

# **The Institute of Actuaries of India**

## **Subject ST5 – Finance and Investment A**

**23<sup>rd</sup> May 2007**

### **INDICATIVE SOLUTION**

#### **Introduction**

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable.

Arpan Thanawala  
Chairperson, Examination Committee

1. [a] On making distributions to investors, the company has to deduct some of the tax payable by investors

And pay it directly to the government

This amount can then be offset against the total corporation tax bill of the company

The tax deducted by the company is 'imputed' to the shareholder who may be able to reclaim it if they are not liable to tax

If instead, the investor's marginal rate of income tax exceeds the imputed rate then they may have to pay additional tax on their dividends received

[b]

[i] *Encouraging Dividend Payments*

The split rate system may encourage dividend payments if the rate of tax on capital gains exceeds that on the dividends and/or the tax rate on distributed profits is less than that on retained profits.

The imputation tax system may encourage dividend payments if the deferral of corporation tax is made possible. Generally, under the imputation tax system distributed profits are taxed only once as dividends. In contrast retained profits may be taxed twice, first when earned and secondly through capital gains tax on the growth generated by the inward investment they finance. The imputation tax system may therefore encourage dividend payments over the retention of earnings.

[ii] *Encourage Diversification :*

Diversification generally occurs through growth [e.g., forming conglomerates]

The classical and split-rate systems are more likely than the imputation system to encourage the retention of profits for the reasons given above.

The split-rate system in particular may encourage growth and diversification if the rate of tax on retained profits is less than that on distributed profits.

Any of the systems will encourage growth and diversification if a lower rate of tax applies to capital gains than what applies to dividend income. Under such circumstances, investors will prefer capital gains [generated by inward investment] to dividends.

[iii] *Favored by Tax Exempt Investors:*

The imputation tax system will be favored over other tax systems because it potentially allows tax paid by the company to be reclaimed by tax-exempt investors.

[8]

2. Investor A has invested the entire amount in the underlying assets thus has no leverage

Investor B has invested partly in the underlying asset and partly in the options on the underlying asset thus having a medium level of leverage but hedged it with substantial amount investing in the risk free bonds

Investor C has the most leveraged investment as he has invested the entire amount in the options.

b)

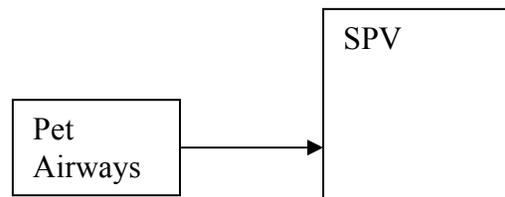
Risk free rate	9%
Risk free rate for 3 months	2.25%
Investment Amount	500,000
Stock Price	500
Option Price	50
<b>No. Of Shares A has</b>	<b>1,000</b>
<b>No. Of Options B has</b>	<b>1,000</b>
<b>Cost of Options</b>	<b>50,000</b>
<b>Interest earned on balance amount</b>	<b>10,125</b>
<b>No. Of Options C has</b>	<b>10,000</b>
<b>Cost of Options</b>	<b>500,000</b>

Strike Price	Investor A	Investor B	Investor C
650	150,000	110,125	1,000,000
450	(50,000)	(39,875)	(500,000)
<b>Returns earned in 3 months</b>			
650	30%	22%	200%
450	-10%	-8%	-100%

The returns earned by three investors demonstrate the impact of the respective strategies pursued by each one of them. While Investor B used leverage, he hedged it with investment in risk free bonds. Hence his returns were lower than the investment returns earned by A and B under the scenario where the share price was higher than the strike price. Also his negative return is the least amongst the three investors under the scenario where the share price was lower than the strike price.

[7]

3. a. (i) **Securitization:** Securitization is the issue of securities, usually bonds, where the bonds are serviced and repaid exclusively out of a defined element of future cash flows owned by the issuer. In this case, the bondholders will not have any recourse to other assets held by the issuer in case of default.
- (ii) **Special Purpose Vehicle:** It is a separate legal entity, usually a company in its own right to which the original owner sells the assets to be securitized such that the SPV will be “bankruptcy remote” from the borrower in case of default.
- b)



- c) **Credit Default Swap:** A credit default swap is a contract that provides a payment if a particular event occurs. For example, it may give Bank A the right to sell a bond issued by company C to Bank B for the full face value of the bond in the event that company C defaults on the bond.

The party that buys the protection pays a fee to the party that sells the protection i.e. Bank A pays the payment to Bank B (1/2)

If company C defaults within the term of the swap a payment is made from the seller to the buyer i.e. from B to A

The payment can be made either a) by way of cash payment representing the fall in the value of the defaulted bond or b) by exchange of both cash and security.

The Bank B has given a guarantee to Bank A for the loan raised to buy the aircrafts.

In the transaction other entities have back to back guarantees. For example the investors are guaranteed their payments by Bank A and in turn Bank A has been given guarantee by Bank B. Therefore Bank B is exposed to credit risk.

However this credit risk is mitigated to a large extent as the aircrafts are registered and hypothecated in a country where the civil laws facilitate quick takeover of aircrafts.

However the Bank B may face difficulty in finding a prospective buyer. Hence if it wishes to completely eliminate the default risk, it can enter into a credit default swap at a lower price since it has the ownership of aircrafts in case of a default

**[12]**

4. The duration of a 4-year zero-coupon bond is 4 years

The annual effective spot rate offered by the zero-coupon bond is equal to:

$$i = e^{0.0675} - 1 = 6.983\%$$

The modified duration of the bond is:

$$D = \text{Duration}/(1+i) = 4/1.06983 = 3.7389 \text{ years}$$

(ii)

The current price of the bond is given by:

$$B_0 = 100 e^{-4 \cdot 0.06983} = 76.338\%$$

So, the forward price of the bond at the strike date of the option is given by:

$$F_0 = 76.338 e^{0.06} = 81.058\%$$

The initial forward yield of the bond  $y_0$  can therefore be found from:

$$100 = F_0 (1 + y_0)^3 = 81.058(1 + y_0)^3$$

$$y_0 = 7.25\%$$

And the modified duration of the forward bond is then found as:

$$D = \text{Duration}/(1+i) = 3/1.0725 = 2.797 \text{ years}$$

We can now find the forward price volatility  $\sigma$  of the bond from:

$$\sigma = D y_0 \sigma_y$$

Where  $\sigma_y$  is the current forward yield volatility of the bond. Thus:

$$\sigma = 2.797 * .0725 * .20 = 0.0405565$$

So the price of the 1-year European put option on the zero-coupon bond is found from:

$$\text{Put} = P(0,1) [X \Phi(-d_2) - F_0 \Phi(-d_1)]$$

$$d_1 = [\ln(81.058/83) + (.0405565^2 \times (1/2))] / 0.0405565 \sqrt{1}$$

$$= -0.56349$$

$$d_2 = d_1 - \sigma \sqrt{T} = -0.56349 - 0.0405565 \sqrt{1} = -0.6040465$$

So:

$$\Phi(-d_1) = .7144734$$

$$\Phi(-d_2) = 0.725884$$

$$\text{The put option price} = e^{-0.06} X \{83 * 0.725884 - 81.058 * .7144734\} = 5.37$$

[8]

5. a) The directors act on behalf of the shareholders and appoint managers as the agents to run the company on their behalf on a day-to-day basis.

The separation of management and ownership has the advantages of freedom for ownership to change without affecting the operations and freedom to hire professional managers

The main disadvantage is divergence in the interests of the management and the shareholders and give rise to agency costs

These agency costs occur mainly (i) for monitoring the managers (ii) seeking to influence the actions of the managers (iii) incurred as managers do not act in the best interests of the shareholders

B)

- i. The shareholders wish to maximize return on their investments.
- ii. The MD's objective is to grow the sales and achieve market share
- iii. He can achieve the increase in sales by providing too many sales incentives, which may not be sustainable from the long-term profitability perspective. Thus he may have achieved his objectives but the shareholders would not have made any profits. Thus there can arise a conflict between the mandate provided to the MD and that of the shareholders' interests.
- iv. In order align the interests of the shareholders and the MD, the MD's incentives should be linked not only with the sales and market share but also achieving a measurable expense ratio and profitability criterion

[8]

### 6.(i) *Benefits and costs*

The main benefits produced by regulation arise from the successful achievement of its aims, which are primarily to:

- correct market inefficiencies, such as a lack of information on behalf of investors, and to promote efficient and orderly markets, in which investors can trade confidently and fairly
- protect consumers of financial products, against losses due to fraud or mismanagement, but not against losses arising purely from market movements
  
- maintain confidence in the financial system, so that it continues to operate effectively for the greater good of society, *e.g.* via the promotion of social goals such as individual saving for retirement.

The regulation is very important as the country is seeing a rapid expansion of the financial markets hence to sustain the growth in the long term, the confidence in the system has to be established which can be achieved by means of strong regulations

The main costs involved are:

- the direct costs that arise in administering the regulation and in compliance for the regulated firms. These will normally be passed on ultimately to the end investor in the form of higher charges/dealing costs.

#### **and the indirect costs, such as:**

An alteration in the behavior of consumers, who may be given a false sense of security and a reduced sense of responsibility for their own actions.

An undermining of the sense of professional responsibility amongst intermediaries and advisors – who again may have less incentive to provide the best advice for the investor.

A reduction in consumer protection mechanisms developed by the market itself, as the providers of financial services know that consumers are in any case protected against mismanagement or insolvency.

A reduced product innovation – due to the additional costs of complying with the regulatory requirements.

A reduced competition – again due to the additional constraints imposed by the regulations on the providers of financial services.

Although, the aim of regulation is to enhance social welfare, these costs are likely to have the opposite effect. The optimal level of regulation is therefore that at which the marginal costs and benefits of regulation are equal.

In the context of a developing country, even though the costs may be substantial, strong regulations will ensure an orderly growth of the markets with strong fundamentals, which will enable the markets to reduce the costs of the regulations in the long run

[6]

## 7. (i)

Data:

Fund asset size at least quarterly

Unit price / time weighted return at least monthly preferably more frequently

Definition of benchmark against which fund is measured

Calculation of benchmark returns as provided by manager

Calculations:

Distribution of returns, including average, standard deviations, evaluation of fat tails of distribution

Correlation with other managers

Correlation with main asset classes

Consistency of performance

Drawdown statistics (i.e. worst period of consistent negative performance)

## (ii)

- Price analysis alone does not capture qualitative factors
- Selection bias - the manager will be tempted to submit best performing accounts for inclusion
- Survivorship bias – choosing only those managers still operating may give inaccurate reflection of risk of fund failure
- Qualitative assessment of management has not been made e.g. stability of team, dependence on key people
- Investment strategy not assessed
  - how does it compare with strategies of other hedge funds on the list?
  - Is it diversifying?
  - Does it change over time?
  - Is it market neutral/directional?
- Fund risk has not been properly captured by volatility of return
  - returns are unlikely to be normal
  - performance should be evaluated under various market conditions
  - performance should be adjusted for gearing levels and limits
  - information on fund compliance and independence of risk management system (especially if the fund is geared) should be assessed
  - recourse if any in the event of a fund bankruptcy should be assessed

Marketability of the investment may be an important consideration. For example, is the fund listed, how are units traded, what are the exit charges

## (iii)

Information on key personnel and remuneration packages (to assess the risk of their moving elsewhere)

Information on investment strategy, and stability thereof

Current fund prospectus

Due diligence information e.g. (one of the following)

- check on risk management

- portfolio management IT systems
- data feeds infrastructure, cleaning and verification procedures

[16]

## 8. (i)

Discount rate of 8% p.a.

$i(4) = 7.771\% \text{ p.a.}$

PV variable interest rate loan =  $10,000,000 \times [5\% \times a_7^{(4)} + 7\% \times v^7 a_8^{(4)}] =$   
£5,096,491

PV fixed rate loan =  $10,000,000 \times [5.5\% \times a_{15}^{(4)}] =$  £4,846,680

Premium = £5,096,491 - £4,846,680 = £249,811

## (ii)

The bank is taking a credit risk in the event of a client default, but the bank will only lose out if the lost future quarterly payments are expected to be paid from the client to the bank

This risk is much more significant if the fixed rate is lower than the initial variable rate, which is more likely if the yield curve is downwards sloping

The bank may have entered into offsetting transactions, so it will be exposed to interest rate fluctuations if the client defaults

The calculation does not allow for the expenses of setting up a swap (e.g. legal expenses, sale and negotiation), nor the cost of any additional regulatory capital required

The bank is exposed to an interest rate risk, which the client is not

This risk can be valued using a Black-Scholes approach or a proprietary model

The bank will have priced the swap based on the client's current credit rating, and is locking into the rate for a 15 year period. This may result in capital strains if the client's credit rating worsens and more capital is required to back the swap.

[11]

9. (i) **Operations**

Initial Margin is the sum of money that each party to a futures contract must deposit with the clearinghouse when a futures contract is opened

As time progresses, the underlying asset price and hence the value of the future to each party is likely to change. This change in value might make it more likely that one party will fail to honor the contract.

Through the 'marking to market' process of daily calculation of the market value of a trader's position, any fall in value is topped up with additional payments of cash, or other acceptable margin, to enable the clearinghouse to continue to give its guarantee

These extra margin payments are known as 'variation margin'

The other party will be less likely to default and so will be able to withdraw some of his initial margin from the clearing house (i.e. variation margin is negative for this party)

The process of 'marking to market' means that the profit or loss on a future is realized over a period of time (i.e. as variation margin is paid or released) rather than simply at the delivery date

### **Limiting Credit Risk**

Following registration of a trade, each party has a contractual obligation to the clearinghouse rather than to the original counter party. In turn the clearinghouse guarantees each side of the original bargain

By standing between the two parties the clearinghouse removes the immediate credit risk of individual participants to each other

However it is important that the ability of the clearinghouse to honor its positions is not vulnerable to default by one or more traders

Initial margin is a cushion against potential losses that the parties may suffer from future adverse price movements

The payment of variation equal to any price movement ensures that the value (and hence credit exposure) of all open contracts is re-set to zero each day. The clearinghouse thus maintains the amount of initial margin as a cushion against daily price movements.

(ii)

### **Hedging**

A process known as hedging can be used to protect the portfolio. It involves taking a position in the UK equity index futures (i.e. long or short), which is opposite to the position held in the equity market. The idea is that a loss or profit made in the UK equity market will be counterbalanced by a profit or loss on the futures

For UK equities the main futures contract is on the FTSE 100 index

### **Short Hedge**

The investor can protect against a market fall by selling index futures with a contract value equal to the size of the portfolio. Any fall in the value of the equities will then be offset by profits on the futures and vice versa

Alternatively, only part of the portfolio may be hedged

By hedging, the equities have effectively been sold in the future at a fixed price.

This type of hedging is particularly useful when a fund is going to disinvest a large sum of money in a few months and wants to avoid any future risk. It can also be used when a manager feels that the market is looking over-priced and vulnerable to a fall.

### **Long Hedge**

If the UK equity portfolio is expecting a large cash inflow in the future the investor may wish to protect against a rise in the market by buying futures.

[12]

## 10. (i)

A deterministic model is based on a single set of assumptions, for example with regard to estimates of the expected return from each asset class

This fails to take into account the variability of asset returns and the correlated variability of the liability values

This is a problem because it is difficult to test whether the nature of the assets (i.e. 'fixed' or 'real') is suitable to match the liabilities

We therefore really need to run a deterministic model a number of times considering different scenarios (e.g. low inflation/high growth, high inflation/low growth, e.g.) in order to investigate how the surplus might vary under different possible outcomes

Scenario setting is, however highly subjective.

If there is a lot of variability in the parameters, insolvency may have a non-negligible probability even where a deterministic approach suggests that there is a large excess of assets over liabilities. Even scenario testing may not identify this problem. A stochastic model is really needed

Additionally some apparently innocuous scenarios may in fact lead to financial difficulties. These will be identified only if the relevant scenarios are actually modeled and investigated, as they may not be if a deterministic model is used.

Again a stochastic model is really needed.

## 10[b] [i]

Fund's performance over the three year period =

$$0.5*(1.35*1.02*1.26) + 0.4*(1.13*1.14*1.02) + 0.1*(1.12*1.16*1.07) = 1.5321$$

i.e., the fund has earned a return of 53.2% over a three-year period.

## Benchmark

$$0.6*(1.31*0.98*1.24) + 0.2*(1.14*1.17*1.01) + 0.2*(1.11*1.17*1.07) = 1.5025$$

i.e. a return of 50.3% over a three-year period.

This shows that the fund has out-performed the benchmark by about 2.96% over the three-year period.

The above calculations assume no new money and reinvestment at no cost into the same sector returns.

## 10[b] [ii]

If invested using the same stocks as the benchmark but using the actual sector split, the total return would have been

$$0.5*(1.31*0.98*1.24) + 0.4*(1.14*1.17*1.01) + 0.1*(1.11*1.17*1.07) = 1.4738$$

Therefore the fund's relative performance attributable to sector selection has been =47.38%-50.25% =(-)2.87% .

The fund's relative performance attributable to stock selection has been

$2.96\% - (-2.87\%) = 5.83\%$ .

**Comments:**

1. The fund was underweight in equities compared to the benchmark whilst equities produced the best sector returns – this reflects a poor sector selection decision.
2. The fund was overweight in fixed interest bonds, which produced lower returns than equities – this again reflects a poor sector selection decision.
3. Individual equity stock selection ensured better equity sector returns in each year compared to the equity index. This outweighed the slightly poorer bond selection as compared to the bond index in some years.

[12]

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