FINA 556 – Structured Products and Exotic Options

Homework Two

Spring 2010   **Course instructor:** *Prof. Y.K. Kwok*

1. (a) A convertible bond can be visualized as a put option on the underlying stock plus stock plus yield advantage. Why?
   (b) Explain why a convertible bond value is less sensitive to interest rate fluctuation compared to its non-convertible counterpart.
   (c) Explain the concept of "delayed equity financing" and the role of the forced conversion in convertible bonds.

2. Consider a convertible bond as follows:
   - par value = $1,000
   - coupon rate = 9.5%
   - market price of convertible bond = $1,000
   - conversion ratio = 37.383
   - estimated straight value of bond = $510
   - yield to maturity of straight bond = 18.7%

   We define the following terms
   - (a) market conversion price = market price of convertible bond / conversion ratio
   - (b) market conversion premium per share
     = market conversion price – current market price
   - (c) market conversion premium ratio
     = conversion premium per share / market price of common stock

   Calculate each of the following
   - (i)   conversion value
   - (ii)   market conversion price
   - (iii)   conversion premium per share
   - (iv)   conversion premium ratio
   - (v)   premium over straight bond value

   Suppose that the price of the common stock increases from $23 to $46. What will be the approximate return realized from investing in the convertible bond? Why the return on investing in the common stock directly be higher than investing in the convertible bond?

3. In the 24-month callable dual accrual cash or share security, the investor may be delivered the worst performing stock (among two stocks) at maturity. To design the structured product which may benefit the writer better, should one choose the two stocks that are more correlated (same industrial sector) or uncorrelated (different sectors / geographical regions)? Give your explanation.

4. The convertibles issued by Resorts World has a negative yield-to-maturity and two conversion price resets. Explain why these structured features facilitate the propensity of conversion by the investors.

5. Consider the Convertible Exchangeable Preferred issued by Microsoft, the terminal payoff structure is

    If $79.875 <= MSFT <= $102.24, the investor receives one share of MSFT.
    If MSFT <= $79.875, the investor receives the number of MSFT shares equivalent in value to $79.875.
    If MSFT >= $102.24, the investor receives the number of MSFT shares equivalent in value to $102.24.

    Show that the Preferred can be decomposed into one unit of stock, one put and one call. Find the respective strike price of the call and put.

6. Consider the Guaranteed Minimum Withdrawal Benefit in Variable Annuities, explain why the Guarantee can be viewed as a **zero-strike** call option. Alternatively, the Guarantee can be viewed as a put option with a random exercise time. What is the nature of this **random time**?

7. Assume that you take out a 15-year mortgage at a 10 percent interest rate and $100 principal. After one year, the interest rate on new loans is 8 percent. If you refinance, there are refinancing costs of 2 percent. Compute the immediate gain from refinancing. Also, compute the refinancing benefit if the refinancing occurs five years after the mortgage is taken out.

8. In what sense has the investor in a mortgage granted the homeowner a call option? How does the spread between prevailing mortgage rates and the contract rate affect prepayments? Also, why is the path that mortgage rates followed in the past important in predicting future prepayments, and why there is seasoned effect in prepayments?

9. How does a collateralized mortgage obligation alter the cash flow from mortgages so as to shift the prepayment risk across various classes of bondholders?

10. Suppose that 8% coupon pass-throughs are stripped into two classes. Class X-1 receives 75% of the principal and 10% of the interest. Class X-2 receives 25% of the principal and 90% of the interest. What are the effective coupon rates on both classes?

11. Given a pair of Collateralized Mortgage Obligations both with the same underlying pool of mortgages but with slightly different collateralized structures, where one A-tranche pays 6% coupon and the other A-tranche pays 7.5% coupon. Which one would you prefer if you believe that interest rates are going to fall? Recall that the A-Tranche receives all the principal payments until the entire amount owed to that bond class is paid off.

12. What are the roles of the credit default swaps and the credit linked notes in the design of a synthetic collateralized debt obligation? What are the potential gains and risks faced by the credit linked note investors? From the perspective of the sponsor, how does a synthetic collateralized debt obligation achieve regulatory arbitrage? What are the issues of moral hazard in synthetic collateralized debt obligations?

13. Explain why the equity tranche investors in a synthetic collateralized debt obligation are essentially "long correlation", why the senior tranche investors "short correlation".
    Hint: Consider the portfolio loss distribution under the scenario of highly correlated assets and uncorrelated assets.

14. Recall the quantity "cushion" used in calculating the shortfall when we determine the dynamic leverage used in a CPDO. When the cushion is set to be zero, the "cash-in" event would never happen. Why? *Hint*: When the cushion is zero, the leverage becomes too small when the shortfall is close to zero.

15. The widening of credit spread may be caused by systemic risk or idiosyncratic risk. Explain why the CPDO investor suffers less when the spread widening is caused by systemic risk due to the 6-month rolling indices mechanism.
    Hint: If spread widening is caused by idiosyncratic risk, it will not be able to benefit from higher spreads after the roll, since the names that have migrated to below investment grade are removed at each roll.

16. Suppose the same number of default losses occur over the legal maturity of a CPDO. Under what scenarios that an investor should prefer the defaults to occur during the early life rather than the later life of the CPDO? Recall the "gambler chasing losses" nature embedded in the CPDO design.

17. In the structural design of the Constant Proportional Debt Obligations (CPDO), there are several measures that mitigate the risk exposure of the investors. Describe the roles of (i) rolling of the credit indexes in every 6-month period, (ii) cash-in event, in achieving mitigation of risks. The CPDO also contains the "cash-out" provision. What is the purpose of including this provision in the structure?