12. Risk Management. Hedging and Speculation. Gap Management

Problem 69

The spot foreign exchange rate was 4,0 PLN/USD yesterday.
The current exchange rate is 4,2 PLN/USD.
(a) Calculate the appreciation rate for the dollar.
(b) Calculate the depreciation rate for the zloty.
(c) Calculate the continuously compounded appreciation rate for the dollar.
(d) Calculate the continuously compounded depreciation rate for the zloty.

Solution

(a)

$S_0 =$ 4 PLN/USD

$S_1 =$ 4,2 PLN/USD

The appreciation rate for the dollar is

5%

(b)

$1/S_0 =$ 0,2500 USD/PLN

$1/S_1 =$ 0,2381 USD/PLN

The depreciation rate for the zloty is

$$r_f = \frac{-r_d}{1+r_d} = -4{,}8\%$$

(c)

The continuously componded appreciation rate for the dollar is

ln(4,2 : 4,0) = 4,879%

(d)

The continuously componded depreciation rate for the zloty is

ln(0,2381 : 0,2500) = -4,879%

Problem 70

Suppose you hold a $25 million position and current spot exchange rate is 4 PLN/USD.
Expected return over a 1-day horizon period is equal to 0.
Expected volatility is equal to 1%.
(a) What is the current market value of this position. What is the forecasted value ?
(b) Make a forecast of the 1-day return on the portfolio, such that there is 5% chance that the realized return will be less than forecasted return.
(c) Calulate the portfolio's "worst case" value based on the forecasted rate (b).
(d) Calculate VAR.
(e) Calculate VaR using simple approximation.

Solution

(a)
The current mark-to-market value is 100 million zloties.
The forecasted future value V_1 is $V_1 = V_0 e^r$

(b)
We assume that the ralized return will be less than the forecasted return with a 5% probability.

$$P(r < \hat{r}) = 5\%$$

$$P(r < -1{,}65\sigma_{1|0} + \mu_{1|0}) = 5\%$$

We assume that the expected return over a 1 day horizon is equal to 0.

$$\mu_{1|0} = 0$$

The forecasted return is

$\hat{r} = -1{,}65\sigma_{1|0}$ = -1,645%

(c)
The portfolio "worst case" value is

$\hat{V}_1 = V_0 e^{\hat{r}}$ = 98,369 million zloties

(d)
The Value at Risk is

$\text{VaR} = V_0 - \hat{V}_1 = V_0(1 - e^{\hat{r}})$ = 1,631 million zloties

(e)
VaR is approximately equal to

$\alpha/2$	t	t σ	V_0	VaR = t σ V_0
5,00%	1,645	0,01645	100	1,645 million zloties

Problem 71

Consider a Eurobond with an annual coupon that pays $1000 in 5 years.
<u>Required</u>
(a) Calculate the duration and the modified of the bonds with following characteristics:
I. Coupon 10% and YTM 10%.
II. Coupon 10% and YTM 15%.
III. Coupon 10% and YTM 5%.
(b) Show the sensitivity analysis of the modified duration on changes in coupon rate and YTM in the range 2-20%.

Solution

(a)

Coupon rate		10%	YTM		10%
Year	Cash Flow	Disc. factor	DCF	Weight	Year * Weight
1	100	0,9091	90,91	0,0909	0,0909
2	100	0,8264	82,64	0,0826	0,1653
3	100	0,7513	75,13	0,0751	0,2254
4	100	0,6830	68,30	0,0683	0,2732
5	1100	0,6209	683,01	0,6830	3,4151
			1000,00	1,0000	4,1699

Duration is 4,17 years.
Modified duration is 4,17 * 1/(1+10%) = 3,79.

Coupon rate		10%	YTM		15%
Year	Cash Flow	Disc. factor	DCF	Weight	Year * Weight
1	100	0,8696	86,96	0,1045	0,1045
2	100	0,7561	75,61	0,0908	0,1817
3	100	0,6575	65,75	0,0790	0,2370
4	100	0,5718	57,18	0,0687	0,2748
5	1100	0,4972	546,89	0,6570	3,2851
			832,39	1,0000	4,0829

Duration is 4,08 years.
Modified duration is 4,08 * 1/(1+15%) = 3,55.

Coupon rate		10%	YTM		5%
Year	Cash Flow	Disc. factor	DCF	Weight	Year * Weight
1	100	0,9524	95,24	0,0783	0,0783
2	100	0,9070	90,70	0,0746	0,1491
3	100	0,8638	86,38	0,0710	0,2130
4	100	0,8227	82,27	0,0676	0,2705
5	1100	0,7835	861,88	0,7085	3,5425
			1216,47	1,0000	4,2535

Duration is 4,25 years.
Modified duration is 4,25 * 1/(1+5%) = 4,05.

(b)
Sensitivity analysis

Coupon	D
2%	4,3288
4%	4,1547
6%	4,0117
8%	3,8922
10%	3,7908
12%	3,7037
14%	3,6280
16%	3,5617
18%	3,5031
20%	3,4510

YTM	D
2%	4,2175
4%	4,1056
6%	3,9972
8%	3,8924
10%	3,7908
12%	3,6924
14%	3,5970
16%	3,5045
18%	3,4148
20%	3,3278

Problem 72

A bond is currently selling for $950 and has 15 years left to maturity and a par value of $1000.
The bond has a 10% coupon (payable annually).
(a) Calculate the YTM, the duration, the modified duration and the convexity.
(b) Calculate the impact of a +-1%, +-5% changes in interest rates on the price of the bond.
Use duration, duration and convexity approximation and the exact price using bond valuation.

Solution

(a)

Year	Cash Flow	DCF	Weight	Duration	Convexity
t	CF_t	$\frac{CF_t}{(1+i)^t}$	$\frac{CF_t}{P(1+i)^t}$	$\frac{tCF_t}{P(1+i)^t}$	$\frac{t(t+1)CF_t}{P(1+i)^{t+2}}$
0	-950				
1	100	90,35	0,0951	0,0951	0,1553
2	100	81,63	0,0859	0,1718	0,4208
3	100	73,75	0,0776	0,2329	0,7604
4	100	66,63	0,0701	0,2805	1,1450
5	100	60,20	0,0634	0,3168	1,5518
6	100	54,39	0,0573	0,3435	1,9628
7	100	49,14	0,0517	0,3621	2,3644
8	100	44,40	0,0467	0,3739	2,7466
9	100	40,11	0,0422	0,3800	3,1018
10	100	36,24	0,0381	0,3815	3,4252
11	100	32,74	0,0345	0,3791	3,7135
12	100	29,58	0,0311	0,3737	3,9651
13	100	26,73	0,0281	0,3657	4,1795
14	100	24,15	0,0254	0,3558	4,3570
15	1100	239,98	0,2526	3,7891	49,4870
	YTM	P		Duration	Convexity
	10,68%	950,00	1,0000	8,2016	83,3362

Internal rate of return (YTM) is 10,68%. Duration is 8,20 years.
Modified duration is 8,20 * 1/(1+10,7%) = 7,41. Convexity is 83,34.

Ad 2.

			Relative change in price ΔP/P		
Δi	i	Market Price	$\frac{\Delta P}{P} = -D\Delta i$	$-D\Delta i + \frac{1}{2}C(\Delta i)^2$	Price Formula
-5%	5,68%	1428,07	37,05%	47,47%	50,32%
-1%	9,68%	1024,54	7,41%	7,83%	7,85%
0%	10,68%	950,00	0,00%	0,00%	0,00%
1%	11,68%	883,39	-7,41%	-6,99%	-7,01%
5%	15,68%	678,37	-37,05%	-26,63%	-28,59%