FINA 556 – Structured Products and Exotic Options

Homework One

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1. Consider a Treasury bond with a face value of $10,000, a coupon of 8% and several years to maturity. Currently this bond is selling for $9,260, and the previous coupon has just been paid. What is the forward price for delivery of this bond in 1 year? Assume that interest rates for 1 year out are flat at 9%.

   Hint: Find the sum of the present value of the cash flows: delivery price and coupons, and equate that to the current market price of the bond.

2. Suppose that the spot rate curve is flat at 6% with continuous compounding and a three-year defaultable bond with a coupon of 5% (paid semiannually) and par 100.00 sells for 90.00. How would an asset swap on the bond be structured? What is the asset swap spread that would be calculated in this situation?

   Hint: It is necessary to compute the time-0 value of the annuity stream paying $1 per annum (6 semi-annual payments during the 3-year life of the asset swap).

3. A company enters into a total return swap where it receives the return on a corporate bond paying a coupon of 5% and pays LIBOR. Explain the difference between this and a regular swap where 5% is exchanged for LIBOR. What are the potential risks faced by the total return payer? Also, explain some of the major differences between a total return swap and an asset swap.

4. Company X is based in the United Kingdom and would like to borrow $50 million at a fixed rate of interest for 5 years in US funds. Since the company is not well known in the United Kingdom, this has proved to be impossible. However, the company has been quoted 12% per annum on fixed-rate five-year sterling funds. Company Y is based in the United States and would like to borrow the equivalent of $50 million in sterling for 5 years at a fixed rate of interest. It has been unable to get a quote but has been offered US dollars at 10.5% per annum. Five-year government bonds currently yield 9.5% per annum in the United States and 10.5% in the United Kingdom. Suggest an appropriate currency swap that will net the financial intermediary 0.5% per annum.

5. "A long forward contract subject to credit risk is a combination of a short position in a no-default put and a long position in a call subject to credit risk." Explain this statement.

   Hint: Loss due to counterparty's default occurs only when the derivative is in-the-money.

6. An investor purchases a 10-year AA corporate bond that is puttable to the issuer at year 5. The puttable bond yields 7.00% pa (versus the comparable yield on conventional ten year non-puttable 10-year AA corporate bond of 7.5% pa). How do we monetize the puttable right using a swaption? Describe the nature of payoff of the swaption. What would be the option premium charged on the swaption per annum in order that it is more advantageous for the investor to own the puttable bond (which has a lower yield than that of its non-puttable counterpart)?

7. Assume that the following market conditions exist:

- 5-year AA corporate bonds with a one time call at the end of third year are trading at 8.3% pa

- 5-year AA corporate non-callable bonds are trading at 7.50% pa

- Receiver swaption at 7.50% pa is priced at a 180bps premium, where the dealer can require the investor to pay 7.5% pa and receive US$ LIBOR for Year 4 and Year 5

- 5-year AA non-callable floating rate bond yielding US$LIBOR

- 3-year and 5-year fixed-floating interest rate swaps, where the floating rate is US$LIBOR

Assume that an investor wishes to create a "synthetic" callable bond (same as the first bond listed above) using a non-callable bond (either fixed rate or floating rate) and swaps and / or swaption. Discuss various strategies that can be adopted using the instruments listed above. Describe the cash flows under different scenarios. Is it more advantageous to own the "synthetic" callable bond (make your own assumptions about the swap rates in the interest rate swaps)?

8. A differential swap may involve three currency worlds: interest payments are calculated based on the floating LIBOR of two currencies but the actual payments are denominated in a third currency. Show that this type of 3-currency differential swap can be decomposed into a portfolio of standard type of differential swaps which involve only two currency worlds.

9. Suppose that the risk-free zero-curve is flat at 6% per annum with continuous compounding. Consider a four-year plain vanilla credit default swap with annual payments on an underlying risky bond. Suppose that the recovery rate is 20% and the compensation payment is $(1-$ recovery rate$)$ times notional. The forward probabilities of default of the bond during the first year, the second year, the third year, and the fourth year are assumed $0.01, 0.015, 0.02$ and 0.025, respectively. Assume that the credit premium is paid by the Protection Seller at the end of each year (if the bond survives), and accrual premium from the last payment date to the time of default is paid when the bond defaults. If default does occur, it would take place either in mid-year or the end of the year. What is the credit default swap spread? What would the credit default spread be if the instrument were a binary credit default swap?

   Hint: The probability of survival until the end of the second year $= 100\% - (1\% + 1.5\%) = 97.5\%$, and the probability of survival until Year 1.5 is $100\% - (1.0\% + 0.5 \times 1.5\%) = 98.25\%$, and similar calculations for other survival probabilities. There are 4 swap premium payments if the bond survives throughout the life of the CDS. However, there are 8 possible dates at which the bond may default.

10. Assume that a regular CDS pays $(1-$ recovery rate$)$ of the notional while a binary CDS pays the full notional (independent of the recovery rate) upon default of the reference asset. Find the ratio of the corresponding CDS spread for the regular CDS for the two cases where the recovery rate is either 10% or 50%. Is the CDS spread of a binary CDS dependent on the recovery rate? Give an explanation to your answer.

11. Suppose that:

   (a) The yield on a 5-year risk-free bond is 7%.

   (b) The yield on a 5-year corporate bond issued by company X is 9.5%.

   (c) A 5-year credit default swap providing insurance against company X defaulting costs 150 basis points per year.

What arbitrage opportunity is there in this situation? What arbitrage opportunity would there be if the credit default spread were 300 basis points instead of 150 basis points? Give two reasons why arbitrage opportunities such as those you identify are less than perfect.