

INSTITUTE AND FACULTY OF ACTUARIES

EXAMINERS' REPORT

September 2016

Subject SA6 – Investment Specialist Applications

Introduction

The Examiners' Report is written by the Principal Examiner with the aim of helping candidates, both those who are sitting the examination for the first time and using past papers as a revision aid and also those who have previously failed the subject.

The Examiners are charged by Council with examining the published syllabus. The Examiners have access to the Core Reading, which is designed to interpret the syllabus, and will generally base questions around it but are not required to examine the content of Core Reading specifically or exclusively.

For numerical questions the Examiners' preferred approach to the solution is reproduced in this report; other valid approaches are given appropriate credit. For essay-style questions, particularly the open-ended questions in the later subjects, the report may contain more points than the Examiners will expect from a solution that scores full marks.

The report is written based on the legislative and regulatory context pertaining to the date that the examination was set. Candidates should take into account the possibility that circumstances may have changed if using these reports for revision.

Luke Hatter
Chair of the Board of Examiners
December 2016

A. General comments on the *aims of this subject and how it is marked*

1. The aim of the Investment Specialist Applications subject is to instil in successful candidates the ability to apply knowledge of the United Kingdom investment environment and the principles of actuarial practice to the selection and management of investments appropriate to the needs of investors.
2. Candidates are reminded to ensure that their answers are sufficiently detailed to demonstrate understanding, as there were instances where inadequate explanations led to candidates scoring less well on questions than they might have done. The model solutions are intended to reflect the level of detail that a high scoring candidate might be able to produce. For many questions there are more marks available than the question requires to achieve full marks. This reflects that the examiners will give credit for valid alternative solutions, particularly in questions focussed on higher level skills.
3. Candidates who give well-reasoned points, not in the marking schedule, are awarded marks for doing so.

B. General comments on *student performance in this diet of the examination*

This paper was relatively well answered. Candidates in general demonstrated a good grasp of Core Reading and were able to apply this knowledge in familiar situations. A number of candidates struggled to score well in parts of questions where higher order skills were being assessed, or where numerical analysis was required.

C. Pass Mark

The Pass Mark for this exam was 55.

Solutions

- Q1** (i) Quantitative Easing (QE) is a monetary policy used by some central banks to increase the supply of money. [1]
It usually involves both a direct increase in the money supply [½]
and a knock-on effect from the fractional reserve system, [½]
increasing the money supply further. [½]
Although it can involve just making changes to the fractional reserve system, [½]
which increases the money supply. [½]
- QE is usually implemented by a central bank by first crediting its own account with money it creates ex nihilo (“out of nothing”). [1]
It then purchases financial assets, for example government bonds, agency debt, mortgage-backed securities and corporate bonds, [1]

from banks and other financial institutions in a process referred to as open market operations. [1]

It can also involve changing the reserve requirements that through the fractional reserve system would increase the money supply. [1]

[Maximum 5]

- (ii) QE drives up the prices of assets making those with assets more wealthy. [1]
This includes borrowers who have used credit to purchase assets. [1]
The more assets owned by an individual, the more they will have gained from QE. [1]

If you have no assets or very little assets, you have gained nothing or only very little. [1]

Due to this, everybody becomes relatively poorer than those who were richer than them in terms of asset wealth. [1].

Consequently, QE is likely to result in a significant increase in inequality levels. [1]

[Maximum 4]

- (iii) Underfunded pension schemes have fewer assets than liabilities, [½]
so the value of the liabilities is likely to increase by more than the asset value under QE. [1]
This would lead to the scheme being worse off, [½]
depending on the asset allocation. [½]
These schemes effectively have negative wealth. [½]
They are directly and indirectly worse off from QE. [½]
Hedging interest rate risk can mitigate this effect. [1]

[Maximum 3]

[Total 12]

Question 1 was the best answered question on the paper. All three parts were well answered although only a few candidates achieved close to full marks despite the question being largely knowledge and application based.

- Q2** (i) **Market sell-order:** A sell order for immediate execution given to a broker to sell at the best obtainable price in the market. [2]

Stop order: An order to sell at the market price once a specified level has been reached. Once the market has reached this designated price, the order is executed at the best price possible, even if this is less favourable than the stop price. [2]

Limit order: An order given to a broker by the investor that specifies a price; the order can be executed only at the designated price, or better. [2]

[Maximum 6]

(ii) **Using volatility futures as an equity tail hedge**

Equity markets generally rise at a slower rate than the rate at which they decline. [1]

This can be seen in the negative skew in the distribution of historical equity returns. [1]

Consequently, historic market volatility measures are typically depressed during long slow market advances [½]
and more elevated during market downturns, [½]
and indeed they spike to very high levels during market crashes. [½]

Forward-looking market volatility measures (e.g. the VIX index, or implied volatility in options markets) [1]
are correlated with historical volatility. [½]
However they can diverge quite significantly at times of market stress due to “lags”. [1]

Therefore a long equity portfolio can be hedged to some extent by a long volatility position, [1]
albeit it will be an approximate hedge. [½]
Hedge ratios would need to be estimated in order to determine how many long volatility contracts would need to be used [1]
to hedge the sensitivity of the equities. [½]

Additional basis risks could arise if the volatility hedge is based on different equities to the equities that are owned. [1]

Ideally, this hedging technique would be used along with the other hedging techniques mentioned above. [1]

[Maximum 7]

(iii) **Call option on the VIX**

Market falls are likely to result in an increase in the VIX. [½]
All else being equal, this will increase the price of a call option on the VIX. [½]

Therefore a sensitivity hedge could be constructed that would rise in value when the VIX rose, [1]
which is correlated to the value of an equity portfolio falling. [½]

[Maximum 2]

VVIX (the VIX of VIX, the volatility of the VIX)

Market falls are likely to result in the VIX changing more quickly, so the VVIX will increase. [1]
Therefore a sensitivity hedge that was long the VVIX will rise in value when the VIX rose, [1]
which is correlated to the value of an equity portfolio falling. [½]

[Maximum 2]

[Maximum 4 – 2 for each example]

(iv) Purchase equity puts

Equity puts could be purchased to provide protection against equity falls. [½]
When equity markets fall the puts will rise in value. [1]
Under this approach the resulting portfolio will underperform in rising markets (due to the cost of the options) [1]
whereas it will outperform in falling markets (as the maximum loss is the option premium). [1]

[Maximum 3]

Equity returns could be paid out using total return swaps

A total return swap allows the owner of equities to pay equity returns and receives cash plus/minus a spread. [1]
Typically these are based on equity prices plus dividends, unlike futures which are typically price returns only. [1]
Therefore, it is equivalent to selling equity futures. [½]
Equity TRS can be written on a wide range of equity indices or baskets, not necessarily corresponding to a futures contract. [1]

[Maximum 3]

Selling call options

Instead of buying protection against falling equity prices, calls could be sold. [1]

Under this approach a premium would be received whilst no payout would be required so long as equity markets did not rise to the call strike. [1]
Losses are potentially unlimited if equity markets rose. [½]

[Maximum 2]

[Maximum 6 – 2 for each example]

[Total 23]

Question 2 was reasonably well answered by most candidates although some candidates struggled with parts (ii) and (iii) due to a lack of familiarity with volatility derivatives.

Q3 (i)

- The **nature of the institution**, i.e. a pension scheme may feel more free to take risk compared to for example a life insurance company or bank [1]
- **Investment beliefs**, including the outlook for achieving positive risk-adjusted returns in different asset classes [1]
- **Regulatory requirements**, including accounting disclosure and accounting treatment of surpluses and deficits [1]
- Presence of the **Pension Protection Fund**, including impact of risk level on Pension Protection Fund levy [1]
- Historical experience of risk events unfolding and **current volatility** of investment markets (equity, credit, property, bonds etc.) [1]
- **Strength of Sponsor covenant**, for example size of balance sheet, current revenue and earnings and growth prospects. Having a strong Sponsor may increase risk appetite [1]
- Existence of any **off-balance sheet protection**, for example escrow accounts or (third party) guarantees, increasing the ability to take risk [1]
- **Term and nature of liabilities**. A Scheme with a longer time horizon may have a higher risk appetite [1]
- **Cash flow position**, cash flow positive schemes may be able to take more risk [1]
- Agreed **schedule of contributions**, time horizon for fully funded and front-loading versus back-loading of schedule [1]

- **Current funding level**, better funded Schemes may be able to take more risk, but worse funded schemes may need to take more risk to make up any deficit [1]
- **Governance structure** in place, for example ability to diversify ability to react quickly would be better should the Scheme have a strong governance structure in place [1]
- **Return required** to meet objectives may also influence risk appetite [1]
- **Industry norms** whilst external to an investor can influence appetite [1]
- [Maximum 9]

(ii) Decisions will be needed on how to make use of the following data related aspects: [½]

- The length of time over which observations should be used [½]
- Frequency of observations used, e.g. daily, weekly, monthly data [½]
- Data sources, selection of indices and geographical markets [½]

Whilst carrying out the analysis, subjective decisions will be needed on the following: [½]

- The way that outliers are treated [½]
- Relevance of the data period, including consideration of whether there has been a regime change during the data period [1]
- Use of proxies. [½]
- If the data period has seen regime changes, then some of the data will be less relevant to the current period [1]
- However if the data period is without regime changes, then volatility is likely to be underestimated [1]
- Correlations also change over time between different asset classes. [½]
- Survivorship bias for some asset classes [1]
- Some asset classes have seen changes to their risk levels, for example gearing levels can increase or decrease over time in equity markets [1]
- The fact that asset income can be affected by political interference, legal and tax changes which cannot be predicted with any accuracy [1]

[Maximum 7]

(iii) By repo-ing some of the Scheme's existing bonds, and using the cash generated to buy more long-dated government bonds, [1]

the Scheme can increase exposure to interest rates and inflation within the asset portfolio. [1]

This means that the Scheme hedge a higher proportion of its liability interest rate and inflation risk, [1]
without fully funding the hedge assets. [½]

A full duration match can sometimes be achieved by using only 30% of the Scheme's funds, [1]
leaving the remainder available to invest in other assets. [½]

The funding cost of repos is the repurchase rate, [½]
and this is unknown beyond the term of the current repos. [1]

The Scheme will take on further credit exposure to the governments whose bonds it buys. [1]

At expiry of the repos any gains or losses will be cash-settled. [1]
Therefore a liquid cash pool will be needed to cover such payments [½]
although repos could be used to generate cash. [½]

A haircut of up to 5% may be required [½]
and collateral will be required to be posted to cover any losses on the repo [½]
and would be received as a result of any gains. [½]
Therefore a pool of cash or government bonds will be required to cover these requirements. [1]

Counterparty exposure to repo counterparties will need to be managed appropriately. [1]

The requirement to roll repos on an ongoing basis should also be considered and managed. [1]

[Maximum 8]

- (iv) There would be some initial collateral requirements, due to haircuts on the gilts. [1]

At outset there would be no variation margin since the value of gilts sold would be identical to their agreed purchase price (allowing for coupons). [1]

However when interest rates rise, the value of gilts posted will fall and additional gilt or cash collateral will need to be posted. [1]

Similarly when interest rates fall, the value of gilts posted will rise and the counterparty bank will post gilt or cash collateral back to the Scheme. [1]

This process will continue daily for each repo until it is rolled over, [½]
at which point the expiring repo is cash settled [½]

and a new repo is entered into at current market levels. [½]

Therefore, in general significant mark to market gains or losses are unlikely to build up, however there will be regular cash settlements. [1]

As such leverage and liquidity management are key priorities for repo-based portfolios. [1]

[Maximum 6]

- (v) $P(T)$ = the price of a zero coupon bond maturing in T years (or the discount factor applying to the period T) [1]
 L = is the notional amount of the swaption [1]
 A = is the annuity value of the underlying par swap [1]
 X = the strike level of the swaption [1]
 F = the current at-the-money-forward rate of the underlying swap [1]
 T = time to expiry of the option [1]
 σ = implied volatility of the swap rate [1]

[Maximum 2]

- (vi) $L = 200,000,000$
 $A = (1 - 1.03^{-30})/0.03 = 19.6004413$
 $R_X = 2.5\%$ (strike, K or X)
 $F_0 = 3.0\%$ (forward level, S or F_0)

Using the formulas given in the question:

$$d_1 = (\ln(3.0/2.5) + (0.3^2 * 1/2))/0.3 * \sqrt{1} \sqrt{1} = 0.7577385 \quad [1]$$

$$d_2 = (\ln(3.0/2.5) - (0.3^2 * 1/2))/0.3 * \sqrt{1} = 0.4577385 \quad [1]$$

$$\Phi(-d_1) = 0.22430377 \text{ or } 0.22430845 \text{ (or other similar answers, dependent on level of rounding and use of tables)} \quad [½]$$

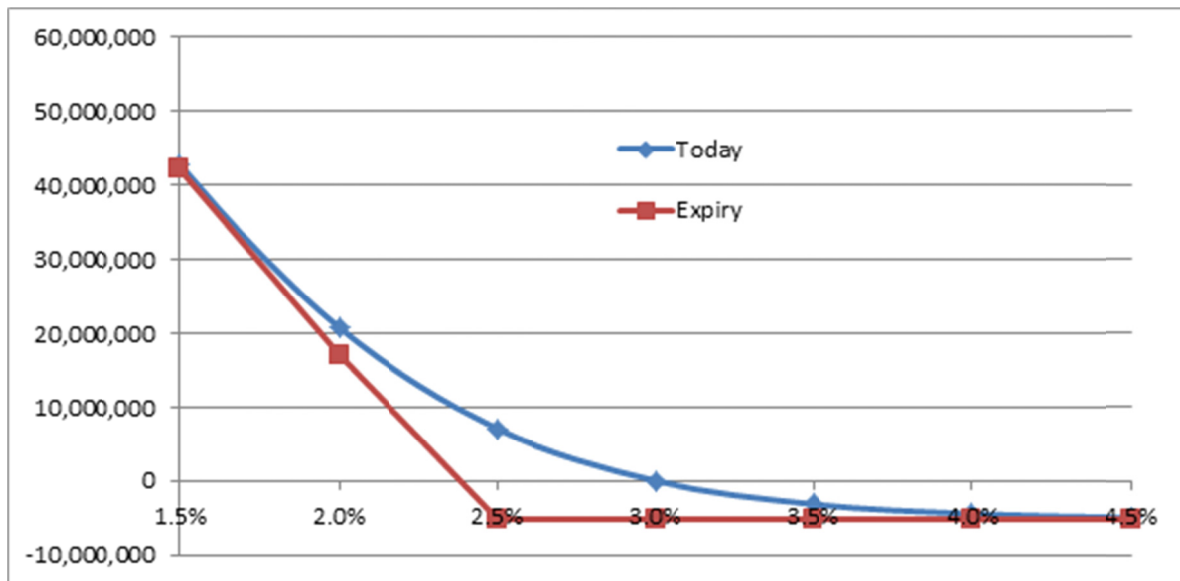
$$\Phi(-d_2) = 0.32357015 \text{ or } 0.32357414 \text{ (or other similar answers, dependent on level of rounding and use of tables)} \quad [½]$$

Remember to include one year of discounting, which is 1.01^{-1} in the formula below

$$\begin{aligned} \text{Receiver premium} &= 200,000,000 * 1.01^{-1} * 19.6004413 * [0.025 * \\ &0.32357015 - 0.03 * 0.22430377] \\ &= £5,279,081 \text{ or } £5,278,922 \text{ (dependent on level of rounding and use of tables)} \end{aligned} \quad [1]$$

[Maximum 4]

(vii)



Payoff at expiry:

Payoff above 2.5% equal to loss of premium paid in (vi) [1]

Payoff below 2.5% becomes increasingly positive, straight line [1]

Payoff today:

Above payoff at expiry and converges to payoff at high and low interest rates [1]

Nil value at 3% interest rate [1]

[Maximum 4]

(viii) (a) **Interest rates rise**

The increase in interest rates has led to the swaption losing a significant proportion of its value, as the probability of the option expiring in the money has significantly reduced. [1]

The swaption now only provides downside protection once interest rates fall by 1.5% (instead of 0.5% at outset), [½]
so the delta of the swaption and hence the level of (PV01 or delta) protection will most likely have decreased significantly. [½]

(b) **Interest rates fall**

The decrease in interest rates has led to the swaption increasing in value. [½]

The Scheme will have enjoyed some protection against interest rates falling. [½]

The swaption is now in the money and will have a high delta, [½]
effectively providing a higher level of overall hedging. [½]

[Maximum 4]

(ix) Considering the decision to eliminate the remaining interest rate risk completely, [½]
the most appropriate actions at any point would be:

1. Keep the strategy in place until maturity and then review [½]

2. Roll the swaption into a new one that achieves the original objective [½]

3. Replace the swaption with a full (linear) hedge (e.g. swaps or gilts plus repo approach) [½]

Keeping the strategy in place until maturity has the benefit of avoiding transaction costs. [1]

Keeping the strategy may be a pragmatic decision from a governance perspective. [½]

Rolling the strategy when rates have risen has the benefit of being able to increase the amount of protection and effectively lock into higher interest rates and extending the time horizon of protection. [1]

The Scheme could consider closing the swaption and replace the hedge with a linear hedge, which would crystallise the increased option value when rates have fallen or lock into higher rates when rates have risen. [1]

Replacing the swaption with a full (linear) hedge would have the benefit of reducing the amount of complexity in the investment strategy and ongoing governance burden and associated costs. [1]

A downside of replacing the swaptions with a linear hedge is less upside in potential in the event of interest rates rising [1]

[Maximum 6]

[Total 50]

Question 3 was the least well answered question overall although most candidates answered parts (i) to (iii) reasonably well. The majority of candidates struggled with the later parts of the question which relied on numerical or higher order skills.

Q4 Liability matching characteristics

EM inflation-linked debt would not be a close match for the investors' liabilities, [½]
and therefore the existing interest rate and inflation hedge would need to be replaced
with domestic assets, [1]
or the investor would need to accept a lower level of hedging. [1]

Diversification

EM debt can be a useful diversifier to developed market debt [½]
although major corrections in emerging markets can be driven by crises originating in
developed markets. [1]

The valuation case

Over the longer term EM debt has generally outperformed developed market debt [1]
and this would be expected to continue due to macroeconomic/secular trends [½]
(normalising business cycles, younger demographic profile, expanding middle class,
growth driven by domestic demand means higher EM GDP growth vs DM growth,
lower debt/GDP ratios in EM vs DM) [½ per point for two points]

Cyclical headwinds and misconceptions about current EM strength may present
attractive entry points. [1]
This may include expected currency appreciation. [½]

Much of the recent volatility in EM debt is tied to perceived sovereign financing
difficulties in an environment of rising global interest rates [1]
rather than fundamental credit weakness. [½]

EM assets structured properly can offer high risk adjusted returns. [½]
Where the investor needs to hold additional capital, this would need to be allowed for
in the valuation assessment. [1]

Risk factors

EM linkers can have significant sovereign credit risks, unlike most DM linkers which
tend to be high quality. [1]

EM linkers are in general less liquid than fixed debt from the same issuer. [1]

At present levels of credit spread, investors may not be adequately compensated for
the additional sovereign credit risks. [1]

The legal framework in emerging markets is in a number of cases less favourable
towards overseas investors than would be the case in major developed markets. [1]

EM inflation measures tend to be less robust than those of major developed markets,
[½]

with greater involvement of the government in setting methodology and measurement. [1]

Where an economy experiences very high inflation, the currency is likely to depreciate which will erode a positive real return in the local currency. [1]

Market structure

In recent years the depth and breadth of EM markets have improved significantly making them more investable and liquid. [1]

There may still be a relative “illiquidity premium” due to market inefficiencies. [1]

The EM linker market has doubled in size in last five years. [1]

The EM linker universe is dominated by Brazil so the fund would need to adopt a custom benchmark rather than adopting a market capitalisation benchmark. [1]

Returns relative to DM linkers

In inflationary environments, EM linkers capture proportionately more of upside due to greater commodity weight in their CPI measures than DM CPI measures. [1]

In deflationary environments, inflation tends to fall less in EM countries due to domestic inflation in the service sector. [1]

Low sensitivity of EM real rates to DM nominal rates – so would be expected to perform better than DM linkers in a rising DM interest rate environment. [1]

However, inflation in EM is not linked with domestic inflation so there will be significant basis risk for an investor seeking a return linked to a domestic CPI measure. [1]

The investor may adopt a lower hedge ratio to reflect the positive correlation between DM real rates and EM real rates. [1]

. [Maximum 15]

Question 4 was fairly well answered. However a number of candidates failed to generate a sufficient number of points in their answers despite credit being given for a wide range of relevant comments.

END OF EXAMINERS' REPORT