

EXAMINERS' REPORT

November 2016 examinations

Subject F105 — *Finance and Investment* Fellowship Principles

INTRODUCTION

The attached report has been prepared by the subject's principal examiner. General comments are provided on the performance of candidates on each question. The solutions provided are an indication of the points sought by the examiners, and should not be taken as model solutions.

QUESTION 1

This was a very simple application of bookwork that was reasonably answered. A number of candidates indicated that the principal was the government and the agent was the central bank. Credit was awarded for this interpretation, but generating enough subsequent points using this interpretation was difficult.

Agency theory, which considers the relationship between a principal and an agent of that principal, includes issues such as the nature of the agency costs, conflicts of interest (and how to avoid them) and how agents may be motivated and incentivised.

Here the principal is the past, current and future tax-payers in the country. The agent is the government. The problem lies where the government is motivated by an objective which is at variance with the interests of the tax-payers. This objective is to be re-elected. Taxpayers/savers wish to see lower taxes/higher real economic growth and returns.

The following effects for the personal tax payers are likely from a cut in interest rates:

- A reduction in mortgage loan interest payments increasing disposable income and personal sector expenditure.
- Lower rates on credit facilities encourages consumer expenditure.
- Discourages saving.

The following effects for the corporate tax payers are likely from a cut in interest rates:

- Increased capital investment due to decreased opportunity cost of committing funds.
- Increased viability of capital investment projects due to depreciating currency.
- Increase corporate profitability due to lower levels of interest payments on outstanding debt.

These are all beneficial for the principal, but in the long term will likely lead to even higher inflation, which is not in the best interests of the principal.

QUESTION 2

In general most candidates managed to attain reasonably good marks on this question. The first part was bookwork and in the second part, most did not take into account the \$15 000 that was due for the year 2019 until the credit event occurred.

i. Examples of credit events include:

- bankruptcy (insolvency, winding-up, appointment of a receiver).
- a rating downgrade.
- repudiation – when the debt issuer simply chooses to cancel all of the outstanding interest payments and the capital repayment of the debt.
- failure to pay a particular coupon.

- cross-default on a bond, meaning that a credit event on another security of the issuing firm will also be considered as a credit event on the bond in question.

ii. Cash-flows and timing for the seller of the CDS:

a. No credit event:

The seller receives $\$10\,000\,000 \times 0.009 \times 0.5 = \$45\,000$ every half-year in arrears, at times $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$ and 3 years respectively.

b. Credit event on 1 Mar 2019:

The seller receives $\$45\,000$ at times $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2 respectively, plus $\$10\,000\,000 \times 0.009 \times \frac{2}{12} = \$15\,000$ at the time of the credit event.

The seller pays $\$10\,000\,000 \times (1 - 0.3) = \$7\,000\,000$ at the time of the credit event.

QUESTION 3

The first part was bookwork and most candidates scored well. In the second part, very few candidates commented on the volatility aspects. The Sharpe ratio demonstrates specific challenges when measuring the performance of a hedge fund, and very few candidates were able to elaborate on these. Most candidates failed to comment on the non-availability of information about the correlation between the portfolios.

i. Investment strategy of a market-neutral hedge fund:

A market-neutral hedge fund simultaneously enters into long as well as short positions at a market or sector level, while trying to exploit market inefficiencies. The fund as a whole is designed to be market-neutral, i.e. as many short positions as long positions are taken, so that the performance of the fund is not affected by general movements in the market.

ii. Sharpe ratio = $(0.1032 - 0.035)/0.0697 = 0.98$

Analysis of results:

- The hedge fund outperformed the global equity portfolio by 3.14% (10.32% – 7.18%).
- The value of the Sharpe measure confirms the outperformance per unit of risk exposure.
- The hedge fund experienced lower levels of volatility than the global equity portfolio.
- I.e. through a lower risk investment strategy, the hedge fund outperformed the global equity portfolio.

iii. Limitations:

- Hedge fund returns are not normally distributed and most likely to be negatively skewed.
- The value of the hedge fund's Sharpe measure will be biased upwards as a result, as the risk is measured in terms of the standard deviation, which is a symmetric measure of risk and does not give a true indication of the level of (downside) risk involved.
- The meaningfulness of the comparison cannot be assessed due to no information given about the level of correlation of the hedge fund with the global equity portfolio.
- Data is based only on 3 years, hence there is a possibility of spurious and / or misleading results.
- The hedge fund and the global equity portfolio may have differing objectives and mandates.
- It is not clear whether the returns are gross or net, allowing for tax and expenses.

QUESTION 4

The bookwork components were done reasonably well. For part (ii) most students were able to reproduce the correct formula for valuing the call option, but then made errors in applying the formula. Common errors included: treating the term structure of yields provided in the question as a yield curve of forward rates rather than zero-coupon yields, forgetting to include the period of discounting in the discounting terms, not treating yields as continuously compounded, assuming the bond is 15 years long, and many students assumed the 15-month bond term is from the start of the option rather than option expiry date. In summary, most of these errors could have been avoided by simply reading the question properly.

i. The approximations include, when interest rates are stochastic:

- The expected value of V_T is assumed equal to its forward price F_0 .
- The stochastic behaviour of interest rates is not taken into account in the way the discounting is done.
- These two assumptions have exactly offsetting effects, when the model is being used to value an option on a bond.

ii. Price of a European call option:

$$c = P(0,T) [F_0 \Phi(d_1) - X \Phi(d_2)] \text{ where } X=R100 \text{ and } \sigma=0.12$$
$$P(0,T) = e^{-\frac{1}{2} * 5\frac{1}{2}\%} = 0.97287$$

Forward bond price = $F_0 = (B_0 - I) / P(0,T)$ where:

$$B_0 = \frac{1}{2} * 8 * [e^{-\frac{1}{4} * 5\frac{1}{4}\%} + e^{-\frac{3}{4} * 5\frac{3}{4}\%} + e^{-1\frac{1}{4} * 6\frac{1}{4}\%} + e^{-1\frac{3}{4} * 6\frac{3}{4}\%}] + 100 e^{-1\frac{3}{4} * 6\frac{3}{4}\%} = R103.891$$
$$I = \frac{1}{2} * 8 * [e^{-\frac{1}{4} * 5\frac{1}{4}\%}] = R3.948$$

Thus $F_0 = R102.73$

$$d_1 = [\ln(F_0/X) + \frac{1}{2} T \sigma^2] / \sigma \sqrt{T} = 0.35984$$
$$d_2 = d_1 - \sigma \sqrt{T} = 0.27499$$

$$\Phi(d_1) = 0.64052$$

$$\Phi(d_2) = 0.60834$$

Hence, $c = R4.832$

iii.

An option with a positive intrinsic value is in-the-money. For a call option, the intrinsic value is the greater of zero and the amount by which the market price of the underlying asset exceeds the exercise (strike) price: *i.e.* $\max[S_T - K, 0]$.

Therefore, the option is in-the-money as the market price of the underlying asset (R103.891) exceeds the strike price (R100).

QUESTION 5

Overall the question was done reasonably well by most students. Part (i) was done well. For part (ii) the most common problem was insufficient points, however a fairly large number of students wasted valuable time by offering ideas about how the valuation would be done, and some even continued to add to the list of information needed to perform the valuation – these were not asked for and showed that students do not read the instructions in the question carefully enough. Part (iii) was done reasonably well by most students.

i. Economic and financial factors that affect the fundamental value of the company:

- Management ability
- Quality of products
- Prospects for market growth
- Competition
- Input costs
- Retained profits
- History

In order to consider the above, the analyst will undertake the following analysis:

- Financial accounts and accounting ratios e.g.
 - Financial and operational gearing
 - Dividend and earnings cover
 - Profitability ratios (e.g. profit margin, ROE)
 - Liquidity ratios
- Profit variability and growth
- Growth in asset value
- Comparative figures for other similar companies

ii. The difficulties include:

- As the company is unlisted, information will be limited to that made available by the company for the public offering;
- The extent to which the available information be relied upon, i.e. has the information been audited or verified in any way?
- The company has a limited track record to use as a basis for projections, and make meaningful conclusions;
- The infrastructure expansion may substantially alter financial metrics and ratios and the prospects for the company, further limiting the usefulness of past data;
- It is very difficult to predict whether or not the infrastructure expansion will result in the company's aims being achieved, therefore considerable uncertainty and risk should be allowed for in projections;
- Emerging country risks may make economic growth projections difficult, and these depend on the economy's exposure to cyclical factors and political/policy stability.
- Competitor strategies and plans may be unavailable or unknown.
- Lack of similar listed companies in the same industry with similar size and operations set-up and similar objectives and strategies.
- While based in the emerging country, the company might operate in other countries, which will complicate the analysis and valuation.
- The impact of current and future telecommunications regulations and pricing policies/changes.
- The impact of current and future financial sector regulations, once the company obtains a listing.
- This could be the first listing of a mobile provider and analysts may not have expertise to undertake meaningful assessment.

iii. The impacts might include:

- A global recession is very likely to affect the emerging economy;
- Mobile network revenues may decline as economic growth declines, as fewer business and higher unemployment rates are likely to reduce voice and data traffic; and increased non-payment of accounts leading to higher number of defaults.
- As the infrastructure costs are mainly fixed, profits should be expected to decline;
- However mobile operators are generally defensive companies, so loss of revenues and profits would be limited;
- In addition, any negative effects might be offset if the company is able to increase its market share, e.g. through better service or innovative products;
- As investors begin to accept this view, it is possible that the PER will decline to reflect any expected decline of future profits and dividends;
- However, the defensive nature of the company is more likely to lead to increased demand for its shares as investors rotate from cyclical to defensive companies.
- Once the recession materialises, the PER could increase if earnings (denominator) declines, but otherwise PER may be expected to remain stable.

QUESTION 6

This question was well attempted by most candidates. Some were able to comment only on one aspect of the suitability of the index (i.e. method of construction or representation) and forfeited some marks.

- i. Assessing performance relative to a published index:

Key advantage – relatively easy to do as the data is readily available, and it should be reliably accurate.

Key disadvantage – the published index may not be appropriate and there may be no single index which is consistent with the investor's objectives.

- ii. Main characteristics:

- a. The DJIA index is an unweighted/price-weighted arithmetic index made up of 30 industrial shares.
- b. The S&P 500 is a free market capitalisation weighted arithmetic index made up of 500 leading US companies representing a broad cross-section of all sectors of the market.

- iii. Appropriateness as a benchmark:

- a. DJIA: unsuitable by construction and representation.
- b. S&P500: suitable by construction and representation.

QUESTION 7

- i. *Almost all candidates were able to correctly list the relevant accounting ratios but their discussion of the types of companies was generally quite limited to a mention of stable industries or mature companies. Few appreciated that a value share could be companies in industries that are out of favour due to overselling or economic cycle. Many responded that value shares are below their intrinsic value but this does not give an answer to the type of company. The marks allocated should have provided guidance that more than just a list of accounting ratios was needed.*
- ii. *This bookwork question was well answered by almost all candidates. Quite a few candidates suggested that Full Replication and using derivatives would result in a perfect tracker (or zero tracking error) which is not strictly correct.*
- iii. *The question was not carefully read. Candidates were asked to consider issues regarding the implementation of the passive component only. Many discussed how to arrive at the correct active vs passive split. Others discussed the relative merits of active versus passive. A more in-depth discussion of the types of index that could be tracked was often missing.*
- iv. *Again it seems the question was not carefully read. Candidates did not limit their discussion to performance measurement and the associated difficulties during the*

transition. While many acknowledged that any measurement and interpretation of a portfolio being traded from one strategy to another introduces complications (and earned a mark for this) they did not explore the specific difficulties, and instead wrote on how to communicate the new strategy to clients. Some merely listed the general difficulties associated with performance measurement, which are not really applicable to this situation. Many candidates also discussed how a transition would impact returns – again this was not what was asked. Many candidates did however score one to two marks for identifying the point described above, and for mentioning the use of derivatives complicating issues or for recognizing that a transition could be a lengthy exercise.

i. Types of companies:

- Value stocks may include stocks of companies:
 - which are out of favour due to the economic cycle,
 - or company fundamentals,
 - or may even have become oversold;
 - at mature stages,
 - or in relatively stable industries.

Types of measure:

- A value stock will have a higher than average ratio (i.e. appear relatively cheap) for either all or for the majority of the following ratios:
 - book to price ratio
 - dividend yield
 - earnings yield
 - cash-flow yield
 - sales to price.

ii.

- Full replication – hold all the shares in an index in proportion to their index weight.
 - Advantage – tracks the index very closely.
 - Disadvantage – costly due to frequent trading.
- Stratified sampling – representative selection of shares to broadly represent the characteristics of the shares in the index.
 - Advantage – cheaper and easier to implement than full replication.
 - Disadvantage – may diverge significantly from benchmark.
- Synthetic fund – using cash and derivatives to replicate an index.
 - Advantage – cheaper and easier to implement, depending on cost of derivatives.
 - Disadvantage – derivatives may not be available, or too expensive, in a developing country. Research costs may be higher in terms of deciding which derivatives to hold and it may introduce other risks, e.g. operational and credit risk.

iii.

- The availability of indices to track in the developing country will determine which index to track.
- The outcome of the investment may vary depending on the index selected.
 - E.g. a market index or a style index? (if the value bias to be maintained)
 - E.g. a market cap weighted or alternative weighted index?
- The selected passive portfolio should complement the satellite strategy.
- The manner in which passive exposure will be obtained, e.g. tracker unit trust, ETF, or indirectly via derivatives?
- Dependent on the size of the passive portfolio.
- Costs are important – by foregoing alpha, costs will be translated as underperformance relative to the benchmark.
- Track record of the potential passive manager – ability to track, judged by historical tracking error.
- Is the proposal consistent with the fund's mandate, or is investor approval required for the new strategy?

iv.

- Performance measurement will be difficult to assess and communicate while shares are being traded – particularly if the benchmarks are different.
- Systems may not be available to provide daily audited values of the transitional portfolio.
- Unavailability of detailed client and regulatory reporting and monitoring.
- Valuation of derivative positions, if implemented as part of the transitional strategy may be complex.
- Consideration of illiquid assets to be included in reporting.
- Issues may be protracted as transition may take a long time depending on the nature of the market.

QUESTION 8

- i. Various interpretations of the questions were possible and all logical calculations were awarded marks. Mixed results, but generally candidates did well here. However some did not know how to correctly apply the correct formulae using the return frequency – especially for Information Ratio. Others made errors performing their calculation and partial marks were awarded here. Remember to check your answers for reasonability.*
- ii. Many candidates did not discuss the interpretation of the tracking error, focusing simply on a discussion of the underperformance. It was surprising how many candidates did not understand the relationship between tracking error and active management – stating that a low was desirable for an active manager, or did not know what represented a low vs a high TE - alternatively stating that a TE of 0.3% was high. Again candidates did not make enough points for the marks awarded. The brevity (or lack) of answers suggests candidates may have run out of time (or were fatigued by this stage).*

i. Calculations:

Quarterly alphas (α) = Portfolio return Q_i – Benchmark return Q_i :

$\alpha_{Q1} = -0.4\%$; $\alpha_{Q2} = 0.5\%$; $\alpha_{Q3} = -0.2\%$; $\alpha_{Q4} = -0.3\%$

Average $\alpha = -0.1\%$

$$\begin{aligned} TE &= \sqrt{[(0.07-0.074)^2 + (0.144-0.139)^2 + (0.059-0.061)^2 + (0.05-0.053)^2]/4} \\ &= 0.0037 = 0.37\% \end{aligned}$$

$$\text{Annualised TE} = TE * \sqrt{4} = 0.75\%$$

$$\text{Quarterly Information ratio} = \text{average } \alpha/TE = -0.21$$

$$\text{Annualised IR} = \text{Quarterly IR} * \sqrt{4} = -0.21 * 2 = -0.41$$

The use of a TE formula using the (n-1) divisor with solution 0.87% p.a. is also accepted. Credit is also given for an interpretation consistent with the approach using the “standard deviation of the individual monthly relative returns”, which translates to 0.73% p.a.

ii. Interpretation of the results:

- Tracking error is quite low for an active portfolio.
- Expectation is that tracking error should be within a higher range (2%-6%).
- This implies that the manager may possibly not be taking significant positions away from the benchmark, which is not what would be expected from an active manager.
- The information ratio is quite low, which might suggest that the manager is less skilled in producing alpha given the degree of risk taken relative to the benchmark.
- The IR is negative indicating that the manager underperformed over the period.
- Both these measures should be compared to those of managers operating similar mandates over the same period to get a more meaningful assessment since the values, in isolation, may not reflect market structure or the investment environment at the time.
- Results are measured over only one year which is probably too short to draw conclusions or make decisions.

QUESTION 9

This question primarily examined candidates' understanding of the process of Asset Liability Modelling. It was reasonably attempted overall. One general point for candidates to heed, however, is the confusion between 'strategic risk' and 'actuarial risk'. Strategic risk is the focus and correct terminology for F105.

- i. *Pure core A301 bookwork. Candidates are reminded that A301 is a prerequisite for F105, particularly core concepts and definitions.*
- ii. *a. Reasonably answered, although candidates still struggle to translate broader concepts into a succinct technical problem specification.*

b. This was reasonably answered, with most candidates showing a reasonable understanding on how an Asset Liability Modelling process would be run.

c. This was the worst attempted sub-part of the Asset Liability Modelling process, with many candidates showing limited understanding of the feedback loop in the actuarial cycle.
- iii. *Simple applied bookwork question that was reasonably answered. Most candidates, however, did not recognise that this is usually how an Asset Liability Modelling exercise would be applied in practice.*

i. Strategic risk:

Strategic risk is the risk of poor performance of the strategic benchmark relative to the value of the liabilities.

It reflects the amount of systematic risk that the investor is willing to accept in an attempt to enhance long-term investment returns.

ii. ALM within the context of the actuarial control cycle:

a. Specifying the problem

- The key objective of the ALM exercise is to determine the optimal asset portfolio allocation (i.e. that minimizes strategic risk).
- Hence, the outcome would consist of specific (fixed) percentages allocated to each allowable asset class which the investment manager is expected to follow.
- Strategic risk is the most significant part of the total risk budget.
- As a boundary condition, the company must remain solvent during the projection period: i.e. at all instances the MV of assets – MV of liabilities (economic capital) must exceed zero.
- The choice of percentile point on the distribution of available economic capital reflects the company's risk appetite, e.g. 99th percentile.
- The more risk averse the company, the further into the tail the percentile is chosen.
- The distribution of available economic capital needs to be determined at the end of each financial year over the 5-year projection period.

- Thus, in summary, the objective can be expressed as choosing the matching asset portfolio allocation that minimises the 99th percentile VaR of the available economic capital at the end of each financial year over the five-year projection period.
- One additional consideration is how to appropriately weight the different VaR values for each of the years, e.g. equally weighted (or any reasonable suggestion).

b. Developing a solution

- Suitable assumptions to use in the ALM must be agreed, which would include any parameters used in the modelling, as well as asset models.
- As the projected liability values are given, the ALM must focus on projecting asset values.
- The ALM need not take into account active risk nor structural risk.
- For each asset class included in the strategic asset allocation, total investment returns must be projected, which will include income and capital values.
- The modelling can be carried out using either deterministic or stochastic methodologies, or a blend of modelling techniques.
- Stochastic modelling would require a distribution assumption and model for each asset class, e.g. Markov regime switching model (or any other reasonable suggestion) whereas deterministic modelling with scenario analyses could be used to generate distributions.
- The model must allow for volatilities and correlations between asset classes, e.g. copulas (or any other reasonable suggestion).
- ALM must allow for expenses (e.g. brokerage fees) and tax (e.g. tax on bond coupons).
- Need to determine whether or not rebalancing of the asset portfolio should be allowed, and the frequency thereof.
- Data must be collected to carry out the projections.
- Run sufficient simulations to produce credible results, e.g. 10 000 simulations (accept any suggestion $\geq 10\,000$).
- Test the sensitivity of the results to different parameter and / or asset model assumptions.
- Identify the strategic asset allocation that meets the primary objective.
- Summarise, present and discuss the results with the Investment Committee.

c. Monitor the experience:

- The model must be regularly reviewed as it is a key input into strategic investment decisions.
- It may require updating the parameters (to mitigate exposure to parameter risk) and asset model choice (to mitigate exposure to model risk) to account for changing market and economic conditions and new modelling technology.
- The model may require testing of different strategic asset allocations over time to include additional / new asset classes.
- It may be necessary to replace the existing model with a new model.
- The experience must be monitored to assess the robustness of the outcome / advice.

iii. A dynamic liability benchmark may be more appropriate:

- The liabilities of a financial services company are unlikely to be static.
- A static liability benchmark could rapidly become inappropriate resulting in unacceptable strategic risk.
- A dynamic liability benchmark for investing the assets changes as the underlying liabilities change.
- It is a better reflection of the underlying liabilities than the static benchmark.