

Actuarial Society of India

Examinations

November 2006

CA11 – Assets

Indicative Solution

[1]

- a) The factors affecting companies in different industries are likely to be different. It may be necessary to project two separate sets of underlying economic factors. It may be difficult to do this in a consistent way.

For example:

- Companies in different sectors will use different resources and therefore have different input cost exposures.
- Markets will be different, so changes in demand have different effects.
- Companies in different sectors may have different financial structures, and will therefore be affected differently by changes in interest rates.
- The information for companies in different industries may come from different sources, may be presented in different ways and may relate to different time periods.
- Few Analysts will be expert in multiple industries because it is normal to specialise.

I think that you could add more bullet points as I would have included (i) different industry growth prospects, (ii) different earnings volatility, (iii) different valuation criteria ie book values, pe ratios, dividend yield.

- b) The yield difference will reflect:

- the inflation protection provided by the index-linked bond
- the greater marketability of the conventional bond
- any differences resulting from the different levels of coupon (*e.g.* due to differential taxation of income and capital gains, or due to differences in duration and hence volatility)

So, the conventional bond will offer an inflation premium compared to the index-linked bond, which may offer an additional return in the form of a marketability premium. The actual yield difference will reflect the net effect of these two factors.

There are more than two factors mentioned and I also wonder if the wording of the question makes it clear that bond B is also GoI. If not you could add credit risk and there is an issue of how wholesale price indexation relates to retail price indexation which is the normal index-linked basis.

c) The risk premium will reflect the:

- Differences in marketability
- Uncertainty of the income provided by the equity
- Much greater uncertainty with regard to the capital value of the equity
- Relative default risk [bonds can go bust as well!]

[11]

[2]

a) The different approaches that may be used to facilitate testing and parameterization of an asset model include:

- *Analytical models* – which describe the main features of the assets using mathematical functions and formulae. However, analytical models that are capable of being solved can usually be used only to describe very simple situations.
- *Historical back-tests using past data* – if the model results are consistent with past data, then they may help us predict future outcomes. However, the past may not be a very accurate indicator of the future.
- *Scenario analysis, i.e., deterministic simulation and sensitivity analysis* – here the modeler maps out a series of scenarios of interest. This will usually allow considerations of only a small number of different scenarios.
- *Tree-building techniques* – can be used to build scenarios in the form of a tree. Again this is likely to be useful for modeling only where there is a small number of stochastic factors involved and hence only a limited number of possible scenarios.
- *Monte Carlo stochastic simulation* using a stochastic asset model – which can be used to generate very large numbers of plausible scenarios. These can be particularly useful where the financial outcomes are path-dependent.

b) In most models, equity returns are assumed to be driven by inflation projections. However, some models also generate wage indices as a further driver of equity returns.

Most of the stochastic asset models in general use generate projected equity dividends and dividend yields.

Equity price indices can then be generated using the relationship.

$$\text{Equity price} = \frac{\text{dividend income}}{\text{Dividend yield}}$$

A total return index series for equities can then also be found by combining the increase in equity prices with the dividend income received, *i.e.*,

$$\% \text{ total return} = \% \text{ increase in price} + \% \text{ dividend income}$$

In some models, however, the process is reversed with price indices and total returns being projected and dividends/dividend yields derived from these results.

A common approach adopted for interest rates and bond returns is to project long-term rates (consol yields) and short-term rates (base rates).

A full yield curve, together with the returns on bonds, can then be derived from the two ends of the yield curve by interpolation. The interpolation process must avoid pricing bonds in such a way as to introduce arbitrage opportunities.

An alternative approach sometimes used is to generate the full yield curve in the initial model.

[10]

[3]

a) We now consider the main credit-related risks associated with managing a portfolio of debt rather than making an individual loan. These are:

- Counterparty risk (and associated replacement risk)
- Credit or settlement risk
- Liquidity risk
- Concentration risk

These risks are described in detail below:

Counterparty risk

This is the risk that a counterparty will not honour its obligations

As well as including the general possibility that the issuer of a loan stock or the counterparty in a swap may fail to meet their legal obligations to make payments as and when due, counterparty risk also refers to the particular situation in which a trade has been agreed, but the counterparty to the deal then fails to go through with the trade.

Counterparty risk is also known as default risk.

If the default occurs before the date when settlement of the underlying transaction is due, the party who has been let down will be exposed to the risk of having to bear any costs of replacing or canceling the deal.

Settlement risk

Credit or settlement risk arises when a party pays away cash or delivers assets before the counterparty is known to have performed their part of the deal.

This differs from counterparty risk in that not only has the trade been agreed, but the settlement process has begun by the time of default by the other party. In contrast, counterparty risk refers to the situation in which a trade has been agreed and the counterparty then pulls out prior to the start of the settlement process.

A bond manager will sell and buy bonds on a daily basis. The settlement department may have to make a large cash transfer into the counterparty's bank account on the day that a bond purchase is settled without knowing whether the counterparty has re-registered the bonds. If the counterparty then goes bankrupt, the cash is in the counterparty's bank account and the bonds are still registered in his name! Settlement risk is very high for foreign exchange deals.

Liquidity risk

Liquidity risk is where a market does not have the capacity to handle (at least, without significant adverse impact on the price) the volume of an asset which is to be brought or sold at the time when the deal is required.

If a bond manager has specific liabilities to meet that are not met by the regular cashflow of the fund, he must monitor the liquidity risk that he will be unable to sell enough bonds to raise the required cash. The most difficult situation is when the manager does not know the likely cash outflows. For example, a unit trust manager does not know when unit holders will sell their units to raise cash and a bank does not know how many customers will wish to take cash out of their deposit accounts in any one month.

In the context of an individual or a company, rather than a market, the term is sometimes also used to refer to an inability to meet debts when they fall due because of inadequate cash or other liquid assets.

This relates to the more general interpretation of liquidity – *i.e.*, whether the company has sufficient assets to meet its short-term liabilities as and when they fall due. If it hasn't, then one way of obtaining cash might be by selling some of its assets, provided it is able to do so.

Concentration risk

Concentration risk is the exposure to a high level of risk on any instrument or in any sector. An extension of concentration risk is a market which is dominated by a small number of firms.

b) Solution

The bank will need to consider the following factors

- The security available
- The expected return
- The costs of the restructure
- The company's business plan
- The company's existing capital structure and the change proposed
- The actual swap terms proposed
- The company's priorities on income and capital repayment
- The level of cover
- The bank's own policy and experience
- Any statutory requirements
- Secondary marketability of the equity
- The bank's existing level of debt and equity (if any) and its exposure to this sector generally.

It will also need to consider the prospects for equity and bonds generally plus specific factors that will affect the investment performance of all companies in the sector and the particular company concerned.

The bank will also need to consider the role of the consultant who may be biased (as he has a vested interest in the deal). The bank should consider other independent sources for recommendations, industry outlook, company announcements, views of suppliers and competitors.

The bank's negotiating strength may have an impact and will be stronger if it is the lead lender to the company.

The bank will need to carry out a fundamental analysis of the company covering:

- Management
- Product
- Market growth
- Competitive position
- Accounting data.

The bank may need to visit the company.

As earnings are not the same as profits the real impact of the new product and how close it is to completion need to be investigated.

The bank will need to consider the current position in the economic cycle and the general outlook for sector and market. It may be that other companies in sector may have similar plans or products with better prospects.

[10]

[4]

a) Actuarial reasons

Often the purpose of a pension fund valuation is to look at the adequacy of the assets compared with the liabilities in order to advise on an appropriate long-term funding rate.

In valuing the liabilities the actuary may use a long-term estimate for the rate of interest used to value the liabilities that remains stable from one valuation to the next, rather than reflecting market conditions. This makes inter-valuation comparison easier.

When valuing the assets, a consistent interest rate assumption must be used.

This means that the assets should be valued by reference to the discounted value of the proceeds expected to emerge from the portfolio.

Practical reasons

It is impractical and inappropriate to value each asset individually on a discounted cash flow approach.

Problems with an individual discounted cash flow method that are avoided by using the notional portfolio method include:

- Complexity where large numbers of individual assets are held
- Difficulty of making appropriate dividend growth assumptions to value individual shares
- Particular difficulty with overseas assets where future exchange rates would have to be allowed for
- Particular difficulty with valuing direct property holdings, where expert advice would be needed in order to establish an appropriate rental growth rate.

Other points

The notional portfolio method can also be used to value the assets on the basis of an appropriate long-term split of the assets between fixed and real investments. This may be better than being too heavily influenced by short-term strategic moves away from a benchmark asset distribution.

For example, the broad discounted cashflow approach has the undesirable feature that an investment manager's decisions might be unduly influenced by the valuation assumptions. Using a notional split of the asset avoids this problem.

The great advantage of the notional portfolio method is its simplicity. All you need in addition to the valuation assumptions is the yield on equity and undated gilt indices and the total market value of the portfolio.

b)

(i) *Conventional government bonds*

The term structure of the liabilities will influence the choice of shorts/mediums/longs *etc.*

The wide range of coupon and term make matching more feasible.

Also, the government bond market is usually reasonably efficient, so there may be little potential for increased returns from mismatching. Therefore, the assets held are likely to reflect the (fixed) liabilities quite closely.

(ii) Other domestic fixed-interest securities

It is harder to use these to accurately match the liabilities. The primary decision is to invest in a particular company. A particular company may have only one series of fixed-interest security to choose from.

However, with some corporate issues, marketability is poor. This can make matching by term quite important.

(iii) Overseas equities

The choice of country should reflect the currency of the liabilities (e.g. for a general insurer with overseas business). Otherwise, it is difficult to see how individual investment decisions can be said to match the institution's liabilities.

(iv) Domestic Property

As with equities, the details of the fund's liabilities do not really impinge upon investment decisions made within the property sector. An exception might be when ground rents or short leaseholds are purchased as an alternative to fixed-interest investment.

[7]

[5]

a) *Nominal amount of each stock needed to match*
(Rupees crore)

$$\frac{5.75}{1.15} = 5 \text{ of Stock C}$$

$$\frac{4.95 - 0.15 \times 5}{1.05} = 4 \text{ of Stock B}$$

$$\frac{4.25 - 0.15 \times 5 - 0.05 \times 4}{1.1} = 3 \text{ of Stock A}$$

b) *Forward rate term structure*

One year forward rate, i_1 :

$$110v_{i_1} 103.774 \Rightarrow i_1 = 6\%$$

Forward rate from year 1 to year 2, i_2 :

$$5v_{0.06} + 105 v_{0.06}v_{i_2} = 97.293 \Rightarrow i_2 = 7\%$$

Forward rate from 2 to 3 year, i_3 :

$$5v_{0.06} + 15 v_{0.072} + 115 v_{0.6}v_{0.7}v_{i_3} = 120.826 \Rightarrow i_3 = 8.5\%$$

Present value of liability:

$$5.75v_{0.06}v_{0.07} v_{0.085} = \$4.67 \text{ m}$$

[7]

6. i. Net asset value = $\frac{\text{Assets} - \text{Liabilities} - \text{Intangibles}}{\text{Number of ordinary shares}}$

Where assets, liabilities and intangibles are valued at book value

[1]

- ii. Normally property shares stand at a discount to their underlying NAV.

The discount reflects:

- Possible tax liabilities on disposals.
- Market valuation of holdings differing from the valuations underlying the NAV because of the lack of current quoted prices on property.
- Risk of loss on forced sale because of cashflow requirements for the property company.

A smaller discount or possible premium on NAV is possible where:

- The market has a positive view of developments.
- The valuations underlying the NAV are conservative.
- The property company has a good management track record.

[4]

7. i. A repayment mortgage has the following cashflows for the financial services group:

- Initial capital sum paid;
- A series of amounts received each of which includes part repayment of the loan in addition to the interest payments.
- The interest rate need not be fixed so the amounts may vary.
- It may be possible for the loan to be repaid early if the bank receives greater payments than required to service the arrangement.
- There is no provision to fund repayment of the loan on death, so there will be a shortfall to be funded on death or if the borrower defaults in their repayments.

A bulk purchase annuity has the following cashflows for the financial services group:

- A large initial capital sum received;
- A series of amounts paid either immediately or after some time in the case of a deferred annuity.

- The annuities need not be fixed so the amounts may vary.
 - The deferment period may not be known and hence the timing of the payments maybe uncertain.
 - If the annuitant dies then the repayments cease for that scheme member. When there are no scheme members alive then all repayments will cease.
 - There may be a lump-sum payment to an annuitant's beneficiary at the time of the annuitant's death.
- ii. Effectively the cashflows are opposite of each other, i.e. when for a loan the group makes a payment for a bulk purchase annuity the group receives a lump-sum and vice versa.

By holding a portfolio of home loans of different durations it may be possible to match the expected the cashflows of a bulk purchase annuity.

- iii. Both products have uncertainty in their cashflows and hence there is a risk that the cashflows will not match each other, for example:
- Loan repayments may be defaulted on and hence there is no income for the group to pay its annuities.
 - Deferred annuitants may start payments sooner than was expected and hence there maybe insufficient repayments to pay the annuity due.
 - If the bulk purchase annuitants are young there is effectively a reinvestment risk because the loans maybe repaid before the annuitants die and hence another loan will be required to match the repayments.
 - The bulk purchase annuity premiums may be insufficient to cover all the loans that are requested.
 - There may be timing issues whereby the cashflows are not synchronised.

[11]

8. Projects need:
- A clear definition of the aim of the project which reflects the needs of the customer
 - Full planning
 - Thorough risk analysis
 - Monitoring of development
 - Measurement of performance and quality standards
 - Thorough testing at all stages
 - Care in managing different strands of the project to ensure that there are no unnecessary delays in one part of the project which depends on the outcome of another (critical path analysis)
 - To move along at an appropriate pace so that the right things are done at the right time
 - Stable but challenging relationships with suppliers of external components of the project
 - A supportive environment
 - Excellent communication between those involved
 - Positive conflict management, which uses conflict as a source of ideas and a tool for development
 - A schedule of what needs to be considered at each milestone review point.

[6]

9. Why a government bond may persistently stand either above or below the yield curve:

- Low coupon – attractive to investor taxed more heavily on income than capital gains (below yield curve)
- Very high coupon (above the yield curve)
- Small, unmarketable issue – higher yield required to offset lower marketability (above yield curve)
- Convertible – the option has value to the stock holder (below the yield curve)
- Double dated – the option is against the holder (above the yield curve)
- Partly paid – investors are happy to defer the rest of the payment (below the yield curve)
- Strippable – high demand (below the yield curve)

[3]

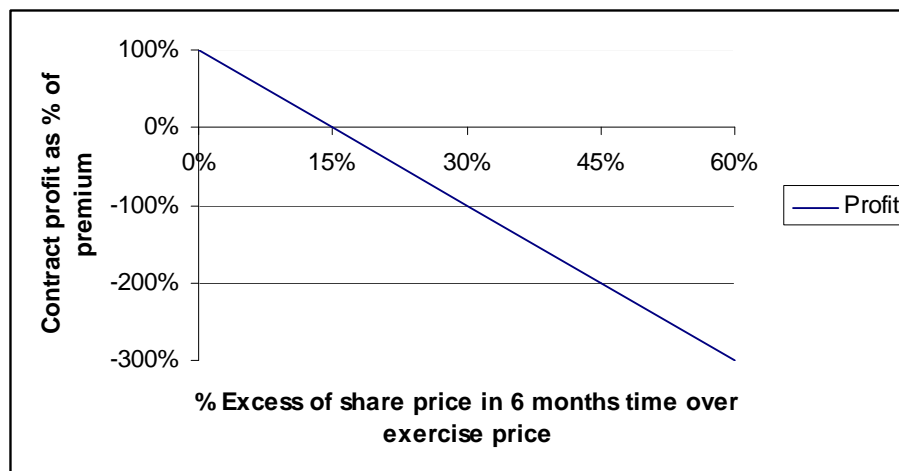
10. i. The contract profit will be determined by the difference between the market price for the shares and the exercise price.

The most profit that can be made is the premium received and this will occur if the share price falls or remains level, since the call will not be exercised.

If the market price rises by less than 15% then the profit will be linearly related to the excess of the share price above the exercise price.

If the market price rises by more than 15% then you will make a loss, again linearly related to the excess of the share price above the exercise price.

The above can be explained in the following diagram:



[Graph should show what happens for negative price falls as well]

- ii. An identical American call option may be exercised at any time up to the contract date. Therefore it is more valuable to the owner of the option.

Therefore it is expected that the premium on the American call option would be higher than on the European call.

The actual difference in premium will be determined by the market and depends on the market's view of how the share price will move over the time to the contract date.

[8]

11. i. Risk is the uncertainty of timing and volatility of future cash flows. Risk includes both upside and downside risk.

Probabilistic risk means risk that can be eliminated (or "average out") by investing in a number of similar projects. Systematic risk is risk that cannot be eliminated by investing in the same type of project many times, nor by diversification. Probabilistic risk should be allowed for by specific risk identification and analysis. Systematic risk should be allowed for by varying the discount rate used in the model.

- ii. The steps necessary to achieve an effective identification of the risks facing the project can be summarised as follows:

1. Make a high level preliminary risk analysis to confirm that the project appears fundamentally viable.

2. Hold a brainstorming session of project experts including all relevant internal and external people who have experience of this type of project and who are used to thinking strategically about the long term. Seek to identify risks, both likely and unlikely, to discuss their likely interdependence and to attempt to place a preliminary evaluation of each risk both in terms of likely frequency, and distribution of amount. Generate potential mitigation options. Risks identified at this time might include:

- The political risk of the two islands and the likelihood of the respective governments seeking to confiscate the bridge or impose maximum charges.
- The risk of the airlines dropping prices to extremely low levels
- The risk of the road system being let go so as to make the bridge unusable
- The risk of other bridges or tunnels being built either by one of the governments or by another private entity
- (Other reasonable risks are equally acceptable.)

3. Carry out a desktop analysis to supplement the results of the brainstorming session. Identify additional risks and proposed mitigation options. Develop a general risk matrix for the project. Research other similar projects and obtain expert opinion where available.

4. Set out the identified risks in a risk register with cross references to show interdependencies.

5. Ensure both upside and downside risks are catered for

- iii. For the risks identified any of the following mitigation options are acceptable provided the option is feasible for the risk:

1. Avoid the risk by redesigning the project
2. Reduce the risk by redesigning the project
3. Reduce the uncertainty through further research
4. Transfer the risk to another entity e.g. Appoint a sub-contractor
5. Insure the risk
6. Share the risk with another party and particularly with a party who is capable of mitigating the risk through expert control

[12]

12. i. The IRR is the effective interest rate (i) that equates the present value of the cashflows to 0.

Need to solve the following:

$$0 = -128 + 12 a_{20}^{(2)} + 100 v^{20}$$

If $i = 9\%$ then equation = 1.90; if $i = 10\%$ then equation = -1.18

Interpolating gives:

$$i \approx 0.09 + 0.01 * 1.90 / (1.90 + 1.18) \approx 9.6\%$$

- ii. The real internal rate of return (r) is given by:

$$r = \frac{(1 + i)}{(1 + e)} - 1$$

where i = nominal internal rate of return
 e = expected inflation rate

$$r = \frac{(1 + 0.096)}{(1 + 0.070)} - 1$$

$$r = 2.4\%$$

[6]
