Asset-Liability Considerations in CPP Portfolio Design

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CPPInvestments

The four pillars of the Canadian retirement income system

Individual Savings	Registered Pension Plans	Old Age Security	CPP/QPP
Personal savings, including tax-favoured investment vehicles	Defined benefit or defined contribution pensions administered by institutions	Universal basic pension; poverty reduction supplement; high income claw-back; pay-go	Earnings-related defined target benefit plans; basic retirement income
Private/Voluntary		**Public/Mandatory**	

Evolution and Features of the Canada Pension Plan (CPP)

	Base CPP	Additional CPP
Inception	1966	2019 (7-year phase-in)
Type	Contributory Target Benefit (No Sponsor – Plan Risk Internalized)	
Funding	1966-1997: largely pay-go From 1997: shift to partial funding	Fully-funded
Balance Sheet for Sustainability	Open group	
Maturity	Fairly mature	Immature
Sustainability Mechanism	Failsafe rule	Failsafe rule
CPPIB Mandate	Maximize returns without undue risk of loss, having regard to the factors that affect the funding of the Plan	
	Separate account	Separate account

# The CPP differs in important ways from a traditional employer-sponsored DB plan

Characteristic	Employer-Sponsored DB Plan	CPP
Sponsor	Employer	None – self contained
Benefit guarantee	Sponsor	No
Sponsor bankruptcy risk	Yes	Not applicable
Ability to rely on future contributions	No	Yes – mandatory, enduring public plan
Funding requirement (sustainability test)	Fully cover past service (**closed group balance**)	Fund + PV future contributions cover PV future benefits (**open group balance**)

CPPIB's Mandate requires Consideration of Asset-Liability Trade-offs

Asset

Maximize return without undue risk of loss...

Liability

*...having regard to the factors affecting the funding of the Plan*

- Asset-liability management balances Plan outcome risk and reward in setting target risk through the Reference Portfolio

- Expressing an acceptable Plan outcome risk-reward trade-off in an explicit objective function enables this to be done consistently for the base and additional CPP over time

- Up to now, CPPIB has seen limited scope for liability hedging – applying an overlay that is negatively correlated with the liability (analysis is ongoing)

The framework enables consistent setting of the risk levels appropriate for the additional and base CPP as their funding levels evolve


Long-Run Investment Risk and Return

OBJECTIVE FUNCTION: Intertemporal Evaluation of Trade-Off Between Adverse and Favourable Plan Adjustments

Funding Status of Each Plan Part

We use a formal objective function to consistently establish the risk levels appropriate for the additional and base CPP as their funding levels evolve.

REFERENCE PORTFOLIO: Target Risk of Each Plan Part
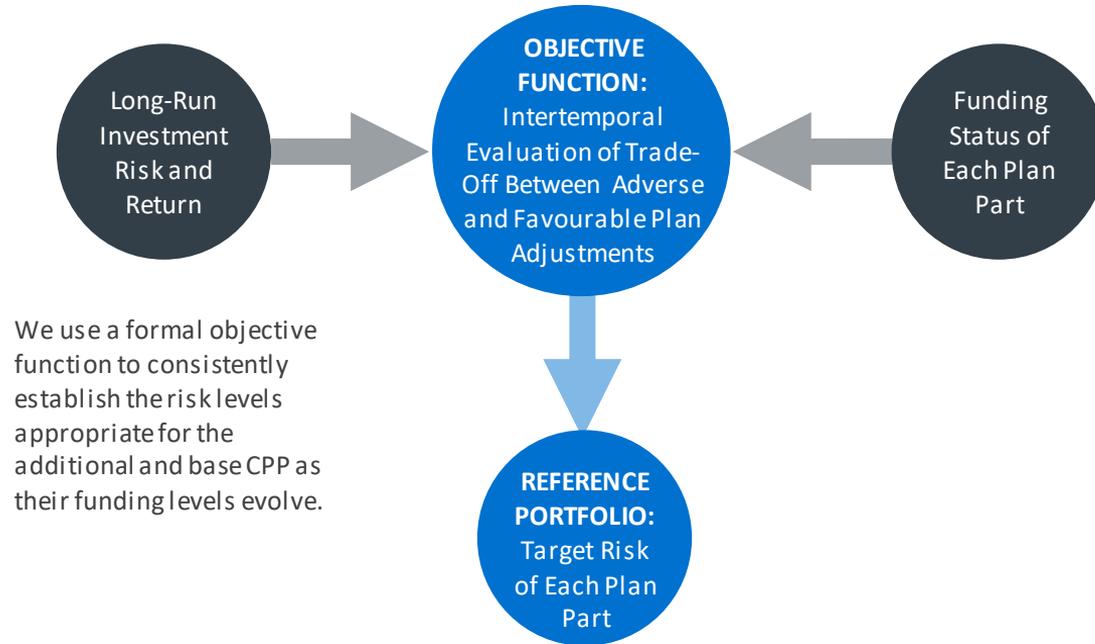
Above and beyond risk level, there are three sources of return: **diversification**, **investment selection**, and **strategic positioning**.

3 Strategic Positioning

2 Investment Selection

1 Diversification

Total Costs

Total Portfolio Return Net of all Related Costs
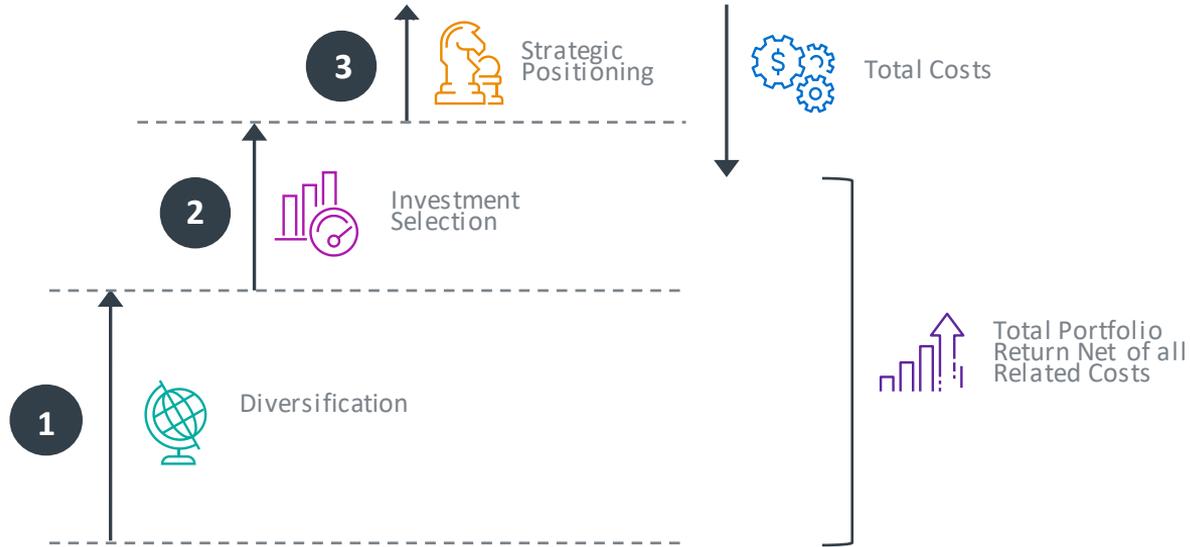
CPP sustainability is effectively assessed using a long horizon *open group* approach...

bCPP Open Group Balance Sheet – Dec 31, 2018

- Legislation defines the bCPP *Minimum Contribution Rate* (MCR) as the rate that implies equality of the actuarially-projected fund/benefit ratio at 10 and 60 years in the future
- This approximates Open Group balance, which implies asymptotic stability of the fund/benefit ratio
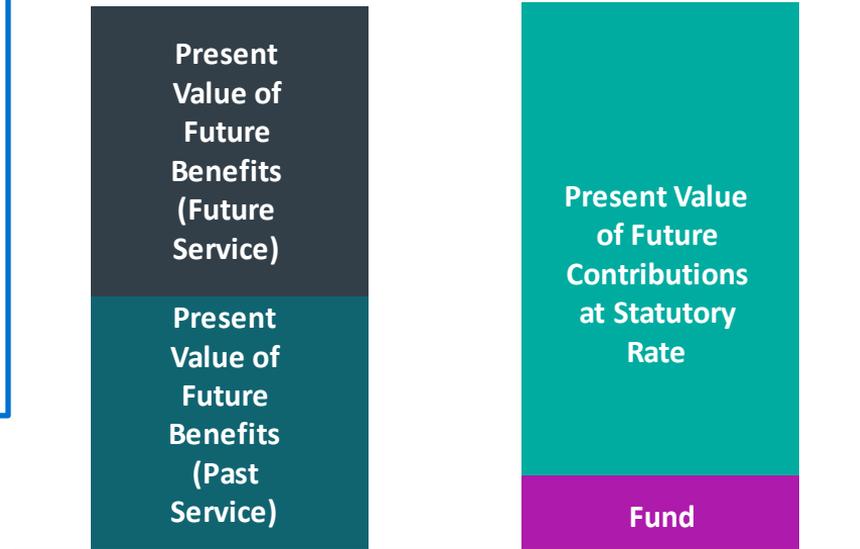
Present value discount rate = actuarial review expected fund return

| Total Liabilities | ≤ | Total Assets |

Present Value of Future Benefits (Future Service)

Present Value of Future Benefits (Past Service)

Present Value of Future Contributions at Statutory Rate

Fund

→ Sustainable (MCR < Statutory Contribution Rate)

Asset-Liability Considerations in CPP Portfolio Design

Open Group Balance – Alternative View
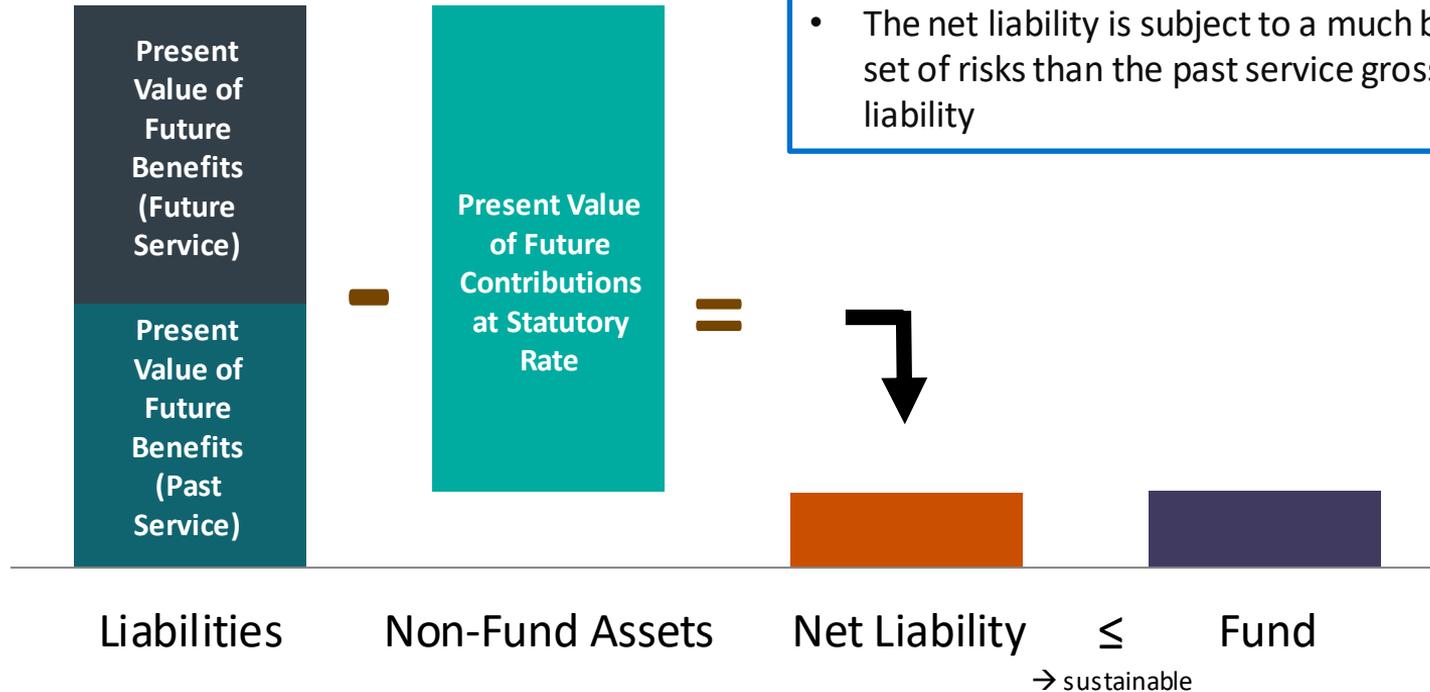
- An employer-sponsored closed group plan might seek to hedge the past service liability
- For an open group perpetual public plan (like the CPP), the net liability is the relevant possible hedging object
- The net liability is subject to a much broader set of risks than the past service gross liability

Present Value of Future Benefits (Future Service)

Present Value of Future Benefits (Past Service)

−

Present Value of Future Contributions at Statutory Rate

=

Liabilities   Non-Fund Assets   Net Liability   ≤   Fund

→ sustainable

Asset-Liability Considerations in CPP Portfolio Design

Key Objective Function Elements

	Plan Value Metric	**Point-in-Time Loss Function**	**Time Steps and Horizon**
Role	What are the Plan outcomes that we care about?	Expresses risk aversion in Plan outcome space	Establishes intertemporal view; discounting
Options	• Contribution rate? • Benefits?	• Power? • Quadratic?	• Single period? • Infinite?
CPPIB Implementation	Plan adjustments: change in contribution rate minus full cost rate (captures benefit adjustments)	Credit favourable adjustments less than unfavourable adjustments	• 3-year actuarial review periods • 75-year horizon; • 2% rate of time preference
CPPIB Motivation	Penalizes Plan outcome dispersion	Simple expression of risk aversion	Reflects open group nature of Plan

Implementation framework

Market assumptions; Plan structure

Specify loss function risk aversion → Generate Monte Carlo paths for benefits and earnings, asset returns, fund, net liability → Plan adjustments via sustainability rules → Optimal Funding-Conditional Equity-Debt Schedule → Dynamic Plan metric implications

Evaluate risk aversion choice
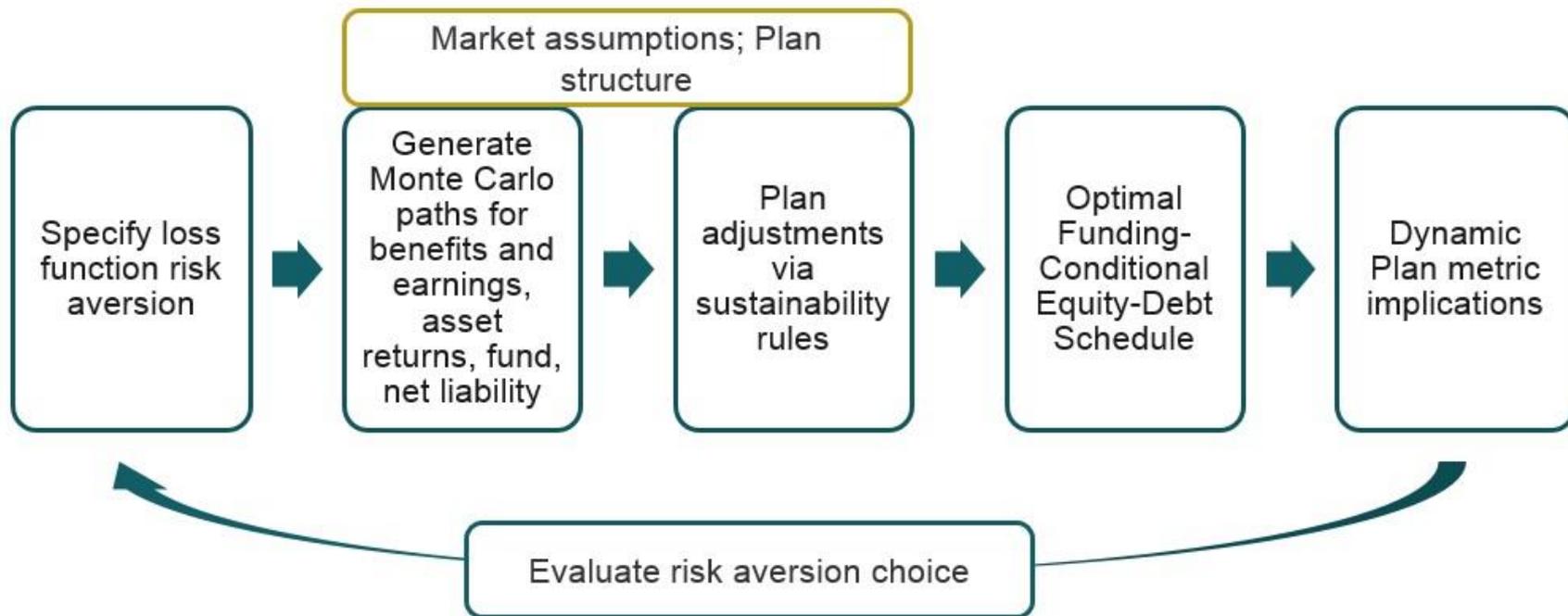
Framework solution: optimal funding-conditional Reference Portfolio risk target rule

Optimal Funding-Conditional Equity-Debt Schedule

- Base CPP
- Additional CPP

Equity Share (y-axis): 0%, 25%, 50%, 75%, 100%, 125%
Funding Ratio (x-axis): 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%

- Consistent application to each part of Plan
- Dynamic rule – optimal risk target as funding statuses evolve
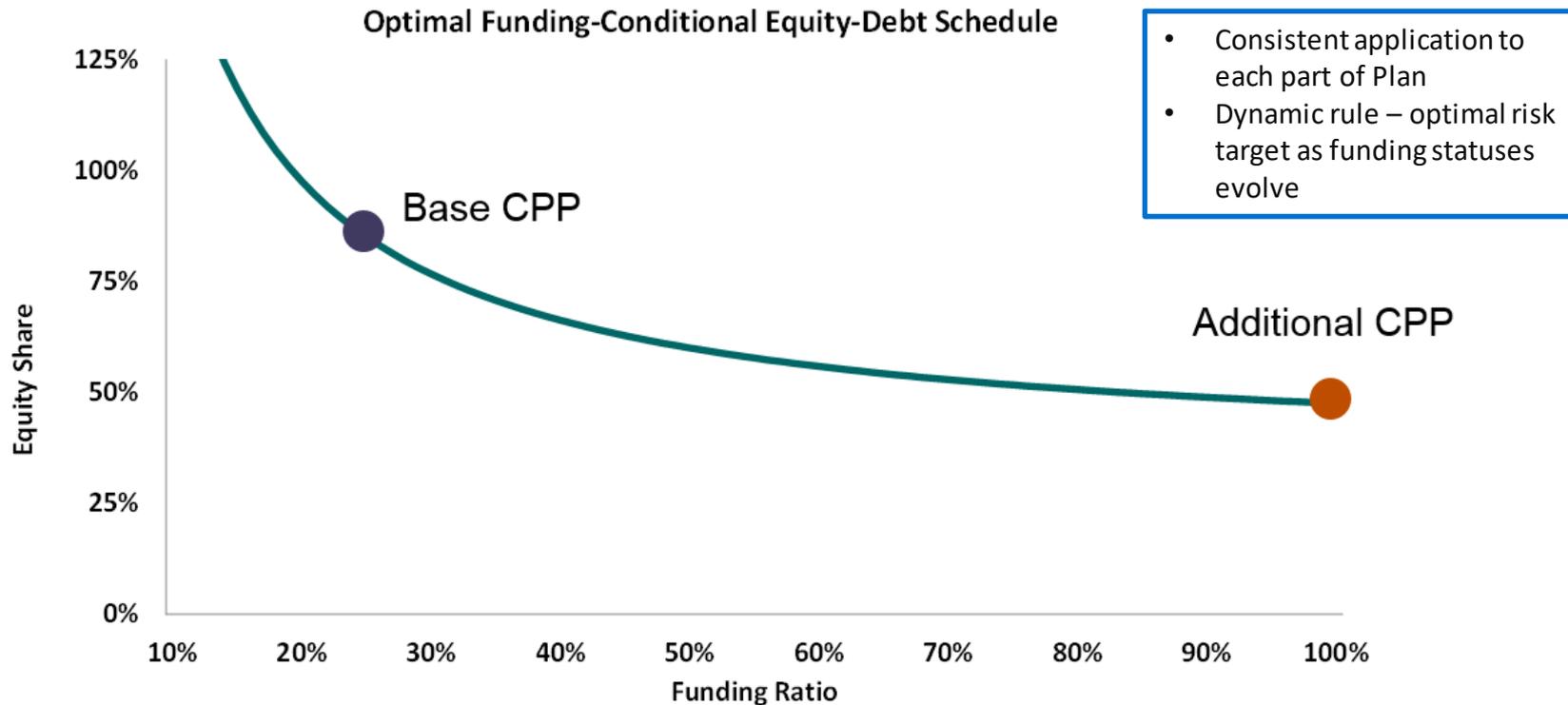
Liability Hedging Considerations

Standard Intertemporal ALM Solution

Composition of GOP depends on expected risk premia and return covariance

Growth-Optimal (Long)

Split depends on risk aversion and funding ratio

Total

Composition depends on covariance of liability with returns

Liability-Hedging (Long-Short)

Cash
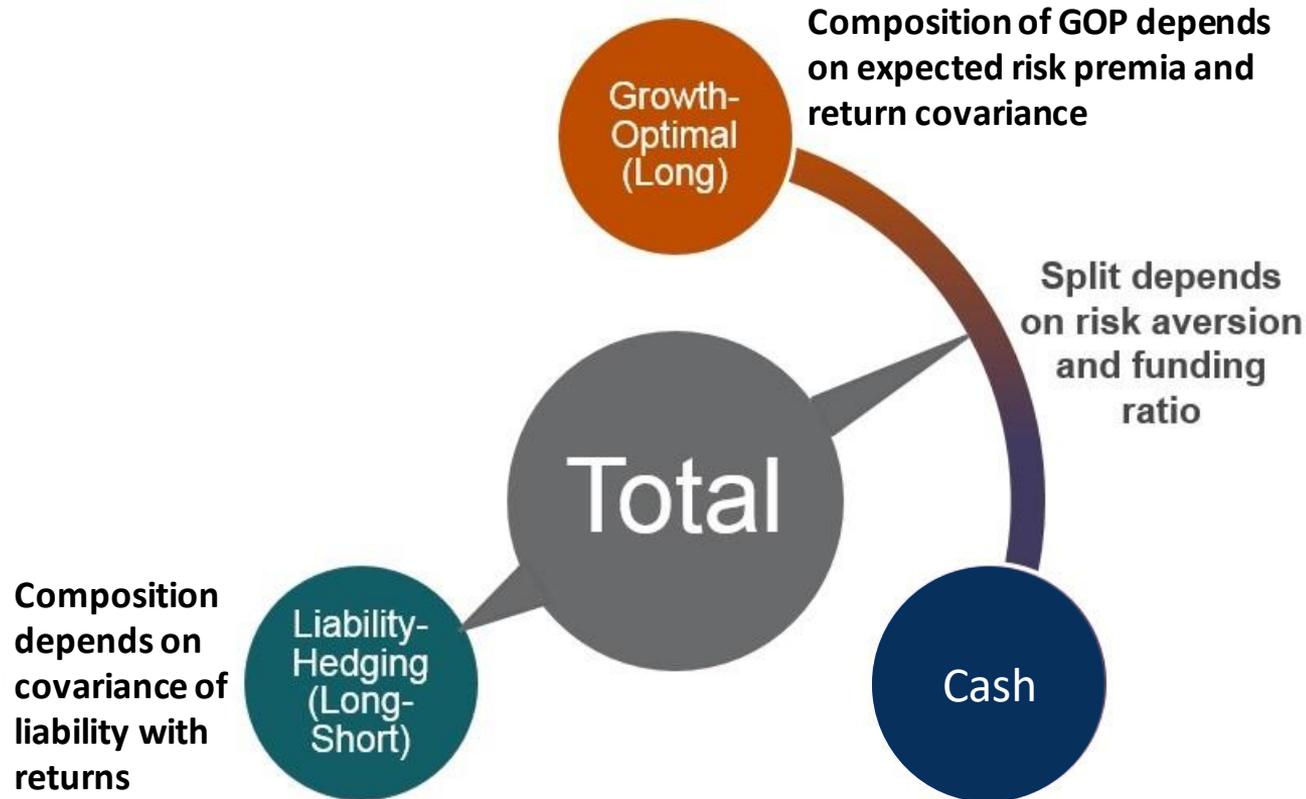
Standard Intertemporal ALM Solution – Explicit Form

- As in Cairns *et al*, the problem is to:

    - choose portfolio weights that minimize a discounted power loss function expressed over the difference between the contribution rate and an ideal (e.g., fully-funded) contribution rate
   - subject to an asset accumulation identity that incorporates returns and cash flows

Υ	Power loss coefficient
f	Funding ratio relative to ideal
Σ	Excess return covariance

q	Expected excess returns
NL/A	Net liability
Σ_{NL}	Net liability covariance with returns

Growth-Optimal Portfolio

Optimal portfolio choice solution:

$$\boldsymbol{\alpha_t} = \frac{1}{\gamma-1} \cdot \left(\frac{1-f_t}{f_t}\right) \Sigma^{-1} \boldsymbol{q_t} + \frac{NL_t}{A_t} \Sigma^{-1} \Sigma_{NL}$$

Liability Hedging Portfolio

Scope for net liability hedging - CPP

Inflation negatively covaries with liability

Net liability covariance with real wages and inflation

Net liability-asset return covariance

Real wage and inflation covariance with asset returns

Real wage growth: negative liability covariance if pay-go component dominates

Possible Liability-Hedging Implications
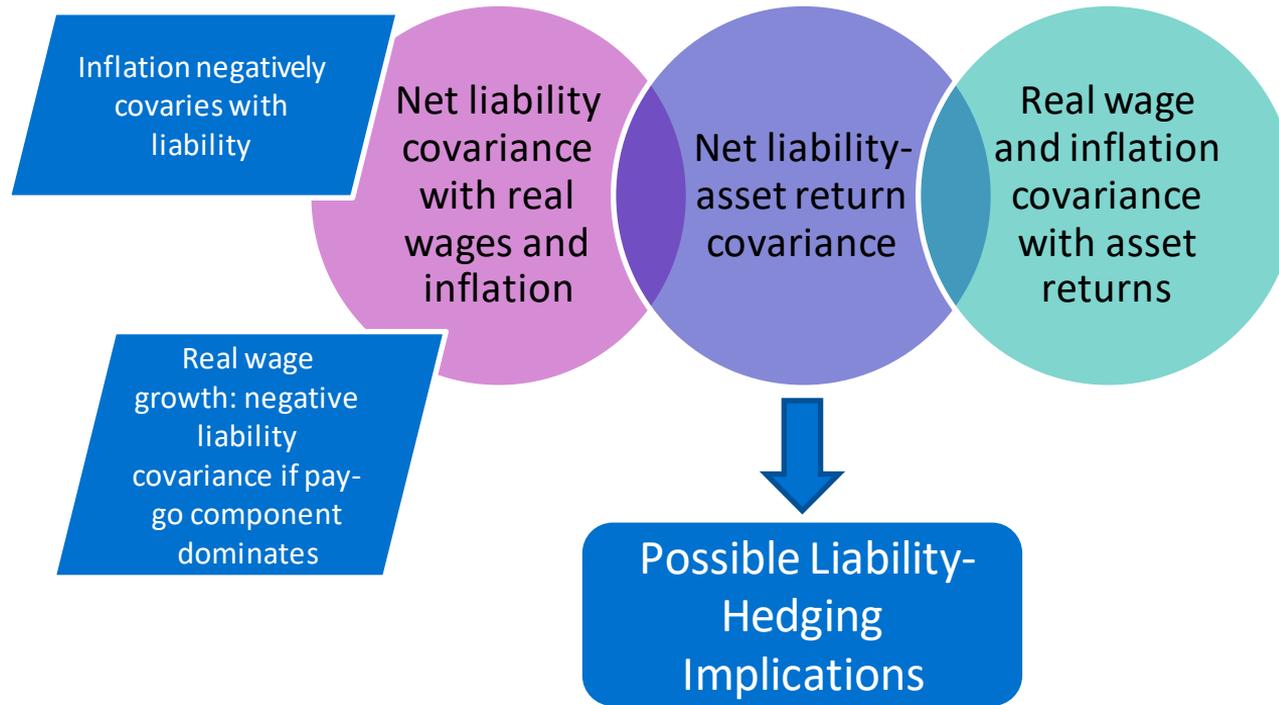
Summary

- A formal objective is useful in performing asset-liability management

- Objective will differ by Plan/Fund type and statutory requirements

- CPPIB's choices reflect the Open Group Target Benefit nature of the CPP

- Public plans are generally quite different from employer-sponsored DB plans

  - Objective will therefore differ

- "Management" does not necessarily mean "matching"

  - The scope for liability matching (hedging) may be less than for Closed Group plans and will be related to the unique structure of each plan