

21st Seminar on Current Issues in Retirement Benefits

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Asset Liability Modelling for Retirement Benefit Plans

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- Modelling scope for DC & DB plans
- Modelling objectives
- Challenges
- Liability projection

Modeling scope – DC Plans

Exempt Provident Fund (PF) Trusts

Run-&-maintain phase

Shutdown phase

A. Projection of income
& expenditure

B. Future cash flow
matching

C. Solvency analysis

AL Modeling for Exempt PF Trusts



A. Projection of income & expenditure

- Objectives:
 - Assess sustainability of given PF rates over next 3 to 5 years
 - Assess the impact on reserves (i.e. how long the reserve will last?)
 - Assess future company funding
 - Assess financial viability of continuing to run the PF Trust
 - Take cues to alter the investment strategy, if required
- Methodology:
 - Make appropriate assumptions pertaining to bond yields, credit spreads & PF rates
 - Estimate income (asset) on fixed income instruments basis the accrual method. Estimate income on mutual funds basis the accounting policy followed by the Trust
 - Estimate expenditure (liability) using “monthly running balance method”
 - Treatment of premium / discount paid on fixed income instruments basis the accounting policy followed by the Trust

AL Modeling for Exempt PF Trusts



A. Projection of income & expenditure (continued)

- Challenges:
 - Low historic correlation between PF rates and bond yields – poses difficulties in making assumption related to future trajectory of PF rate & bond yield gap
 - Contribution escalation rates & attrition rates can deviate significantly from the assumptions – impacts accuracy of income & expenditure projection

AL Modeling for Exempt PF Trusts

A. Projection of income & expenditure – sample output

Income-Expenditure Projection (Figures in INR Crore)											Exempt PF Trust vs. EPFO Cost-Comparison (Figures in INR Crore)				
Financial Year	Summary										Exempt PF Trust			EPFO	Savings in Maintaining Exempt PF Trust [2-1]
	Annual Income	Annual Expenditure	Surplus (+) / Deficit (-)	Opening Reserve	Closing Reserve	Potential PF Rate	Income Shortfall in Excess of Reserves (a)	Funding of Principal Losses (b)	Company Funding [a+b]	Cumulative Company Funding	PF Inspection Charges @ 0.18% of Basic Salary (a)	Company Funding (b)	1. Total [a+b]	2. PF Administrative Charges @ 0.50% of Basic Salary	
2023-24	6.76	6.50	0.26	0.57	0.83	8.56%	0.00	0.00	0.00	0.00	0.09	0.00	0.09	0.25	0.16
2024-25	6.83	7.19	-0.36	0.83	0.47	7.84%	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.27	0.18
2025-26	7.54	7.98	-0.45	0.47	0.03	7.79%	0.00	0.00	0.00	0.00	0.11	0.00	0.11	0.30	0.19
2026-27	8.30	8.86	-0.56	0.03	0.00	7.73%	0.53	0.00	0.53	0.53	0.12	0.53	0.65	0.33	-0.32

AL Modeling for Exempt PF Trusts



B. Future cash flow matching

- Objectives:
 - Assess sufficiency of cash inflows to meet obligatory payouts over next 5 to 7 years
 - Assess steepness of mismatch, if any
 - Change investment strategy (post evaluation of tradeoffs) to mitigate potential cash flow mismatches
 - Mitigate / minimize exposure to interest rate risk by changing the investment strategy
- Methodology:
 - Map monthly & yearly coupon inflows & redemption inflows (asset)
 - Project outflows on account of resignation & retirement (liability)
 - Ascertain gap (asset – liability) & its steepness

AL Modeling for Exempt PF Trusts

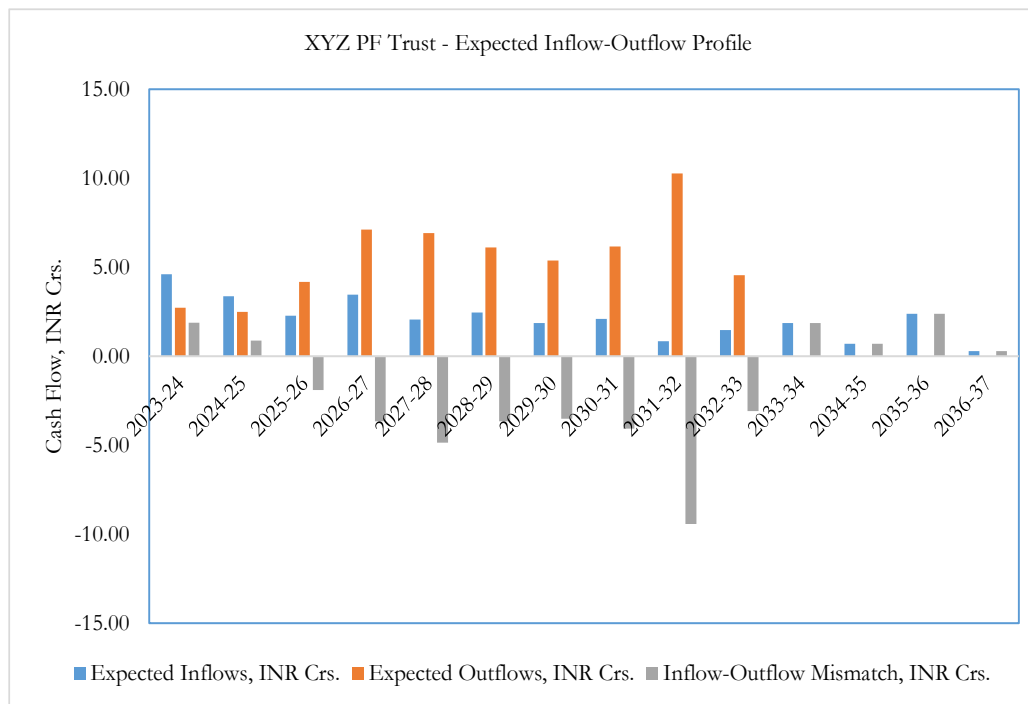


B. Future cash flow matching (continued)

- Actuarial support:
 - Estimating future value of payouts
 - Sensitivity analysis around key variables (such as the PF rate)
- Challenges:
 - In an event of significant projected cashflow mismatch, duration matching investment continues to be a challenge given limited instruments at hand & due to regulatory restrictions
 - May entail trade-off with return maximization objective (given need to match the PF rate by Exempt PF Trusts)

AL Modeling for Exempt PF Trusts

B. Future cash flow matching – sample output



Financial Year	Bond Redemptions, INR [A]	Coupon Inflows, INR [B]	Expected Inflows, INR Crs [A+B]	Expected Outflows, INR Crs.	Inflow-Outflow Mismatch, INR Crs.
2023-24	2.92	1.69	4.61	2.72	1.89
2024-25	1.95	1.42	3.37	2.49	0.88
2025-26	1.01	1.26	2.27	4.18	-1.91
2026-27	2.28	1.18	3.46	7.12	-3.66
2027-28	1.07	0.98	2.05	6.91	-4.86
2028-29	1.56	0.89	2.45	6.12	-3.66
2029-30	1.10	0.77	1.87	5.38	-3.51
2030-31	1.41	0.69	2.10	6.17	-4.07
2031-32	0.26	0.58	0.84	10.26	-9.43
2032-33	0.90	0.56	1.46	4.55	-3.08
2033-34	1.36	0.50	1.86	0.00	1.86
2034-35	0.30	0.40	0.70	0.00	0.70
2035-36	2.00	0.38	2.38	0.00	2.38
2036-37	0.05	0.23	0.28	0.00	0.28
Total	18.17	11.53	29.70	55.89	-26.19

AL Modeling for Exempt PF Trusts



C. Solvency analysis

- Objectives:
 - Estimate potential one-time funding requirement from the company to facilitate EPFO migration
 - Change investment strategy (from yield-maximization to capital-preservation) to minimize company funding
- Methodology:
 - Estimate potential realization from portfolio liquidation basis realistic market valuation of investments (asset) as on a cut-off date
 - Estimate value of liability as on a cut-off date using “monthly running balance method” (liability)
 - Estimate potential asset-liability gap
 - Estimate sensitivity of the asset-liability gap for +/- 0.25% bond yield & PF rate movement

AL Modeling for Exempt PF Trusts



C. Solvency analysis (continued)

- Challenges:
 - Volatility in bond & equity markets can change the asset-liability gap drastically
 - EPFO regulations around treatment of accumulated reserves is ambiguous – can increase or decrease the company funding requirement

AL Modeling for Exempt PF Trusts



C. Solvency analysis – sample output

Summary of Liquidation Valuation as on 30-June-2024 (Figures in INR Crore)							
Investment Category	Face Value	Cost Value	Market Value	Accrued Interest	Settlement Value	Net Profit (+) / Loss (-)	% Appreciation (+) / Depreciation (-)
Central Govt. Securities	3.44	3.39	3.59	0.08	3.67	0.19	5.74%
State Govt. Securities	43.74	43.79	43.38	0.40	43.77	-0.41	-0.94%
PSU Bonds	24.17	24.05	23.77	0.74	24.50	-0.28	-1.18%
Private Sector Bonds	2.60	2.60	2.58	0.14	2.72	-0.02	-0.87%
Special Deposit Scheme (SDS)	0.97	0.97	0.97	0.03	1.01	0.00	0.00%
Bank Fixed Deposits	1.62	1.40	1.40	0.14	1.54	0.00	0.00%
Mutual Funds	4.62	4.62	7.15	0.00	7.15	2.53	54.91%
Total Portfolio	81.16	80.82	82.83	1.53	84.36	2.01	2.49%

Summary of Funding Requirement (Figures in INR Crore)		
Scenario	1. Complete Liquidation of Portfolio	2. Transfer of Govt. Securities + Liquidation of Remaining Portfolio
1. Total asset [a+b+c+d+e]	89.53	89.73
a. Estimated realization from portfolio liquidation	84.36	84.57
b. Coupon interest receivable during March 2024 to June 2024	2.19	2.19
c. Net contribution receivable during March 2024 to June 2024	2.47	2.47
d. Expected amount receivable from PSIDC in March 2024	0.12	0.12
e. Bank balance as on 29-February-2024	0.39	0.39
2. Total liability @	87.00	87.00
3. Asset-liability gap (-) / surplus (+) [1-2]	2.53	2.74

Modeling scope – DB Plans

Gratuity Fund (GF) Trusts

A. Asset-allocation study
(For Insurer-managed Funds)

B. Future cash flow matching
(For self-managed Funds)

AL Modeling for GF Trusts



A. Asset-allocation study

- Objectives:
 - Assess the optimality of the existing strategic asset-allocation
 - Use scenario analysis to evaluate potential alternatives to the existing asset-allocation
 - Guide Trustees in choosing an optimum asset-allocation
 - Aid changing the Investment Policy of the Trust, if required
- Methodology:
 - Actuarially project the Defined Benefit Obligation (DBO) and payouts for the next 5 to 10 years
 - Formulate long-term capital market assumptions
 - Simulate returns on different asset-allocations using Monte Carlo simulation to project for the next five 5 to 10 years - rupee funding, Funding Ratio & identify risk-return attributes associated with different asset-allocations
 - Identify an optimum asset-allocation
 - Highlight implementation challenges

AL Modeling for GF Trusts

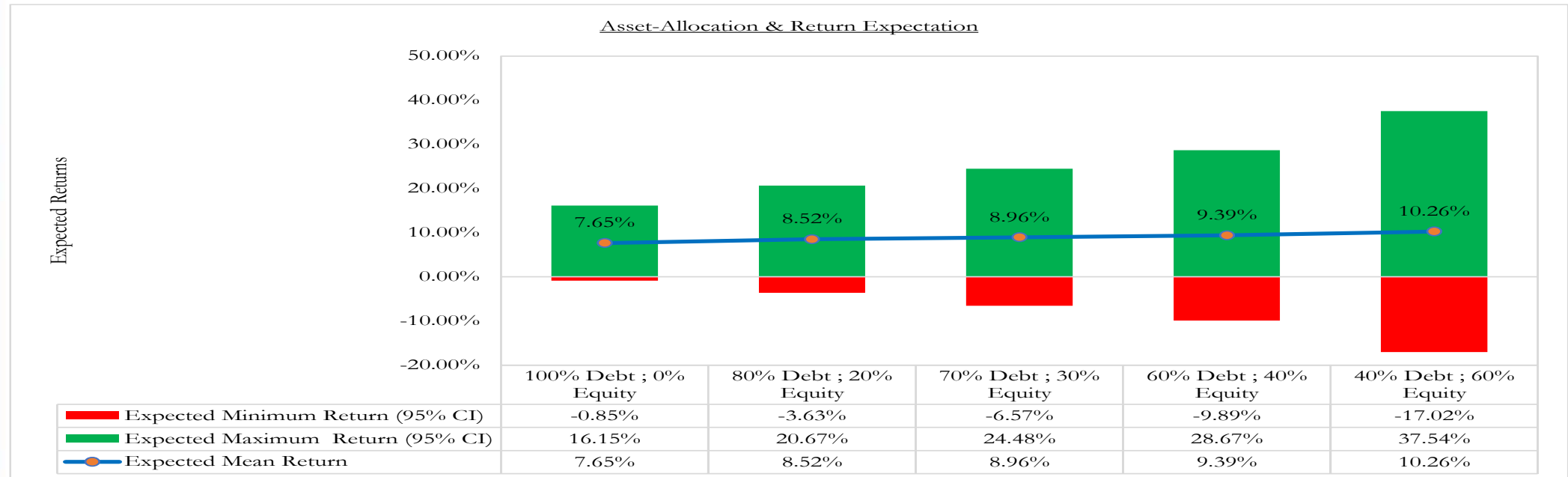


A. Asset-allocation study (continued)

- Actuarial support:
 - Projection of Defined Benefit Obligation
 - Projection of yearly benefit payments
 - Estimation of the Duration of the liability
 - Assumptions that are typically made, pertain to (a) discount rate, (b) salary escalation rate, (c) attrition rate, (d) mortality rate, (e) future headcount level and (f) age & salary profile of new hires
 - Sensitivity analysis around key assumptions to generate scenarios
- Challenges:
 - Realized returns on asset classes can deviate from the assumptions due to long cycles (as observed in recent times)
 - Implementation can be constrained due to lack of investible Fund options offered by Life Insurance companies (under Group Policies)

AL Modeling for GF Trusts

A. Asset-allocation study – sample output (1/4)

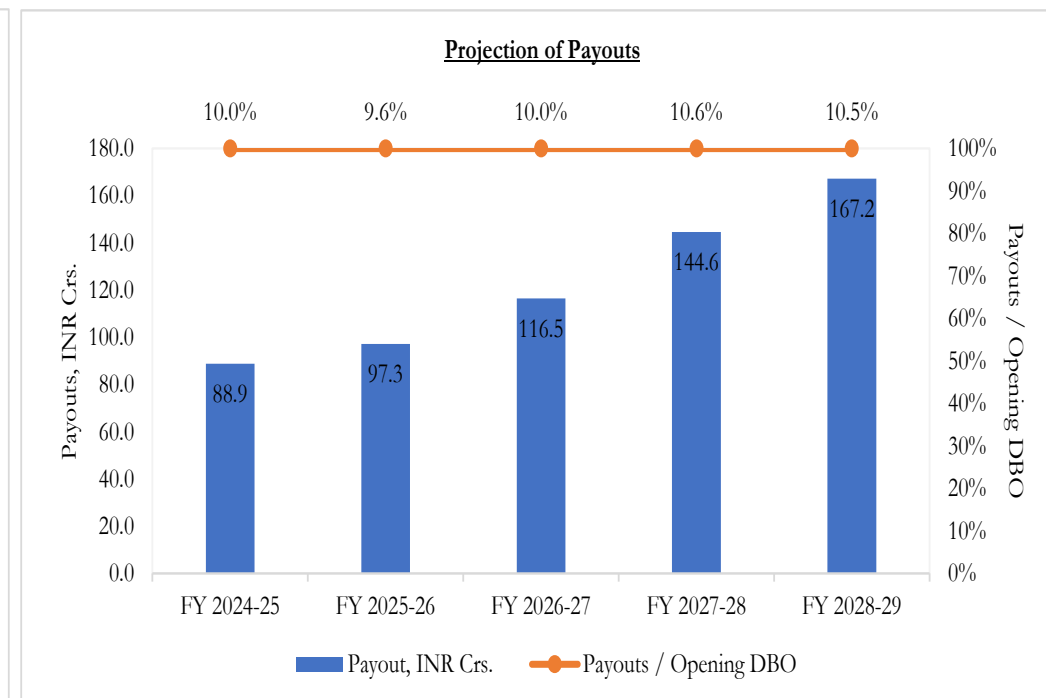
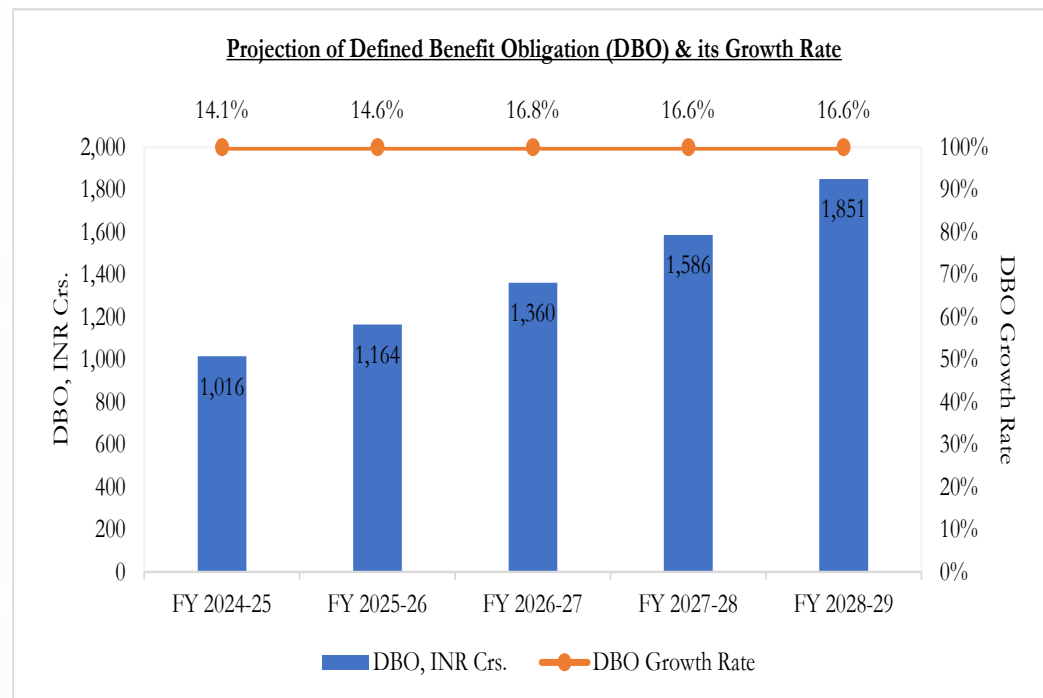


➤ Note:

1. To arrive at expected returns on the above asset-allocations, following assumptions have been made:
 - a. Long-term return on Debt (with mark-to-market) : 7.65% p.a.
 - b. Long-term equities : 12.00% p.a.
 - c. Annualized volatility on Debt : 4.25% p.a.
 - d. Annualized volatility on Equity : 22.00% p.a.
 - e. Debt-Equity correlation : 20.00%

AL Modeling for GF Trusts

A. Asset-allocation study – sample output (2/4)



AL Modeling for GF Trusts

A. Asset-allocation study – sample output (3/4)

Probability Distribution of Contribution Funding Over Next 5 Years					
Contribution Funding Range, INR Crs.	100% Debt	80% Debt	70% Debt	60% Debt	40% Debt
0 to 30	1.82%	2.60%	3.12%	7.04%	15.46%
30 to 60	6.24%	6.72%	8.60%	9.78%	11.42%
60 to 90	8.96%	11.42%	12.52%	13.46%	12.92%
90 to 140	15.28%	17.86%	18.40%	16.40%	13.86%
140 to 190	22.82%	20.06%	16.36%	14.90%	11.28%
190 to 240	19.78%	17.86%	15.70%	13.36%	10.22%
240 to 290	14.90%	12.42%	12.30%	10.38%	8.22%
290 to 340	7.66%	6.94%	6.94%	7.64%	6.12%
340 to 390	2.26%	2.80%	3.74%	3.52%	4.30%
390 to 440	0.26%	1.06%	1.48%	1.94%	2.68%
440 to 490	0.02%	0.24%	0.70%	1.14%	1.50%
490 to 540	0.00%	0.02%	0.10%	0.26%	1.14%
540 to 590	0.00%	0.00%	0.04%	0.08%	0.50%
590 to 640	0.00%	0.00%	0.00%	0.08%	0.28%
640 to 690	0.00%	0.00%	0.00%	0.02%	0.04%
690 to 740	0.00%	0.00%	0.00%	0.00%	0.00%
740 to 790	0.00%	0.00%	0.00%	0.00%	0.02%
790 to 840	0.00%	0.00%	0.00%	0.00%	0.04%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

-----Tail-----

AL Modeling for GF Trusts

A. Asset-allocation study – sample output (4/4)

Probability Distribution of Funding Ratio Over Next 5 Years					
Funding Ratio	100% Debt	80% Debt	70% Debt	60% Debt	40% Debt
10% to 50%	0%	0%	0%	0%	0%
50% to 60%	0%	0%	0%	0%	1%
60% to 70%	0%	0%	1%	2%	7%
70% to 80%	15%	20%	22%	23%	21%
80% to 90%	81%	68%	58%	48%	35%
90% to 100%	4%	12%	19%	24%	26%
100% to 110%	0%	0%	0%	3%	9%
110% to 120%	0%	0%	0%	0%	2%
120% to 130%	0%	0%	0%	0%	0%
130% to 140%	0%	0%	0%	0%	0%
140% to 150%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%

Consideration for liability and cashflow projection

Difference in future liability projection

- ALM concept is relatively simple but its implementation is difficult.

Header	Liability calculation for accounting	Liability calculation for ALM
Employees to be valued	Only current active employees	Current active employees plus expected new entrants
Service	Only past accrued service or leaves	Expected new service, leave at each valuation period.
Discount rate	At time of valuation	Yield curve considering future changes
Duration of calculation	Expected period of youngest employee to retire	No. of years of projection plus extended period of youngest employee to retire

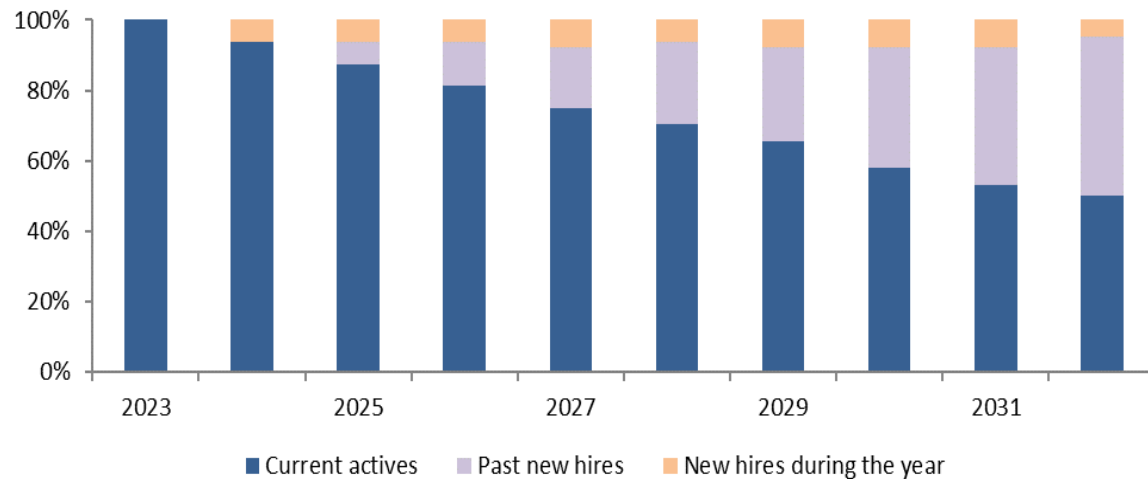
Building a liability projection

- Three stages of liability projection work:
 - Preparation of data
 - Running multi-year valuation
 - Consolidation of information & checks

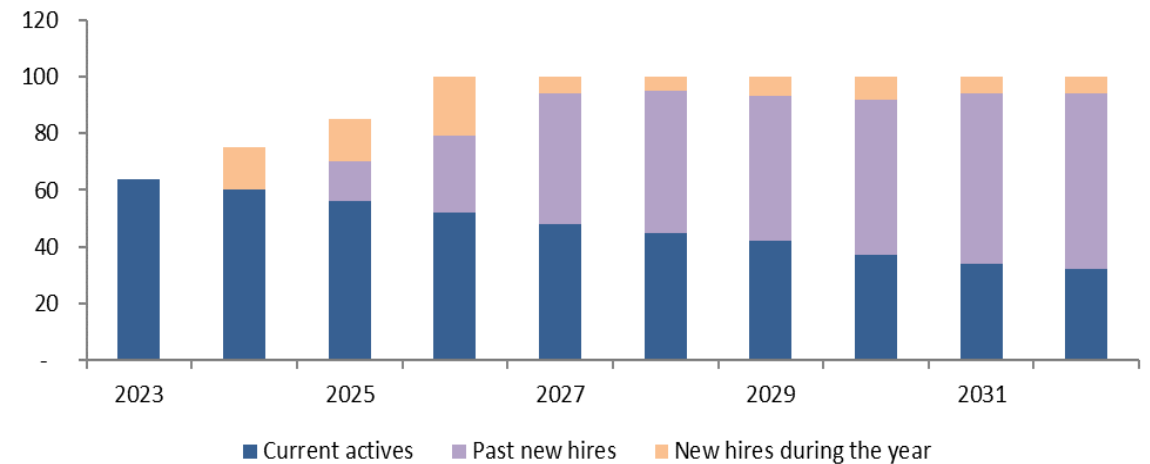
A. Population projection

- In our annual valuations we need to consider three kinds of employees:
 - Actives as on date of first valuation and still active at year X
 - Actives added as new hires in year X, either as backfill or ramp up
 - Actives added in past years (from year 2) and still active at year X

Development of scheme membership



Development of scheme membership



A. Population projection

- Sample projection

Year	0	1	2
HeadCount Projection	3/31/2023	3/31/2024	3/31/2025
Target HC	64	75	85
Existing EE	64	60	56
New Entrants Yr 1	-	15	14
New Entrants Yr 2	-	-	15
New entrants for backfill		4	5
New entrants for ramp up		11	10

A. Population projection

- Define sample profiles of future new entrants
 - Age of new joiners at time of joining – E.g., as average active population, average of exiting employees. Vary by gender, seniority etc.
 - Employee salary at time of joining – E.g. same as average population at year X or some other assumption.
- Other considerations
 - One single profile for each year or multiple profiles. E.g. in case of capped Gratuity different profiles may have different period of hitting the cap.
 - Timing of exit and timing of new joiners to be consistent
 - Changes in salaries for different profile
 - For leave benefit - expected increase in future leaves.

B. Liability & Cashflow projection

- Once data is finalized valuation for each future year can be run.
- Following adjustments might be needed in modelling for a valuation running at year t :
 - Probability of survival of past employee who enter company at $t - X$
 - Past cumulative salary increases of employee who entered company at $t - X$
 - If different profiles are used as new entrant then weightage of each profile as replacement of existing profile
 - Past accumulations of service or leaves for period X years
 - Any changes in assumptions expected to happen with period elapsed

C. Consolidation of results

- Results from multiple of valuations need to be brought together and aligned to different periods so that overall consolidated results can be prepared.

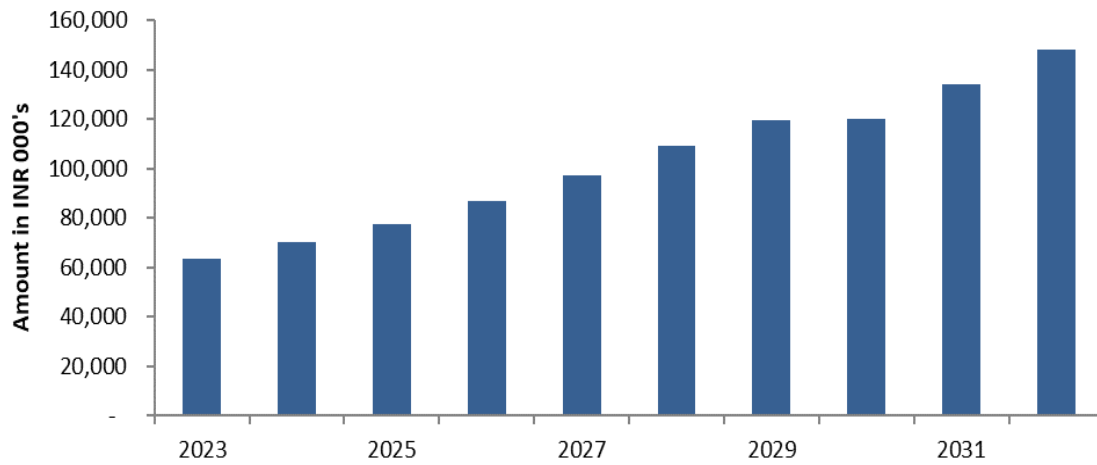
PBO Projection	3/31/2023	3/31/2024	3/31/2025
Existing EE	790,555	1,272,619	1,832,934
New Entrants Yr 1	-	252,782	548,710
New Entrants Yr 2	-	-	354,485
Total	790,555	1,525,401	2,736,128

Expected Cashflows	3/31/2023	3/31/2024	3/31/2025
Existing EE	3,802	5,599	7,326
New Entrants Yr 1	-	1,355	2,659
New Entrants Yr 2	-	-	1,935
Total	3,802	6,954	11,920

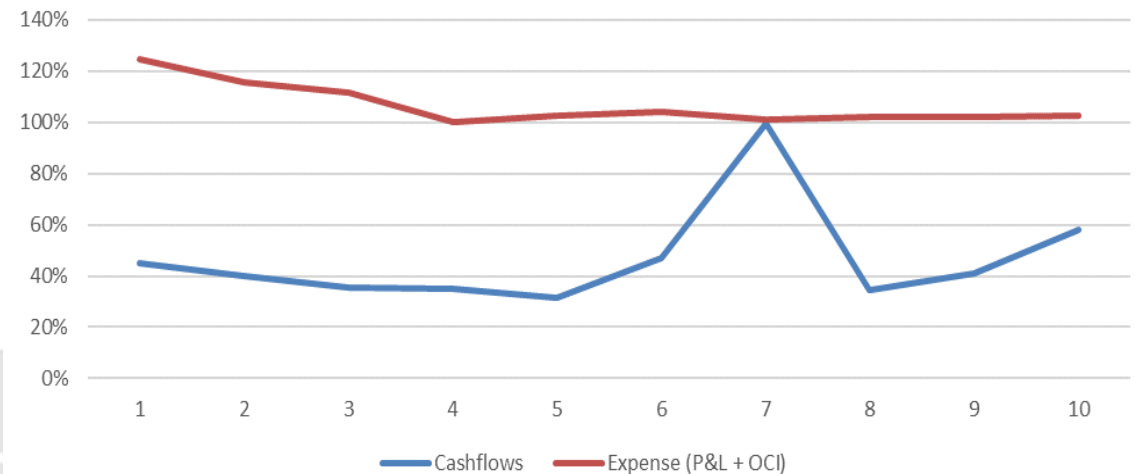
C. Consolidation of results

- Actuary needs to review development of results over multiple years
 - Compare movement of liability as a proportion of total salary
 - Develop expense and review its progression over years
 - Total benefit payments as a proportion of liability

Development of scheme obligation



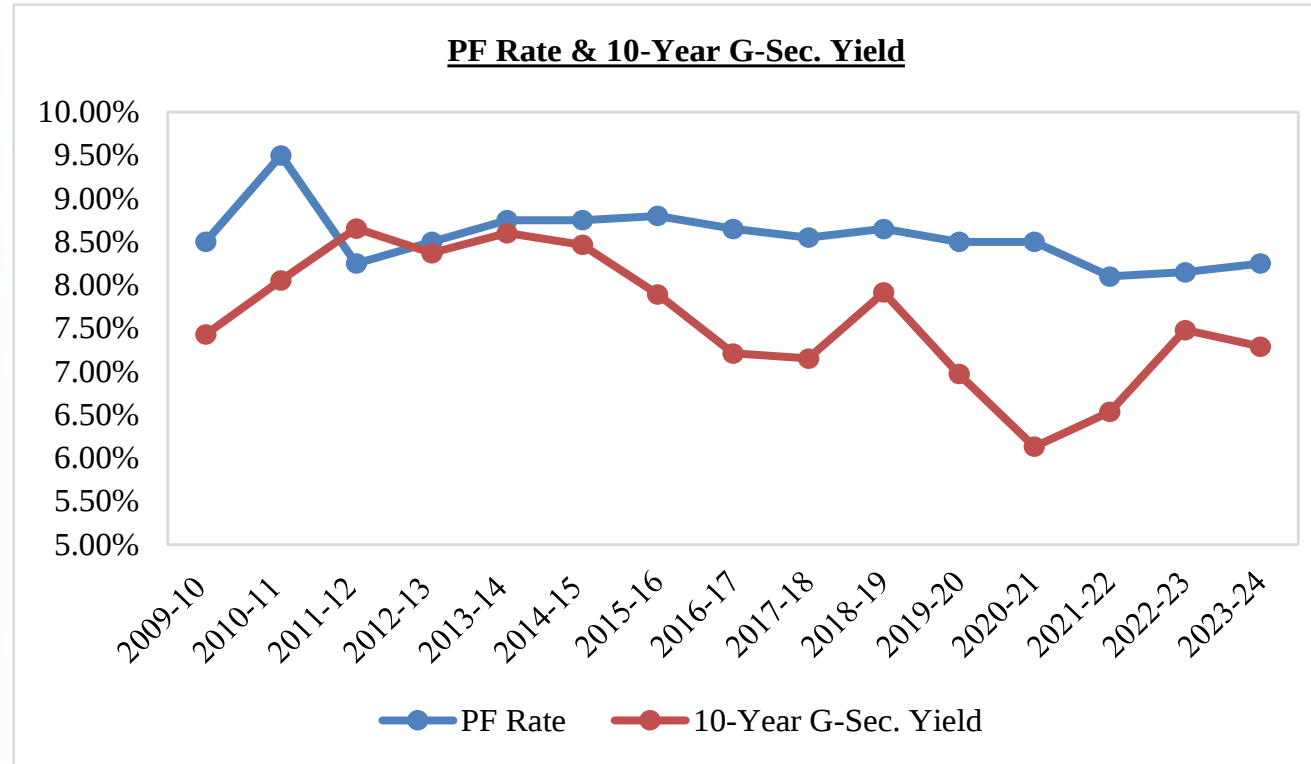
Progression of Expense and Cashflow as % of Basic salary



Thank You

ANNEXURE

PF rate & bond yields



FY	PF Rate	10-Year G-Sec. Yield
2009-10	8.50%	7.43%
2010-11	9.50%	8.06%
2011-12	8.25%	8.65%
2012-13	8.50%	8.37%
2013-14	8.75%	8.60%
2014-15	8.75%	8.47%
2015-16	8.80%	7.89%
2016-17	8.65%	7.21%
2017-18	8.55%	7.15%
2018-19	8.65%	7.92%
2019-20	8.50%	6.97%
2020-21	8.50%	6.13%
2021-22	8.10%	6.53%
2022-23	8.15%	7.48%
2023-24	8.25%	7.29%

Correlation	0.35	
Max.	9.50%	8.65%
Min.	8.10%	6.13%
Range	1.40%	2.52%

Return

Investment pattern regulation

