

RET RPIRM Model Solutions

Fall 2023

1. Learning Objectives:

2. The candidate will recognize and appropriately reflect the role of plan investments in managing plan sponsor risk and make recommendations.

Learning Outcomes:

- (2d) Apply and evaluate strategies and techniques for asset/liability management.

Sources:

RPIRM-111-23: Mind the Gap: Using Derivative Overlays to Hedge Pension Duration, pp 3,5

Commentary on Question:

Candidates generally performed well on this question.

Solution:

- (a) Describe the impact of a duration gap on a defined benefit pension plan.

Commentary on Question:

Candidates performed well on this question. Some candidates described what a duration gap is instead of describing the impact of such a gap in the context of a pension plan.

Asset/liability duration mismatch can result in volatility of funded status, contributions and balance sheet impacts.

The pension plan is exposed to changes in market interest rates. When there is a negative duration gap, a decrease in bond yields raises the value of assets much less than it raises the level of liabilities.

- (b) Describe strategies to mitigate a negative duration gap.

Commentary on Question:

Candidates generally performed well on this question. Partial credit was given when candidates listed the strategies without describing them.

Plan sponsor can choose to close the duration gap fully or partially, and can choose to do so gradually (e.g. using a glide-path approach) or immediately. Strategies to close a negative duration gap include:

1. Continued

1. Asset diversification: increase the fixed-income asset allocation in order to increase the duration of the portfolio, for example by replacing equities with corporate or government bonds, or any other fixed-income asset with a duration greater than 0.
 2. Duration management (increase duration of fixed income portion of the assets) - minimizing volatility without changing the asset allocation. For example, replacing short term bonds with long term bonds.
 3. Derivatives overlay strategy - underlying asset portfolio remains intact while derivatives transform key aspect of portfolio by increasing duration synthetically
 - a) DB pension plan can close negative duration gap by entering receive-fixed interest rate swap with positive duration. This involves the right but not the obligation to enter into an underlying interest rate hedge transaction at a predetermined strike rate.
 - b) DB pension plan purchases a receiver swaption and/or enters into a swaption collar. Purchased receiver swaptions protects pension plans against a fall in yields below a predetermined strike level. A swaption collar involves buying one swaption and selling another to reduce upfront expense.
 4. Buy-in group annuity contract: Contract entered in which the plan pays a premium to an insurance company. In return, the insurance company pays the actual benefit payments for a group of participants (e.g. retirees). The duration of the assets transferred to the insurer becomes the duration of the liabilities for the affected members.
 5. Matching key rates durations (not only the effective duration) with zero coupon bonds - a full immunization strategy that would help protect against non-parallel shifts of the yield curve.
- (c) Company XYZ enters into a receive-fixed interest rate swap with notional principal of \$100,000. Determine the swap duration needed to fully hedge interest rate risk on the portfolio funding the ABO.

$$NP = MV * (\text{Target Duration} - \text{Portfolio Duration}) / \text{Swap Duration}$$

where,

$$NP = \text{Notional Principal} = 100,000$$

$$MV = \text{Market Value} = 87,384$$

$$\text{Portfolio Duration} = 40\% \text{ fixed income allocation} * \text{fixed income duration } 8 + 60\% \text{ equities} * \text{assumed equity duration } 0 = 3.2$$

$$\text{Target duration} = \text{ABO duration} = -(ABO_- - ABO_+) / (n_- - n_+) / ABO$$

where n = nominal discount rate, subscript - means reduced, + means increased

$$\text{Target duration} = -(113,207 - 67,811) / (.04 - .06) / 87,384 = 25.98$$

$$100,000 = 87,384 * (25.98 - 3.2) / \text{Swap Duration}$$

$$\text{Solve for Swap Duration} = 19.90$$

2. Learning Objectives:

3. The candidate will understand how to evaluate the stakeholders' financial goals and risk management with respect to their plan.

Learning Outcomes:

- (3d) Understand and apply the principles of financial economics with respect to pension plan investing.
- (3f) Provide advice and analysis to plan sponsors and other stakeholders regarding the mitigation of pension plan risks.

Sources:

RPIRM 120-13

RPIRM 121-13

RPIRM 162-19

Pension Actuary's Guide to Financial Economics and Pension Arbitrage Example

Commentary on Question:

Many candidates did not respond with enough information to earn full points on the question and generally performed better on Part B than Part A.

Solution:

- (a) Critique the following statements related to the financial economics viewpoint:
 - (i) Pension plans should invest 100% in bonds
 - (ii) Liabilities must be discounted at the risk-free rate

Commentary on Question:

In order to receive full credit both strengths and weaknesses (pros and cons) were required however many candidates focused on one or the other. The answer below includes more pros and cons than would be needed for full credit.

- (i)
Pros:

- Pension liabilities are a series of future cash flows which most closely resemble debt i.e., bonds
- A portfolio of assets that most closely matches these future cash flows would consist of 100% risk-free bonds
- Investing in bonds through the pension plan may drive attractiveness of company stock, as shareholders can experience a tax arbitrage opportunity
- Due to the asymmetry of surplus vs. deficit, the payoff from bearing risk in the corporation is usually better than taking that risk in the pension plan.

2. Continued

- Debt interest tax shield: companies can deduct interest paid on debt from taxable income, and all things being equal, debt financing is less expensive on an after-tax basis than equity financing.

Cons:

- If the cash flows have economic risk, for example future salary increases, investing in 100% bonds actually increases risk
- The portfolio that minimizes risk may actually be one that include stocks to the extent that the stock matches the risk of the liability cash flows
- If a pension plan has access to lower cost or better managed assets compared to an individual investor, there could be an argument for including non-bond assets in the pursuit of alpha.

(ii)

Pros:

- If you argue that the liability cash flows are best matched by 100% risk free bonds, the liability should therefore be calculated using the corresponding risk-free rates of return on bonds
- The maturities should match the timing of the liability payments
- Liabilities should be marked-to-market.

Cons:

- Liabilities should be discounted at the expected return on the assets of the cash-flow matching portfolio;
- The cash-flow matching portfolio could include a variety of asset classes beyond just risk-free bonds, such as corporate bonds, equities or other asset classes
- In the case where the matching portfolio does not include 100% risk-free bonds, it would not be appropriate to use the risk-free rate of return to calculate the liability.
- Risk-free interest rates may not capture all the risk associated with liabilities, for example economic risk (salary growth).

- (b) Explain why an investment strategy of investing in 100% cash flow matching bonds may not be optimal for a pension plan.

Commentary on Question:

Candidates generally performed well on this part of the question.

2. Continued

- If the pension plan is not fully funded, will make it difficult to reduce the plan deficit with investment returns;
- Practically, there is a scarcity of long-term bonds so matching pension liabilities may not be even possible
- Bonds may introduce a large amount of credit spread and yield curve risk
- Typically, bonds do not help with hedging the economic risk in the liability, such as future salary accruals
- A 100% bond portfolio with 100% cash flow matching bonds may not be appropriately diversified

3. Learning Objectives:

1. The candidate will understand the issues facing retirement plan sponsors regarding investment of fund assets.
3. The candidate will understand how to evaluate the stakeholders' financial goals and risk management with respect to their plan.

Learning Outcomes:

- (1a) Assess the different types and combinations of investment vehicles for providing retirement benefits given the particulars of the stakeholders' financial circumstances, philosophy, industry, work force and benefit package.
- (1b) Distinguish the various strategies, approaches and techniques used to manage retirement fund assets.
- (1d) Assess the potential effects of various investments and investment policies on all of the stakeholders, including tax implications.
- (3f) Provide advice and analysis to plan sponsors and other stakeholders regarding the mitigation of pension plan risks.

Sources:

Modern Investment Management, Litterman Ch. 24

Commentary on Question:

This question's objective was to test the candidate's ability to understand portfolio characteristics and constraints AND how they impact the portfolio's risk and return profile. Most candidates proved the former, but many did not prove the latter.

Several candidates listed and described characteristics of Portfolio A and Portfolio B in sequence; this was not considered an appropriate response for this question given candidates were asked to "Compare and contrast".

As a reminder, candidates are expected to be familiar with the verb list included in the Guide to SOA Written Exams (see section 5.3.3 [Guide to SOA Written Exams](#)). As stated in the guide: Compare / Contrast – There must be at least two items being considered. Both similarities and differences are to be articulated, but no conclusion is expected.

Solution:

Compare and contrast Portfolio A and Portfolio B taking into consideration Company ABC's goal and concerns.

Commentary on Question:

Points were given for any other reasonable answers not listed below.

3. Continued

The company's **objective** is to **achieve a higher return**.

Its **concerns** are **interest and currency risks**.

Comparison:

- Both portfolios are not fully invested in fixed income. This allows an opportunity to invest in return seeking assets, which will be a step towards **achieving the company's goal of higher returns**.
- Both portfolios hedge at least a portion of the interest rate risk, as can be seen through their target hedge ratio. This addresses the company concern about **interest rate risk**.
- Both portfolios **minimize their currency risk**, which is the second concern, by not allowing foreign investments (Portfolio A) or allowing maximum foreign bonds (Portfolio B).

Contrast:

- Portfolio B has potential for **higher return** than Portfolio A due to higher allocation in Non-Fixed Income assets and to allowance of lower credit quality bonds and foreign investments (bonds and equities). However, the allowance of lower credit quality bonds and foreign investments introduces **credit risk** and **currency risk** for Portfolio B that Portfolio A does not bear given its restrictions. However, it should be noted that credit risk is not a concern for Company ABC.
- With a target hedge ratio of 100%, **interest rate risk** for Portfolio B will be fully hedged (if target is attained), while for Portfolio A it will only be partially hedged, given its 50% target hedge ratio.
- Given that Portfolio B allows foreign bonds and Portfolio A does not, they will bear different **interest rate risks** because of the differences in the yield curves and in macroeconomic and inflationary environments. This will also reduce **interest rate risk** for Portfolio B through diversification.
- Given that Portfolio B allows for the use of derivatives such as forward/future contracts, options contracts and swaps, it will allow Portfolio B to mitigate **interest rate and currency risks**. Credit derivatives could also be used to mitigate credit risk. These are not options for Portfolio A because derivatives are not allowed. Also, by using derivatives, Portfolio B has the possibility to achieve higher returns than Portfolio A due to higher diversification opportunities.

4. Learning Objectives:

3. The candidate will understand how to evaluate the stakeholders' financial goals and risk management with respect to their plan.

Learning Outcomes:

- (3f) Provide advice and analysis to plan sponsors and other stakeholders regarding the mitigation of pension plan risks.

Sources:

ACPM ESG White Paper

Commentary on Question:

In general, the candidates did not perform well on this question.

Some candidates explained and/or described investment selection, investment manager selection, investment monitoring, governance, fiduciary duties, regulations or other general tasks and responsibilities of DC plan sponsors, but did not provide an answer in the context of the implementation of an ESG factor program into an institutional investment program. Other candidates mainly described the characteristics of an ESG investment and how to select ESG investments without a focus on implementation.

Solution:

- (a) Explain how plan sponsors can consider environmental, social and governance ("ESG") factors for defined contribution pension plans with member-directed investments.

Sponsors consider ESG factors by selecting DC providers that have ESG investment options and information about how ESG factors are considered in the context of their investment process. They also inform members on how the funds available to them integrate ESG factors (in the same way members have access to performance, fees, style, etc.).

- (b) Identify the main tasks involved in implementing an ESG factor program into an institutional investment program.

The following tasks are involved in implementing an ESG factor program into an institutional investment program:

1. Articulate the organizational purpose and objectives of implementing an ESG factor program.
2. Seek views from the investment program stakeholders.
3. Determine which ESG factors are identifiable and measurable to enhance the investment management.
4. Review the legislation to understand their applicability to the fiduciaries and ESG.

4. Continued

5. The detailed investment strategy should be development and documented in the SIPP.
6. Adjust the investment governance process to reflect the additional ESG objectives and requirements imposed on the investment strategy.
7. Modify existing portfolio to reflect the ESG factor program (a transition plan should be developed).
8. Modify the existing investment manager search, review and termination process to reflect the requirements imposed by the ESG program,

4. Continued

- (c) Describe the considerations when implementing an ESG factor program into an institutional investment program.

Investment manager selection: Careful consideration should be given to the selection of investment managers. The sponsors need to be alert to naïve analysis of investment manager marketing efforts to ascertain if the investment managers investment belief, style, and process are consistent with the plan's specific ESG requirements.

Investment framework: The whole investment framework including investment beliefs, investment strategy, applicable legislation, size of portfolio, available investment management resources, investment governance structure, investment objectives, and constraints must be considered when implementing an ESG factor program.

Portfolio review: The sponsors should consider using this opportunity to scrutinize other aspects of the portfolio investment strategy and/or governance process and consider other ideas to improve the probability of meeting the portfolio's objectives.

Assistance of an external service provider: Depending on the extent of internal resources, the Board or investment committee might consider engaging with an external service provider to provide assistance with some of the development of strategies, policies and detailed ESG criteria.

Balancing the conflicts: Consideration should be given to how any conflicts between managing return expectations, risk management and ESG factors will be balanced. There will most likely be differences between asset classes in which these conflicts need to be balanced. As well, balancing asset class compliance and compliance at the total portfolio level will need to be addressed.

Investment Beliefs: Depending on the organization's resources and how much has already been achieved in this area, considerations should be given if it might be more effective to start with broad factors and add additional factors over time within the investment strategy or to identify the ESG factors right away.

5. Learning Objectives:

2. The candidate will recognize and appropriately reflect the role of plan investments in managing plan sponsor risk and make recommendations.

Learning Outcomes:

- (2c) Evaluate how factors including cash flow requirements, various plan designs and various economic environments affect setting investment strategy.
- (2e) Provide advice and analysis to plan sponsors regarding the mitigation of investment risks.

Sources:

Study Note: RPIRM 165-21

Study Note: RPIRM-112-13

“The SOA is aware that study note RPIRM-112-13 was not included in the syllabus for this exam. To account for this, candidate performance was reviewed both including and excluding this question to ensure candidates were not penalized.”

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Describe the process for conducting an asset/liability modeling (“ALM”) study.

Commentary on Question:

To receive full credit for part (a), candidates were expected to discuss the entire process for conducting an asset/liability modeling study, from discussing sponsor objectives to implementing results. Common mistakes included only describing one part of a study (e.g., only describing collection of inputs) or a general misunderstanding of the types of modeling associated with an asset/liability study (for example, some candidates discussed only a deterministic projection).

The first step of conducting an asset/liability study should be a comprehensive discussion with the plan sponsor to understand their objectives and desires for the modeling. The discussion should not only cover high-level objectives, but also include a conversation around the sponsor’s risk tolerance within the plan, policies for funding/accounting/asset allocation, and any key aspects of the future outlook of the corporation or plan that might affect the results of the study.

Next, the consultant (or other party conducting the study) should construct a stochastic asset/liability model, incorporating sponsor feedback, detailed plan characteristics, assumptions for asset returns/other capital market factors, and a host of other items to allow the consultant to produce a set of initial forecasts. These forecasts and accompanying information should discuss and illustrate the range of potential outcomes for the pension plan in the next 10+ years (or other

projection period). The forecasts should be presented to the plan sponsor, and discussion around these forecasts can inform the next steps of the study.

5. Continued

After developing initial forecasts, the consultant could use efficient frontiers, along with other asset allocation tools and processes, to determine whether there is a more efficient investment strategy to help meet the sponsor's needs and goals. Once the strategy (or strategies) are identified, the consultant should conduct a comprehensive analysis showing projected results for recommended vs. current strategy. The consultant may also consider a dynamic strategy (e.g., glide path), which should be evaluated as part of the analysis.

Once the analysis is complete, the consultant and sponsor should discuss the final results, settle on an ongoing strategy, and implement any necessary changes within the Investment Policy Statement and the portfolio. These changes should of course be monitored on an ongoing basis to identify when/if additional changes are necessary.

- (b) Describe the inputs for an ALM study.

Commentary on Question:

To receive full credit on this portion of the question, candidates needed to identify multiple inputs from each of the three major categories of inputs/assumptions: Asset, Liability, and Financial.

There are a large number of inputs required to conduct an ALM study:

- Asset Assumptions
 - Define expectations for return levels and volatility of modeled asset classes
 - Define correlations between asset classes, and ensure that they are reasonable
 - Develop Capital Market Simulations of future returns, inflations, and yields
 - Determine the type of simulations that will be used – may be based on macro-economic predictions of relationships between asset returns and economic variables, or be more simple
- Liability Assumptions
 - Baseline liability projections should be based on the valuation assumptions used to calculate the initial liability valuation
 - Liability projection should reflect changes in valuation assumptions over the course of the forecast (assumptions like discount rates, salary scale, etc. may change based on underlying economic conditions)
 - Include assumptions to reflect future plan experience including any new entrants, accruals, retirements, terminations, or other decrements
 - Reflect planned future plan-design events, such as risk transfer or partial termination

5. Continued

- Financial Assumptions
 - Consider the sponsor's contribution policy (both level and timing of future contributions) as well as potential modeling of alternate contribution patterns
 - Reflect the sponsor's accounting policy and the impact of asset allocation and/or projection results on corporate expense/balance sheet measurements
 - Investment Policy should also be an input, particularly the current asset allocation/strategy as well as rebalancing strategies and limitations on particular asset classes

- (c) Describe the typical financial outputs of an ALM study.

Commentary on Question:

Most candidates did well on this portion of the question. The most common mistake was describing the outputs as a single deterministic scenario; ALM results should generally be presented stochastically.

Output data for a stochastic ALM forecast generally consists of detailed financial results for each of hundreds (or thousands) of stochastic scenarios, year-by-year. Typically, graphical output would show a variety of percentiles of the distributions (such as 10th, 25th, 50th, 75th, 90th, or other percentiles if deemed more relevant by the sponsor/consultant).

Typical financial outputs shown in this manner could include:

- Contributions (in dollars, or percentage of payroll). May be useful to include both annual and cumulative average data.
- Projected funding levels, potentially based on multiple different liability measures that are deemed necessary to the sponsor. May be useful to include both annual and cumulative average data.
- Projected benefits paid to participants (i.e., annual cashflows).

6. Learning Objectives:

1. The candidate will understand the issues facing retirement plan sponsors regarding investment of fund assets.

Learning Outcomes:

- (1a) Assess the different types and combinations of investment vehicles for providing retirement benefits given the particulars of the stakeholders' financial circumstances, philosophy, industry, work force and benefit package.

Sources:

RPIRM-143-17: Attracting Pension Plan Assets: What Alternative Investment Managers Need to Know

RPIRM-144-17: Patient Capital, Private Opportunity: The Benefits and Challenges of Illiquid Alternatives

Commentary on Question:

Commentary listed underneath question component.

Solution:

- (a) Compare the level of liquidity of each investment type within each asset category below by ranking them from 1 to 4, with 1 being the most liquid and 4 being the least liquid.

Commentary on Question:

Points were given only if all 4 investment types in their respective asset category were correctly ranked.

Equity		Fixed Income		Real assets	
4	Venture Capital	3	Mezzanine Debt	3	Private real estate debt
3	Private equity	1	Government bonds	4	Private real estate
2	Actively managed global small cap equity	4	Distressed debt	1	Passive real estate investment trust
1	Exchange Traded Funds	2	High yield bonds	2	Active commodity fund

6. Continued

- (b) Compare and contrast investing in public markets and private markets for the following:
- (i) Liquidity
 - (ii) Asset valuation
 - (iii) Timing of returns
 - (iv) Implementation

Commentary on Question:

To get full credit, candidates were required to compare each section and give enough details. Points were awarded for answers not included in the solutions below.

Liquidity

Private markets are more illiquid than public markets. Public markets readily trade on a public exchange, but private markets do not. As a result, there is an illiquidity premium associated with investing in private markets that provides return enhancement compared to public market investing.

Asset valuation

Given that they trade on public exchanges, public market investments have readily available and continuous valuations. Private markets have less frequent valuations, and may be done on a monthly or quarterly basis.

Timings of returns

Public markets may begin to realize immediate returns as implementation is quicker. Private markets may take time to realize returns as implementation takes longer and the fees in the first few years may outweigh returns, giving rise to 'j-curve' types of return.

Implementation

Public market investments are generally easily sold and purchased on exchanges within a reasonable time frame. Private markets may take a much longer time horizon to build up the desired allocation. Private investments like real estate, infrastructure and private equity for example, may require patience while waiting for opportunities to arise in the market, which may delay implementation compared to public markets.