APM Model Solutions
Spring 2013

1. Learning Objectives:

8. The candidate will understand the behavior characteristics of individual and firms and be able to identify and apply concepts of behavioral finance.

Learning Outcomes:

(8a) Explain how behavioral characteristics of individuals or firms affect the investment or capital management process.

(8c) Identify and apply the concepts of behavioral finance with respect to individual investors, institutional investors, portfolio managers, fiduciaries and corporate managers.

Sources:

Byrne & Brooks, "Behavioral Finance: Theories and Evidence"

V-C171-09: Behavioral Finance and Investment Committee Decision Making

Commentary on Question:

Commentary listed underneath question component when available.

Solution:

(a) List and describe four behavioral biases that may inhibit an individual from making rational financial decisions.

Commentary on Question:

The question requires candidate to identify and describe only four biases; additional credit is not given for more than four biases. The model solution below lists and describes seven biases, but full credit will be earned for any four of the seven.

Overconfidence and overoptimism – investors overestimate ability and accuracy of the information they have;
Representitiveness (heuristics) – investors assess situations based on superficial characteristics rather than underlying probabilities (ex.: putting more weight on knowing a person who owned a Ford, rather than considering Ford's overall company statistics);
Conservatism – forecasters cling to prior beliefs in the face of new information (or mention of "sell winners; hold losers" mentality);

1. Continued

Frame dependence / anchoring / extrapolation – the form of presentation of information will affect the decision made;
Mental accounting – allocating wealth to separate mental compartments and ignoring correlation effects;
Regret aversion – individuals make decisions in a way that allows them to avoid feeling emotional pain in the event of an adverse outcome;
Misconceptions of randomness – trying to apply a pattern to a random event.

(b) List biases that are introduced when relying on committees, instead of individuals, to make decisions.

Committees do not learn from experience, lack of memory on prior decisions, poor feedback cycles;
Homogeniety;
Common knowledge syndrome;
Task-oriented agendas;
Pressure to conform/ social pressures;
Expert authority can induce convergence.

(c) Identify examples in the case study reading where these biases may be present.

Homogeniety – all retirees, except one age 30 unemployed; 4 of 5 are ex-Wonka employees; 1 individual member dissents on major decisions but is out-voted/overruled (see Nominating Committee);
Task-oriented agendas – Audit committee focus could be lacking; no attention is given to review of Mark Peacock's audit reports;
Pressure to conform/ social pressures- Lyon is on several boards and appears to be driving many of the decisions. The Wonka vote outnumbers the independent vote 4 to 1.

(d) Assess the effectiveness of the Investment Committee and Risk Management Committee at Wonka Life.

Investment Committee
Major decisions were postponed. Mr. Salmon is concerned about regret;
Recommendations: Put major decisions at the top of the agenda; if a meeting cannot be held, find another means of coming to a concensus; thank members for contributions – openly regretting prior decisions will not help in future discussions.

1. Continued

Risk Management Committee
This group appears to be running the most effectively, including meeting quarterly, relying on reports and interviews with key people (actual facts) to drive decisions;
Recommendations: This is the most effective team outlined in the reading; don't disband it.

2. Learning Objectives:

1. Candidate will understand and be able to follow the investment management process for insurance companies, pension funds and other financial intermediaries.

3. The candidate will understand the importance of the techniques and theory behind portfolio asset allocation.

5. The candidate will understand the specific considerations relative to managing an equity and/or alternative asset portfolio within an asset allocation framework.

6. The candidate will understand the specific considerations relative to managing a fixed income portfolio within an asset allocation framework.

Learning Outcomes:

(1c) Determine how a client's objectives, needs and constraints affect the selection of an investment strategy or the construction of a portfolio. Considerations include:

- Funding objective
- Risk-return trade-off
- Regulatory and rating agency requirements
- Risk appetite
- Liquidity constraints
- Capital, tax and accounting considerations

(1d) Identify and describe the impact on investment policy of financial and non-financial risks including but not limited to: Currency risk, credit risk, spread risk, liquidity risk, interest rate risk, equity risk, product risk, operational risk, legal risk and political risk.

(3c) Evaluate the significance of liabilities in the determination of the asset allocation.

(5c) Evaluate situations associated with the presence of embedded options and hedging strategies.

(5d) Recommend an investment strategy for a given situation:

- Portfolio policy and objectives
- Asset selection criteria
- Capital market expectations
- Risk management strategy
- Portfolio rebalancing strategy

(6e) Show the impact of risk analysis, including interest rate and equity risk, on portfolio construction.

2. Continued

(6g) Explain how derivatives, synthetic securities, and financial contracting may be used to manage risk and recommend appropriate ones for a given situation.

Sources:
Marginn & Tuttle, Managing Investment Portfolios

- Chapter 3, Managing Institutional Investment Portfolios, pgs. 68, 72 and 73
- Chapter 8, Alternative Investments to Portfolio Management," by Yau, Schneeweis, Robinson & Weiss

V-C111-07: Creating Value in Pension Plans (Or, Gentleman Prefer Bonds)

V-C185-11: Mind the Gap: Using Derivative Overlays to Hedge Pension Duration, Financial Analysis Journal, Volume 65, #4 CFA Institute

V-C135-08: Living with Mortality: Longevity Bonds and Other Mortality Linked Securities, by Blake, Cairns and Dowd, Institute of Actuaries, 2006 (Sections 3 – 5)

Commentary on Question:
Commentary listed underneath question component when available.

Solution:

(a) One member has asked for a review of the risk objectives and risk tolerance of the plan, as well as its liquidity needs.

(i) Identify and describe four factors that affect the risk objectives and risk tolerance of the employees' DB pension plan.

Commentary on Question:
The question requires candidate to identify and describe only <u>four</u> factors; additional credit is not given for more than four factors. The model solution below lists and describes five factors, but full credit will be earned for any four of the five.

Factors affecting the risk objectives and risk tolerance of a DB pension plan:

<u>Plan status</u>
Plan funded status (whether it is in surplus or deficit). A higher surplus or a higher funded status implies greater risk tolerance. Vice versa, a plan in deficit implies a lower risk tolerance.

<u>Sponsor financial status and profitability</u>
Lower debt to total assets, and higher current & expected profits of the sponsor (Wonka Life) imply a greater risk tolerance.

2. Continued

Sponsor and Pension Fund common exposures
High correlation of sponsor (Wonka Life) operation results with pension plan returns implies a lower risk tolerance, all else being equal.

Plan Features
Options like provision for lump-sum distributions, early retirement and cost-of-living adjustments tend to reduce the duration, implying a lower risk tolerance, all else being equal.

Workforce Characteristics
Age of the workforce (Wonka Life's average = 49 years) and actives-lives relative to retired-lives (Wonka's retired-lives represent 25% of the total). The younger the workforce and the greater the proportion of active lives then the greater the duration of plan liabilities and the greater risk tolerance.

(ii) Comment on the factors affecting the plan's liquidity requirements, and outline an investment strategy to meet any substantial liquidity requirements that may occur.

Commentary on Question:
Just identifying the factors is not enough as the question asks for comments.

A plan's liquidity requirement = benefit payments minus contributions.

Factors affecting liquidity:

- The greater the number of retired lives, the greater the liquidity requirement, all else being equal
- Wonka's retired employees currently at 25%, so unlikely to create substantial liquidity requirement in the near future, even with 5% annual increases related to Consumer Price Index
- The smaller the plan contributions, the greater the liquidity requirement
- Plan features like lump-sum options and/or option to retire early cause higher liquidity needs

Investment strategy for any substantial liquidity needs:

- Hold a buffer of cash & money market instruments (versus the Wonka pension plan's current 0% in cash)
- With cash balance buffer, gain equity or bond exposure by stock index future or bond future contracts.

2. Continued

(b) A second member of the Board has suggested that in order to mitigate the volatility in its funding status, the pension plan should sell all of its holdings in Equity, Real Estate and Hedge Funds and invest the proceeds in longer maturity bonds so that the durations of the assets and liabilities match.

Describe the advantages and disadvantages of the above proposal.

Advantages:

- Possible tax benefits when considering consolidated sponsor/plan tax picture (Tepper's arbitrage & Fisher Black's arbitrage) of holding bonds in the pension plan
- There is little or no evidence that equities are a hedge against future salary increases
- Bonds will improve the overall Wonka's risk profile (security)
- Duration matching also reduces risk
- Risk-adjusted returns for equities & bonds may be equal
- Investing in bonds means getting out of lackluster performance of stock market of the past several years
- Reduced fees of investing in bonds vs. equity.

Disadvantages:

- No diversification when invested entirely in bonds
- If there are lower returns from bonds, even after adjusting for higher risk of equities, this would increase plan contributions in future years
- Pricing of long futures (to match pension longer time-horizon) may be wrong.

(c) A third member has suggested that there are ways of leaving the current asset allocation unchanged but still mitigate volatility in the funding status, by transforming the risk attributes using derivatives to hedge the duration mismatch.

(i) Calculate the impact to the economic surplus of the pension plan if current interest rates were to decrease instantaneously by 25 bps in a parallel shift of the yield curve on 12/31/10, using the risk profile information given on page 40 of the Case Study.

Commentary on Question:
Partial credit was given for the various steps of the calculation in the solution below.

Interest rate sensitivity of the pension plan:

Liability duration = 17.1 (as given in Case Study)

2. Continued

Liability value = $340.2 M (as given in Case Study)
Shock of -25 pbs => 17.1 / 100 * 0.25 * $340.2 M = increase of $14.54 M

Asset duration = 20% * 5.1 (Fixed Income) + 80% * 0 = 1.02 years
Asset value = $321.4 M (as given in Case Study)
Shock of -25 pbs => 1.02 / 100 * 0.25 * $321.4 M = increase of $0.82 M

So net decrease of surplus (economic value) = +$0.82 M (assets) - $58.17 M (liability) = -$13.72 M

(ii) Calculate the amount of 10-year interest rate swap that would be needed to minimize the interest rate risk of the funded ratio (Asset / Liability), assuming that the duration for the available 10-year swaps is 7.2 years and that all assets other than fixed income have a duration of zero.

Commentary on Question:
Partial credit was given if a candidate used the dollar duration of the liability as the target.

Interest rate derivative overlay strategy:

Current asset portfolio duration = 1.02 years (already calculated in i))
10-year swap duration = 7.2 (given)
Target duration = 17.1 (objective = duration of liability)
Market Value of asset portfolio = $321.4 M (as given in Case Study)

NP = $321.4 M * (17.1 – 1.02) / 7.2 = $717.79 M (10-yr swap notional))
(as per formula in Study Note)

(d) A fourth member of the Board has commented that due to the long-term nature of the DB plan's liabilities, a substantial holding in equity type investments is necessary. However, in order to take advantage of higher returns in alternate equity investments, he has proposed that all of the current 30% in Domestic Public Equities should be switched to Domestic Private Equities.

Describe the advantages and disadvantages of the above proposal for the pension plan.

Commentary on Question:
Full credit for this question is possible even if all the points in the solution below are not mentioned.

2. Continued

Advantages:

- Private equities have had historically higher returns
- Limited information available for private equities can be an advantage due to price anomalies it creates from which a good researching investor could benefit.

Disadvantages:

- All domestic private equity means no diversification within the domestic equity holdings
- It is difficult to construct a benchmark index for private equities – often custom benchmarks are used
- Appraised values in private equity, vs. market prices, are slow to adjust to new circumstances, so the calculated returns may be erroneous
- Illiquid – no secondary market for private equities – difficult to find a buyer
- Private equities have higher cost of sale and purchase
- They also have a higher risk than public equity; risk of complete loss is also higher
- A capital commitment period is typical for private equities
- Much higher level of evaluation/due diligence, financial/legal review is necessary than for public equities.

(e) Another member is worried about the effect of continuing improvement in mortality of the DB plan members. She has suggested that the trustees consider using mortality swaps, mortality futures or longevity bonds to help the plan mitigate the longevity risk.

(i) Compare the advantages and disadvantages of mortality swaps and mortality futures as instruments to manage the longevity risk.

Commentary on Question:
Full credit for this question is possible even if all the points in the solution below are not mentioned.

- Mortality linked securities have the usual features we would expect of bonds, swaps, futures and options
- Mortality swaps being OTC can be tailor-made and can be designed with lower basis risk
- Mortality swaps can also be arranged at low transaction costs and are flexible instruments
- Mortality swaps have the disadvantage that they could have thin secondary markets being OTC and this could make positions harder to unwind (low liquidity)

2. Continued

- Mortality swaps have potentially greater credit risk being bilateral agreements
- Mortality futures being exchange-traded have the attraction of great market liquidity which facilitate unwinding, but have the disadvantage of greater basis risk since they are less customizable
- Credit risk on futures is handled by the exchange itself, which means exchanges guarantee all trades so traders no longer have to worry about each other's credit worthiness
- However, this protection comes at the cost of margin payments and other restrictions imposed by the exchanges.

(ii) Describe key considerations in the selection of a longevity bond.

Considerations in the selection of a longevity bond:

- Time horizon of the bond: Too short a time horizon would likely provide a less effective longevity hedge than a bond with a longer horizon would
- The amount of capital required: Some designs (e.g. the BNP bond) might require capital that is too high relative to the reduction in risk exposure
- The degree of model and parameter risk
- Level of basis risk relative to the price being charged
- The underlying mortality/survival index used.

3. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

6. The candidate will understand the specific considerations relative to managing a fixed income portfolio within an asset allocation framework.

Learning Outcomes:

(4c) Describe, contrast and assess techniques to measure interest rate risk.

(6c) Evaluate situations associated with the presence of embedded options and hedging strategies.

(6d) Recommend an investment strategy for a given situation:

- Portfolio policy and objectives
- Asset selection criteria
- Capital market expectations
- Risk management strategy
- Portfolio rebalancing strategy

(6g) Explain how derivatives, synthetic securities, and financial contracting may be used to manage risk and recommend appropriate ones for a given situation.

Sources:

Fabozzi, Handbook of Fixed Income Securities, 8th Edition 2012

- Chapter 48, Hedging Interest Rate Risk with Term Structure Factor Models
- Chapter 61, Controlling Interest Rate Risk with Futures and Options

Maginn and Tuttle, Managing Investment Portfolios, 3rd Edition, 2007

- Chapter 6, Fixed-Income Portfolio Management, by Fong & Guin, pgs. 373 – 384

V-C189-11: Salomon Smith Barney, Mortgage Duration and Price Moves, March 6, 2001

Commentary on Question:

Commentary listed underneath question component when available.

Solution:

(a) Estimate the market value of surplus for the Traditional Life Products Portfolio assuming the yield curve shifts downwards by 70 bps.

3. Continued

Commentary on Question:
The market value of surplus can be estimated by calculating the impact to assets and liabilities of a 70bps downward shift using durations or dollar durations. Alternatively it can be estimated by directly looking at the impact to surplus using duration of surplus or dollar duration of surplus. You might get different answers depending on which input you used (for example, the duration of surplus in the case study is actually inconsistent with the dollar duration of surplus), but full credit would have been granted to any correct approach. Care should be paid to units as the market values and dollar durations in the case study were quoted in thousands.

For example (using durations of assets and liabilities)

When rates decrease by 70 bps:
Asset MV = [1+(7.8%*70/100)]*309.7M = 326.6M
Liability MV = [1+(13%*70/100)]*318M = 346.9M
Estimate MV of Surplus =326.6 – 346.9 = -20.3M

(b) Describe how the following interest rate derivatives can be used to manage Wonka's Traditional Life Products Portfolio risks.

(i) Futures

(ii) Swaps

(iii) Options

Commentary on Question:
Full credit could be received whether describing futures/options on interest rates or bond prices as long as the decision (e.g. buy a bond future) is consistent with the risk being managed (e.g. hedge against low/falling interest rates).

(i) Futures

Prices of bond futures contracts are negatively correlated with changes to interest rates. Buying a futures contract will increase the portfolio's duration and can be used to hedge the loss in surplus when interest rates fall. Selling bond futures would lower duration and could help in a rising rate environment.

(ii) Swaps

A received fixed-pay floating swap could also increase the portfolio's duration and hedge the loss in surplus when interest rates fall.

3. Continued

(iii) Options

A call option on a bond or a put option on the interest rate could also help the portfolio hedge against decreasing interest rates.

(c) Compare the advantages and disadvantages of the derivatives in (b) to manage Wonka's Traditional Life Products Portfolio risks.

Futures – Advantages
- Very liquid, due to depth of the market
- Cost effective
- Practically no counterparty risk

Futures – Disadvantages
- Basis risk in cross hedging. Cross hedging occurs when the bonds in the portfolio differ from those used for the futures contract.
- Limited/no customization

Swaps – Advantages
- Cost effective
- High level of customization

Swaps – Disadvantages
- Higher counterparty risk

Options – Advantages
- Establishes a floor value for the portfolio while allowing the manager to benefit from rate declines – for example, buying a put in a protective put.
- Provides some income to offset losses – for example, writing a call option in a covered call.

Options – Disadvantages
- Put buying has an upfront cost, and does lower expected performance.
- Call writing eliminates potential for gains from falling rates.

(d) Determine the minimum T-Bond Futures trade to bring Wonka's Traditional Life Products Portfolio within the suggested dollar duration guideline.

Commentary on Question:
While a correct solution would receive full credit, it is important to list out the steps for partial credit in case any calculation errors occur.

3. Continued

ALM Guideline: |Dollar Duration of Surplus | < 300M
Current Dollar Duration of Surplus = - 1,710M

Need to increase Dollar Duration to -300M to bring into compliance.

Dollar Duration to be picked up = -300M – (-1,710M) = 1,410M

Dollar Duration of Futures from the CTD issues = (7 * 0.1M)/(1.1) = 0.636M

Minimum number of contracts # of contracts = 1,410 / 0.636 = 2,216.98
So we would need to buy 2,217 contracts to bring the Traditional Life Products Portfolio within the suggested dollar duration guideline.

(e) During a discussion on using interest futures and options to manage interest rate risk of Wonka's Traditional Life Products Portfolio your colleague, Walter, makes the following comments:

"A futures hedge is great for managing interest rate risk when I have no view of the market, but I like using options when I have good sense of where the bond market is going. For example, I usually execute a covered call strategy when I'm feeling bullish and a protective-put strategy when I am feeling bearish."

Critique Walter's comments.

"A futures hedge is great for managing interest rate risk when I have no view of the market, but I like using options when I have good sense of where the bond market is going." – This is correct.

"I usually execute a covered call strategy when I'm feeling bullish" – This is incorrect, as a covered call strategy is more appropriate if the manager is neutral to mildly bearish since it is better to receive the premium on the covered call-writing strategy. A more bullish strategy would be to leave the position unhedged.

"A protective-put strategy when I am feeling bearish." – This is correct.

(f) Senior management has reservations about using duration hedging. A proposal has been submitted to replace duration hedging with duration/convexity hedging.

(i) Describe the shortcomings of duration/convexity hedging.

(ii) Recommend a hedging strategy that overcomes these shortcomings.

3. Continued

(i) Shortcomings of duration/convexity hedging include:

- Not being able to account for nonparallel deformation of the term structure (e.g. change in slope and curvature).
- Not being able account for rates with different maturities not always changing in the same way. In particular, long-term rates tend to be less volatile than short-term rates.

(ii) Recommendation to overcome these shortcomings.

- Consider hedging using key rate/partial durations
- Consider using the Nelson-Siegel hedging scheme, which allows us to account for changes in slope and curvature in addition to level shocks.

4. Learning Objectives:

7. The candidate will understand the purposes and methods of portfolio performance measurement.

Learning Outcomes:

(7a) Describe and assess performance measurement methodologies for investment portfolios.

(7b) Describe and assess techniques that can be used to select or build a benchmark for a given portfolio or portfolio management style.

(7c) Recommend a benchmark for a given portfolio or portfolio management style.

(7d) Recommend a performance measurement methodology.

Sources:

V-C168-09: Journal of Performance Measurement Fall 2006, Murira, B. and H. Sierra, Fixed Income attribution: A unified Framework – Part 1, pgs. 23 - 35

Commentary on Question:

None

Solution:

(a) List the key requirements for the fixed income portfolio performance attribution framework.

The attribution framework should be consistent with the investment decision-making process of the portfolio

The attribution framework should be compatible with the organization's performance measurement and risk measurement system

(b) Describe the components of fixed income portfolio total return as used by the factor attribution model.

Return to a bond can be attributed to following factors
Income return: interest that accrues during analysis period
Currency return: return results from taking currency exposure
Price return: return due to change in price of the underlying portfolio.

The components of price return are:
Term structure:
Duration explains the return due to change in the level and/or the shape of the benchmark yield curve

4. Continued

Shift: change in the level of the yield curve
Twist: change in the slope of the yield curve
Shape: change in the shape of yield curve
Roll down: bond ages along a sloped yield curve
Convexity provides a correction to the linear estimation provided by duration component
Spread: the percentage change in a bond's price attributable to a widening or tightening of sector/quality spreads
Prepayment/Optionality: the percentage change in a bond's price attributable to a change in the prepayment speed
Time: passage of time
Accrection: convergency of a bond price to par as it approaches maturity
Drift: changs in a bond's duration as time elapse
Residual: the unexplained return

(c) Calculate

(i) The total return over the period.

(ii) The price return.

(iii) All term structure components of the price return.

Total return over the period = (1,047 -1,150 + 1000*5%)/1,150 =-4.61%
Price return (1,047 -1,150)/1,150 =-8.96%

Term Structure Return			
	Δy		-MD *Δy
Duration Return	Δy=y(at time 1)-y(at time 0)	4.70%-4.13%=0.57%	-9.35%
Roll down	$\Delta y^{Roll}=y_{29}-y_{30}$	4.12%-4.13%=-0.01%	0.16%
Shift	$\Delta y^{shift}=1/4(\Delta y_2+\Delta y_5+\Delta y_{10}+\Delta y_{30})$	1/4(3.80%-3.02%+4.12%-3.20%+4.35%-3.53%+4.7%-4.13%)=0.77%	-12.63%
Twist	$\Delta y^{Twist}=\Delta y_{30}-\Delta y_2$	4.70%-4.13%-(3.80%-3.02%)=-0.21%	3.44%
Shape	$\Delta y^{Shape}=\Delta y-\Delta y^{Roll}-\Delta y^{Shape}-\Delta y^{Twist}$	0.57%-(-0.01%)-0.77%-(-0.21%)=0.02%	-0.33%
Convexity Return	1/2* Conv *Δy^2	0.57%	**0.63%**

5. Learning Objectives:

2. The candidate will understand the variety of financial instruments available to managed portfolios.

6. The candidate will understand the specific considerations relative to managing a fixed income portfolio within an asset allocation framework.

Learning Outcomes:

(2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.

(6d) Recommend an investment strategy for a given situation:

- Portfolio policy and objectives
- Asset selection criteria
- Capital market expectations
- Risk management strategy
- Portfolio rebalancing strategy

Sources:

Fabozzi, Frank, The Handbook of Fixed Income Securities, 8th Edition, Chapter 17

Commentary on Question:

Parts (a), (b) and (c) of the question tested candidates' knowledge on the characteristic of floater and inverse floater. Part (d) tested candidates' knowledge on "Discount Margin" method, and ability to point out why "Discount Margin" is not a good method to evaluate assets with embedded options.

Solution:

(a) Determine the coupon formula for the inverse floater.

Coupon payment on the collateral = Coupon payment on floater + Coupon payment on Inverse floater

Coupon payment on the collateral = NxC = 100x5.5% = 5.5
Coupon payment on floater = 0.8NxLIBOR = (0.8x100)xLIBOR = 80xLIBOR
Coupon payment on Inverse floater = Coupon payment on the collateral – Coupon payment on floater
= 5.5-80xLIBOR
Coupon rate on the Inverse floater = Coupon payment on Inverse floater/Par value
= (5.5-80xLIBOR)/20
=27.5%-4xLIBOR

(b) Determine whether the duration of the inverse floater is higher or lower than that of the original fixed-rate bond and explain why.

5. Continued

- Duration of the Inverse floater will be higher than the original fixed-rate bond
- The dollar duration of the collateral must equal the dollar duration for the combined floater and inverse floater
- Floaters have low duration because floaters adjust to the interest rate periodically
- The payments on the inverse floater are leveraged and will have a higher duration

(c) Describe a situation where it would be appropriate to include an inverse floater in the asset portfolio to manage the interest rate risk of a fixed payout liability portfolio.

- Inverse floater may be a useful hedge against reinvestment risk as the coupon payments increase when interest rates decrease.
- Inverse floater has high duration and may be a suitable instrument in extending the overall duration of the portfolio for ALM matching.

(d) Your manager suggested using the "discount margin" method to evaluate a callable floater.

(i) Explain how "discount margin" method works.

- Discount margin method determines the average margin over the reference rate the investor can earn over the security's life given a particular assumed path that the reference rate will take to maturity.
- Process:
  - Determine the cash flows given a particular reference rate
  - Set a margin
  - Discount the cash flows using reference rate plus the margin selected in prior step
  - Repeat the process until the present value of the cash flows equal to the price. Discount margin is the margin over the reference rate such that the present value of the cash flows equal to the price.

(ii) Assess the manager's suggestion.

- Not a good idea to use "Discount Margin" method
- "Discount Margin" method does not recognize the presence of embedded options

5. Continued

- Since issuer can call an issue when presented with the opportunity and refund at a lower spread. Investor will then reinvest at the lower spread. Hence, it is important to recognize the embedded options and value them properly.
- Can value the call option using
  - Arbitrage-free binomial interest rate trees
  - Monte Carlos simulations

6. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

Learning Outcomes:

(4a) Describe, contrast and assess techniques to measure credit risk, including spread risk.

(4b) Describe, contrast and assess techniques to measure equity risk.

Sources:

Active Credit Portfolio Management in Practice, Chapter 3, Structural Models

Commentary on Question:

The question tested the candidates understanding of the Black-Scholes-Merton model via an understanding of the mechanics of the model and an application of the model to a specific situation.

The candidates were also asked to describe limitations of the BSM model and what alternatives may be available.

Generally candidates did well on part (a).

Candidates began to struggle on part (b) as they did not apply the formulas properly or incorrectly assumed the DD from part (a) instead of recalculating it.

Most candidates were able to identify limitations of the BSM model in part (c) but did not identify the empirical approach. Candidates were given credit for mentioning models other than the empirical approach.

Solution:

(a) Calculate the amount of debts that the company needs to repay to achieve the goal of lowering default probability to 2.5% using the Black-Scholes-Merton model and assuming that the default distance follows the normal distribution.

Infer that target Distance to Default (DD) is 1.96 from 2.5% default probability.

Use formula for DD to solve for new debt amount. Subtract new debt amount from old debt amount to determine the amount of debt that needs to be repaid

$$\text{DD} = \frac{\ln(\frac{A}{X}) + (\mu_A - \frac{1}{2}\sigma_A^2)T}{\sigma_A SQRT(T)}$$

6. Continued

$$\frac{\ln(\frac{100}{(30-x)}) + (0.25 - \frac{1}{2}\times 1^2)\times 1}{1\times SQRT(1)} = 1.96$$

$$x = 19$$

(b) Assume the debts in (a) have been repaid through successful new equity issuance.

(i) Calculate the value of the remaining debt using the Black-Scholes-Merton model.

(ii) Calculate the impact on the company's credit spread.

$$D = Xe^{-rT} - (Xe^{-rT}\,\phi(-d_2) - A_0\phi(-d_1)$$

Or

$$D = A_0 - E = A_0 - A_0\phi(-d_1)Xe^{-rT} - Xe^{-rT}\,\phi(-d_2)$$

Where

$$d_1 = \frac{\ln A_0 + (\mathrm{r} + \frac{1}{2}\sigma_A^2)\,T - \ln X}{\sigma_A\sqrt{T}}$$

and

$$d_2 = \frac{\ln A_0 + (\mathrm{r} - \frac{1}{2}\sigma_A^2)\,T - \ln X}{\sigma_A\sqrt{T}} = d_1 - \sigma_A\sqrt{T}$$

$$d_1 = \frac{\ln 100 + (.05 + \frac{1}{2}1)\,1 - \ln 11}{1\sqrt{1}}$$

and

$$d_2 = \frac{\ln 100 + (.05 - \frac{1}{2}1)\,1 - \ln 11}{1\sqrt{1}} = d_1 - 1$$

d_1 = 2.76
d_2 = 1.76
D = 10.32

6. Continued

$$D_{old} = 25 => CreditSpread_{old} = \frac{30}{25} - 5\% = 15\%$$

$$CreditSpread_{new} = \frac{11}{10.32} - 5\% = 1.6\%$$

$$\Delta CreditSpread = 13.4\%$$

(c)

(i) Criticize using the assumption that default distance follows normal distribution in the real world.

Default points are dynamic, not deterministic. The correlation between Default Point and DD does not appear to be stable.

Asset values do not always follow geometric Brownian motion. There could be sudden and dramatic moves in asset value.

(iii) Recommend an alternative approach.

Estimate a DD distribution empirically.

7. Learning Objectives:

2. The candidate will understand the variety of financial instruments available to managed portfolios.

Learning Outcomes:

(2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.

Sources:

Fabozzi, Handbook of Fixed income Securities, 8th Edition, 2012

- Chapter 25, Agency Mortgage-Backed Securities

V-C174-09: Anson, The Handbook of Alternative Assets, Second Edition, 2006, Chapter 20

V-C179-10: The Economics of Structured Finance, Journal of Economic Perspective, Winter 2009

Commentary on Question:

None

Solution:

(a) List and describe key factors that impact prepayment behavior.

Level of interest rates – reflects a borrower's opportunity to refinance. Prepayment speed increases when cost of refinancing decreases.

Aging – reflects that new loans typically exhibit slower prepayment speeds compared with "seasoned" loans.

Loan - Premium loans experience higher prepayment speeds sooner compared with the discount loan.

Burnout – Refinancing activity within a loan pool declines over time regardless of interest rate environment.

Seasonality – reflects the close interaction of prepayments with housing maket activity. Prepayments tend to be faster during the summer and slower during winter months, reflecting increased home turnover during the summer months. Houses prices and general economy can affect prepayments. Weak economic activity, declining housing prices and unemployment depress prepayments.

Shape of the yield curve – when the yield curve is steep, borrowers may refinance into shorter maturity loans to reduce the borrowing costs.

7. Continued

(b) Describe the following conventions:

(i) Single Monthly Mortality

(ii) Conditional Prepayment Rate

(iii) Public Securities Association Model

Single Monthly Mortality (SSM) – measures the percentage of dollars prepaid in any month, expressed as a percentage of the expected mortgage balance.

Conditional Prepayment Rate (CPR) – converts SSM to an annual rate. Expressed as a percentage of nonamortized balance prepaid on an annual basis.

Public Securities Association Model – expressed in CPR, where prepayment rates are assumed to follow a standard path over time.

(c) Compute the prepayment rate using above conventions, assuming:

- Scheduled Balance: $150,000
- Actual Balance: $148,000
- Age (months): 24

SSM = 100 x (Scheduled Balance – Actual Balance)/Scheduled Balance
SSM = 100 x (150000-148000)/150000
SSM = 1.33%
CPR = 100 x [1-(1-SMM/100)^12]
CPR = 100 x [1-(1-1.33/100)^12]
CPR = 14.88%
PSA = 100x CPR/Minimum (age,30)x0.2
PSA = 100x14.88/Min(24,30)x0.2
PSA=309.94%

(d) Your manager told you that AAA rated CDOs are far riskier than AAA rated corporate bonds.

Explain the rationale behind his assertion.

7. Continued

Modest imprecision in the parameter estimates can lead to variation in the default risk that is sufficient to cause a security rated AAA to default with reasonable likelihood.

The pooling of tranching amplified mistakes in the assessment of underlying asset defaul risk and correlation.
It substitutes risks that are largely diversifiable for risks that are highly systematic.
Therefore, structured securities have far less chance of surviving a severe economic downturn than traditional corporate securities of equal rating.

8. Learning Objectives:

6. The candidate will understand the specific considerations relative to managing a fixed income portfolio within an asset allocation framework.

Learning Outcomes:

(6d) Recommend an investment strategy for a given situation:
- Portfolio policy and objectives
- Asset selection criteria
- Capital market expectations
- Risk management strategy
- Portfolio rebalancing strategy

(6g) Explain how derivatives, synthetic securities, and financial contracting may be used to manage risk and recommend appropriate ones for a given situation.

(6i) Explain and recommend best practices in credit risk management, including:
- Credit and underwriting policies
- Comprehensive due diligence
- Diversification requirements and aggregate counter-party exposure limits
- Use of credit derivatives and credit support agreements

(6j) Recommend a credit risk management strategy for a given situation.

Sources:

V-C198-12: Risk Management, Crouchy, et al., 2001 Chapter 7, Credit Rating Systems

V-C199-12: Credit Derivatives, Saunders and Allen, Chapter 12

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) List additional steps that would expand this RRS to assign facility ratings.

Commentary on Question:

Listing 4 steps is enough to pass.

- Consider 3rd party support
- Consider maturity of the transaction
- Review structure of the transaction
- Assess collateral amount

8. Continued

(b) Describe the mechanics of how a generic Total Return Swap would work between your bank and a hedge fund.

Commentary on Question:
As long as the description of buyer and seller is correct, it can pass.
A lot of students get buyer/seller mixed up.

Hedge fund is buyer, and the bank is the seller of credit risk:

- The buyer makes periodic floating payments and the seller makes periodic coupon payments and change in the value of the instruments
- The buyer passes loss to seller (when asset value decreases) while receives gain when asset value increases from seller.

(c) Compare and contrast a Total Return Swap to a Credit Default Swap.

Commentary on Question:
Candidate should point out credit swap only covers default risk while TRS covers both market and credit risk.

Total return swaps contain both credit risk and market risk (interest risk) while pure credit default swap does not have interest rate risk.

(d) Carmen is considering a 3-year credit default swap for Bauxite Bank's largest outstanding loan. The notional value of the CDS is \$75M and the fixed swap fee is 40bps annually (payable at the beginning of each year). Cash settlement has been specified. In a projection, no default event occurs in years 1 and 2, but a default event occurs at the end of year 3 causing the loan's price to fall to \$30 per \$100 of face value.

Calculate the net amount Bauxite Bank would pay/receive under the CDS in each of the first 3 years of the projection.

Commentary on Question:
Not many candidates get the net receivable for year 3.

Year 1 and 2, Bauxite net payment = 40bps * 75M =0.3 M
Year 3, Bauxite pays 0.3M, receives 70%*75M=52.5M
net receipt = 52.5-0.3=52.2M

9. Learning Objectives:

1. Candidate will understand and be able to follow the investment management process for insurance companies, pension funds and other financial intermediaries.

Learning Outcomes:

(1b) Identify the obligations of a fiduciary in managing investment portfolios and explain how they apply in a given situation.

Sources:

V-C136-10: Fiduciary Liability Issues for Selection of Investments

Maginn & Tuttle, Managing Investment Portfolios, 3rd Edition, 2007

- Chapter 3, Managing Institutional Investor Portfolios, by Tschampion, Siegel, Takahashi & Maginn

Commentary on Question:

Commentary listed underneath question component when available.

Solution:

(a) List and describe the duties of a trustee as they relate to tax-favored retirement plans.

1. Duty of Loyalty
   For the benefit of the beneficiaries
2. Duty of Care
   Manage with attention and skill
3. Duty to Diversify Plan Assets
   Minimize the risk of large losses
4. Duty of Impartiality
   Does not favor one beneficiary at the expense of another
5. Duty to Delegate
   Can delegate authority to investment manager, but retains responsibility
6. Duty to Follow Statutory Constraints
   Usually involve self-dealing and imprudent investments
7. Duty to Make the Property Productive
   Seek a reasonable return on the investment
8. Duties Regarding Co-Trustees
   Cooperate with, keep an eye on co-trustees
9. Duty to Act in Accordance with the Trust Agreements
   Should not breach other duties, to the detriment of plan participants

9. Continued

(b) Explain the difference in the prudent investor standard between ordinary trusts and retirement plan trusts.

With retirement plans, duty is higher than with ordinary trusts
Duty to act as "professional investor" not just prudent person
ERISA defines in the U.S.

(c) For a defined-contribution retirement plan with self-directed accounts, the following investment choices are available to plan participants:

- Foreign Stock Fund
- Short-term Government Bond Fund
- Gold Mining Sector Equity Fund
- Commercial Real-Estate Investment Trust
- Company Stock of Employer

(i) Assess the appropriateness of the offerings and recommend any changes.

(ii) Compare the legal liability of the trustee and plan participants as it relates to investment selection and performance.

Commentary on Question:
For part (i) candidates were expected to point out the choices that may not be appropriate and why, and also make suggestions to round out the options available to plan participants. Reasonable answers all received credit. The example below would have received full credit.

(i)
ERISA requires at least 3 "core" investment options
Company stock should be limited
Sector funds may be too risky
Foreign stock fund, ST Govt bond fund, REIT all appropriate
Consider adding:

- Domestic equity fund
- Corporate bond fund
- TIPS
- Money market fund
- Lifecycle funds

9. Continued

(ii)
The trustee remains legally responsible for investment decisions, until responsibility is successfully shifted to the participants.
If responsibility is shifted, trustee not liable for duty of care with respect to specific decisions made by participants.
Shifting responsibility defined as (by DOL):

1. At least 3 core options
2. Ability to transfer with appropriate frequency
3. Sufficient info to make informed decisions

10. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

Learning Outcomes:

(4e.) Describe, contrast and assess techniques to measure liquidity risk.

Sources:

Matz, Neu, pgs. 15 – 28, 33 - 35

Commentary on Question:

This question tested the candidates understanding of liquidity risk and quantitative frameworks for liquidity risk management. The candidates' performance on this question was below average and many candidates were not able to identify the important points.

Solution:

(a) Describe liquidity risk and explain how it differs in nature from other types of financial risks.

Liquidity is different from capital;
Liquidity risk is a secondary risk;
Liquidity risk always follows one or more spikes in other financial risks;
Liquidity risk can be called a consequential risk;
Hard-to-imagine a liquidity problem without earlier problems/losses related to other risks;
Coverage of liquidity is different from other risks;
Usual coverage framework (ex. VAR) does not apply to liquidity;
Instead of VAR, must meet NCO : Net Cumulative Outflow;
Instead of maintaining excess capital, cash inflows must be generated, and cash outflows reduced;
Goal is to reduce NCO within a given time interval;
Liquidity risk must be analyzed under different bank-specific and market-systemic scenarios.

(b) Critique the CFO's opinion.

Large amounts of capital in itself do not constitute a proper safeguard for liquidity. Those specific amounts of capital could be tied in totally illiquid assets and holdings. So when a liquidity crisis occurs, these holdings cannot be transformed into cash, and prove useless.

A well/very-well capitalized company says nothing about its liquidity risk profile. The CFO is therefore wrong or simply naïve/ignorant about this issue, and should be clearly advised/informed about this matter.

10. Continued

Similar to a rapidly expanding company that expands too fast and cannot find money to fuel the growth adequately, it can be run out-of-business by having grown too fast.

(c) Compare and contrast the following quantitative frameworks for liquidity risk management:

- Balance Sheet Liquidity Analysis
- Cash Capital Position
- Maturity Mismatch Approach

Balance Sheet Liquidity Risk

Sets in relation various items from the asset and liability side of the balance sheet;
Based on their liquidity characteristics: liquid / illiquid, stable / sticky funding;
Appropriate balance sheet structure :
sticky assets funded by stable liabilities;
liquid assets funded by volatile liabilities.

Problems with this type of analysis:

- Missing time dimension : black-or-white, no horizon specified;
- Impact of accounting rules;
- Off-balance sheet commitments;
- Marketability of securities;
- Commercial papers;
- Non-bank deposits.

Cash Capital Position

Method originally invented by Moody's as part of its external rating process;
Measures bank's ability to fund its assets on a fully collateralized basis, assuming loss of financing (loss of unsecured funding);

Cash capital is defined as the aggregate of :
Long-term debt, core deposits and equity
Minus
Firm-wide haircuts, contingent outflows and illiquid assets.
OR
Cash capital is defined as the gap between :
Collateral value of unencumbered assets and,
Volume of short-term inter-bank funding and non-core parts of non-bank deposits.

10. Continued

Definition of unencumbered assets and haircuts, based on marketability of securities;
Cash Capital Position method addresses many of the shortcomings of Balance Sheet method.

Maturity Mismatch Approach

Estimate NCO over specific time periods, and under different scenarios;
Liquidation cash flows from all liquefiable balance and off-balance sheet items are mapped to a maturity ladder;
4 categories :
Cat I : amount deterministic / timing deterministic;
Cat II : amount stochastic / timing deterministic;
Cat III : amount deterministic / timing stochastic;
Cat IV : amount stochastic / timing stochastic.

Cat I cash flow mapping is straightforward;
Cat II-IV need more work and assumptions, and are dependent on the scenario considered;
Cumulative sums of all inflows is compared to cumulative sum of all outflows;
In pure run-off mode – no new business, no rollover of funding asssumed;
Resulting gaps by time buckets show adequacy (if positive) or inadequacy (if negative);

Compared to the 2 other approaches, the Maturity Mismatch approach is more elaborate/refined and more useful – it has less flaws than the two others.

(d) Identify what questions should be answered by Redsquare management in order to provide a sound recommendation to its Board regarding qualitative aspects of liquidity risk management.

Quantitative approach to liquidity management is very much assumption driven;
Qualitative assessment of liquidity risk is as at least as important as the quantitative one.

Qualitative elements / questions :

Are diversified funding sources established, in use and back-tested?

What is the current long-/short-term rating and what is the outlook?

Is there a board-approved liquidity policy in place with fixed standards on responsibilities, methodologies, limit system and reporting?

10. Continued

Has the company implemented an IT-infrastructure that allows for daily quantitative assessment of liquidity risk?
(Gap analysis for example)

Does the bank measure liquidity risk under different environments, including consideration of stress levels / fixed-variable cash flows?

Does a liquidity contingency plan exist that addresses responsibilities of each unit and the measures to be taken?

- Has the bank established an internal transfer pricing system for liquidity risk?

11. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

Learning Outcomes:

(4c) Describe, contrast and assess techniques to measure interest rate risk.

Sources:

V-C191-11: B. Tuckman, Fixed Income Securities, Chapters 5 -7

Commentary on Question:

The question addressed the topic of duration and duration matching. The question was relatively easy and the candidates' performance was above average, with many candidates able to show a good understanding of these concepts.

Solution:

(a) Compare Macaulay duration, empirical duration, effective duration and key rate duration.

Macaulay duration is the time-weighted present value of the cash flows divided by price. It measures the price change relative to the yield-to-maturity change and does not account for cash flows changing by interest rate scenario.

Effective duration measures price sensitivity to parallel treasury rate changes assuming no change in other factors. It can account for cash flows changing by interest rate scenario.

The key rates duration technique uses several key rates to define the term structure of whole yield curve. The price sensitivity to the movement of each key rate, holding the other constant, is the key rate duration. The sum of all key rate durations will be similar to effective duration.

Empirical duration is obtained by regressing daily price changes against corresponding yield changes using historical data.

(b) Explain the possible reasons that the value of assets could move differently from the duration predicted value.

Duration predicts the change in value for small, parallel changes in the yield curve. The following could cause the value of assets to move differently from the duration predicted value:

- Convexity may be high. Duration itself could therefore be changing as interest rates move.
- The yield curve may have a non-parallel deformation. For example, a change in slope or curvature, which is not captured by effective duration

11. Continued

- Credit spreads may be changing.
- Price movements may be asymmetric due to optionality in the assets as interest rates move up and down.

(c) Identify risks that XYZ faces in a falling interest rate environment.

The company's asset duration is shorter than liability duration and in a falling interest rate environment it will not have enough assets to cover liabilities.

In addition, the company faces pre-payment and call risk in falling interest rate environment and this exacerbates reinvestment risk, where the company is forced to reinvest at lower rates. The reinvested assets may not earn enough yield to support liability products which are priced at higher interest rates.

Furthermore, certain options/guarantees on the liability side may move into-the-money on the liability side when interest rates fall, which could further squeeze profitability and lower surplus.

(d) Estimate the value of assets and liabilities following a 70bps drop in interest rates using duration and convexity.

Commentary on Question:
While a correct solution would receive full credit, it is important to list out the steps/formulas for partial credit in case any calculation errors occur.

Duration = $- (P^{+}-P^{-})/(2*P*\Delta y)$
Convexity = $(P^{+} + P^{-} - 2P) / (P*\Delta y^{2})$
Duration of asset = $- (180-210)/ (2*200*0.005) = 15$
Duration of liability = $-(160-220)/(2*180*0.005) = 33$
Convexity of asset = $(180+210-2*200)/(200 * 0.005^{2})= -2000$
Convexity of liability $=(160+220 – 2*180)/(180 * 0.005^{2})= 4444$

When rates decrease 70 bps:

Asset price = $200 * (1 – (15*-0.007) + ½ * -2000 * (-0.007)^{2})$
$= 200+21-9.8 = 211.2$ M

Liability price = $180 * (1 – (33 *-0.007) + ½ * 4444 * (-0.007)^{2})$
$=180 +41.6+19.6=241.2$ M

11. Continued

(e) Evaluate suitability of adding the following assets to improve the company's asset liability risk management.

(i) 30 year high yield bond

(ii) 15 year callable investment grade bond

(iii) 5 year government bond

The company currently has a negative duration gap, with asset duration < liability duration. To improve the company's asset liability risk management, we would prefer assets that could extend duration, which have positive convexity.

(i) 30-year high yield bond would extend the duration of asset portfolio, but it would add credit risk. While high coupons may lower duration, it should still be able to extend the duration of the portfolio.

(ii) Callable bond has negative convexity which is undesirable vis-à-vis the liabilities. In addition, the 15-year callable bond will not be able to extend asset duration (currently at 15) since the duration of a 15-year callable will be less than 15 yr. Overall, this asset is not recommended.

(iii) The 5-year government bond won't help alleviate the duration gap since it has too short a duration and will not lengthen the asset portfolio duration. Therefore, this asset is also not recommended

Of the three assets, the 30-year high yield bond would be the most suitable for improving the ALM profile, despite the added credit risk.

12. Learning Objectives:

2. The candidate will understand the variety of financial instruments available to managed portfolios.

7. The candidate will understand the purposes and methods of portfolio performance measurement.

Learning Outcomes:

(2a) Compare and select specialized financial instruments that can be used in the construction of an asset portfolio supporting financial institutions and pension plan liabilities.

(7b) Describe and assess techniques that can be used to select or build a benchmark for a given portfolio or portfolio management style.

(7c) Recommend a benchmark for a given portfolio or portfolio management style.

Sources:

Fabozzi, Handbook of Fixed Income Securities, 8th Edition, 2012

- Chapter 12, Corporate Bonds
- Chapter 24, An Overview of Mortgages and the Mortgage Market
- Chapter 25, Agency Mortgage-Backed Securities
- Chapter 26, Agency Collateralized Mortgage Obligations
- Chapter 50, Quantitative management of Benchmarked Portfolios

Commentary on Question:

Candidates needed to understand different financial instruments and assess their risk. For parts (a), (b) and (c), candidates did well to explain an Agency MBS or CMO but most did not understand what a mortgage bond was.

Solution:

(a) Describe each of the assets: agency MBS, agency CMOs and mortgage bonds.

Agency Mortgage backed securities (MBS)

- Cash flows of an underlying pool of mortgages – mortgage pass through
- Securitized by a government agency such as Ginnie Mae, or a government-sponsored enterprise (GSE) such as Fannie Mae or Freddie Mac
- Non-conforming ("Jumbo") loans do not qualify for the agency loan program

Agency Collateralized Mortgage Obligations (CMO)

- Underlying collateral is the same as MBS (loans on residential)
- CMO's are structured so that there are several classes of bondholders with varying maturities
- Principal is divided up into pieces / tranches

12. Continued

Mortage bonds

- Bondholder is granted a first- mortgage lien on all properties of the issuer
- A lien is a legal right to sell mortgaged property to satisfy unpaid obligations to bondholders

(b) Compare the credit risks of each instrument.

Agency Mortgage backed securities (MBS)

- Very limited credit risk
- Ginnie Mae guarantee (full faith of the US) – explicit guarantee
- Fannie Mae and Freddie Mac, not backed by full faith of the US but have access to support from the U.S. Treasury – implicit guarantee

Agency Collateralized Mortgage Obligations (CMO)

- Same situation as agency MBS – very limited credit risk

Mortgage bonds

- Very limited credit risk (granted a first-mortgage lien on all properties)

(c) Compare the prepayment risks of each instrument.

Agency Mortgage backed securities (MBS)

- Very high prepayment risk
- Generally no penalties on prepayments on residential mortgage loans
- Cash flows are greatly affected by the prepayment behavior of underlying mortgages within the MBS pool

Agency Collateralized Mortgage Obligations (CMO)

- Very dependent on the tranche/structure
- Some tranches allows investors more control when they receive principal from MBS
- In general, Sequentials tranches are very sensitive to prepayments (particularly longer-duration sequentials)
- PAC is the most stable tranche of CMO
- Companion tranche absorb whatever principal is left

Mortgage bonds

- Limited prepayment risk
- Non-callable or callable but with punitive covenants (e.g. make-whole clause): difficult to retire debt before maturity

12. Continued

(d) As part of the company's ALM interest rate risk policy, Tom is required to manage his portfolio to match a target duration and cash-flow profile to fund a specific set of liabilities. ABC Life is looking to better measure Tom's performance by implementing a benchmark for his agency MBS investments.

(i) Describe the considerations in selecting a benchmark.

(ii) Recommend a benchmark for the agency MBS portfolio.

Commentary on Question:
Most candidates scored well on the considerations for benchmark selection, however candidates did not convey a good understanding of the challenges in benchmarking an MBS portfolio that is managed to a stable duration target.

(i) A benchmark should (1) be diversified (2) reflect the investor's opportunity set and consider any constraints such as required allocations or duration matching criteria (3) be investable so that a manager could "buy the benchmark."

(ii) Recommend a custom, "liability-based" benchmark to match the duration and cash-flow profile of the liabilities. However, the duration of an MBS portfolio can be quite volatile. Therefore in order to maintain a stable duration the manager may engage in delta hedging to overcome the impact of negative convexity. The benchmark should reflect the cost of this delta hedging in two ways (1) apply delta hedging to the benchmark or (2) construct a "constant duration" index that provides a fairer benchmark for a delta-hedged mortgage portfolio.

(e) ABC Life is also looking to setup an index for Tom's mortgage bond portfolio to mitigate risk.

Identify the key risk associated with a fixed income credit portfolio and explain ways to mitigate this risk.

Excessive exposure to individual issuers is the key risk in a credit index. Two possible ways to mitigate this risk are (1) using an issuer-capped index whereby a cap is placed on the largest issuers to limit exposure (2) use a swap-based benchmark as a total return benchmark for the credit portfolio due to the close relationship between interest rate swap spreads and high-grade credit spread. The added benefit of a swap-based benchmark is it alleviates the pressure for a manager to have at least some exposure to the largest issuers in the benchmark, especially in cases where the manager has a negative view on the issuer.

12. Continued

(f) Tom plans to use a stratified sampling approach to replicate the credit index.

Explain whether this is an appropriate approach.

Stratified sampling is a form of cash replication that attempts to match an index's allocation to each important segment with a few securities. It works well in homoeneous markets, such as US governments or MBS. It works less well for markets with much idiosyncratic risk such as credit so this is not an appropriate approach to construct a proxy credit portfolio. Matching broad risk dimensions still leaves the proxy portfolio vulnerable to issuer-level risk because the proxy over-weights each issuer relative to the benchmark. It also ignores historical variances and correlations of risk factors.

13. Learning Objectives:

5. The candidate will understand the specific considerations relative to managing an equity and/or alternative asset portfolio within an asset allocation framework.

8. The candidate will understand the behavior characteristics of individual and firms and be able to identify and apply concepts of behavioral finance.

Learning Outcomes:

(5a) Explain how an investment policy affects the selection of an investment strategy or the selection of an optimal portfolio.

(5c) Evaluate situations associated with the presence of embedded options and hedging strategies.

(8b) Describe how behavioral finance explains the existence of some market anomalies.

Sources:

V-C122-07: Anomalies: The Law of One Price in Financial Markets, Lamont & Thaler, Journal of Economic Perspectives, Fall 2003

Maginn & Tuttle, Managing Investment Portfolios, 3rd Edition, 2007

- Chapter 8, "Alternative Investments Portfolio Management," by Yau, Schneeweis, Robinson, & Weiss

Commentary on Question:

This analysis and synthesis question tested the candidates' knowledge of investing in commodities, pricing of futures and the law of one price. The candidates did relatively well on this question.

Solution:

(a) Describe the advantages of investing in commodities in the portfolio.

Investing in commodities in the portfolio has the advantages of providing (1) portfolio risk diversification, where commodities have a negative correlation with equities and bonds and (2) a hedge against inflation, where commodities provide an expected offset to conventional debt instrument which typically lose value during periods of unexpected inflation.

(b) Explain why purchasing oil futures is more effective in getting commodity exposure than purchasing stocks of an oil company.

By purchasing oil futures, oil companies could hedge a major portion of their company risks as such they may not be exposed to the risk of the commodity price movement.

13. Continued

(c) Propose a formula to determine the relationship between futures price and spot price. Define all terms.

Commentary on Question:
Quite a few of the responses to this question were similar to the response for question (e)(i).

Forward price = spot price + forgone interest from purchasing and storing the commodity + cost of storage – convenience yield.

(d) Define the law of one price and describe how it relates to oil ETFs.

The law of one price states that identical goods must have the same price. This law maybe violated if it is not possible to directly own oil. It maybe violated if the cost of owning oil is higher than cost of owning ETF.

(e) The available crude oil futures contracts are shown in the below table:

Contract Maturity	Futures Price as of November 2013 (US$)	Futures Prices as of October 2013 (US$)	Change in Spot Price (US$)
December 2013	92.20	91.20	0.55
January 2014	91.55	90.65	0.55
February 2014	89.50	88.60	0.55

(i) Describe the three components of returns on a futures contract.

(ii) Explain the sloping structure of the futures prices listed in the table.

(iii) Recommend a futures strategy that is expected to provide a positive return with the above oil futures contracts.

(i) The three components of returns on a futures contract are spot return, collateral return, and roll return.
Spot return – earned from the change in spot price of the underlying commodity
Collateral return – assumed risk-free rate earned on collateral
Roll return – earned from rolling futures contract to the next time period

(ii) The structure of future prices listed in the table is downward sloping. The available crude oil futures market is in backwardation. Backwardation is when future prices are lower than current spot price.

13. Continued

One reason backwardation may occur is because oil producers hold valuable "real options" to produce or not to produce, where they may not exercise their option to produce unless the spot price climbs up.

(iii) Recommendation. When futures market contracts is in backwardation, a positive return will be earned from a simple buy-and-hold strategy. This is because as the futures contract gets closer to maturity its price will converge to the higher spot price.

14. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

Learning Outcomes:

(4e) Describe, contrast and assess techniques to measure liquidity risk.

Sources:

Fabozzi, Handbook of Fixed Income Securities, 8th Edition, 2012

- Chapter 12, Corporate Bonds

Commentary on Question:

Commentary listed underneath question component.

Solution:

(a) List and describe the mechanisms that ABC can use.

Commentary on Question:

Most candidates only mentioned call and sinking fund options.

Four options can be used:

- Call and refunding provision, which enables the issuer to buy bonds back at a fixed price or market price
- Sinking-fund provision can be used to retire a portion of the debt each year
- Maintenance and replacement funds used to retire debt
- Sale of assets and/or collateral

(b) Calculate the redemption price.

Commentary on Question:

Most candidates did not get the yield right, or state redemption price is the larger of the present value and principal and accrued interest.

Redemption price is the larger of principal and accrued interest, and the make-whole redemption price.

- Make-whole redemption price is the present value of remaining coupon and principal, valued with treasury rate plus call premium =6-year CMT + call premium= 2% + 0.1%= 2.1%
- Coupon = 60,000 per year (6 years), principal=10m at year 6
- Make-whole redemption price= PV(60,000) for 6 years + PV(10 M) at year 6 at 2.1% =12,177,205
- Principal + accrued interest = 10M + 60k=10.6M
- Redemption price = max(12M, 10.6M)=12M.

14. Continued

(c) Compare the convexity of a bond with the fixed-priced call provision relative to a bond with the make-whole call provision.

Commentary on Question:
Most candidates did not state make-whole convexity is positive.

Fixed price call provisions have negative convexity; make-whole call provisions have positive convexity.

(d) Recommend a provision to be included in the bond's indenture that helps mitigate the credit risk for ABC's bondholders.

Commentary on Question:
Most candidates only mentioned sinking-fund provision.

- Grant bondholders lien on properties
- Use collateral
- Limit additional debt
- Include sinking-fund provision, maintenance and replacement fund provision

(e) ABC's CFO believes that an extendible reset bond is the same as a floating-rate asset because the coupon rate may reset annually or even more frequently.

Critique this statement.

Commentary on Question:
Not many candidates understand how extendible reset bond works.

Extendible reset bond is different from a floating-rate asset

- A floating-rate asset reset coupon with a fixed spread over the reference rate
- An extendible reset bond coupon rate reflects market condition and credit spread at time of reset

15. Learning Objectives:

3. The candidate will understand the importance of the techniques and theory behind portfolio asset allocation.

Learning Outcomes:

(3a) Explain the importance of asset allocation, relative to a particular situation.

(3b) Critique and propose asset allocation strategies that can be used to construct an asset portfolio.

(3c) Evaluate the significance of liabilities in the determination of the asset allocation.

(3d) Demonstrate how to include risk management principles in the establishment of investment policy and strategy including asset allocation.

Sources:

Litterman, Modern Investment Management: An Equilibrium Approach, 2003
Chapter 10, Strategic Asset Allocation in the presence of Uncertain Liabilities

V-C127-09: Liability-Relative Strategic Asset Allocation Policies

V-C174-09 Anson, Handbook of Alternative Assets; Chapter 20

Commentary on Question:

This question focused on the approaches to developing strategic asset allocation policies. It also addressed investing in alternative asset classes such as emerging markets and private equity. Many candidates struggled with this question and the results were below average.

Solution:

(a) Describe the approach to, as well as the advantages and disadvantages of modeling the liability (i.e. the college education fund) using bond indices under these frameworks.

Approach

- Model the liability as bonds or fixed income asset plus a noise term to capture the uncertainty

- Framwork#1: Rl – Rf = Beta *(Rb – Rf) + et
- Framework#2: Liability consists of three components: Rl = Rf +B*Rq +alpha and Liability risk is: sigmaL2 = B * sigmaQ2 + wL2

- The Beta for the bond index has to be levered to match the duration of the liability stream
- The noise term is defined to be uncorrelated with the bond index

15. Continued

Advantage:

- Analyzes asset and liability instead of just asset only
- Modeling of liability is simplified

Disadvantage:

- Noise term may not capture the characteristics of the liability (e.g. oversimplification - mean of zero)
- Single discount rate that does not capture the changes in the liability cash flow (e.g. cost of captical calculation uses a constant mix of assets and a constant rate of return)

(b) Describe the advantages and disadvantages of the Asset/Liability Management (ALM) approach over the asset-only approach to the strategic asset allocation process.

Advantage:

- ALM explicitly models liability and optimizes asset allocation with relation to the liability.
- The risk of not meeting the liabilities are lowered by using an ALM approach

Disadvantage:

- May be omitting great investment opportunities that are not correlated with the liability (AO high return)

(c) Explain the individual impact of each error on the recommended asset allocation.

Framework #1 (i)

- Higher correlation of asset and liability means that the existing assets are hedging the liability quite well
- Higher correlation implies that the shift from equity to bond may not need to be as much as the recommended amount

15. Continued

Framework #1 (ii)

- The larger the payout and the more underfunded the plan, the larger the required return

- With payouts and underfunded, the plan may need larger equity allocations or higher yielding assets than recommended

Framework #2 (i)

- The MSV portfolio minimizes the surplus variance and thus minimizes the return on surplus

- Since there is deficit in the plan, there can probably be more equity than recommended

Framework #2 (ii)

- Lower cost of capital for the liability cash flow means the market value of the liability should be higher, which means the deficit is understated

- More equity allocation than recommended may be needed to make up for the deficit.

(d) Your client has stated the following:

(i) In the current low interest rate environment, the fund should lower the allocation in bonds.

(ii) With the nearly flat yield curve, the fund should reduce the duration of the assets to stay liquid in case interest rates spike up.

(iii) The fund should invest more in emerging market equity because last year it achieved a high rate of return.

Critique the statements above separately.

(i)

- Investment choices should focus on the surplus of the plan not just the asset side

15. Continued

(ii)

- The duration between asset and liability should be closely matched for better immunization, not just because the yield curve is flat.
- These frameworks are not based on timing interest rate changes – difficult to predict rates

(iii)

- Foreign equity may be an attractive opportunity for overfunded plans, but not underfunded plans
- Underfunded plans are better off investing domestically
- Simply focusing on more return (i.e. from more equity allocation) is not properly managing the surplus of the plan – need to consider risk
- Basing your decision on last year's results is wrong.

(e) Due to the current shortfall of assets relative to the anticipated tuition costs, your client suggests adding private equity to the portfolio, either Venture Capital or Distressed Debt.

(i) Describe the differences between the two types of private equity.

(ii) Compare and contrast their risk/return profiles.

(iii) Select which of the two types would be more appropriate for the portfolio. Justify your answer.

Commentary on Question:
Part (iii) has two solutions that are acceptable and additional justification is awarded points

(i)

- Venture Capital invests in early stage, high potential and high risk startup companies.
- Distressed Debt invests in companies that are in trouble (have either file for bankruptcy or appear likely to do so in the near future).
- Venture Capital seeks high returns by first owning equity of the startup companies and then reaps the rewards through IPOs or trade sales of these companies.
- Distressed Debt seeks high returns by first purchases cheap debt securities of trouble companies, converts them to stock, turns around the company, and reaps the rewards of appreciations.
- However, Distressed Debt is less risky than Venture Capital because debt holders stand in line at a higher seniority than equity investors.

15. Continued

(i)

- Venture Capital has a much higher expected return than Distressed Debt
- Venture Capital has more risk (a higher std. dev.) than Distressed Debt.

- Venture capital has a large positive skew with a large value of kurtosis, indicating a large fat tail to the upside.
- Distressed Debt has a negative skew value along with a large value of kurtosis, indicating a fat downside tail.

(iii)

Select Distressed Debt:

- Better diversification
- Lower risk
- Potentially better matching with liabilities

OR

Select Venture Capital

- Higher return
- Large fat tail to the upside

16. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

Learning Outcomes:

(4a) Describe, contrast and assess techniques to measure credit risk, including spread risk.

(4e) Describe, contrast and assess techniques to measure liquidity risk.

Sources:

V-C183-10: "Bond-CDS Basis Handbook," February 2009, pgs. 3 - 48

Commentary on Question:

This question tested candidates understanding of the relationships between a bonds and credit defaults swaps. It tested the candidates understanding of how changes in conditions or assumptions changes bond and credit default swap relationships and to assess trading opportunities given realistic market data. Many candidates did relatively well on this question.

Solution:

(a) Define the Bond-CDS basis.

Commentary on Question:

Most students correctly identified the mathematical expression for Bond-CDS basis which accounted for most of the credit for the section. Maximum credit required identifying that the CDS and the bond had the same maturity.

Bond-CDS basis = CDS spread less spread of bond with similar maturity

(b) Determine whether the impact on Bond-CDS basis is negative or positive for each of the following events. Justify your answer.

(i) Bond issued in illiquid credit condition

(ii) Recognize maturity extension as a credit event

(iii) CDS buyer can choose the cheapest bonds to deliver

(iv) Bond issuer can call back bonds

Commentary on Question:

Well prepared conditions correctly identified all four impacts and provided appropriate justification for each. Candidates who only identified the impact, and did not provide justification only received partial credit.

16 Continued

Issuance in illiquid credit conditions will **negatively impact** Bond-CDS basis. To issue in these conditions bond issuers will need to incent bond buyers with increased spreads

Recognizing maturity extension as a credit event will **positively impact** Bond-CDS basis. Will be advantageous to credit protection buyers, so, will widen CDS spreads

CDS buyer ability to choose the cheapest to deliver bond will **positively impact** Bond-CDS basis. If protection buyers are allowed to choose cheapest to deliver bonds, this will increase CDS spread relative to equivalent bonds and protection sellers will need additional spread.

Bond issuer call options negatively impact Bond-CDS spread. Call options advantageous to bond issuer and increase bond spread.

(c)

(i) Propose a bond-CDS basis trade to generate credit risk-free income for each bond.

(ii) Calculate the credit risk-free income for each trade.

(iii) Determine which trade is better. Justify your answer.

Commentary on Question:
Most candidates did not do well in this section because they did not model the appropriate trades to perform the necessary analysis.

<u>Bond A</u>
Bond-CDS basis = 65bps – 45bps= 20 bps (positive basis)

Short bond A
Pay 45 bps
Sell CDS protection
Receive 65 bps
Fund with reverse Repo
Pay 35 bp repo funding cost

Net income/"carry" = 65- (45+35) = -15 bps

16 Continued

Bond B
Bond-CDS basis = 110bps – 120bps= -15 bps (negative basis)

Buy bond B
    Receive 125 bps
Buy (8yr) CDS protection
    Pay 110 bps
Fund with reverse Repo
    Pay 5 bp repo funding cost

Net income/"carry" = 125- (110+5) = +10 bps

Recommend the negative basis trade. It has a positive net carry, is easier to execute than a negative basis trade and risks are partially hedged for negative basis trades.

17. Learning Objectives:

4. The candidate will understand and apply quantitative techniques for portfolio management.

6. The candidate will understand the specific considerations relative to managing a fixed income portfolio within an asset allocation framework.

Learning Outcomes:

(4a) Describe, contrast and assess techniques to measure credit risk, including spread risk.

(6i) Explain and recommend best practices in credit risk management..

Sources:
Bohn and Stein, Active Credit Portfolio Management in Practice, 2009

- Chapter 4, Econometric Models
- Chapter 6, Reduced Form Models

V-C198-12: Risk Management, 2001, Chapter 7, Credit Rating Systems, pgs 259 – 265, 273 – 280, and 282 - 301

Commentary on Question:
The question addressed modeling of default and calculation of default-adjusted expected returns. The overall candidates' performance was satisfactory.

Solution:

(a) Describe the differences between a reduced-form and a structural (Merton) model of default.

SM – causal models (define how various quantities relate to each other in a meaningful way)
RFM – subset of data-driven models (rely on statistical regularity of data relationships)
SM – rooted in economic explanations of default based on firm value and capital structure
RFM – take observable data as generated by a hidden mechanism and use these to infer quantities relating to the default likelihood of a firm

SM – solve for endogenous variable relationships
RFM - reflect exogenously specified variable relationships

SM – causal: link specific variables within a causal structure to the firm's specific probability of default

17. Continued

RFM – intensity: assume that the time of default is unpredictable, so specify intensity process of default

SM – produce output that is intuitive to interpret and diagnose and provide framework for sorting out the source of outlier behavior
RFM – use framework not grounded in economics so data errors may lead managers astray

SM – offer elegant descriptions of firm behavior and default, perform well when good market prices are available
RFM – offer attractive options during market turmoil

SM – may not be appropriate in difficult and illiquid markets or for some type of debt (e.g. sovereign)
RFM – attractive choice for marking to market of illiquid securities, may be used for all kinds of debt

SM – economic models with an empirical track record of parameter stability
RFM – relative parameter instability and lack of obvious theoretical underpinnings

SM – currently draw on option pricing theory
RFM – mathematically tractable and flexible

(b) Calculate the default-adjusted expected 2-year return of bond X.

prob A rating =.80 =.80*.80+.15*.20 = .67
prob B rating =.15 =.80*.15+.15*.70 = .225
prob default =.05 =0.05*1 +0.15*0.1 + 0.8*0.05 = 0.105

Value at end of two years from no default scenario:
= (.670+.225)*1000 = 895

Value at end of two years from default year 1 scenario
=.05*(1-0.3)*1000*1.03 = 36.05

Value at end of two years from default year 2 scenario
=0.055*(1-0.3)*1000 = 38.5

Total expected value at end of two years: 969.55

2 year return = 969.55/Price of bond = 1.0773

18. Learning Objectives:

5. The candidate will understand the specific considerations relative to managing an equity and/or alternative asset portfolio within an asset allocation framework.

Learning Outcomes:

(5a) Explain how an investment policy affects the selection of an investment strategy or the selection of an optimal portfolio.

(5b) Assess a portfolio position against portfolio management objectives using qualitative and quantitative techniques.

(5d) Recommend an investment strategy for a given situation:

- Portfolio policy and objectives
- Portfolio rebalancing strategy

Sources:

Maginn & Tuttle, Managing Investment Portfolios, 3rd Edition, 2007
Chapter 11, "Monitoring and Rebalancing," by Arnott, Burns, Plaxco, & Moore, pgs. 684 – 695 and 701 - 709

Commentary on Question:

The focus of this question was on understanding and recommending a rebalancing policy for a portfolio. Note that writing down only the key points from each part would be sufficient to achieve a high score.

Solution:

(a) Explain what aspects of the portfolio should be monitored for changes in RLIC's circumstances and constraints, and how each will likely change over time.

1. The company wishes to maximize surplus and is risk adverse
   a. Changes in RLIC circumstances
      (i) operating performance
      (ii) expenditures
      (iii)risk exposures
      (iv)risk preferences
   b. Changes in RLIC Wealth
      (i) Risk tolerance may change as a result of increased or decreased wealth
2. Liquidity requirements
   a. RLIC has no liquidity constraints in the first 35 years, as the portfolio does not have to payout.
   b. Because RLIC doesn't have any liquidity requirements, they can earn a return premium on their PE investments.
   c. This will change as the annuities begin payment in 35 years, and the portfolio requires liquidity.
   d. RLIC should begin shifting its asset mix away from PE into more liquid investments

18. Continued

3. Time horizons
   a. This portfolio has a multistage time horizon
      (i) Will not be abrupt, will be gradual
   b. Deferral Period
      (i) The portfolio mix should be maintained at the mix given
      (ii) Gradually shift to the shorter term asset mix
   c. Payout Period
      (i) Add more shorter duration bonds
      (ii) Remove equities, private equity
      (iii)Duration match
4. Taxes circumstances
   a. As the time horizon shortens, the municipal bond holdings will change.
   b. Unrealized gains from equities will have to be realized and shifted into shorter assets.
   c. Private Equity gains will have to be realized and shifted into shorter assets.
5. Changes in legal and regulatory factors
   a. Unique circumstances

(b) If the stock market decreases by 30%, explain the benefits and costs of rebalancing the portfolio.

Benefits of rebalancing

1. Reducing the present value of expected losses from not tracking the optimum portfolio
   a. Because the CEO is risk averse, a commitment to rebalance to the strategic asset allocation offers an effective way to dissuade RLIC from abandoning policy at inauspicious moments.
2. Controls drift in the overall level of portfolio risk.
   a. The portfolio was selected for the deferral period, with equities for long term growth and private equity because its liquidity constraints can be handled.
   b. The portfolio is out of balance, and may need more equities.
3. Maintains the client's desired systematic risk exposures.
   a. There is too much weight on PE and bonds.

Cost of rebalancing

1. Transaction costs
   a. Costs to rebalance illiquid Private equity is very high
   b. Costs to purchases public equities much lower
   c. Implicit costs
      (i) Commissions, bid-ask spread, market impact
      (ii) Market impact = realized price – price that would have prevailed in the absence of the order

18. Continued

d. Cumulative erosion of value can significantly deteriorate portfolio performance
e. Unobservable Opportunity cost
   (i) Trades seek but fail to execute

2. Tax costs
   a. Selling private equities and bonds will generate a tax liability

(c) You are considering the following rebalancing disciplines

- Calendar rebalancing
- Percentage of portfolio rebalancing

(i) Explain why the calendar rebalancing might be more appropriate during the deferral period.

(ii) Explain why the percentage of portfolio rebalancing might be more appropriate during the payout period.

Deferral Period

1. I would recommend using annual calendar rebalancing in the deferral period
   a. Calendar rebalancing involves rebalancing a portfolio to target weights on a periodic basis, for example, monthly, quarterly, semiannually, or annually.
2. Benefits
   a. The portfolio contains a significant portion of Private Equities, with hard to calculate returns and MVs.
      (i) This method does not involve continuously monitoring portfolio values within the rebalancing period.
   b. Because the private equity transaction costs are so high, transacting less often will preserve portfolio value.
   c. Calendar rebalancing is the simplest rebalancing discipline, and most logical because the portfolio view is so long
      (i) A lot of trading today doesn't make sense.
3. Costs
   a. Method is unrelated to market behavior, but the portfolio view is so long term that market cycles are of less importance
   b. On any given rebalancing date, the portfolio could be very close to or far away from optimal proportions.
      (i) In the former case, the portfolio would be nearly optimal and the costs in rebalancing might swamp the benefits.
         - If equities gained, it will be less costly to rebalance
         - If equities lost, it will be more costly to rebalance

18. Continued

Payout period

1. I recommend using percentage-of-portfolio rebalancing.
   a. Method involves setting rebalancing thresholds or trigger points stated as a percentage of the portfolio's value.
2. Because the CEO is risk adverse, tighter controls are necessary on the portfolio during the payout period.
   a. Compared with calendar rebalancing, percentage-of-portfolio rebalancing can exercise tighter control on divergences from target proportions because it is directly related to market performance.
3. The tighter controls will facilitate the CEO's duration matching strategy. The issues of monitoring portfolio values will be less of an impact because there will be less private equity in the portfolio.