

The Big Thaw: Unfreeze Defined Benefit Pension with Cash Balance Plans

Yijia Lin

University of Nebraska - Lincoln

Tianxiang Shi

Temple University

Presented at the 19th International Longevity Risk and Capital Markets Solutions Conference

September 16, 2024

Defined Benefit (DB) Pension Surplus

- ◆ Strong market returns and a surge in interest rates in the past few years
- ◆ The Milliman 100 largest DB pension plans sponsored by U.S. public companies
 - A funding ratio of 105.6% with a funding surplus of \$73 billion in March 2024
 - A funded ratio of 108.5% by the end of 2025, resulting in a \$108 billion surplus (Wadia, 2024)
- ◆ IBM had a pension surplus of \$3.5 billion for its U.S. DB plan in 2022.

IBM's DB Pension Unfreezing

- ◆ On January 1, 2024, IBM discontinued its 401(k) plan and unfroze its DB plan.
- ◆ Forty years ago, IBM created a retirement-plan headline when it debuted its 401(k) plan in 1984.
- ◆ After forty years, IBM made waves once again by completely discontinuing its 401(k) match policy.
 - The company switched back to DB pension in the form of a cash balance (CB) plan.

Cash Balance (CB) Plan

- ◆ The CB plan is a “hybrid” retirement plan that combines features of a traditional DB plan and a defined contribution (DC) plan.
- ◆ DB features in CB plan
 - A CB plan promises retirement benefits to employees determined by an account balance
- ◆ DC features in CB plan
 - Each year, employees receive salary credits (akin to company contributions) and interest credits (similar to investment earnings).
 - IBM’s CB participants receive 5% of salary credits with a guaranteed annual interest rate set at 6% for the first three years.

“IBM is not the only employer thinking about restarting a defined-benefit plan. Jonathan Price, who leads the national retirement practice at benefits consulting firm Segal, said he has fielded more calls about unfreezing or starting a new pension plan in the past year than he has in the past decade.” (Miller, 2023)

“We estimate that about 34 companies (in addition to IBM) [out of the 100 U.S. public companies with the largest DB pension plan assets] have frozen U.S. pension plans with excess assets. A desire to tap into the surpluses to see immediate cash savings may drive more companies to shift spending strategies from defined contribution to defined benefit vehicles for their employer-provided retirement benefits.” (Wadia and Perry, 2024)

Benefits of unfreezing DB pension through CB Plans

- ◆ Unfreezing DB plans allows the pension surplus to be utilized for future benefit accruals of new plan participants.
 - Pension regulations prevent companies from using the surplus of their frozen DB plans to offset expenses related to DC benefits.
 - Companies can allocate their excess DB pension assets to fulfill their CB plan obligations.

Benefits of unfreezing DB pension through CB Plans

- ◆ A more balanced cost sharing arrangement between employers and employees
 - Benefit accruals of older DB plans are heavily tied to pay raises and service increments.
 - CB plans often align accruals with the prevailing investment climate.
 - IBM's CB plan offers a guaranteed 6% interest in the first three years, followed by a yield based on the 10-year Treasury rate. From 2027 to 2033, there is a minimum floor of 3%, and beyond 2034, the yield is the same as the 10-year Treasury rate (Munnell, 2023).

Benefits of unfreezing DB pension through CB Plans

- ◆ The excess returns can be used to reduce future pension contributions.
- ◆ Operating a CB plan provides IBM with an embedded investment call option.
 - The average return for the stock market: 6.5% to 7%
 - The guaranteed interest rate of IBM's CB: 6% during the initial three years, after which it aligns with the 10-year Treasury rate
 - In 2022, 61.3% of IBM's CB funds were invested in risky asset classes that generate higher expected returns compared to cash and government securities.

Costs of unfreezing DB pension through CB Plans

- ◆ Pension Benefit Guaranty Corporation (PBGC) premium costs.
 - \$101 per participant in 2024
- ◆ Asset/liability mismatch
 - The promised “interest credits” in CB plans do not directly correlate with the performance of the underlying assets.

Contributions

- ◆ Our study offers the first comprehensive analysis on whether reopening CB pension, a hybrid model of DB pension plan, enhances or impairs firm value.
- ◆ We introduce and quantify CB investment call options, which are largely overlooked in existing literature.

Contributions

- ◆ We examine the specific conditions under which pension unfreezing outweighs pension de-risking for employers.
 - Previous research has examined how pension risk transfer impacts firm operations and overall value (Lin et al., 2015, 2017; Klingler et al., 2022).
 - We compare the total pension costs of pension risk transfer and unfreezing DB pensions with CB plans.
 - Unfreezing DB pensions with CB plans dominates pension risk transfer when a firm has a high pension surplus and has to pay high salaries to its employees.

Two Divisions of a Corporation at $t = 0$

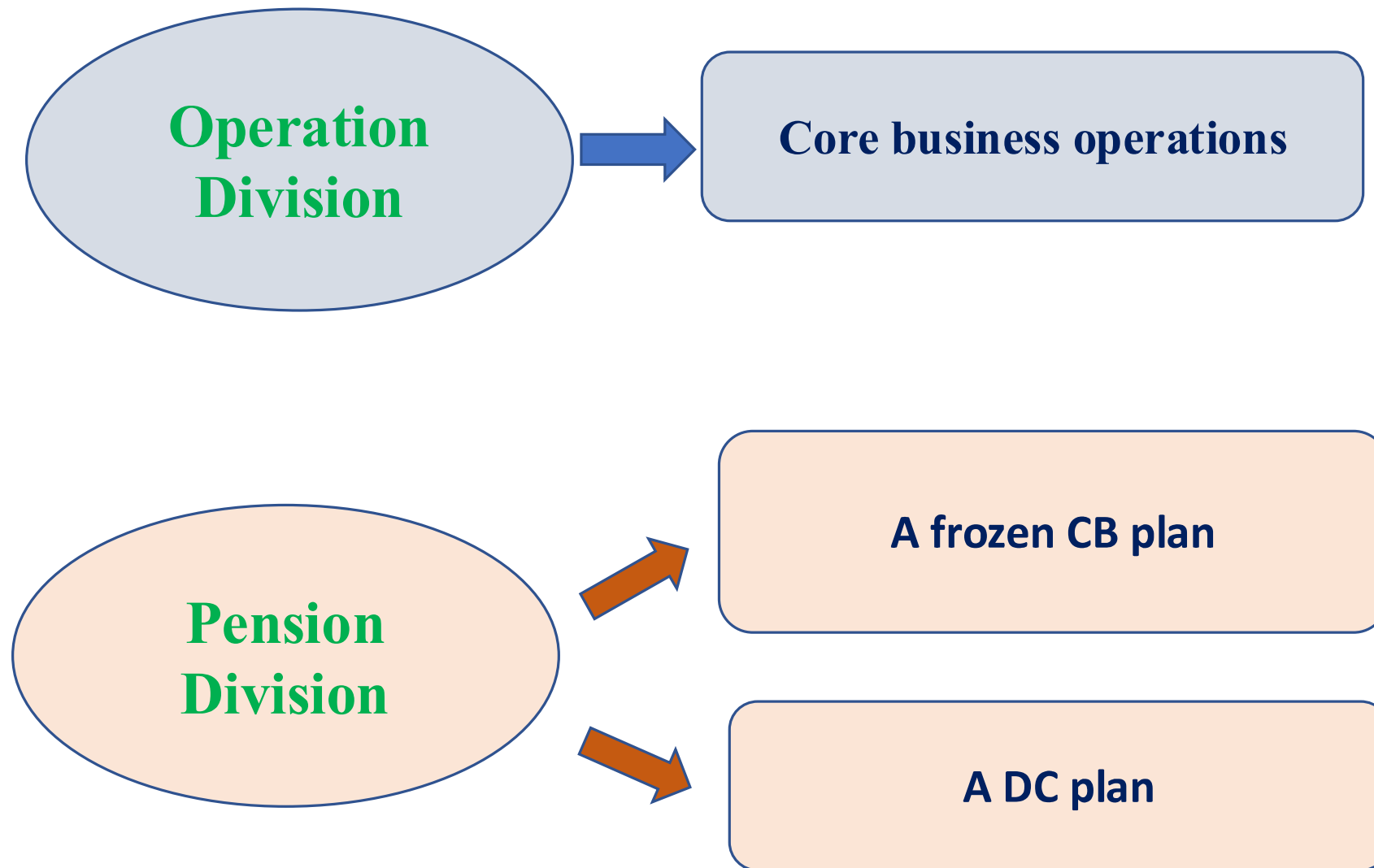


Table 1. Stylized Economic Balance Sheet of a Corporate DC Plan Sponsor with a Frozen CB Plan at $t = 0$

	Assets		Liabilities	
Operation	V^f	Firm Assets	D	Debt
	$P_E^{f,o}$	Operation Insolvency Put	E^f	Equity
Frozen CB Pension	A^f	Pension Assets	L^f	Pension Liabilities
	$P_E^{f,c}$	Pension Insolvency Put	X^f	PV of PBGC Premium
			C^f	Investment Call Option
DC Pension			S	PV of DC Contributions

Table 2. Stylized Economic Balance Sheet of a Corporate Pension Sponsor that Unfreezes its CB Pension at $t = 0$

	Assets		Liabilities	
Operation	V^{uf}	Firm Assets	D	Debt
	$P_E^{uf,o}$	Operation Insolvency Put	E^{uf}	Equity
Reopened CB Pension	A^{uf}	Pension Assets	L^{uf}	Pension Liabilities
	$P_E^{uf,c}$	Pension Insolvency Put	X^{uf}	PV of PBGC Premium
			C^{uf}	Investment Call Option

Table 3. Stylized Economic Balance Sheet of a Corporate Pension Sponsor that Transfers its Frozen CB Pension at $t = 0$

	Assets		Liabilities	
Operation	V^h	Firm Assets	D	Debt
	$P_E^{h,o}$	Operation Insolvency put	E^h	Equity
Transferred CB Pension	W	Surplus Withdrawal	U	Funding Deficit
			B	Buyout Annuity Loading
DC Pension			S	PV of DC Contributions

Note: If Surplus Withdrawal W is greater than 0, Funding Deficit U will be zero, and vice versa.

Basic Framework

□ CB Pension Liabilities

- Consider a CB pension plan with a cohort of $N(0)$ members
- x_j is the j th participant's age at time 0.
- All retirees receive a lump-sum benefit at retirement age x_r (Lowman, 2000).
- The total CB pension liabilities PL_t at time t :

$$PL_{j,t} = CB_{j,t} \cdot E \left[\frac{\prod_{k=0}^{M-1} (1 + i_{t+k}^c)}{(1 + r_{p,t})^M} \right], \quad t = 0, 1, 2, \dots, x_r - x_j - 1.$$

$$PL_t = \sum_{j=1}^{N(0)} PL_{j,t} \cdot 1_{\{x_j + t < x_r, T_{x_j} > t\}}, \quad t = 0, 1, 2, \dots$$

Basic Framework (Cont')

□ CB Pension Assets

- The firm invests its pension funds in 3 asset indices: the S&P 500 index ($i = 1$), the Merrill Lynch corporate bond index ($i = 2$), and the 3-month T-bill index ($i = 3$)
- The three indices follow a lognormal process:

$$\frac{dA_{i,t}}{A_{i,t}} = \alpha_i dt + \sigma_i dW_{it}^{\mathbb{P}}, \quad i = 1, 2, 3$$

Basic Framework (Cont')

□ CB Pension Assets

- Pension assets after pension benefit payments at time t

$$PA_t = PA_{t-} - BP_t, \quad t = 1, 2, \dots$$

where BP_t is the total benefits payable at time t to the participants who exit the plan during the period t .

- Pension assets after pension benefit payments and contributions at time $t+$

$$PA_{t+} = PA_t + RC_t + AC_t - PBGC_t, \quad t = 0, 1, 2, \dots,$$

where $RC_t = \max \{ NC_t + PBGC_t - SL_t \cdot 1_{\{SL_t > 0\}}, 0 \}$ is the normal contribution and PBGC premium payment adjusted by the pension surplus at time t .

Basic Framework (Cont')

□ Total funding cost

$$\text{FundingCosts} = EPV_{RC} + EPV_{AC} = E^{\mathbb{Q}} \left[\sum_{t=0}^{T_a} e^{-rt} (RC_t + AC_t) \cdot 1_{\{\tau > t\}} \right].$$

- EPV_{RC} : expected present value of normal contributions and PBGC premiums adjusted by the pension surplus.
- EPV_{AC} : expected present value of mandatory contributions to cover amortized funding deficits (if there are any).

□ CB investment call option

$$EPV_{IC} = E^{\mathbb{Q}} \left[e^{-rT} \max \{ PA_T - PL_T, 0 \} \right],$$

where $T = \min \{ T_a, \tau \}$ is the pension termination time.

□ Total Pension Cost

$$\text{The total costs} = EPV_{RC} + EPV_{AC} - 50\% \cdot EPV_{IC}.$$

Basic Framework (Cont')

□ Credit Risk Model

- The firm's default arrival rate λ_t follows a Cox process (e.g., Duffie and Singleton (1999, 2002); Carr and Wu (2010):

$$d\lambda_t = (\theta - \kappa \lambda_t) dt + \sigma \sqrt{\lambda_t} dW_t^{\mathbb{Q}}, \quad (1)$$

- The risk-neutral parameters in (1) can be estimated with CDS spreads through the unscented Kalman filter (Wan and Van Der Merwe, 2000; Carr and Wu, 2010).

Numerical Illustration

- ❑ Assume all employees join a firm at age 30 and the salary grows at an annual rate of 2%.
- ❑ Assume all employees retire at age 65 and receive a lump-sum payment from their CB pension at retirement (Lowman, 2000).
- ❑ Based on the US male and female population mortality tables from 1970 to 2021 in the Human Mortality Database, we obtain the parameter estimates for the Lee-Carter model.

Numerical Illustration (Cont')

- ❑ The CB plan was closed and the firm started a DC plan 5 years ago.
- ❑ For example, an age 40 at time 0 only accrues five-year CB benefits from age 30 to age 35.

Employee Age/Gender Composition at time 0

	<u>Current Participants/Frozen (70%)</u>			<u>New Entrants/Reopen (30%)</u>
	Age 40	Age 50	Age 60	Age 30
Female	14%	14%	8%	15%
Male	13%	14%	7%	15%

Numerical Illustration (Cont')

- ❑ Suppose the CB plan invests the funds in $n = 3$ asset indices: the S&P 500 index, the Merrill Lynch corporate bond index, and the 3-month T-bill
 - ❑ Weights invested in stocks, bonds and cash by IBM in 2022
 - ❑ Data: Monthly data of the three asset indices from January 1990 to December 2023 from LSEG Eikon Datastream
- ❑ We calibrate the credit risk parameters using the Wednesday's CDS spreads on IBM's senior unsecured debt with terms of 1, 2, 3, 5, 7, and 10 years from January 2010 to January 2024.
- ❑ The annual risk free rate is $r = 3\%$.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.

Total Pension Cost = $EPV_{RC} + EPV_{AC} - 50\% \cdot EPV_{IC}$,
 where CB pension surplus withdrawal is subject to a 50% tax rate.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

A frozen CB plan and a DC plan with a 5% contribution rate

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.

Total Pension Cost = $EPV_{RC} + EPV_{AC} - 50\% \cdot EPV_{IC}$,
 where CB pension surplus withdrawal is subject to a 50% tax rate.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Terminate the DC plan and reopen the CB plan with a 5% salary credit and a 6% guaranteed interest credit

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.

Total Pension Cost = $EPV_{RC} + EPV_{AC} - 50\% \cdot EPV_{IC}$,
 where CB pension surplus withdrawal is subject to a 50% tax rate.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

De-risk the CB plan and maintain the DC plan with a 5% contribution rate

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.

Total Pension Cost = $EPV_{RC} + EPV_{AC} - 50\% \cdot EPV_{IC}$,
 where CB pension surplus withdrawal is subject to a 50% tax rate.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.

Total Pension Cost = $EPV_{RC} + EPV_{AC} - 50\% \cdot EPV_{IC}$,
 where CB pension surplus withdrawal is subject to a 50% tax rate.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.



Pension risk transfer via a pension buyout is the best.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.



Unfreezing CB plan is the best.

Total Pension Cost Comparison of Different Retirement Benefit Strategies

Monthly Salary @ Age 30	$PF_0 = 100\%$			$PF_0 = 120\%$		
	Frozen + DC	Reopen CB	PRT + DC	Frozen + DC	Reopen CB	PRT + DC
2,500	5.53%	5.79%	5.00%	4.31%	4.06%	4.16%
5,000	5.40%	5.53%	5.00%	4.25%	3.84%	4.16%
10,000	5.31%	5.32%	5.00%	4.21%	3.68%	4.16%
20,000	5.25%	5.20%	5.00%	4.19%	3.58%	4.16%

Note: The values are in percentage of the EPV of total future earnings.



Unfreezing CB plan is the best.

The higher the salary, the lower the PBGC premium per dollar pension liability.

Is CB unfreezing good for IBM?

Monthly Salary @ Age 30	PF_0	Surplus Amount (% of EPV_{salary})	Equivalent Total Costs
2,500	117.9%	1.51%	4.24%
5,000	112.0%	1.01%	4.49%
10,000	108.0%	0.68%	4.66%
20,000	104.9%	0.41%	4.79%

Note: The total costs are in percentage of the EPV of total future earnings.

- According to Glassdoor, the average entry-level annual salary at IBM in 2024 is \$79,000, which is \$6,583 per month.
- In December 2023, IBM's CB plan had a funding ratio of 116.8%.

Is CB unfreezing good for IBM?

Monthly Salary @ Age 30	PF_0	Surplus Amount (% of EPV_{salary})	Equivalent Total Costs
2,500	117.9%	1.51%	4.24%
5,000	112.0%	1.01%	4.49%
10,000	108.0%	0.68%	4.66%
20,000	104.9%	0.41%	4.79%

Note: The total costs are in percentage of the EPV of total future earnings.

- According to Glassdoor, the average entry-level annual salary at IBM in 2024 is \$79,000, which is \$6,583 per month.
- In December 2023, IBM's CB plan had a funding ratio of 116.8%.
- **CB unfreezing will reduce IBM's total pension cost by \$0.91 billion, a greater cost saving of \$0.64 billion compared to the saving from pension risk transfer.**

Conclusion

- ◆ This study aims to investigate the value effect of unfreezing DB pension via CB plans.
- ◆ Unfreezing CB plans can yield greater cost efficiency than pension risk transfer when a firm has
 - A large amount of pension surplus
 - A high employee salary payment