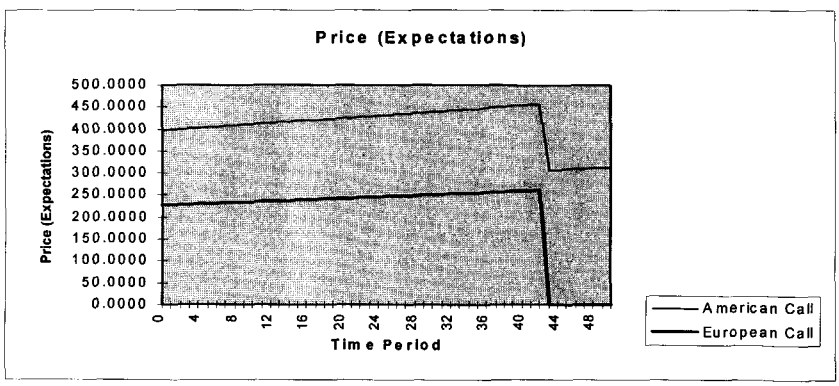
With both compared investments, if "things go well" during the initial time period of 3.5 years in which the options cannot be exercised, the option holder has an American call option with 1.5 years remaining to maturity in his/her portfolio. The initial investments are of course

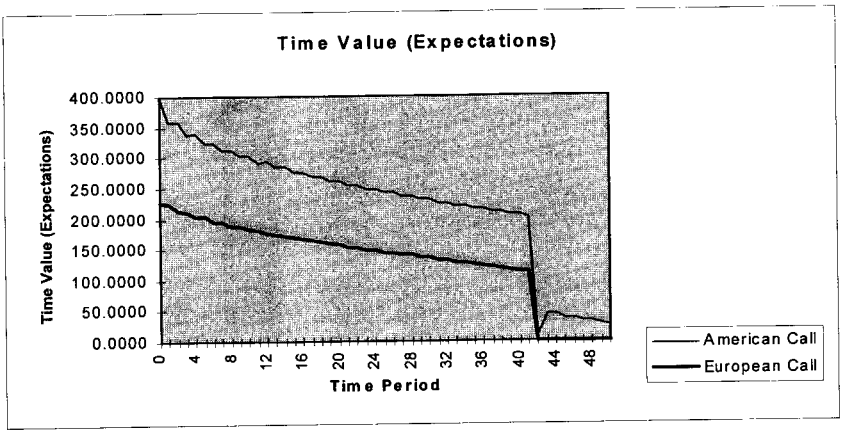
different due to the fact that the second investment opportunity is of the compound option type. The leverage in the case of a compound "Mitarbeiter-Option" structure with investment protection is higher. If "things go wrong" during the initial time period of 3.5 years, then in both cases the initial investment of the option holder is paid back with interest.

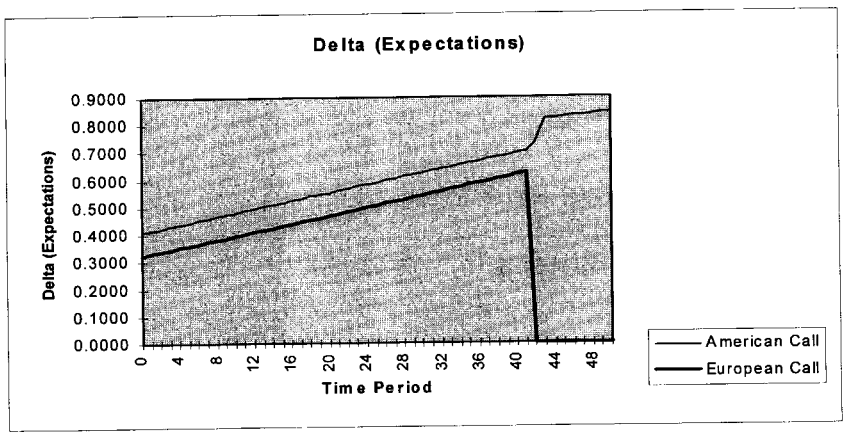


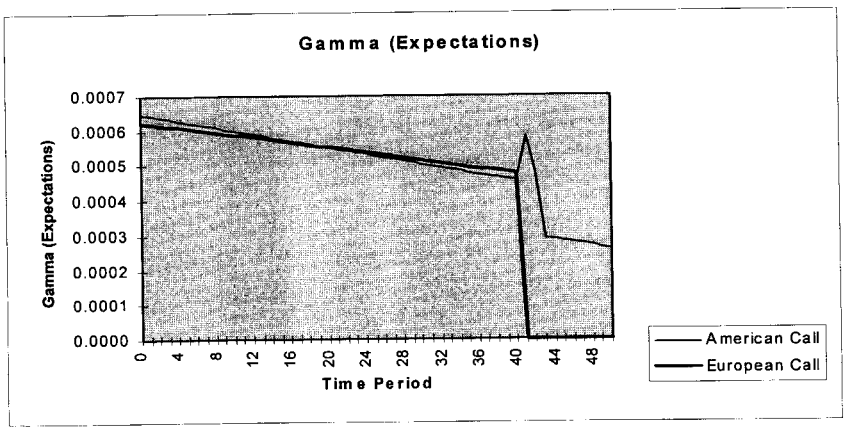
Note the premium reduction of almost 30% at a strike of CHF 1218.00 and the fact that the "insurance" premiums for the built-in investment protection decrease with increasing exercise prices. In the above comparison of the two prossible "Mitarbeiter-Option" concepts with built-in investment protection it was noted that the leverage of the European call (compound) option was higher than that of the originally proposed American forward-start call option. We are now going to also have a look at the option risk exposure dynamics as expressed by the stochastic sensitivities delta, gamma and theta (conditionally expected rates of change in the option value with respect to a change in the price of the underlying Swiss Re registered share and time) in the AM Basic Lattice Model. Such a risk exposure analysis should always be carried out because of the long-term nature of the proposed option structures as it gives an indication of the associated value dynamics (upside/downside potential).

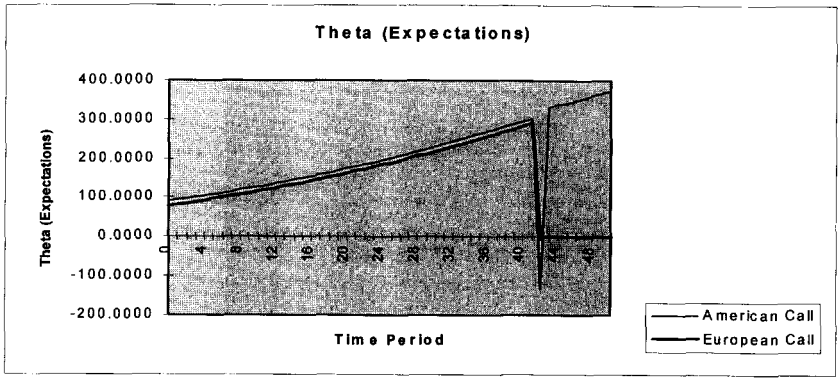
Example - Strikes at CHF 1218.00 / 305.15:




Time Value (Expectations)
Time Value (Expectations)
400.0000
350.0000
300.0000
250.0000
200.0000
150.0000
100.0000
50.0000
0.0000
0
4
8
12
16
20
24
28
32
36
40
44
48
Time Period
American Call
European Call


Delta (Expectations)
Delta (Expectations)
0.9000
0.8000
0.7000
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
0
4
8
12
16
20
24
28
32
36
40
44
48
Time Period
American Call
European Call


Gamma (Expectations)
Gamma (Expectations)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
4
8
12
16
20
24
28
32
36
40
44
48
Time Period
American Call
European Call



Note that in terms of these options risk dynamics the protected European call (compound) option has a very favourable profile: first order risk exposure (delta, theta) of the European compound call is smaller than the corresponding first order risk exposure of the American forward-start call option, while the respective second order risk exposures (gamma) are the same. This favourable risk profile of the protected "Mitarbeiter-Option" of the European call (compound) type can also be observed in the other scenarios (i.e., the minimum and maximum premium cases).

In the minimum premium case we have similarly:

Price			
Strike Underlying	Exercise Price	Ordinary Call	Protected Call
818.0000	467.3314	152.0517	253.8998
918.0000	395.6616	142.5031	239.9432
1018.0000	332.7458	130.9189	222.5819
1118.0000	277.9788	118.0648	202.9397
1218.0000	230.1581	106.2747	183.4649
1318.0000	192.2230	94.4655	164.7842
1418.0000	159.1030	82.9824	146.3541
1518.0000	130.6175	71.8098	128.1682
1618.0000	108.7325	61.8572	111.5116
1718.0000	88.2951	52.6509	95.6484

Investment Protection			
Strike Underlying	Exercise Price	Payment	Premium
818.0000	467.3314	168.8854	101.8481
918.0000	395.6616	158.2797	97.4400
1018.0000	332.7458	145.4130	91.6630
1118.0000	277.9788	131.1358	84.8750
1218.0000	230.1581	118.0404	77.1902
1318.0000	192.2230	104.9239	70.3187
1418.0000	159.1030	92.1694	63.3717
1518.0000	130.6175	79.7599	56.3584
1618.0000	108.7325	68.7055	49.6544
1718.0000	88.2951	58.4800	42.9974

Premium Comparison		Premium	
Strike Underlying	American Call	European Call	Reduction
818.0000	152.0517	101.8481	33.02%
918.0000	142.5031	97.4400	31.62%
1018.0000	130.9189	91.6630	29.98%
1118.0000	118.0648	84.8750	28.11%
1218.0000	106.2747	77.1902	27.37%
1318.0000	94.4655	70.3187	25.56%
1418.0000	82.9824	63.3717	23.63%
1518.0000	71.8098	56.3584	21.52%
1618.0000	61.8572	49.6544	19.73%
1718.0000	52.6509	42.9974	18.33%

Finally, in the maximum premium case the corresponding characteristics of the European call (compound) option with built-in investment protection are:

Price			
Strike Underlying	Exercise Price	Ordinary Call	Protected Call
818.0000	626.7791	193.4714	325.5992
918.0000	557.4776	186.7996	315.6611
1018.0000	496.0594	178.4007	303.0954
1118.0000	440.6540	168.9514	288.8262
1218.0000	388.5090	158.9476	273.6548
1318.0000	345.9566	147.9197	256.5341
1418.0000	304.3747	136.9035	239.3821
1518.0000	271.1259	125.8761	221.7367
1618.0000	237.8877	115.2246	204.3892
1718.0000	212.3279	106.3878	188.7142

Investment Protection			
Strike Underlying	Exercise Price	Payment	Premium
818.0000	626.7791	230.4721	132.1278
918.0000	557.4776	222.5243	128.8615
1018.0000	496.0594	212.5191	124.6947
1118.0000	440.6540	201.2627	119.8748
1218.0000	388.5090	189.3458	114.7072
1318.0000	345.9566	176.2088	108.6143
1418.0000	304.3747	163.0858	102.4786
1518.0000	271.1259	149.9494	95.8606
1618.0000	237.8877	137.2609	89.1646
1718.0000	212.3279	126.7341	82.3264

Premium Comparison		Premium	
Strike Underlying	American Call	European Call	Reduction
818.0000	193.4714	132.1278	31.71%
918.0000	186.7996	128.8615	31.02%
1018.0000	178.4007	124.6947	30.10%
1118.0000	168.9621	119.8748	29.05%
1218.0000	158.9476	114.7072	27.83%
1318.0000	147.9198	108.6143	26.57%
1418.0000	136.9035	102.4786	25.15%
1518.0000	125.8761	95.8606	23.85%
1618.0000	115.2246	89.1646	22.62%
1718.0000	106.3878	82.3264	22.62%

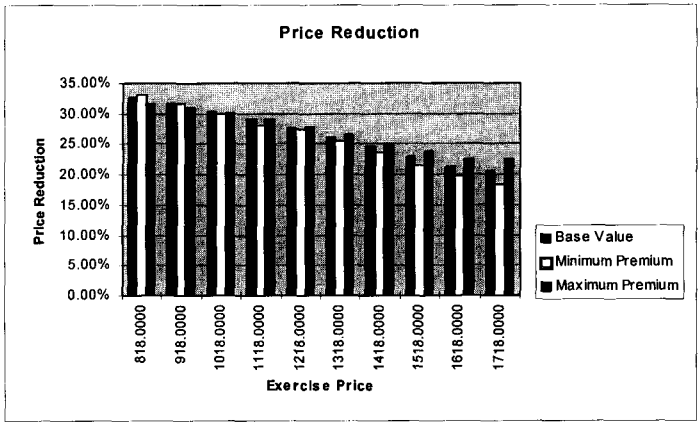
The striking fact about the American forward-start call option and the European call (compound) option with investment protection is however, as mentioned above, that it can be

argued that their "real" prices are only the corresponding "insurance" premiums since the ordinary call parts of the option values are paid back with interest after 3.5 years upon the option holder's choice to exercise. With this remarkable fact in mind the two most favourable "Mitarbeiter-Option" concepts so far are consequently:

American Call Option		Option Price	
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	172.1647	152.0517	193.4714
918.0000	162.8201	142.5031	186.7996
1018.0000	152.4491	130.9189	178.4007
1118.0000	142.5974	118.0648	168.9621
1218.0000	132.0034	106.2747	158.9476
1318.0000	120.5828	94.4655	147.9198
1418.0000	109.2641	82.9824	136.9035
1518.0000	98.0901	71.8098	125.8761
1618.0000	87.4022	61.8572	115.2246
1718.0000	78.2603	52.6509	106.3878
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%

European Call (Compound) Option		Option Price	
Strike Underlying	Base Value	Minimum Premium	Maximum Premium
818.0000	115.8671	101.8481	132.1278
918.0000	111.4184	97.4400	128.8615
1018.0000	106.2165	91.6630	124.6947
1118.0000	101.0596	84.8750	119.8748
1218.0000	95.4268	77.1902	114.7072
1318.0000	88.9628	70.3187	108.6143
1418.0000	82.4074	63.3717	102.4786
1518.0000	75.5704	56.3584	95.8606
1618.0000	68.8224	49.6544	89.1646
1718.0000	62.0388	42.9974	82.3264
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%

Price Reduction			
Exercise Price	Base Value	Minimum Premium	Maximum Premium
818.0000	32.70%	33.02%	31.71%
918.0000	31.57%	31.62%	31.02%
1018.0000	30.33%	29.98%	30.10%
1118.0000	29.13%	28.11%	29.05%
1218.0000	27.71%	27.37%	27.83%
1318.0000	26.22%	25.56%	26.57%
1418.0000	24.58%	23.63%	25.15%
1518.0000	22.96%	21.52%	23.85%
1618.0000	21.26%	19.73%	22.62%
1718.0000	20.73%	18.33%	22.62%
	Base Value:	*Minimum Premium:*	*Maximum Premium:*
	volatility = 22.5%	volatility = 20%	volatility = 25%
	dividend yield = 2%	dividend yield = 2.4%	dividend yield = 1.6%
	interest rate = 4%	interest rate = 3%	interest rate = 5%



Note the option premium reduction of almost 30% at the strike of CHF 1218.00.