RET RPIRM Model Solutions
Fall 2017

1. Learning Objectives:

1. The candidate will understand how to analyze the issues facing retirement plan sponsors regarding investment of fund assets and make recommendations.

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.

(1f) Identify and assess the sources of investment risk applicable to retirement fund assets.

Sources:

Litterman Chapter 24

Commentary on Question:

Most candidates performed well on this question. To receive full credits the candidate is expected to clearly describe the inherent risks with fixed income investments, and the active management strategies associated with fixed incomes. Some candidates lost marks for not providing a proper explanation for the risks/strategies. Some candidates also confused active management strategies with passive strategies such as simply matching the portfolio duration.

Solution:

(a) Describe four sources of risk inherent in fixed income investments.

Commentary on Question:

Most candidates did well on this part of the question. Full credit was obtained for listing and describing at least four risks.

Sources of risk inherent in fixed income investments are:

- Interest rate risk:
    - Risk that yield of a bond will change due to changes in the otherwise risk-free bond with the same cash flows.

1. Continued

- Yield curve risk:
  - Risk that a portfolio's value will change due to a change in the shape rather than the level of the yield curve.
- Sector risk:
  - Volatility of returns due to yield changes derived from changes in spread between the sector in question and the baseline yield curve (either the government or swap curve.)
- Credit risk:
  - Risk borne by the fixed income investor that the cash flows that the issuer has contracted to pay will not be paid due to the inability or unwillingness of the issuer to do so.
- Volatility risk:
  - Risk that portfolio's value is impacted by how much interest rates move or are expected to move in either direction rather the change in the level of interest rates.
  - It arises when the portfolio has instruments with asymmetric payoffs (an interest rate movement in one direction generates a larger gain than the loss associated with the equal but opposite interest rate move)
- Prepayment risk
  - Volatility risk arising from the over or underestimation of actual prepayment rates
- Currency risk:
  - Exposure than an investor bears when investing in financial instruments denominated in a currency that is not the investor's base currency; prevalent in bond portfolios that have holdings across multiple markets.
- Security-Specific Risk:
  - Risk due to changes in the supply and demand balance of that security or due to changes in the market's perception of the credit quality of the issuer of the security.
  - Can be thought of as the volatility of a bond's return that cannot be explained by the other fixed income risk factors.

(b) Describe four active management strategies for fixed income investments.

Commentary on Question:
Most candidates did well on this part. Some candidates were not able to describe the active management strategies and only received partial credit. Full credit was obtained for listing and describing at least four strategies.

1. Continued

Active management strategies for fixed income investments are:

- Duration timing strategy:
  - Market timing strategy where portfolio manager positions the portfolio to have a longer or shorter average duration than the benchmark.
- Yield curve positioning strategy:
  - Strategy where manager overweights the contribution to duration of one or multiple parts of the yield curve and offsets these long positions with underweights of other parts of the yield curve.
  - Strategy is usually run market neutral (i.e. net duration of zero) since any residual market exposure would be part of the duration timing strategy.
- Sector allocation strategy:
  - Strategy where manager overweights and underweights position in the various fixed income sectors relative to the chosen benchmark.
  - Weighting can be based on relative spread advantage to other sectors and/or an expectation of future spread tightening or expanding.
- Security selection strategy:
  - Series of strategies in which the manager is selecting individual securities within each of the sectors in which the portfolio is invested.
  - Allows managers to diversify across many different active decisions rather than just a small number of bets.
- Country allocation strategy:
  - Strategy where manager takes active long and short positions in bonds priced off the yield curve of one country versus bonds priced off of the yield curve of another country.
  - Generally run to market neutral with respect to global interest rates. The net of the long and short positions in various countries would not be expected to perform better or worse in rallying markets versus declining markets.
- Currency allocation strategy:
  - Strategy implemented by using currency forward contracts that explicitly expose the portfolio to one currency versus another or by leaving securities denominated in currencies that are expected to appreciate unhedged or only partially hedged.

2. Learning Objectives:

1. The candidate will understand how to analyze the issues facing retirement plan sponsors regarding investment of fund assets and make recommendations.

Learning Outcomes:

(1g) Solve for a measure of investment performance relevant to a given benchmark

Sources:

RPIRM-104-15

Commentary on Question:

This question tested candidates' ability to perform a macro-level attribution of portfolio returns, an analysis that is essential to determining whether portfolio managers are adding value, and if so, how. To receive maximum credit, candidates should decompose total return into the macro attribution categories, by percentage and dollar amount, as illustrated in the assigned reading. This is a step-by-step process.

Most candidates received credit for listing the components of macro-level attribution, which was given in the stem of the question. Many understood that net contributions did not contribute towards returns, only toward fund value. Another area where candidates did fairly well was in recalling the formulas for performance attribution, especially those for asset classes and benchmarks. However, the number of candidates who applied the correct data to the formula, and calculated accurately, progressively declined.

Most candidates who completed the question showed the performance attribution categories in terms of dollars or % return, but few provided both. Credit was available for either, separately.

Solution:

Calculate the following macro-level attributions of the fund return:

(i) Net contributions

(ii) Risk-free asset

(iii) Asset categories

(iv) Benchmarks

(v) Investment manager

(vi) Allocation effects

Show all work.

2. Continued

One must decompose the fund return into its various components:

1. net contributions
2. risk-free asset
3. asset class
4. benchmarks
5. investment manager
6. allocation effects

In table form:

XYZ Fund - Return Attribution Chart			
Source	($000) Resulting Fund Value	Return Contribution, %	($000) Value Contribution
Beginning Value	$250,000		
Net Contributions	$250,715	0.00%	$715
Risk-Free Asset	$250,966	0.10%	$251
Asset Classes	$252,359	0.56%	$1,393
Benchmarks	$252,386	0.01%	$27
Investment Manager	$252,155	-0.09%	-$231
Allocation Effects	$252,300	0.06%	$145
Total Fund	$252,300	0.63%	$2,300

Calculations for entries

All values given in ($000)

Beginning Value

Given.

Net Contributions

$250,715 – $250,000 = $715
Does not contribute to return.

Risk-Free Asset

$250,715 * (1 + 0.0010) = $250,966 (rounded).
$250,966 – $250,715 = $251

2. **Continued**

Asset Class

Formula:

$$r_{AC} = \sum_{i=1}^{n} w_i \times \left(r_{Ci} - r_f \right)$$

0.70 × (0.0085 – 0.0010) +
0.30 × (0.0020 – 0.0010) =

0.00525 + 0.0003 = 0.00555

$250,966 * 1.00555 = $252,359
$252,359 – $250,966 = $1,393

Benchmarks

Formula:

$$r_{IS} = \sum_{i=1}^{n} \sum_{j=1}^{m} w_i \times w_{ij} \times \left(r_{Bij} - r_{Ci} \right)$$

0.28 × (0.0080 – 0.0085) +
0.42 × (0.0090 – 0.0085) +
0.075 × (0.0010 – 0.0020) +
0.225 × (0.0025 – 0.0020) =

-0.000140 + 0.000210 – 0.000075 + 0.000113 = 0.000108

$252,359 * 1.000108 = $252,386
$252,386 – $252,359 = $27

Investment Managers

Formula:

$$r_{IM} = \sum_{i=1}^{n} \sum_{j=1}^{m} w_i \times w_{ij} \times \left(r_{Aij} - r_{Bij} \right)$$

2. **Continued**

0.28 × (0.0083 – 0.0080) +
0.42 × (0.0068 – 0.0090) +
0.075 × (0.0045 – 0.0010) +
0.225 × (0.0010 – 0.0025) =

0.000087 – 0.000923 + 0.000261 – 0.000338 = – 0.000914

$252,386 * (1 – 0.000914) = $252,155.
$252,155 – $252,386 = – $231

Allocation Effects

Ending value of $252,300 is given, so:

$252,300 – $252,155 = $145

$252,300/$252,155 – 1 = 0.0006 (rounded)

Total return contribution from all sources ($):
$252,300 – $250,000 = $2,300

Total return contribution from all sources (%):
0.00% + 0.10% + 0.56% + 0.01% – 0.09% + 0.06% = 0.63% (rounded exact answer), or
= 0.64% (rounding all components to 1 bp)

3. Learning Objectives:

2. The candidate will recognize and appropriately reflect the role of plan investments in retirement plan design and valuation.

Learning Outcomes:

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

Sources:

Study Notes: RPIRM – 111-13 - Mind the GAP: Using Derivatives Overlays to Hedge Pension Duration

Commentary on Question:

The candidates should be able to explain how assets and liabilities are affected by changes in interest rates and calculate the impact of using an interest rate swap to mitigate the impact of a change in interest rates. In addition, the candidate describe when a company would enter into a swap instead of an interest rate swaption.

Solution:

(a) Explain whether the plan should be the "receive-fixed" or "receive-floating" party in an interest rate swap.

Commentary on Question:

Candidates generally di nott provide a comprehensive answer to this part of the question, but all of the points below were not required for candidates to receive a full credit answer.

- The plan has a negative PBO duration gap of 8.7 – 4.2 = 4.5.
- The net settlement payments on a receive-fixed (and pay-LIBOR) interest rate swap are the same as being long a fixed-rate bond and short an offsetting floating-rate bond that is tied to LIBOR.
- The duration of the swap is the difference between the (relatively high) duration of the fixed-rate bond and the (very low) duration of the floating-rate bond.
- For the fixed-rate receiver (and floating-rate payer), the interest rate swap has positive duration; the same swap has negative duration for the counter party.
- The initial market value of the swap is zero.
- If interest rates fall, the value of the swap becomes positive because the value of the long position in the implicit fixed-rate bond goes up more than the value of the short position in the floating-rate bond.
- Therefore, the plan should enter into a receive-fixed interest rate swap that has positive duration.

3. Continued

(b) Describe when ABC Company would enter into an interest rate swap versus an interest rate swaption.

Commentary on Question:
Candidates generally did not provide a comprehensive answer to this part of the question (similar to the first part), but all of the points below were not required for candidates to receive a full credit answer. Some candidates did not properly answer the question. For example, some candidates described why ABC would prefer a swaption instead of explaining when the company would enter into a swap agreement.

- Cost – a swap can be entered without the upfront cost of purchasing a swaption.
  i. However, swaption cost could be reduced (or eliminated) by entering into a swaption collar – sell a swaption to offset the cost of buying a swaption
- Timing – Swaptions have an option expiration date, at which time the duration gap will need to be reassessed
  i. The inevitable difficulty in measuring the duration gap is another reason for a cautious approach to closing the duration gap.
- Complexity / Monitoring – Swaptions need continual monitoring to determine whether they should be exercised.
  i. In practice, many plan managers choose a partial swap hedge rather than a full hedge
  ii. There is risk in the model because assets and liabilities will not change exactly as expected based on duration alone.

OR

Yield curves rarely shift in parallel; they regularly steepen and flatten

(c) Calculate the notional value of the interest rate swap that would fully hedge the plan's interest rate risk.

Show all work.

Commentary on Question:
Candidates should be sure to show all work as requested in the question. Most candidates did not calculate the correct total notional value of the swap because they only used the asset value and neglected to include the unfunded PBO.

3. Continued

i. Key formula:

$$\text{Notional Principal (NP)} = \frac{\text{Market Value (MV)} \times (\text{Target duration} - \text{Portfolio duration})}{\text{Swap duration}}$$

ii. Key Values:
   i. MV of assets = $382 million
   ii. PBO = $518 million
   iii. Target duration = duration of PBO = 8.7
   iv. Portfolio duration = duration of MV of assets = 4.2
   v. Swap duration = 10.6 for 15-year swap;

iii. Calculation:
   1. Assets: $382 x (8.7 – 4.2) / 10.6 = $162.17M
   2. Unfunded PBO: ($518 - $382) x 8.7 / 10.6 = $111.62M
   3. Total: $162.17 + $111.62 = $273.79M

(d) Calculate the change in the plan's unfunded liability assuming a 0.50% decrease in interest rates.

Show all work.

Commentary on Question:
Common omissions from candidates were (1) not correctly incorporating the swap value into the net change in the unfunded liability and (2) not showing all work. (For example, some candidates correctly calculated the asset and liability impact, but did not show how that affected the unfunded liability.)

Calculation of change in unfunded PBO
i. Increase in PBO = $518 x 8.7 / 100 x 0.50 = $22.3M
ii. Increase in MV = $382 x 4.2 / 100 x 0.50 = $8.0M
iii. Increase in 15-year swap value = $273.8M x 10.6 / 100 x 0.50 = $14.5M
iv. Net change is effectively zero = $22.3 – ($8.0 + $14.5)

4. Learning Objectives:

1. The candidate will understand how to analyze the issues facing retirement plan sponsors regarding investment of fund assets and make recommendations.

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.

Sources:

Patient Capital, Private Opportunity - The Benefits and Challenges of Illiquid Alternatives

Commentary on Question:

This question tested the candidates understanding of the benefits and challenges of investing pension plan assets in illiquid alternatives. Additional commentary is underneath each question component.

Solution:

(a) Describe the advantages of investing in illiquid alternatives.

Commentary on Question:

A well prepared candidate was able to identify and describe the advantages of investing in illiquid alternatives. Most candidates did well on this part. Note that not all of the points below were required to receive full credit.

The following are advantages of investing in illiquid alternatives:

- Illiquidity premium provides for an opportunity for enhanced return relative to an equivalent liquid asset
- Illiquid alternatives are attractive for a pension plan that can tolerate long investment horizons and the restrictions on withdrawals
- Avoids the inherent discount with tradeable nature of public assets
- Aligned interest of owners and managers help limit the waste of free cash flow
- Asymmetric information exists allowing some investors to achieve returns substantially different from public market indices

4. Continued

(b) Explain the J-Curve as it relates to the return of private market investing.

Commentary on Question:
This question was intended to test the candidates understanding of the structure of private market investing. Many candidates adequately described the shape of the J-curve, but for full credit a more thorough answer was required.

- Investors' cumulative net cash flows form a "J-Curve"
- First slope down into negative (outflow) territory, then rise back to neutral, and if successful, becoming strongly positive
- Investors make an upfront commitment to invest a specific dollar amount into a limited partnership
- Commitment is then "called down" incrementally by the fund manager over the investment period to fund investments in portfolio companies and to pay fees and expenses
  - Investment period over a term of 3-6 years
  - Harvesting investments additional 3-6 years
  - Results in a total commitment of 10 years or more
- Invested capital is returned in the form of distributions generated by company sales or IPOs

(c) The CFO has made the following two statements about the new allocation to private market alternative investments.

(i) The private market alternative investment is expected to maintain a constant $10 million asset value over the investment horizon.

(ii) In the future, the allocation to private market alternative investments can easily and quickly be increased from 10% to 20%.

Critique each of the statements.

Commentary on Question:
The CFO's statements highlighted two challenges of investing in private market alternative investments. Most candidates did well at questioning the statements' validity but a smaller number of candidates provided sufficient justification. Some candidates provided critique of the statements without reference to private market alternative investments, which received little credit.

Part (c)(i)
- Making a $10 million commitment to alternative investments will not achieve a constant $10 million continuous allocation for the period
- Over the years the average exposure changes and often only half of the capital is "at work"

4. Continued

- $10 million allocation is target 10% of current assets of $100 million, as the pension fund assets increase/decrease it will change the amount allocated to private market alternative investments +/- $10 million
- May be able to keep closer to $10 million commitment at work by front-loading or "over-committing" to the allocation or by smoothing the cashflows (calls and distributions) across successive funds

Part (c)(ii)

- While the time and cost were spent identifying and negotiating the first deal, it is not like the public market where the fund can quickly and efficiently increase the allocation by purchasing shares in the open market
- Cannot gain instantaneous exposure as managers need time to identify and negotiate attractive deals

5. Learning Objectives:

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

Learning Outcomes:

(3b) Describe how the retirement plan financial and design risks integrate with the sponsor's risk management strategy.

Sources:

RPIRM-134-14 Liability responsive asset allocation

Solution:

XYZ Company is considering implementing a dynamic liability-responsive asset allocation (glide path) strategy for its defined benefit pension plan.

Describe how the following four considerations influence the implementation and on-going management of XYZ Company's asset strategy:

(i) Data availability

(ii) Contributions

(iii) Trading

(iv) Governance

There are eight practical considerations outlined in the paper by Russell Investments. However, four were chosen as appropriate discussion points for the question.

Data availability

Grader commentary: Candidates were required to sufficiently explain why data availability is a concern in implementing/monitoring a dynamic asset allocation, and then propose two approaches to estimate the liability. Most candidates understood that data availability could be problematic, but few proposed ways to estimate the liability at frequent intervals.

Other relevant points with appropriate explanation and not rewording the points below were also awarded credit. For example, the need to accommodate less frequent availability of market values for illiquid assets.

5. Continued

Reasonable estimates of the liability are required to monitor the funded status at frequent intervals, such as on a monthly or quarterly basis.

One approach is to use cash flows which include benefit accruals and month-end yield curves to estimate the liability.

Another approach is to age the liability using accruals and actual benefit payments, and then adjust to reflect changes in market interest rates.

Contributions

Grader commentary: The meat of this consideration is in successfully explaining how the contribution policy can be integrated with the dynamic asset allocation. Candidates were awarded credit for writing out B and C below ***or*** *providing a specific example, such as D below. Most candidates successfully identified the need to integrate contributions, but few noted the specifics around this process (as outlined in points B, C and D below).*

Other relevant points with appropriate explanation and not rewording the points below were awarded credit as well.

A: The implementation of a liability responsive asset allocation can be integrated with contributions to the Plan.

B and C **or** D were awarded equal credit

B: A contribution improves the funded status of the Plan, which may lead to a glide path trigger and, thus, a different target asset mix.

C: If tactfully deployed, contributions can be invested in such a way as to minimize trading costs. Deploying the contribution based on the outdated asset allocation and then rebalancing the portfolio would result in higher transaction costs.

D: Consider a plan that has $100 in liabilities and $70 in assets ($42 fixed income, and $28 equity). A contribution of $10 improves the funded status to 80% which may trigger an asset allocation change. Therefore, the contribution can be used to purchase securities in a manner that allows the portfolio to attain the revised asset allocation based on a funded status of 80%.

Trading

Grader commentary: The key points under this consideration included the need to consider how trading will be managed, the width of the triggers and resulting impact on trading costs. Most candidates successfully outlined that dynamic asset allocations require more trading and that this can be managed through the width of the triggers.

Other relevant points with appropriate explanation and not rewording the points below were awarded credit as well. For example, candidates that mentioned re-risking and its impact on trading costs were awarded credit.

5. Continued

The asset allocation policy should articulate how trading will be managed as funded status triggers are hit and the asset allocation is revised.

Tighter funded status triggers can result in frequent asset allocation changes and high trading costs.

Wider funded status triggers might be more suitable as they are reached less frequently.

Wider triggers may also be appropriate because the resulting size of transactions may warrant a transition plan to minimize trading and other administrative costs.

Governance process

Grader commentary: Most candidates successfully noted that dynamic asset allocations require a more robust governance framework than their static counterparts. Some candidates mistook governance for government/regulations and spoke of the impact on contribution requirements etc.

Other relevant points with appropriate explanation and not rewording the points below were awarded credit as well. For example, outlining the need for periodic reviews to ensure the policy is still appropriate was awarded credit.

A dynamic liability responsive asset allocation is more complex than a static asset allocation. This requires increased monitoring and introduces additional procedures in the plan's operation.

Even though it is a dynamic policy, the course is fixed which ensures a systematic and unemotional method of revising the plan's asset allocation and dialing down risk.

Once the dynamic liability responsive asset allocation is adopted, it is imperative that the governance process allows its implementation without additional layers of approval. For example, requiring CFO approval for every asset allocation change would be counterproductive to the policy's objectives.

6. 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.

Sources:

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

Commentary on Question:

The question is asking about the assumptions required, on a holistic level, regarding the financial economics viewpoint. This is directly from the Study Note referenced above. Only a few candidates picked up the correct four assumptions in Part (a) below.

Solution:

(a) The financial economics viewpoint is that, in most cases, company-sponsored pension plans should only be invested in bonds.

Describe four assumptions underlying this viewpoint.

Commentary on Question:

Most candidates put in the results of applying financial economics to pension plans not the assumptions. For example, one typical response was there is tax arbitrage gained from putting pension funds into bonds and personal assets in equities. This is not an assumption but a conclusion.

1. Transparency: Shareholders can always see the plan assets and liabilities

2. Corporate Valuation: Shareholders can value corporations economically by reference to the capital markets

3. Risk: Rational investors will adjust their own portfolios to their desired level of risk

4. Default: Promised benefits will be paid by the plan because it remains sufficiently funded and/or the corporation is strong enough to make up any pension deficits.

6. Continued

(b) Critique the assumptions in (a) with respect to investing only in bonds.

Commentary on Question:
For Part (b), partial credit was given to critiques related to answers provided in Part (a) even if those Part (a) responses were not the appropriate answers based on the Study Note referenced.

1. Transparency: (see page 22 of the Study Note)
   i. Shareholders cannot see pension plan assets, liabilities or cash flows on a timely
   ii. Pension expense is based on smoothed asset values with gains and losses further smoothed

2. Corporate Valuation: (see pages 22-23 of the Study Note)
   i. In theory, the company value would be determined independently from its pension fund
   ii. "Net asset value of plan" would be added to the value of the company

3. Risk: (see page 23 of the Study Note)
   i. On an individual basis, shareholders will not always include value-adding transactions (e.g., a shift of pension assets to bonds) in their valuation of a company unless they believe that other market participants will soon perceive that value has been added
   ii. In addition, smoothing mechanisms in current contribution and accounting calculations mute the risk of holding equity investments in the pension plan.

4. Default (see page 23 of the Study Note)
   i. When PBGC is added to the model, it differs from case-to-case
   ii. Since there is a PBGC put (serves as a floor), sponsors can be more aggressive in their investing.