Back on Track:
Modeling the Recovery of Chicago's Underfunded Pension System

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2025–26 Modeling the Future Challenge

Executive Summary

The Chicago Municipal Employees' Annuity and Benefit Fund (MEABF) holds $5.06 billion in assets but $19.92 billion in obligations, resulting in a funded ratio of only 25.4% [1, 2]. Over 25,000 retirees depend on this fund to live, and nearly 39,000 active city employees face uncertain retirement security in the future. In the case of insolvency, the city would be required to make up the difference of about $1.1 billion for benefits out of its general revenues each year, which would amount to about $400 for each citizen of Chicago annually, despite high taxes. In this paper, we investigate what strategies can allow the fund to recover to the state-mandated 90% funded target by 2055.

We built three models to test two different strategies: an investment modification strategy and an insurance based annuity strategy. Our **liability projection model** uses exponential regression adjusted for the new Tier 2 benefits. Our **Monte Carlo asset simulation** generates results for five different investment strategies, using correlated returns, compliance, and cash flow dynamics. Our **annuity valuation model** estimates the cost to transfer the fund's obligations to a private insurer, using insurance pricing benchmarks [11]. The purchase of all retirees would amount to $19.1 billion, or almost four times the present value, but a selective buyout, covering only the oldest 25%, amounts to $3.1 billion, saving $300 million annually in benefit payments, giving an alternative fallback.

Our analysis draws on four key datasets: 24 years of Chicago pension fund data from the Public Plans Database(PPD), S&P 500 historical returns from Macrotrends, Moody's Aaa Corporate Bond Yields from the Federal Reserve Economic Database (FRED), and annuity and retirement payout benchmarks from ImmediateAnnuities.com.

What stood out most in our analysis is that contribution compliance, meaning whether the city actually pays what actuaries say they need to, matters far more than investment strategy. We found that moving compliance from 70% to 100% shifts the median 2055 funded ratio up by 79 percentage points, which is nearly five times the effect of switching between the best and worst investment portfolios. If the city sustains full compliance, every investment strategy we tested achieves a median funded ratio above 90%. Without it, no strategy exceeds a 47% chance of reaching even 80%. Another concerning finding is that the fund has no safeguard against compound stress. Our worst-case scenario, where a market crash, stagnant payroll, and contribution retreat all hit at once, leads to insolvency in 99.4% of simulations. Each of these shocks alone is survivable, but together they completely devastate the fund.

Based on our model results, we recommend three actions: (1) establish full contribution compliance through dedicated revenue and a binding ordinance (**behavior change**); (2) adopt a Growth investment while considering options to de-risk the investments as the funded ratio gets closer to 90% (**behavior change**); (3) commission analysis of pending Tier 2 benefit legislation (**behavior change**); An alternative recommendation we explored was to evaluate the feasibility of a partial annuity buyout for the oldest retirees (**insurance**). We also explain why we could not find any viable *modifying outcomes* strategies, as the pension benefit structure is constitutionally protected in Illinois [8]. Our recommendations are directed to the Chicago City Council, the MEABF Board of Trustees, and the Illinois Comptroller.

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1 Introduction and Background

1.1 What Is a Public Pension Fund?

Among the many financial challenges facing Chicago today, few are as severe as the lack of sufficient funds for public employee pension systems [20,22].

Public pension systems are retirement systems for government workers that offer guaranteed income, typically a fixed monthly amount, depending on salary and years of service [23]. These funds have three sources of income. First, **employer contributions**: the city of Chicago makes contributions into the fund every year. Actuaries, financial professionals who calculate long-term pension obligations, determine the 'required contribution', the amount necessary to move the pension fund towards a healthier state [24]. The *actual* amount the city of Chicago pays, however, is based on legal requirements set by state laws. Second, **employee contributions**: active city workers have around 8.5% of their salary deducted automatically and sent into the fund [19]. Third, **investment returns**: the funds invest in stocks, bonds, real estate, and other assets, and the money gained on these investments adds to it [21].

Underfunded pension liability occurs when the amount of money that the government owes to the retirees (liabilities) is more than the amount of money that the government currently has (assets). The money that leaves the fund is the **benefits** that the government pays to the retirees, which is the monthly check that the government sends to the retirees. In the year 2024, the government spent $1.098 billion on benefits to 25,828 retirees, averaging $42,518 per year per retiree [1,2]. When the inflows to the fund are more than the benefits that the government pays to the retirees, the fund will grow; when the inflows are less, the fund will shrink. In these cases, other sources of funding that the government may use to cover the difference may include increased taxes, loans, or using funds from other parts of the city's budget. The **funded ratio** is a measure that helps us know the health of a pension fund. It is the ratio of the total assets of the fund and the total liabilities. When the funded ratio is 100%, this shows that the fund is fully funded, while a funded ratio of 50% or less shows that the fund is in severe distress.

1.2 The MEABF Crisis

Currently, the city has five pension funds. This report will be based on the Municipal Employees' Annuity and Benefit Fund (MEABF), which has the highest active membership compared to the other four funds. According to the MEABF 2024 Annual Comprehensive Financial Report, the fund has only $5.06 billion in assets compared to $19.92 billion in liabilities [1, 14]. This shows that the funded ratio for the MEABF is only 25.4%, which is only a quarter of what it needs to be. The median funded ratio for the U.S. public sector pension funds was approximately 72% as of 2023 [18]. The ratio of 25.4% for MEABF places it in the 2nd percentile among nearly 230 plans in the Public Plans Database, just ahead of a small number of plans in Kentucky, New Jersey, and Connecticut [1, 18]. This shows that the MEABF has one of the lowest funded ratios, making it one of the worst-funded public sector plans in the U.S. (Figure 1) shows that the decline in the funded ratio is a common phenomenon for all the five funds maintained by the city of Chicago.

Chicago's pension crisis has developed over two decades of challenging circumstances. In 2001, the combined Chicago pension funds stood at a funded ratio of 90%, a healthy level. Following this, the 2008 financial crisis was disastrous for the funds as their assets plummeted (MEABF alone lost roughly $2.8 billion in a single year, a −28.2% return) while benefit payments to retirees continued to increase. To make matters worse, throughout the 2000s and 2010s, the city systematically underpaid its pension obligations. State law previously mandated Chicago to contribute only 1.25 times employee contributions, which is a formula so inadequate that the city paid a flat $130–

150 million per year from 2001–2016 despite the fact that the actuarially required amount grew tenfold (Figure 2). By 2016, the city was paying just $1 for every $6.40 it owed, a compliance rate (percentage of required contributions made) of 15.6% [1]. Meanwhile, benefit obligations grew steadily as retirees collected 3% annual cost-of-living increases and new employees earned additional service credit.

In 2016, state legislation replaced the old formula with actuarially calculated contributions and with actual enforcement: the Illinois Comptroller, the state's chief fiscal control officer, can now take state funds if Chicago fails to pay what it is required to. Compliance has since risen from 15.6% to 90.3% by 2024 [1], which has helped slow the decline but this trend still falls short of putting the fund on a sustainable trajectory. The fund hit negative cash-flow for 21 of 24 years (Figure 3). That means it had to sell investments just to pay retirees, regardless of the market.

In spite of these problems, there is still opportunity to fix the fund and reduce its financial risks, which is exactly what we model in this paper.

1.3 Problem Statement

In this paper, we focus on the risk presented by the underfunded MEABF pension fund. This problem affects over 25,000 retirees who depend on their pension monthly checks to live, 39,000 current city employees facing uncertain retirement security, and 2.7 million Chicago taxpayers who already face one of the highest combined property taxes of any major U.S. city. Pension contributions now take up around 40% of the city's corporate fund budget [12, 13, 15]. As pension obligations grow, the city has had to raise property taxes in the past, which in turn causes residents and businesses to leave. In addition, if the fund becomes insolvent, retirees would suffer significantly lower benefits without the support of the federal government. Unlike private pensions, public pension funds do not fall under the Pension Benefit Guaranty Corporation.

We investigate whether the fund can recover from 25.4% to the state-mandated 90% target by 2055 under different investment strategies and contribution scenarios. We consider risk mitigation strategies across three separate categories. First, ***behavior change***: improving contribution discipline through establishing requirements for compliance and modifying the investment portfolio to optimize returns while also accounting for risks and volatility. Second, ***insurance***: partially transferring pension obligations to a private insurer through annuity purchases, reducing the fund's liabilities at an increased cost. Third, ***modifying outcomes***: we did not identify a viable modifying outcomes strategy, as the pension benefit structure is constitutionally protected and cannot be changed for current members [8]. For example, reducing COLAs from 3% to 1.5% would significantly reduce growth, but these types of structural changes would require a constitutional amendment, which is beyond the scope and politically infeasible.

2 Data Methodology

We use publicly available financial data in order to model the MEABF's recovery success under different strategies. All of our data is from reliable sources and we cleaned it sufficiently in order for it to be used in our model. We have four main datasets, each of which we assessed for reliability and then classified by the type of data it contains: data that helps define *historical frequency*, data that helps define *risks and potential outcomes*, and data that helps define the *historical range of severity* of losses. We describe each of our four datasets with these details.

2.1 Dataset 1: Public Plans Database (PPD)

Source & Reliability: The PPD is maintained by the Center for Retirement Research at Boston College [1]. They compile data from Comprehensive Annual Financial Reports (CAFRs) and other key figures published by state and municipal retirement systems, making it the standard source for U.S. public pension analysis. We cross-checked the data and found that data from the PPD was consistent with 2024 figures published in the MEABF Annual Report.

Purpose: This dataset is our primary source for the three main modeling tasks: (1) establishing the base-year assets ($5.06B) and liabilities ($19.92B) from which all projections begin, (2) calibrating our exponential liability regression model from 24 years of historical growth, and (3) parameterizing our Monte Carlo return distributions from asset-class-specific return histories. It also provides the contribution compliance history that helps create the compliance model.

Features: The PPD Dataset contains 24 years of annual data (2001–2024) for each of Chicago's five funds, including: assets and liabilities, funded ratios, required and actual employer contributions, investment returns by asset class (equity, fixed income, alternatives, cash), active employee counts and average salaries, retiree counts and average benefits, and benefit payment totals.

Risk data type: This dataset contains data from all three categories. It provides *frequency data* through 24 years of annual return data, *categorization data* through asset-specific and compliance data allowing us to distinguish different factors causing risks, and *severity data* through the magnitude of adverse events like investment return percentages.

Data cleaning: The dataset has 24 complete annual observations with no missing values for key fields. We use nominal dollars throughout for consistency. The liability data includes jumps between four discount rate reductions (8.0% to 6.75%); to isolate real growth, we model our regression on the 2016–2024 window when the rate was relatively stable.

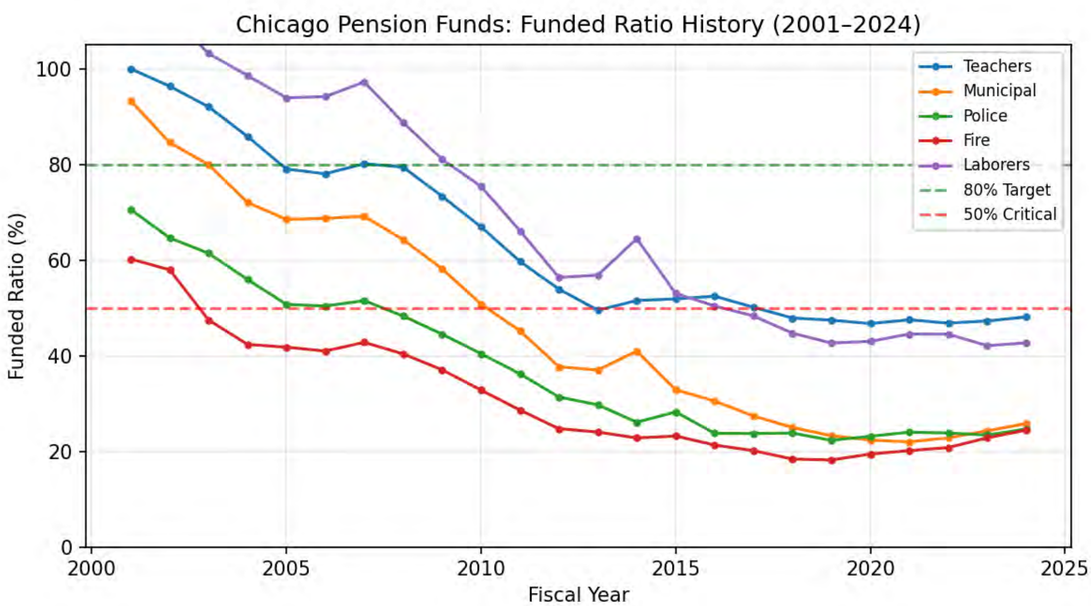

Figure 1: Funded ratio history for all five Chicago pension funds, 2001–2024 [1]. All funds have declined from near 70–90% to 20–43%, showing the crisis is prevalent across the city's pension system.

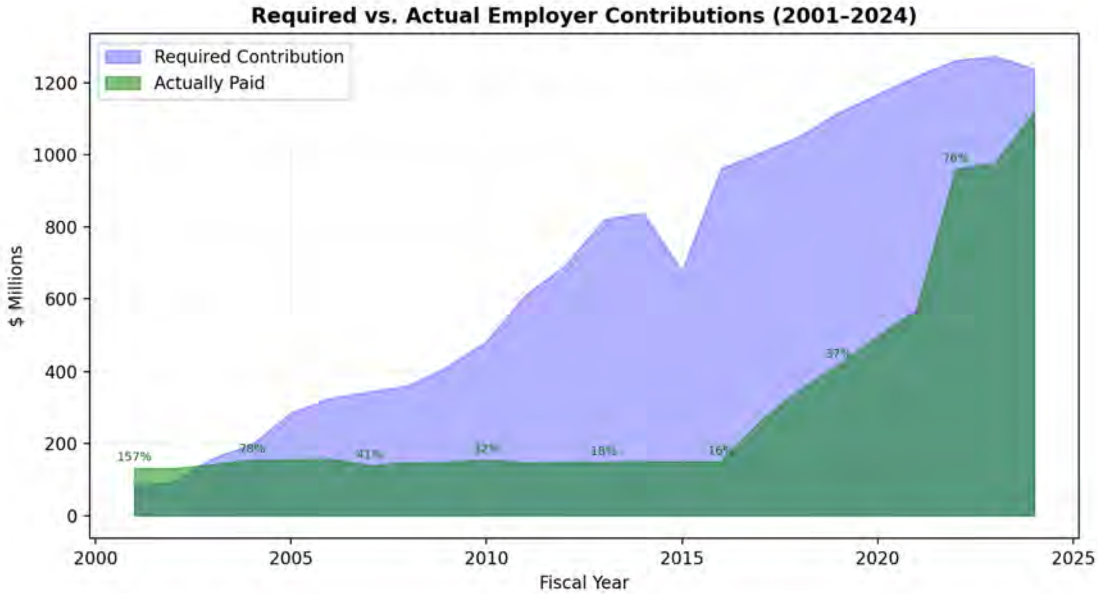

Figure 2: Comparison between the required employer contributions and actual contributions for the years 2001 to 2024 [1]. The difference between the required (blue line) and actual (green line) shows the total amount of $9.17 billion shortfall which resulted in the crisis. The percentages depicted on the graph denote the degree of compliance (actual/required) as a percentage.

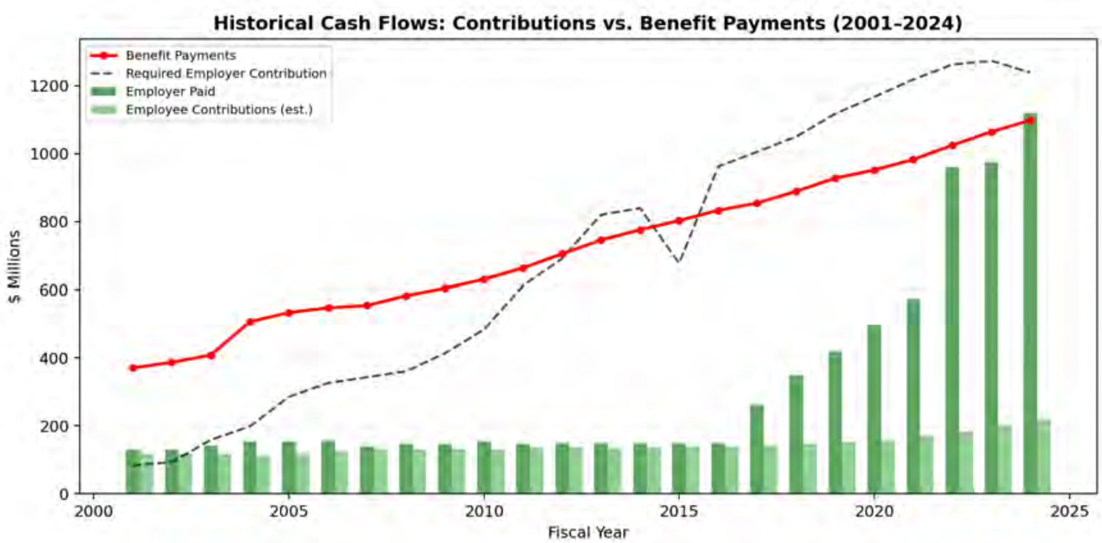

Figure 3: Cash flow history, 2001–2024 [1]. Benefit payments (red) grew steadily while employer contributions (green) only recently approached the required amount. The fund was cash-flow negative for 21 of 24 years.

2.2 Dataset 2: S&P 500 Historical Returns (2001–2024)

Source & Reliability: Historical S&P 500 return data were obtained from Macrotrends [10], which gets its data from verified financial records like exchanges and other credible sources. The S&P 500 is a very popular equity benchmark, and their returns are directly obtained from exchange records, making this data highly reliable.

Purpose: This dataset is used to simulate potential asset growth and to model investment volatility using Monte Carlo simulations. It allows us to generate key information like standard deviations which helped us validate whether the fund's 24-year return history from the PPD is representative of long-term equity behavior of the market as a whole.

Features: The data includes annual percentage returns, cumulative returns, and historical standard deviations of returns for the S&P 500 index.

Data cleaning: No cleaning is required; the dataset is complete with no missing values for our specific period.

Risk data type: The dataset contains *frequency* data (95 years of return history providing a longer baseline of data), *categorization* data (allows us to benchmark fund equity returns against the market as a whole), and *severity* data (magnitudes of returns useful for analyzing how good or bad the market is).

2.3 Dataset 3: Moody's Aaa Corporate Bond Yields (FRED)

Source & Reliability: This dataset was obtained from the Federal Reserve Economic Data (FRED) database [9], maintained by the St. Louis Federal Reserve. FRED is considered a highly reliable source as it is a primary-source federal database.

Purpose: Insurance companies price pension annuity buyouts using safe market-based discount rates rather than the pension fund's own assumed return. The Moody's Aaa yield provides this market-based rate, which we use in our annuity valuation model (Model 3) to estimate what a private insurer would charge to take over the fund's obligations.

Features: The dataset contains annual yield rates for top-rated (Aaa) corporate bonds, representing one of the lowest-risk borrowing costs available to corporations. We use the 2024 average yield of approximately 4.5%.

Data cleaning: FRED provides clean, continuous time series data. We use the annual average of monthly yields for 2024.

Risk data type: The dataset contains *frequency* data (yield history spanning decades, showing how market discount rates fluctuate), *categorization* data (provides a benchmark for low-risk borrowing costs distinct from the fund's assumed return), and *severity* data (the range of historical yields quantifies the uncertainty in annuity pricing).

2.4 Dataset 4: Annuity and Retirement Payout Benchmarks

Source & Reliability: ImmediateAnnuities.com [11] is a company which compiles real-time annuity and retirement payout rates directly from insurance companies. Although it is not a government or university source, it is widely used and accepted in retirement planning research and is considered reliable for providing accurate and up-to-date rates. As this data represents point-in-time pricing and not historical data, there is additional uncertainty in the cost estimates of our annuity valuation model with respect to the 30-year projection period, as insurance pricing can fluctuate substantially with interest rate environments.

Purpose: This dataset is used to compare the projected pension fund payouts with annuity rates. It allows us to model the potential costs of purchasing insurance-based annuities as a risk mitigation strategy for Chicago's pension liabilities, and to test our annuity valuation model's cost estimates with actual market pricing.

Features: Includes annuity payout rates for different ages, genders, and payment frequencies, including monthly and annual payouts. These figures are expressed as percentages of the initial investment. We use the 12% average markup over present-value calculations as our insurance loading factor.

Data cleaning: Point-in-time pricing data; no time series cleaning is required. We averaged rates across multiple insurers to obtain the most representative pricing.

Risk data type: Does not contain *frequency* data (point-in-time pricing), but contains *categorization* data (allows comparison of pension vs. market annuity costs, distinguishing self-insurance from commercial insurance) and *severity* data (quantifies the insurance premium markup from present value).

Dataset	Historical Frequency	Risk Categorization	Severity Range
PPD [1]	Contains	Contains	Contains
S&P 500 Returns [10]	Contains	Contains	Contains
FRED Bond Yields [9]	Contains	Contains	Contains
Annuity Benchmarks [11]	Does Not Contain	Contains	Contains

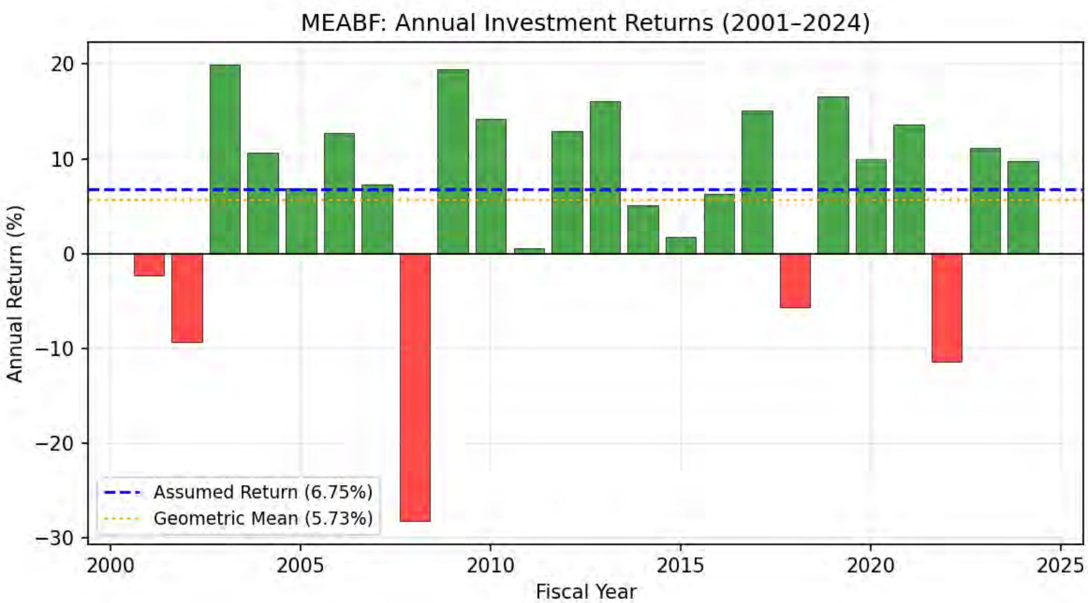

Figure 4: MEABF annual investment returns, 2001–2024 [1]. The fund's actual geometric mean of 5.73% falls 1.02 percentage points below its assumed 6.75% rate, a gap that compounds to roughly $4.5 billion in unrealized returns over a 30-year projection.

3 Mathematics Methodology

In order to examine the influence of varying investment strategies on the likelihood of recovery, we have developed three related models. **Our liability projection model** (Model 1) calculates what the fund will owe each year based on an exponential regression curve fit to historical data, adjusting for the Tier 2 benefit transition, which changes retirement ages and benefit calculations for members hired after the Tier 2 cutoff date. This model is deterministic since liabilities are a function of demographics and benefit rules, which evolve gradually in a predictable fashion. **Our Monte Carlo asset simulation** (Model 2) calculates 10,000 potential futures for the fund's assets based on five varying investment strategies. This model simulates random investment return outcomes, stochastic contribution compliance (accounting for variability in government contributions), and tracks the funded status year by year over a 30-year period. **Our annuity valuation model** (Model 3) calculates what a private insurance company would charge to assume the liabilities of the fund based on market rates used for discounting [9] and insurance pricing [11].

To prepare the investment plan, we model assets and liabilities separately and then calculate the funded ratio at the end. The difficulty is that what the fund *owes* is relatively predictable, whereas what it *has* depends on volatile markets and political decisions. A single average scenario cannot capture this range of possibilities, and this is where the Monte Carlo method is significant.

3.1 The Discount Rate

For pension mathematics, the most important figure is the discount rate. This is the investment return assumed for calculation of the amount of money required now to meet future benefits. When this figure increases, the amount of money required now decreases because of the expectation of money growing in the future. The current discount rate for the MEABF is 6.75%, which was lowered from 8.0% and has been happening for the past two decades [1, 2, 14]. Every time this figure is lowered, the reported liabilities increase even though the benefits have not changed. This is important for our model because the overall increase in the liabilities for the entire period is biased upwards by this change in the discount rate. In order to keep our model honest, the calibration was based on the 2016-2024 time period when this figure was constant at 6.75%, which has a corresponding growth of 3.58% per year.

However, there is a larger concern. The fund is based on the expectation of earning 6.75%, but its true geometric return is actually 5.73% (Figure 4). The difference between the two increases every year and continues to add to the unfunded liability even as the city maintains its contribution schedule.

The geometric mean also differs from the arithmetic mean because of **volatility drag**: the true compound growth rate of an asset with an arithmetic mean return μ and volatility σ is approximately $\mu - \sigma^2/2$. For the MEABF's equity asset class, this means the true compound return is 6.75%, rather than the 8.40% arithmetic mean. This is important because the fund's discount rate assumption of 6.75% is an implicit geometric return goal, but the averages used by plan sponsors are typically arithmetic means, which are biased to be too high. In addition, the **sequence of returns** has a material effect because a big loss early in the projection period reduces the asset base before the contributions begin to rebuild it, permanently affecting the compound growth rate in a way that the same average return received in a different sequence would not. We define these concepts mathematically in Section 3.4.2. In short, the fund is targeting a return it has never consistently achieved, and every year it falls short quietly deepens the hole.

3.2 Model Assumptions

Every model requires assumptions. We detail each one and explain why it is necessary.

1. Single fund focus (MEABF). Chicago has five pension funds with varying benefit structures and funding levels: 19% in the Fire fund to 43% in the Laborers' fund. Our focus is on MEABF, which has the largest active membership at 38,655 employees, as it has the best available data. Combining funds would require assumptions not supported in the data.

2. Thirty-year projection window (2025-2055). Illinois law mandates the Municipal and Laborers' funds to attain 90% funded status by 2055 [3]. This time frame is sufficiently long for compounding to occur, yet sufficiently short for our projections to remain relevant. A well-defined endpoint is a necessary assumption for our simulations to remain relevant.

3. Dollar-based employer contribution growth at 2.5% per year. The actuarial requirement is not simply scaled by the increase in pay. The actuarially required contribution is recalculated by professional actuaries annually. The increase from 2017 to 2024 has been about 3.25% per year. However, this range also includes the ramp-up period where the increase was higher. We will use a conservative rate of 2.5%, slightly below the average rate. We have to project this for

30 years. A simple percentage increase approach would result in wildly inaccurate results. In fact, the percentage of pay going into the required contribution has been decreasing (62.7% in 2020, decreasing to 47.6% in 2024 [1]).

4. Cap for employer compliance at 85% with floor at 40%. Over the last 24 years, the city has reached 90% only once, in 2024, when it reached 90.3% [1]. Rather than assuming perfect compliance over three decades, we use a baseline cap for employer compliance and adjust it with stochastic shocks based on economic conditions. This is important because overstating compliance would make our projections unrealistically optimistic. Additionally, we keep a minimum employer compliance of 40% because the lowest percentage compliance has been after the 2016 reforms was 43% in 2017.

5. Payroll growth steady at 3.5% annually. Note the average from 2016 to 2024 of 5.28% due to the hiring rush after the pandemic. Municipal jobs jumped from 30,296 to 38,655. If this rate continued over 30 years, we would be at 80,000 employees in 2055. That doesn't fit with the flat/declining population. Let's assume a sustainable growth rate of 3.5%, which includes 2.5% due to salary inflation and 1% due to headcount.

6. Employee contributions at 8.5% of payroll. This is the statutory contribution for MEABF members. This amounts to around $221 million at current levels.

7. Liability growth: reduce from 3.58% down to 2.50%. The basis for this is the flat discount rate in the 2016-2024 window [1]. The decrease is due to the Tier 2 transition: employees hired after 2011 receive lower cost-of-living adjustments (half CPI instead of steady 3%) and higher retirement ages (67 instead of 55-60). As Tier 2 workers gradually replace retiring Tier 1 workers, liability growth slows down. We model this as a linear transition occurring over 2030-2050 years (Equation 1).

8. Administrative expenses are 0.5% of assets. This is a normal cost for a public fund of this type that covers investment management fees and operations.

3.3 Model 1: Liability Projection

We have tested three different regression forms with our 24-year history. They have similar accuracy ($R^2 > 0.988$), yet they have different extrapolative characteristics (Figure 5). We prefer the exponential form due to the compound growth of liabilities. Current liabilities compound at interest rates, cost-of-living adjustments increase future liabilities, and service credits increase liabilities each year. The polynomial form can have negative growth in liabilities in the future, which is not consistent with the current benefit structure.

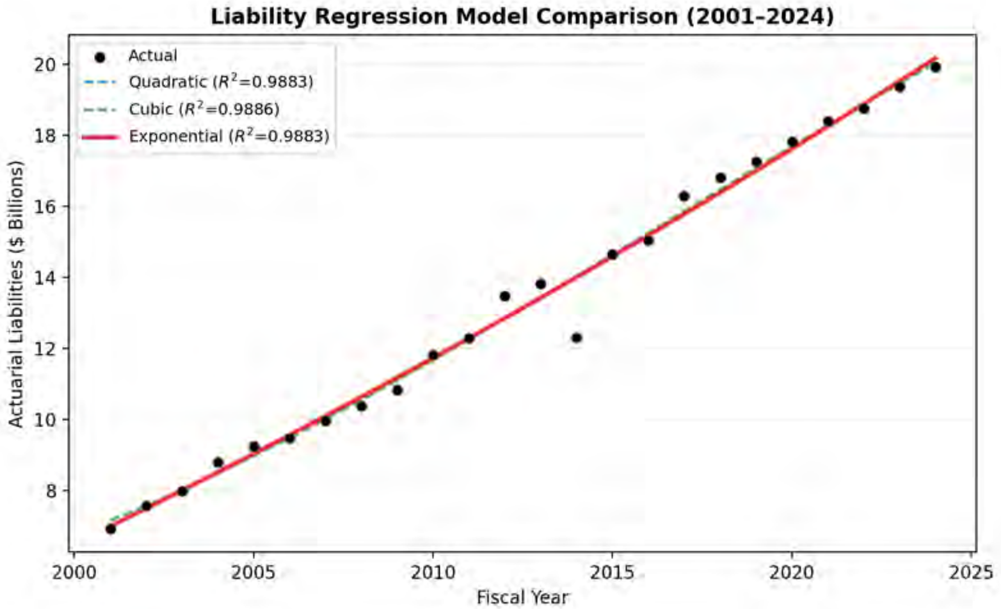

Figure 5: Three models were run using the MEABF liabilities from 2001 to 2024 and fit the historical data nearly identically ($R^2 > 0.988$), making the individual lines difficult to distinguish in the historical time period. Of the available choices, only the exponential form resembles the way pension liabilities compound over time.

We used the 2016-2024 data, with a 3.58% annual increase, and add in the Tier 2 transition adjustments. Illinois created "Tier 2" benefits for new hires after January 1, 2011. The biggest differences are straightforward: Tier 1 retirees receive a flat 3% compounded cost-of-living adjustment (COLA) each year, while Tier 2 recipients receive the smaller of 3% or half of CPI, not compounded (approximately 1.5% historically). Tier 2 also requires a higher retirement age (67 vs. 55-60 for Tier 1) and caps pensionable salary. As Tier 1 retirees pass away and Tier 2 new hires comprise a majority, the rate at which liabilities increase is projected to slow down, and we express this in the following way:

$$\underbrace{g_L(t)}_{\text{liability growth}} = \begin{cases} 0.0358 & t \leq 2030 \\ 0.0358 - \frac{0.0108(t-2030)}{20} & 2030 < t < 2050 \\ 0.0250 & t \geq 2050 \end{cases} \tag{1}$$

Based on current demographics, it would appear that such a transition would begin around 2030 as Tier 2 employees, those hired in 2011 or later, begin to retire in significant numbers, and would be largely complete by 2050. The 2.50% terminal rate reflects a reduced Tier 2 cost of living offset by ongoing accruals of new benefits. With such a system, liabilities for 2055 are projected to be around $50.4 billion. The same basic principles are used for growth in benefit payments, but the transition would begin a bit later, 2035-2050, as current payments are still largely from Tier 1 retirees.

3.4 Model 2: Monte Carlo Asset Simulation

The fate of a pension fund is not determined just by the average return; the sequence in which the returns are realized is just as important. Let's illustrate this with two scenarios with the same average return over three decades: 7%. In Path A, the fund loses 20% in year one, then struggles to live. In Path B, the fund has a great run in the early years, then loses 20% in year 25. But in Path B, the loss in year 25 doesn't hurt as much, as the base has grown to the point where it can absorb the loss. Same average return, very different ending funded ratios. And this **sequence of return risk** is particularly dangerous when you are already at 25% funded, like MEABF, with a relatively small asset base of $5.06 billion compared to the $1.098 billion in annual benefits. A single "expected case" forecast completely ignores this risk. So, what can be done?

The Monte Carlo simulation approach to this problem is to create 10,000 unique sets of random return series. They all draw from the same probability distribution (which in this case corresponds to the actual history of the fund [1]), but they are all unique. When all 10,000 are viewed together, the complete picture is seen: not just "the fund will likely reach X%", but "there's a Y% chance the fund reaches 80% and a Z% chance it goes insolvent."

3.4.1 Asset Evolution Equation

In each of the 10,000 simulations, assets evolve annually according to:

$$A(t{+}1) = \underbrace{A(t)(1 + R_p(t))}_{\text{investment growth}} + \underbrace{C_{ER}(t{+}1)}_{\text{employer}} + \underbrace{C_{EE}(t{+}1)}_{\text{employee}} - \underbrace{BP(t{+}1)}_{\text{benefits}} - \underbrace{E(t)}_{\text{admin}} \tag{2}$$

In the case when $A(t{+}1) < 0$, the fund becomes insolvent and cannot honor its liabilities. Now, breaking down the components of the formula: $R_p(t)$ is stochastic and comes from correlated distributions (annual rate of return); C_ER is the required contribution multiplied by a stochastic factor; $C_{EE} = 0.085 \times \text{Payroll}(t)$ with payroll growing at 3.5%/year; BP starts at $1.098 billion and has the Tier 2 adjusted growth; and $E = 0.005 \times A(t)$.

3.4.2 Return Modeling

Asset classes' return series are subject to a geometric Brownian motion: $\ln(1 + R_i) \sim \mathcal{N}(\mu_i - \sigma_i^2/2,\ \sigma_i^2)$. The correction factor $-\sigma_i^2/2$ in the mean is known as the **volatility drag correction**, (as introduced in Section 3.1), and it is essential for the simulation to correctly capture compound growth. If we do not use this correction factor, then for an asset with a mean return of 8.40% and a standard deviation of 18.19%, the asset will appear to compound correctly at 8.40%, but in fact, its true compound growth rate will only be 6.75%. This difference in compounding rates from 8.4% to 6.75% over a 30-year period on a $5 billion base leads to $4.5 billion in unrealized returns.

Asset Class	**Arith. Mean**	**Geom. Mean**	**Std. Dev.**	**Source**
Equity	8.40%	6.75%	18.19%	Fund equity, 24 yrs [1]
Fixed Income	4.40%	4.31%	4.44%	Fund FI, 24 yrs [1]
Alternatives	7.00%	~6.1%	15.00%	Adjusted for smoothing [1]
Cash	4.00%	4.00%	0%	Deterministic
Total Fund	*6.38%*	*5.73%*	*11.28%*	*Cross-check [1]*

One row in this table which needs a bit of an explanation is the "Alternatives" row. Private equity and real estate have a return based on periodic appraisals rather than every-day market prices. This has the effect of reducing the apparent volatility. Research suggests that true economic volatility should be in the 20-25% range. We are taking a more conservative estimate in the middle at 15%. The use of an alternative value for the volatility for the Growth asset allocation, set at 20% rather than 15%, increases the 5th and 95th percentile spread by around 8% but only alters the median funded ratio by less than 2%. The "Total Fund" row is a cross-check: the actual return of the fund is consistent with our parameters.

3.4.3 Correlated Returns

However, in the real world, asset classes are not independent from each other. When the stock market crashes, for example, the performance of private equity and real assets will also deteriorate, while bonds will remain flat or even increase in value. We use a correlation matrix to take these relationships into account, which we estimated using historical data from the fund:

	Equity	Fixed Income	Alternatives
Equity	1.00	0.10	0.55
Fixed Income	0.10	1.00	0.20
Alternatives	0.55	0.20	1.00

The small link between stocks and bonds, about 0.10, ensures that bonds are useful for diversification. The mid-range estimate for equity to private alternatives of 0.55 makes sense because private equity has a lot of equity risk. To achieve correlated returns for our model, we use **Cholesky decomposition**, which is a technique for creating correlated random samples from independent ones. We also included a crisis mode where, if the funded ratio falls below 20%, we increase correlations($\rho_{\text{EQ-ALT}} = 0.85$) because diversification fails during bad economic times.

3.4.4 Stochastic Contribution Compliance

Sometimes, the city cannot supply that which is needed; compliance is weak when the economy suffers and there is less tax revenue coming in. Rather than a constant rate, compliance varies according to economic conditions:

$$\underbrace{\rho(t)}_{\text{compliance}} = \text{clip}\Big(\rho_{\text{base}}(t) + \underbrace{\varepsilon(t)}_{\text{shock term}}, \underbrace{0.40}_{\text{min}}, \underbrace{0.85}_{\text{max}}\Big) \tag{3}$$

From an initial base rate of 90.3% in 2024, it decreases steadily to 85% in 2027. The shock term, ε, is dependent on what happened to the portfolio in the previous year. That is, if a market crash occurred ($R_p < -10\%$), then compliance is reduced by 5-15pp. If a less severe market decline occurred ($-10\% \leq R_p < 0$), then compliance is reduced by 0-8pp. In normal years, compliance is barely affected, by ($\pm$3pp). We constrain it to be at least 40% and at most 85%, as a practical matter, since even in the worst scenarios, there is a minimum payout, and sustained compliance is unlikely to exceed 85% based on historical trends.

This is, in effect, a reproduction of the very feedback loop that occurred between 2008 and 2012. That is, if markets tank, then the fund loses money from two directions: investment returns are poor and employers contribute less, at a time when the fund needs money most.

3.5 Investment Strategies and Results

We considered five portfolios at different points on the risk/return trade-off. "Status Quo" reflects the actual composition of the fund's portfolio in 2024 [1], while the other portfolios span the range from Conservative (30% equity) to Aggressive (70% equity).

Strategy	Equity	FI	Alts	Cash	$E[R_p]$	σ_p
Status Quo	47%	20%	23%	10%	6.86%	10.55%
Conservative	30%	50%	10%	10%	5.82%	6.84%
Moderate	50%	30%	15%	5%	6.77%	10.45%
Growth	60%	20%	18%	2%	7.26%	12.38%
Aggressive	70%	10%	18%	2%	7.66%	14.10%

Strategy	Med FR	5th–95th	$P(\geq 90\%)$	$P(\geq 80\%)$	$P(\geq 50\%)$	P(Insol.)
Status Quo	69%	25–190%	32%	41%	70%	0%
Conservative	59%	31–111%	11%	21%	66%	0%
Moderate	68%	25–181%	31%	40%	70%	0%
Growth	73%	22–229%	37%	45%	70%	0%
Aggressive	76%	19–288%	40%	47%	70%	0%

No approach provides the fund better than a 47% chance of reaching 80% by 2055. This finding underscores the severity of the fund's position.

Considering the strategies individually: The Conservative approach is particularly poor with a 21% probability of success and a median of 59%. For a fund with this severity of underfunding a low-return portfolio will not be able to close the nearly $15 billion funding gap. Bonds alone will not provide the necessary return. A low-risk approach is actually the riskiest because it significantly increases the chances of failing to meet the legislative goal.

The best risk-adjusted portfolio is the Growth portfolio with a 73% median funded ratio and zero risk of insolvency. It has a 14-percentage-point better median result than Conservative and better worst-case outcomes. Aggressive has a slightly better median (76%) and probability of success (47%), but its 5th percentile is 19%, which means in the worst-case scenarios, the fund is still just making small gains on its current position.

The good part across all of the models is in the $P(\geq 50\%)$ column where about 70% of simulations result in the fund being double its current position. The problem is getting all the way to 80%+. That takes both good market conditions and continued contributions.

Figure 6 illustrates this for the best-performing portfolio. The widening fans represent the increasing uncertainty of outcomes as time progresses. More equity in the portfolio results in a wider fan, indicating both greater potential for gain and risk of loss. Figures 7–8 compare the strategies and add historical data and projected outcomes.

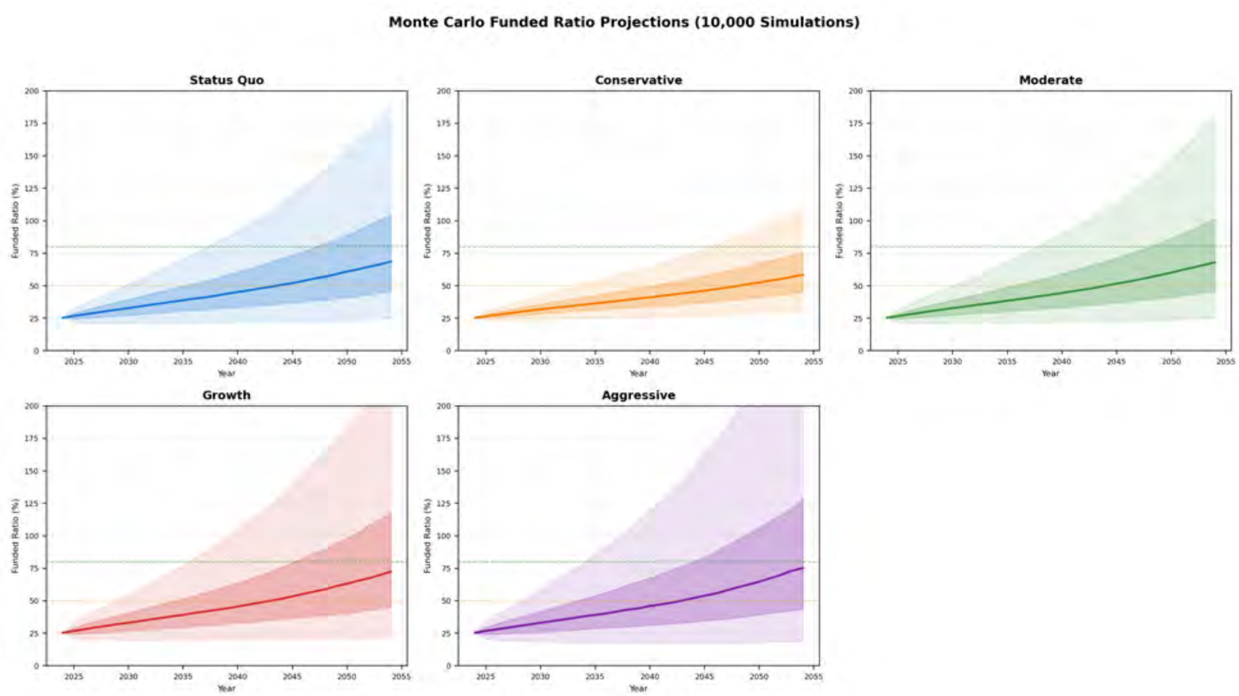

Figure 6: Fan charts for all five strategies (10,000 simulations each). Solid line = median; dark shading = interquartile range; light shading = 5th–95th percentile. Green dashed = 80% target. Key takeaway: the Growth portfolio offers the best balance of upside (73% median) and downside protection (5th percentile remains above 20%).

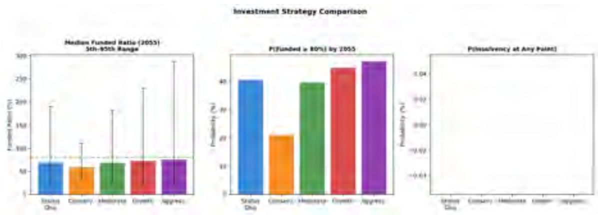

Figure 7: Comparison of strategies based on their performance against important criteria. In the left graph, we see the median ratio of funding for 2055 (Growth strategy performs best with a ratio of 73%). In the middle graph, we can see the probability of reaching a ratio of 80% (the Aggressive strategy is highest with a probability of 47%). Finally, in the right graph, we see the probability of insolvency (all strategies have a zero probability).

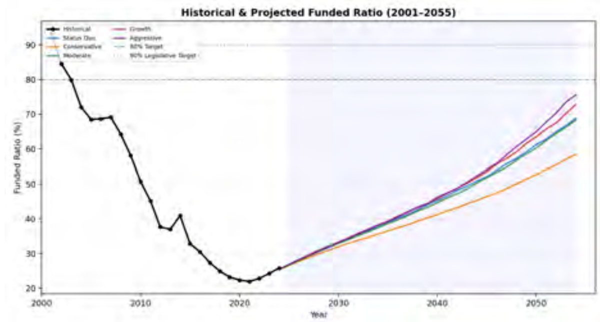

Figure 8: Historical data with median projections.

3.6 Sensitivity Analysis and Stress Tests

We test each of these assumptions individually to determine which factors are driving the outcomes. The results are shown in Figure 9. The crystal-clear takeaway: policymakers should focus on contribution compliance. It matters a great deal. Contribution compliance has a 79-point impact on the median funded status. Contribution growth has a 58-point impact on funded status. Market returns have only a 25-point impact.

In the stagflation scenario, where we have five years of zero returns and lower payroll growth, it's tough but survivable: we end up at 43%, and insolvency is not an issue. We stay solvent because we continue to receive contributions even in an environment where growth has stopped. In the Combined Crisis scenario, where we have all three bad events happening at once – an early market crash, stagnant payroll growth, and declining contributions – we have 99.4% insolvency. The difference between surviving a crisis and succumbing to one appears to be a matter of timing.

Scenario	**Med FR**	$\boldsymbol{P(\geq 80\%)}$	$\boldsymbol{P}$**(Insol.)**
Base Case	*68%*	*40%*	*0.0%*
Full Compliance (100%)	108%	72%	0.0%
Reduced Compliance (70%)	29%	11%	5.7%
High Contribution Growth (3.5%/yr)	101%	68%	0.0%
Low Contribution Growth (1.5%/yr)	43%	21%	1.5%
Liability Growth +1pp (Enhanced Tier-2 benefits)	51%	23%	0.0%
Stagflation (5yr zero returns)	43%	16%	0.0%
Combined Crisis*	0%	0%	99.4%
*3 yrs of −15% returns, 2% payroll, 1% contribution growth, 70% compliance.			

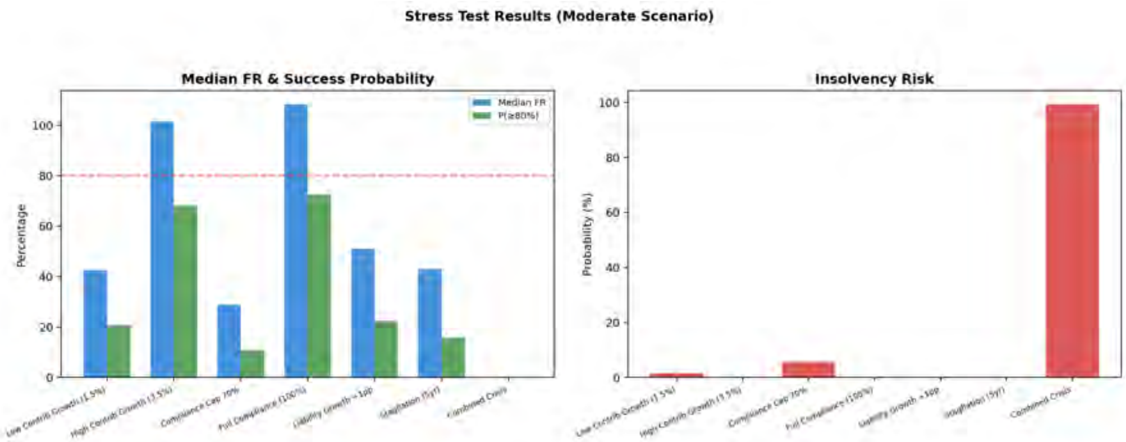

Figure 9: Stress test outcomes. Left panel shows median funded ratio and P(80%) by scenario; right panel shows insolvency probability. Two highest bars in the left panel correspond to the Full Compliance (median of 108%) and High Contribution Growth (median of 101%), respectively; the only scenario with a material insolvency probability is Combined Crisis (99.4%). Contribution-related variables account for almost all variation, at 137 percentage points compared to 25 due to market returns.

Figure 10 shows the process of cash flows in the Moderate scenario. In this case, the contributions are always ahead of the benefits, but the margin increases slowly. This explains why the recovery process is slow because the fund is accumulating slowly.

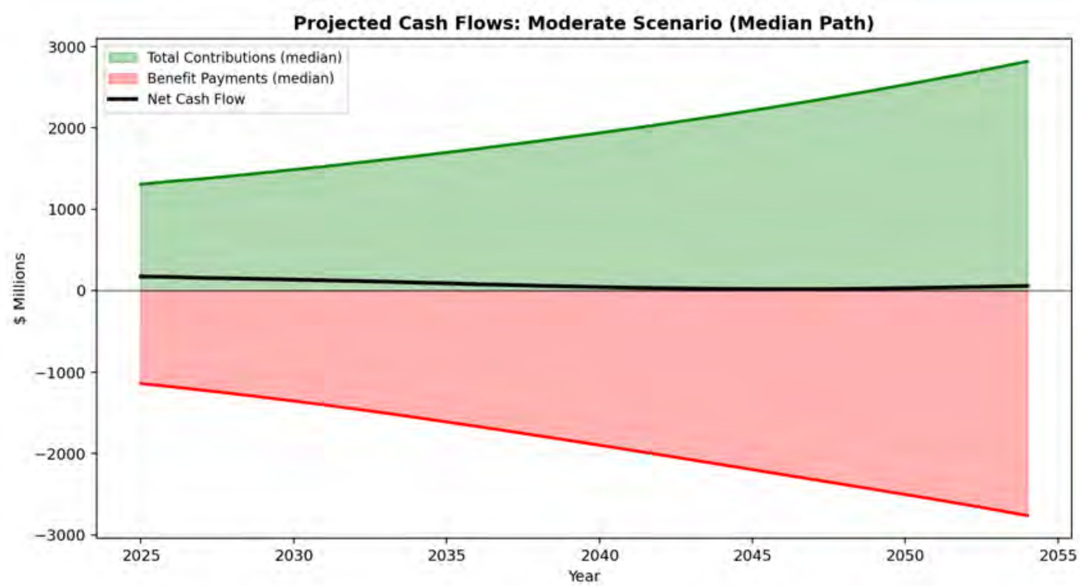

Figure 10: Projected cash flows under the Moderate scenario. Contributions (green) exceed benefits (red) throughout, but the net cash flow margin (black) does not surpass $500 million annually until the mid-2040s, explaining why recovery takes decades even when inflows consistently exceed outflows.

As a key takeaway from our stress tests, the following table highlights one of the findings. In an environment in which the city pays 100% of what it needs to contribute, all strategies have a median funded ratio above 90%. In other words, the problem is not which funds to invest in; it is whether the city will pay what it needs to.

Strategy (100% compliance)	Median FR	$P(\geq 80\%)$
Status Quo	109%	72%
Conservative	94%	69%
Moderate	107%	72%
Growth	114%	72%
Aggressive	119%	72%

3.7 Model 3: Annuity Valuation

We used a three-cohort model to estimate the cost of buying out all the retiree liabilities with a private insurer, using a 4.5% discount rate, a 3% COLA, and a 12% insurance markup derived by benchmarking our annuitization costs against PPD values entered into ImmediateAnnuities.com. Had the markup for insurance been anywhere from 8 percent to 16 percent, as opposed to our hypothetical figure of 12 percent, the cost of the oldest cohort buyout would have varied between \$2.87 billion and \$3.39 billion, illustrating why competitive bids are critical in purchasing. A complete retiree buyout costs \$19.12 billion, or roughly four times the current assets under the fund, making it impractical. A partial buyout covering the oldest 25% of retirees costs \$3.13 billion. We use this method to sanity-check the fund's own accounting numbers and as a basis for our insurance recommendation.

Annuity buyout cost by retiree cohort (discount rate = 4.5%, COLA = 3%, insurance markup = 12%). Data from PPD 2024 [1, 9, 11].

Cohort	Retirees	Annual Benefit	Horizon	Insurance Cost
Youngest (under 65)	10,331	\$38,266	25 years	\$9.22B
Middle (65–75)	9,040	\$42,518	18 years	\$6.77B
Oldest (75+)	6,457	\$46,770	10 years	\$3.13B
All Retirees	**25,828**	**\$42,518 avg**		**\$19.12B**

3.8 Limitations

Tail risks are underestimated by our log-normal model: The loss of −28.2% in 2008 translates into a 160-year event in our model, while there were two such losses within 24 years; hence, our insolvency probabilities can be considered conservative lower bounds. In case of a fat-tailed probability density function (five-degree Student's t distribution), the fifth percentile of the Growth portfolio falls from 22% to 16%, and the insolvency probability jumps from 0% to 0.3-0.5%, while the median does not change significantly. Approximately 23% of the assets are illiquid, and in the case of forced selling in a crisis, investors could face losses of 30-50%, which we do not model. Moreover, we assume the returns and liabilities growth to be uncorrelated, which tends to understate the impact of inflation squeezes.

Additionally, our model maintains a constant rate of growth for the necessary contribution of 2.5% annually and does not react to investment underperformance by changing the actuarially necessary contribution. In real life, a substandard return would cause an unfunded liability, which would be represented as a higher necessary contribution in following years, which would partially offset the effect of the compliance shock already built into our model. With these limitations in mind, we turn to the model outputs to classify and rank the risks facing the fund.

4 Risk Analysis

Our Monte Carlo model quantifies the probability distribution of outcomes. In this section, we classify each risk by severity (the magnitude of funded ratio impact, quantified as potential dollar losses), likelihood (historical frequency and current conditions), and uncertainty (the range of possible outcomes). We then present risk mitigation strategies.

4.1 Risk Hierarchy

Figure 11 puts this in perspective. Each bar shows how much the median funded ratio swings when we change one variable from its worst to best value. The contribution compliance bar spans 79 percentage points, nearly three times the width of the market returns bar.

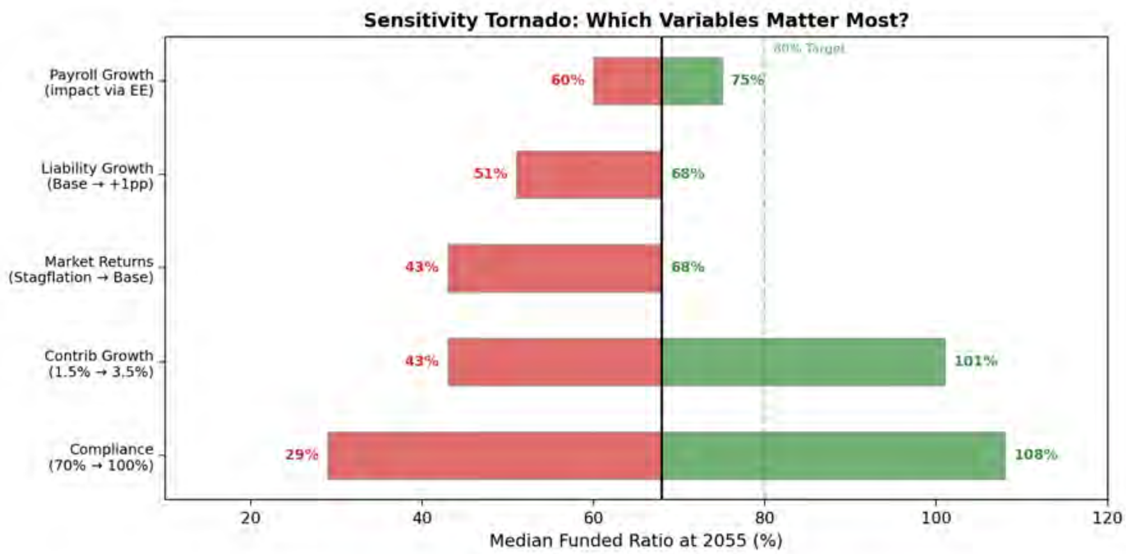

Figure 11: Sensitivity tornado chart. Each bar shows the median funded ratio range when one variable moves from unfavorable (red) to favorable (green). Black line = base case. Compliance dominates.

4.2 Risk 1: Employer Contribution Shortfall (Critical)

This is by far the most important issue facing the Chicago pension funds. When the city does not match its required payments, the shortcoming is not temporary. It turns into additional unfunded liability that accrues interest, and continually underfunding just makes the issues worse as years go on. This creates a compounding effect that accelerates the crisis over time. In our stress tests, the median funded ratio swings by 79 percentage points depending on compliance alone, from 29% at 70% compliance to 108% at full compliance.

To put the severity of this risk in perspective: at 70% compliance, the fund would struggle to reach 29% funded by 2055, not much better than the current situation of the fund. If that were to happen, the unfunded liability would balloon to approximately $35 billion, representing an additional $20 billion in money the taxpayer need to supply beyond the already large amount. If this were to occur, annual benefit payments would soon exceed the fund's total assets, forcing the city to pay retirees directly from the general budget, taking away from many key social services and angering the general public.

Figure 12 clearly shows the historical damage this issue can have. Both the red and green lines were simulated under the same market conditions starting in 2001 to the present, including the same 2008 crash and the 2022 market crash. The only difference between these lines was whether the city paid what it owed or not. With full compliance, the fund would be 108% funded today instead of 25%. That 82 percentage point gap is worth over $16 billion in lost compounded contributions and investment returns [1].

The likelihood of this occurring is moderate to high. Chicago's average compliance over the last 24 years is just 45%[1]. It is true, however, that following the 2016 enforcement mechanism (state fund intercepts) has been effective, but this solution is only applicable to statutory minimums and is reliant on continued legislative support. With pension consuming 40% of the corporate fund [12], the pressure to redirect money toward other city services is intense. Ultimately, compliance is a variable (driven by political decisions), and no actuarial model can predict it reliably over 30 years.

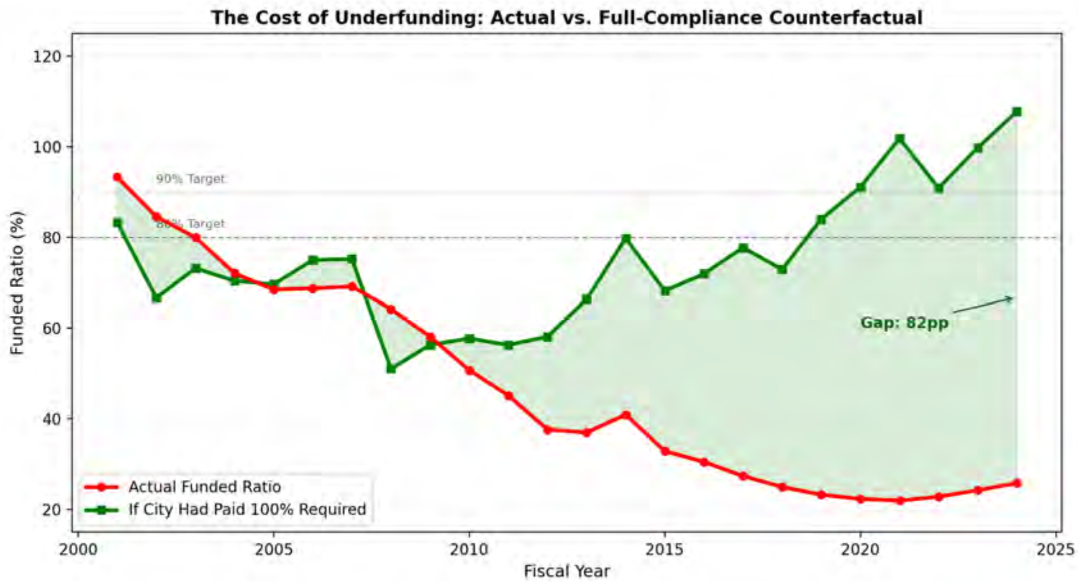

Figure 12: Actual funded ratio (red) vs. what would have occurred with 100% compliance (green) [1]. The 82pp gap is attributable to political decisions.

4.3 Risk 2: Contribution Growth Stagnation (High)

If contributions grow at a slower rate than our 2.5% assumption, it would immensely affect the outcomes. The fund's primary source of new capital comes through these contributions; this is crucial since investment returns need to have a lot of capital to get compounding results that can close the funded gap quickly. If contributions do not grow, the fund cannot attain capital fast enough to outpace growing liabilities through benefits.

The severity is shown within ours. At 1.5% annual growth (compared to our assumed/base case of 2.5%), the median funded ratio drops all the way down to 43% and the insolvency risk appears at 1.5% (compared to 0%), with the unfunded liability amount being more than $29 billion by 2055. At 3.5% annual growth(1% more than the base case of 2.5%) the median funded ratio exceeds 100%. This risk has a 58 percentage point differential, making it the second-most impactful risk after contribution compliance (Figure 11).

The likelihood of this occurring is moderate. Our 2.5% projection is based on only 8 years of post-reform data, collected during an economic expansion. Additionally, another concern is that Chicago's population has declined in 8 of the last 10 census estimates, and the post-pandemic hiring surge was funded partly by one-time federal stimulus money that has now been used up [1]. The uncertainty is medium, as contribution levels are at least partially controlled by policy which is difficult to predict.

4.4 Risk 3: Market and Investment Returns (Moderate)

The investment returns could fall below what we expect, an issue especially severe in the next 5 to 10 years while there are less assets. Having a market crash during this period, before contributions have had time to build a safety-net would be extremely damaging compared to the same crash in

2045 when the fund holds enough assets to be relatively more safe from a crash.

Our stagflation scenario (five years of zero returns followed by normal conditions) brings the median funded ratio down to 43%, which results in around $27 billion in unfunded liabilities by 2055. This scenario poses a significant threat even beyond short-term issues. This is because the fund assumes 6.75% annual returns through the discount rate, but its actual geometric mean over the last 24 years has only been 5.73%(Figure 4). 1.02% percentage point gap compounds over time and results in approximately $4.5 billion in returns over 30 years. Furthermore, every year the fund earns less than its assumption, the unfunded liability grows even if the city meets its contributions, making it difficult to set goals.

Sustained stagnation is unlikely but not impossible; however, the 1.02pp return gap is essentially certain to persist. The uncertainty is high because our log-normal model underestimates extreme events, meaning our insolvency estimates are likely conservative lower bounds.

4.5 Risk 4: Tier 2 Benefit Enhancement (Moderate)

In 2010, Illinois created "Tier 2" benefits for new hires with lower COLAs (half-CPI vs. flat 3%), higher retirement ages (67 vs. 55–60), and a cap on pensionable earnings. Our model heavily depends on these changes to slow down liability growth over time. However, these legislative changes might not last as there are significant pressures to reverse them.

If the state legislature enhances Tier 2 benefits, it would invalidate our assumption that liability growth declines from 3.58% to 2.50%. Under our "Liability Growth +1pp" stress test, the median drops from 68% to 51%, and the probability of reaching 80% falls from 40% to 23%. According to the Civic Federation, HB 5909, which proposed raising the salary cap, improving COLAs, and reducing the retirement age, would add $3.3 billion to MEABF obligations through 2055 [3, 7]. On top of this, the Tier 2 pensionable salary cap ($125,774 in 2024) is growing at roughly half the rate of the Social Security wage base ($168,600 in 2024). If this gap keeps widening, the plans may fail the IRS "Safe Harbor" test, forcing the state to either enhance benefits or start paying Social Security taxes of roughly 12.4% of payroll.

HB 5909 did not pass, but the underlying pressure is not going away. The likelihood is moderate and increasing, with medium uncertainty since the timing is unknown but the direction of pressure is clear.

4.6 Risk 5: Compound Stress (Existential)

The scenario that worries us most is when multiple risks occur at the same time: a recession that tanks market returns, slows payroll growth, and triggers contribution cuts all at once. As stated above, singular risks are possible to survive. Even five years of zero returns leaves the fund solvent, and 70% compliance alone will not cause insolvency. But when these shocks coincide, the fund is staring down near-certain collapse.

Our Combined Crisis test leads to insolvency in 99.4% of simulations, meaning assets reach zero and the fund cannot pay any benefits. That would be a total loss of the remaining $5.06 billion in assets, and the city would need to pay retirees directly from the general budget indefinitely.

This scenario could occur, it is not just hypothetical. In fact between 2001 and 2012, the funds experienced this type of stress from multiple risks: market returns of −9.3% (2002) and −28.2% (2008), average compliance of only 53%, and the retiree count growing from 14,900 to 22,200 with benefits doubling. As a result, the funded ratio dropped 55 percentage points, from 93% to 38% [1]. Starting from 93%, this was devastating but survivable. Starting from today's 25%, similar situations occurring would mean complete insolvency. At 25% funded, there is simply no buffer left.

Will this exact combination happen? Probably not. But the uncertainty is very high, and if it does happen, the severity would be catastrophic.

4.7 Risk Mitigation Strategies

There are three categories of risk mitigation: behavior change, insurance, and modifying outcomes. We looked at all three.

We believe that the most effective mitigation strategies in this scenario fall under **behavior change**. Our model shows that contribution discipline is by far the most powerful variable available, so ensuring compliance through dedicated revenue streams and binding ordinances directly addresses the fund's most severe risk. Optimizing the investment strategy (shifting to the Growth allocation) is a second behavior change that improves the median by 14 percentage points over the Conservative approach at no additional cost.

For **insurance**, we explored the possibility of transferring some of the fund's obligations to a private insurer through an annuity buyout. Our annuity valuation model shows that a partial buyout of the oldest retirees could reduce near-term cash flow pressure, though at significant cost. We evaluate this option in detail in our recommendations.

In this scenario, **modifying outcomes** strategies do not hold much promise, and we do not spend time developing recommendations around them. This is because most modifying outcomes approaches would require massive structural reforms within the pension system, such as changing the payment structure or reducing COLAs (cost-of-living adjustments). Illinois' constitution (Article XIII, Section 5) prohibits reducing benefits for current employees and retirees [8], and a constitutional amendment is both beyond the scope of fund-level recommendations and politically infeasible in the foreseeable future. The impact of a COLA reduction from 3% to 1.5%, a Tier 1 cut, would decrease growth of liabilities by an estimated 0.8% per year and increase the 2055 median by 15 to 20 percentage points; however, the Illinois Supreme Court struck this down in 2015.We therefore focus our recommendations on the behavior change and insurance categories where actionable solutions exist.

5 Recommendations

Based on the results of our model, we make three recommendations and one alternative recommendation. Each addresses a specific risk identified in our analysis and we then evaluate the benefits along with the costs and trade-offs of each.

5.1 Recommendation 1: Establish Full Contribution Compliance (Behavior Change)

Regardless of the investment strategy, if the city pays 100% of what it says it owes, every single investment strategy we tested achieves a median funded ratio above 90%. That is the most important number in this entire report. Going from 85% to 100% compliance, a 15 percentage point increase results in the median funded ratio going up by 40 percentage points and nearly doubles the probability of reaching an 80% funded ratio (from 40% to 72%). No other change we tested comes close to this impact.

Two reinforcement measures can be considered: (a) an enforceable contribution resolution stipulating that 100 percent of the contribution shall be paid on an actuarial basis, with variance only possible through supermajority voting, and (b) revenue sources (like the current water/sewer tax and 911 surcharge) earmarked exclusively for pension contributions, shielded from yearly budget deliberations.

Of course, this solution is not very cheap. Reaching full compliance requires roughly $1.24 billion in 2025, growing to $2.60 billion by 2055. Going from 85% to 100% adds about $186 million from the city per year. Chicago already carries a heavy tax burden, and further increasing taxes could result in multiple harmful results including a population exodus and a decline in businesses. But each dollar not contributed today compounds into roughly $3 to 4 of additional unfunded liability over 30 years, highlighting the need to act now rather than in the future. And the S&P BBB downgrade [4] already reflects the market's assessment that the current trajectory is unsustainable. Furthermore we know solutions of this kind can work: compliance jumped from 15.6% to 90.3% in eight years [1].

5.2 Recommendation 2: Growth Investment Strategy (Behavior Change)

With the Conservative strategy, the likelihood of reaching insolvency is significant: only a 21% probability of reaching 80%, and a median funded ratio of just 59%. For a fund that needs to make up a $15 billion gap, bonds alone simply cannot generate the returns required. By contrast, Growth (60% equity) achieves a 73% median, which is 14 percentage points higher, with no risk of insolvency. That said, a static 60% equity allocation becomes inappropriate as funding improves. A fund at 80% does not need the same level of investment risk as a fund at 25%. That is why in the future, as the fund improves, the city may want to consider reducing the risks of their investments in order to stabilize it for the long term. At 80% with the Conservative allocation, there is greater than 99% probability of staying above 70%, effectively making it guaranteed.

Funded Ratio Tier	**Equity**	**Fixed Income**	**Alternatives**	**Cash**
Below 40% (current)	60%	20%	18%	2%
40–60%	50%	30%	15%	5%
60–80%	40%	40%	12%	8%
Above 80%	30%	50%	10%	10%

Of course, the trade-off here is higher short-term volatility. In the worst 5% of Growth outcomes, the fund ends at just 22% funded, which is actually worse after 30 years. There is no need to further the risk of this by incorporating the aggressive strategy which is below 20% funded in the worst 5% of scenarios for only minimal upside.

5.3 Recommendation 3: Actuarial Analysis of Tier 2 Scenarios (Behavior Change)

What the stress test tells us is that the increase in Tier 2 benefits without funding will almost cut the probability of getting 80% funded in half. That is, the chances of attaining 80% funded decline from 40% to 23% (see Figure 9), while HB 5909 will result in additional $3.3 billion in liabilities through 2055. Based on our stress test, a one-percentage point increase in liability growth rate leads to an additional $12 billion in unfunded liabilities over the horizon up until 2055. The Safe Harbor provision gap will keep growing due to the slower growth in the salary cap for pensionable income compared to social security wage base. The state may have to increase benefits anyway. The core of our recommendations, therefore, is that any change to Tier 2 benefit should come with an offset requirement – that is, the same amount of money must be added to pension fund. The city cannot afford to cover its liabilities as it stands right now; introducing hundreds of millions without an adequate plan will undermine other proposed measures. In order to determine how much the increase in Tier 2 benefit will actually cost, we recommend a study worth at least $200-$500K to determine the cost of three current proposals: the entire HB 5909 plan, the salary cap Safe Harbor solution, and a separate COLA increase. The binding offset requirement is the key recommendation; the study is its implementation mechanism.

5.4 Alternative Recommendation: Evaluate Partial Annuity Buyout for Oldest Retirees (Insurance)

Based on our annuity valuation model, transferring the oldest 25% of retirees to a private insurer would cost around $3.13 billion [9, 11] and would eliminate roughly $300 million in annual benefit payments. This would reduce near-term cash flow pressure and provide payment certainty for the most vulnerable retirees. With the fund discounting at a rate of 6.75%, an annual payment of $300 million over the span of 10 years is worth $2.05 billion today. As such, the $3.13 billion acquisition represents a net certainty premium of $1.08 billion, which is the price tag for passing on the risk of mortality and investment to a private insurer. Nevertheless, this will mean a huge chunk of the fund's capital worth $5.06 billion is used up, and since the markup is 12%, the city ends up paying more money than the funding option [11]. We recommend the MEABF Board commission a formal feasibility study within 12 months. Provided that contribution compliance is maintained at 95% or above, the buyout will be unnecessary. However, should contribution compliance remain at 85% or less for a period of three or more consecutive years, the partial buyout should be a priority rather than an optional risk management tool.

5.5 Summary of Recommendations

Recommendation 1 (Behavior Change, Ensuring Compliance): Standardizing 100% contribution compliance is the action with the greatest impact on the fund. Our models show that this action alone can increase the median funded ratio from 68% to 108% and raise the chance of reaching an 80% funded ratio from 40% to 72%. This action should be implemented within 1 to 2 years through a binding ordinance and dedicated revenue streams. Since this action directly addresses the fund's most significant risk, no other suggestion comes close to its potential impact.

Recommendation 2 (Behavior Change, Type of Investment): Adopting a Growth strategy improves the median by 14 percentage points over the Conservative approach (investing in less volatile asset classes), while avoiding the risk of insolvency. The fund can consider investing in more fixed income options as the funded ratio gets closer to 90%. This solution is relatively easy to implement, as it incurs no additional cost and requires only a vote by the Board of Trustees.

Recommendation 3 (Behavior Change, Planning): We could prevent an increase of over $3.3 billion in liabilities by commissioning an independent actuarial analysis of Tier 2 benefit scenarios to determine the probable changes in liabilities and assets. This recommendation is relatively low cost ($200-500k) and, as a result, has one of the highest ratios of avoided losses to associated cost. The timeline for this recommendation would be around 6 to 12 months.

Alternative Recommendation (Insurance): A partial annuity buyout could be a possible solution given the right situation. If the compliance rate does not grow significantly, transferring some of the oldest retirees' pension obligations to another organization, such as an insurance company, would provide temporary relief. Since this solution is costly and depletes a large portion of assets, it should be pursued only after confirming that cash flow will not take a significant hit.

5.6 Implementation and Accountability

(Figure 13) traces how recovery would unfold over time. Under 85% compliance(the base case), the fund would reach 50% by around 2042 and 80% by 2054, barely meeting the legislative deadline. On the other hand, with 100% compliance, those same milestones and legislative goals are achieved nearly a decade earlier.

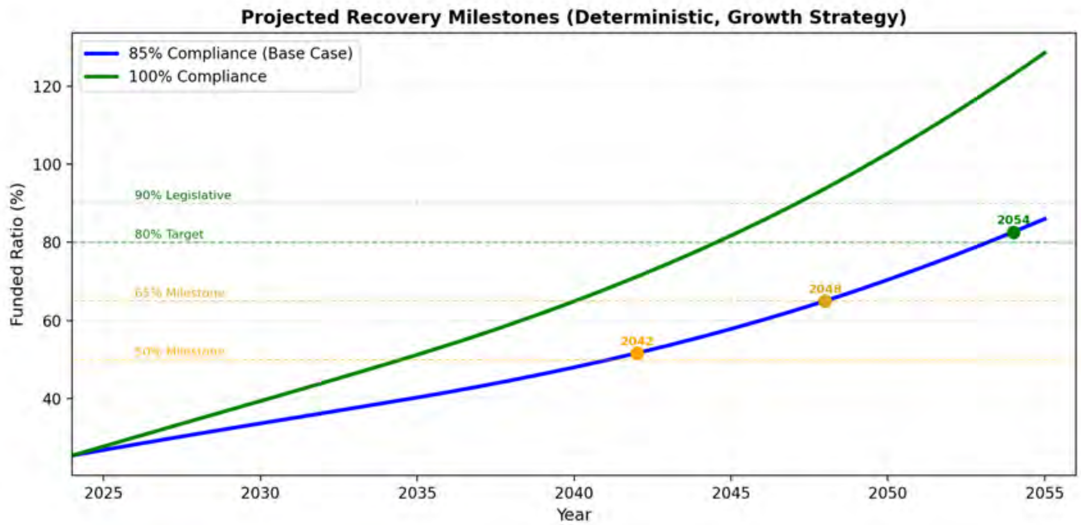

Figure 13: Recovery milestones: Growth strategy at 85% compliance (blue) vs. 100% compliance (green). Full compliance accelerates the 80% milestone by nearly a decade.

We also think there should be formal accountability checkpoints: if the fund has not reached 50% by 2042, an automatic review of contribution levels and strategy should be triggered. Waiting until 2055 is too late for corrective action.

Implementation sequence recommended: Year 1 (2025-2026): Enact binding contribution ordinance and initiate Tier 2 actuarial study. Year 2 (2026-2027): Transition to Growth allocation through Board decision and conduct Tier 2 cost assessment. Year 3 (2027-2028): Assess viability of annuity buyout using first two years' data. This process guarantees that the most significant and least costly measures, compliance and investments redirection, come first, followed by the more capital-intensive measure of annuity, which is only initiated after a proper evaluation of need based on actual data.

6 Conclusion

Four main lessons can be taken away from our models. First, **escaping a bad situation is possible**; but there is no certainty in that: the Growth approach reaches a 73% median funded ratio in 2055 with a 45% probability of reaching 80%. Second, and perhaps even more importantly, **making timely contributions is way more important than the investment choices**; contribution levels can affect the median funded ratio by 79 percentage points versus the mere 17 percentage points contributed by investments. Paying 100% of actuarially required contribution will ensure the median above 90% for any strategy selected. Third, **the fund was unlikely to survive several negative and unpredictable occurrences**; when risks materialize at the same time, insolvency takes place in 99.4% of all simulations under consideration regardless of the strategy applied. And fourth, **aiming at achieving 90% funded status by 2055 under existing conditions sounds extremely difficult**; therefore, intermediate goals should be set (e.g., achieving 50% in 2042 and 80% in 2054) to make sure that implemented strategies perform as expected.

After all, the main challenge that needs to be faced is not related to the asset classes that would be chosen; but, rather, whether or not Chicago City Council will commit itself to making its required annual contributions to the pensions funds over the next 30 years. This decision alone will affect more than 25,000 retirees and almost 39,000 employees.

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