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**Question 5 Derivatives in Portfolio Management****(48 points)**

You are a portfolio manager at BB Asset Management and you are in charge of a well-diversified stock portfolio of EUR 175 million representing the investments of an important corporation. You meet the legal officer appointed by your customer and show the very positive results achieved over the last three months. You then suggest partially hedging the stock portfolio for the next year because you suspect a corrective trend is likely to occur in the financial markets, due to registered excessive speculation in the real estate market over the last period. After explaining your point, you are asked to proceed.

- a) Your first target is to protect the managed portfolio against a decline in capital value of more than 7.5% over the next 12 months. The stock portfolio has a beta equal to 1.20 versus the DJ EURO STOXX 50 index and the dividend yield on the portfolio is equal to 2% p.a. The last quotation of the DJ EURO STOXX 50 is 4,100 and its dividend yield is 3% p.a., while the risk-free interest rate is 3.5%. Initially, you want to use index put options to insure the whole managed portfolio. All yields, interest rates and returns are given with annual compounding.
- a1) Assuming a perfect correlation between the stock portfolio and the index, and that the insurance cost is to be borne externally from the managed funds, which European option maturing within exactly 12 months from now should be considered? Calculate the theoretical strike price. (10 points)
- a2) How many option contracts should be purchased or sold if the option size is EUR 10.00 per index point? (5 points)
- a3) Give four main practical difficulties of applying 'static' portfolio insurance. (4 points)
- b) Comparing the theoretical and the market prices of the index put options to be used, you conclude that the insurance strategy at point a) is too costly. Therefore, you decide to apply the put-call parity to create a corresponding protective strategy based on index call options with the same strike price and the same maturity. Describe such strategy and how to implement it.
- Hint: Consider the Put-Call Parity for a European option on a stock paying a dividend yield. You can just replace  $S$  by  $S \cdot e^{-yT}$  in the basic Put-Call Parity for a European option on a stock with no dividend yield.
- c) Alternatively, you consider a dynamic portfolio insurance strategy based on 'synthetic' put options.
- c1) Present two main advantages of this strategy with respect to the application of the static portfolio insurance and also one main disadvantage of this strategy. Then explain how to create the synthetic put. (7 points)

- c2) Based on the parameters given under part a), and assuming that the returns are normally distributed, describe how to create a synthetic put option by trades in the underlying assets, when  $N(d_1) = 0.6178$  (where  $N$  indicates the cumulative distribution function of the Normal distribution and  $d_1$  the characteristic coefficient in the well-known Black & Scholes Model). (5 points)
- d) The current value of the DJ EURO STOXX 50 Futures with 1-year maturity is 4,120 and its contract size is EUR 10.00:
- d1) What is the hedge ratio for fully hedging the original portfolio described above? (5 points)
- d2) How many futures contracts are needed to fully hedge your original portfolio? (5 points)