Solutions to practice questions – Study Session 14

Solution 14.1

Solving the revised equation of value for R, we have:

$$0=\frac{R-0.140271}{1.12^3}+\frac{R-0.160539}{1.13^4}+\frac{R-0.180893}{1.14^5}$$

$$1.8447R=0.29225$$

$$R=15.84\%$$

The fixed swap rate in this case is 15.84%.

Alternatively, we can use the table approach to determine this value. In this case, since we want to determine the fixed 3-year swap rate with a deferred start of two years, we sum the Column 5 values for Years 3 through 5 and divide this amount by the sum of the Column 3 values for Years 3 through 5:

$$R=\frac{0.099842+0.098462+0.093950}{0.711780+0.613319+0.519369}=\frac{0.29225}{1.84447}=15.84\%$$

We can also determine this fixed swap rate as the difference between the time-2 zero-coupon bond price and the time-5 zero-coupon bond price divided by the sum of the zero-coupon bond prices from Year 3 to Year 5:

$$R=\frac{0.811622-0.519369}{0.711780+0.613319+0.519369}=\frac{0.29225}{1.84447}=15.84\%$$

Solution 14.2

(1) Year	(2) Spot	(3) Zero-coupon Bond	(4) Forward	(3)x(4)	Swap	Net	F. Factor	Loan bal.
1	0.1	0.90909	0.10000	0.09091		0.10000		
2	0.11	0.81162	0.12009	0.09747		0.12009		
3	0.12	0.71178	0.14027	0.09984	0.15845	-0.01818	1.14027	-0.01818
4	0.13	0.61332	0.16054	0.09846	0.15845	0.00209	1.16054	-0.01901
5	0.14	0.51937	0.18089	0.09395	0.15845	0.02244	1.18089	0.00000
Totals (Years 3-5)		1.84447		0.29225				

Solution 14.3

(1) Year	(2) Spot	(3) Zero-coupon Bond	(4) Forward	(3)x(4)	Swap	Net	Expected payment	Present value
1	0.14	0.87719	0.14000	0.12281	0.15845	-0.01845	-18,449.00	-16,183.33
2	0.15	0.75614	0.16009	0.12105	0.15845	0.00164	1,638.72	1,239.11
Total								-14,944.23

The value of the swap is \$14,944.23. This represents a profit to the floating rate payer and a loss to the fixed rate payer.

Solution 14.4

The solution is as follows:

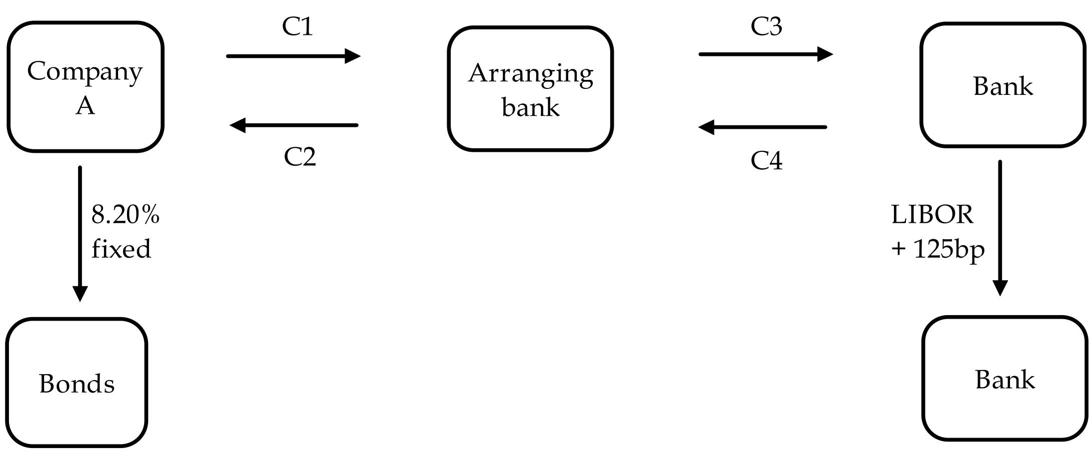
(1) Quarter	(2) Forward	(3) Principal	(2)x(3)	Present value
1	126	1	126.00000	124.13793
2	134	1.05	140.70000	136.57211
3	129	1.1025	142.22250	136.00979
4	121	1.157625	140.07263	131.97422
Total				528.69405

The present values have been calculated using an interest rate of 1.5% per quarter, for example:

$$\frac{126}{1.015} = 124.13793$$

The rate of 1.5% per quarter is equivalent to an annual effective rate of 6.1364%.

Solution 14.5



The diagram shows how the arranging bank sits between the two parties that have sought the swap. It may be that the arranging bank has acted to find counterparties with complementary comparative advantages. Alternatively the two parties may have involved the arranging bank simply to act as a counterparty to each of them and thereby provide credit protection against the default of the other party.

Since the benefit of the swap arrangement (100bp) is to be split evenly between the three parties we need to find cashflows C1, C2, C3 and C4 such that:

$$8.20\% + C1 - C2 = (LIBOR + 0.35\%) - 0.33333\%$$

$$LIBOR + 125bp + C4 - C3 = 10.10\% - 0.33333\%$$

$$C1 + C4 - C2 - C3 = 0.33333\%$$

Three equations with four unknowns means that there is no unique solution. However, note that we only need to determine the net cashflows $C1 - C2$ and $C3 - C4$ as it is these that are actually payable rather than the individual components.

Let's set $C1 = C3 = LIBOR$ (this means that the bank's profit will be expressed in terms of a difference between the fixed rates only and will create a unique solution). Then:

$$8.20\% - C2 = 0.01666\%$$

$$1.25\% + C4 = 9.76667\%$$

Giving us:

$$C2 = 8.18333\%$$

$$C4 = 8.51667\%$$

You can easily check that the net cashflows represent a profit of 0.33333% to the arranging bank and a saving of the same amount for the other two parties compared to what they could have obtained without the swap arrangement.

Note: If we hadn't fixed $C1 = C3 = LIBOR$ then we could have obtained a different set of cashflows but the net cashflow to each party would have been the same as the above.

Solution 14.6

The spot rates and implied forward rates are as shown in the table below. The table also shows the notional principal amounts on which the payments are based at the end of each year.

(1) Year	(2) Spot rates	(3) Implied forward	(4) Accreting principal	(4) Amortizing principal
1	10%	10%	–	–
2	11%	12.0091%	\$20 million	\$20 million
3	12%	14.0271%	\$40 million	\$40 million
4	13%	16.0539%	\$60 million	\$60 million
5	14%	18.0893%	\$80 million	\$80 million

So, for the accreting deferred swap, the present value of the fixed-rate payments is therefore:

$$R\left[20(1.11)^{-2} + 40(1.12)^{-3} + 60(1.13)^{-4} + 80(1.14)^{-5}\right] = 123.0523R$$

And the present value of the variable payments is:

$$0.120091 \times 20 \times (1.11)^{-2} + 0.140271 \times 40 \times (1.12)^{-3} + 0.160539 \times 60 \times (1.13)^{-4} + 0.180893 \times 80 \times (1.14)^{-5}$$

$$= 19.36676$$

Equating the two expressions, we solve for R, the swap rate for the accreting deferred swap:

$$R = \frac{19.36676}{123.0523} = 15.74\%$$

Likewise, for the amortizing deferred swap, the present value of the fixed-rate payments is:

$$R\left[80(1.11)^{-2} + 60(1.12)^{-3} + 40(1.13)^{-4} + 20(1.14)^{-5}\right] = 140.5875R$$

And the present value of the variable payments is:

$$0.120091 \times 80 \times (1.11)^{-2} + 0.140271 \times 60 \times (1.12)^{-3} + 0.160539 \times 40 \times (1.13)^{-4} + 0.180893 \times 20 \times (1.14)^{-5}$$

$$= 19.57786$$

So, the swap rate for the amortizing deferred swap is:

$$R = \frac{19.57786}{140.5875} = 13.93\%$$

The swap rate for the amortizing deferred swap is therefore lower than that for the accreting deferred swap. This is because the decreasing series of principal amounts means that the swap rate it is more heavily weighted towards the implied forward rates in the earlier years, which are lower due to the upward-sloping yield curve.

Recall that the swap rate for the level deferred swap was 14.67%.

Solution 14.7

The correct answer is E.

Statement I is true.

Statement II is true.

Statement III is true. With a prepaid swap, the buyer pays at time zero, and has no further obligation to the seller, who therefore faces no credit risk.

Solution 14.8

The correct answer is C.

Statement I is false. An interest rate swap is typically exposed to less credit risk than a bond with the same term and principal. This is because the notional principal isn't exchanged and so the credit risk relates only to net interest payments.

Statement II is false. An accreting swap is one in which the notional principal *increases* over time.

Statement III is true. The value of a swap changes over time due to its implicit borrowing/lending.