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Municipal Market Focus

US Public Pension Primer

US Fixed Income Strategy
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See page 26 for analyst certification and important disclosures.

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US Public Pension Primer

In this publication, we provide a primer and reference document on US Public Pensions. The publication is partitioned into five sections: 1) Historical context and background, 2) Rise of underfunded pension obligations and missed assumptions, 3) Plan and sponsor distress, catch-up, and legal challenges, 4) Pension reforms and the way forward, and 5) Metrics and salient factors for investors.

Readers familiar with public pensions and their impact on the municipal market may choose to move directly to the final section (5), which focuses on the most salient attributes of public pensions. Those looking for more background or a refresher on legacy challenges facing US public pension systems may choose to view the first four sections.

Section I: Historical context and the beginnings of US public pensions

Creation of US pensions

The idea of lifetime payments and a pension can be traced back to the Roman Empire. American pensions began during the American Revolution, and army pension shortfalls almost caused a mutiny. **Military pensions were commonplace since the creation of the colonies, to provide replacement income for those that were injured in battle, and to provide an incentive for recruitment and retention.**

Retirement plans were created for civilian and public sector employees in the mid-1800's. **New York City created the first US public pension plan in 1857, providing lump sum payments to police officers injured in the line of duty.** Years later, coverage was broadened to include firefighters and lifetime payments were provided for officers at age 55 after 21 years of service. Other states and localities soon followed, with North Dakota, California, Massachusetts, Connecticut, Pennsylvania, and New Jersey all creating pensions for teachers during the 1910's.

The early years and favorable demographics, funding, and returns

Funded ratio is the ratio of the plan's assets to its pension obligations/liabilities. A funding ratio above 100% indicates that the pension liabilities are fully funded through the actuarial life of the plan at the time of the evaluation

After the passage of the Federal Employees Retirement Act in 1920, which established a pension system for Federal employees, pension coverage in the public sector became widespread. **Following the Great Depression, the post-war boom and uninterrupted US economic growth of the mid-1900's boosted many plans, and it was common to see plans with an overfunded status (>100%).**

A snapshot of the broader population in 1970 illustrates favorable public pension demographics at that time. The population pyramid shows large proportions of working age (20-64) (52.7%) and those about to enter the work force (ages 15-19) (9.3%), versus the percentage of the population at retirement age (ages 65+) (9.8%) (Exhibit 1).

These demographics suggest that pension systems at the time had more new and active members than retirees along with a lower average life expectancy (leading to

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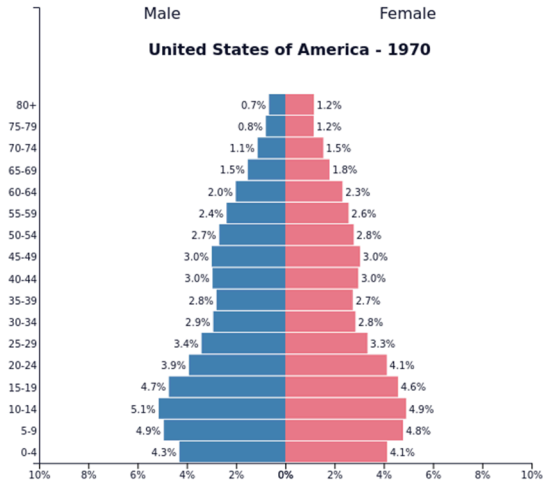
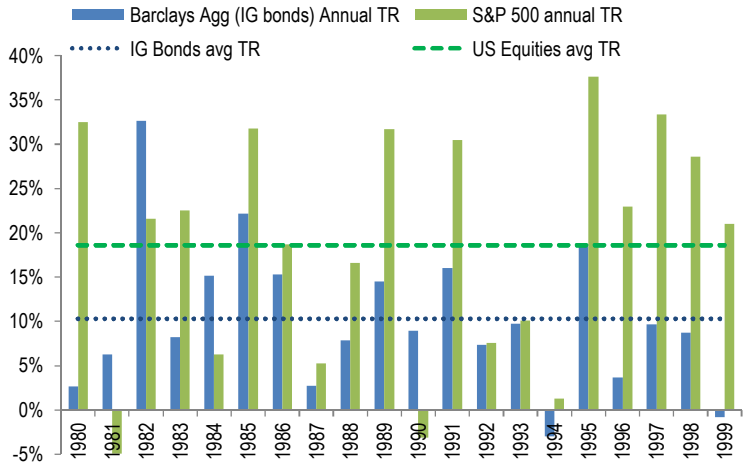
lower payments). Capital market returns also buoyed public pensions with higher yields on Treasury and broader fixed income securities, as well as strong global returns in the equity markets.

Exhibit 1: Pension plans during the mid/late 1900's were aided by a supportive population pyramid, uninterrupted US economic growth, increasing number of new members, and strong returns in fixed income and equity markets

US population pyramid, 1970



Total return, %



Source: PopulationPyramid.Net, Bloomberg, JPMorgan

These robust funding levels, high proportions of active members, manageable benefit payouts, and strong returns led many plans to maintain higher discount/return rates, and provide pension benefits reflective of the high-water mark for pension health. **Projecting these favorable pension attributes going forward, plans also back loaded amortization and contribution schedules, resulting in some of the pension stress we see playing out today.**

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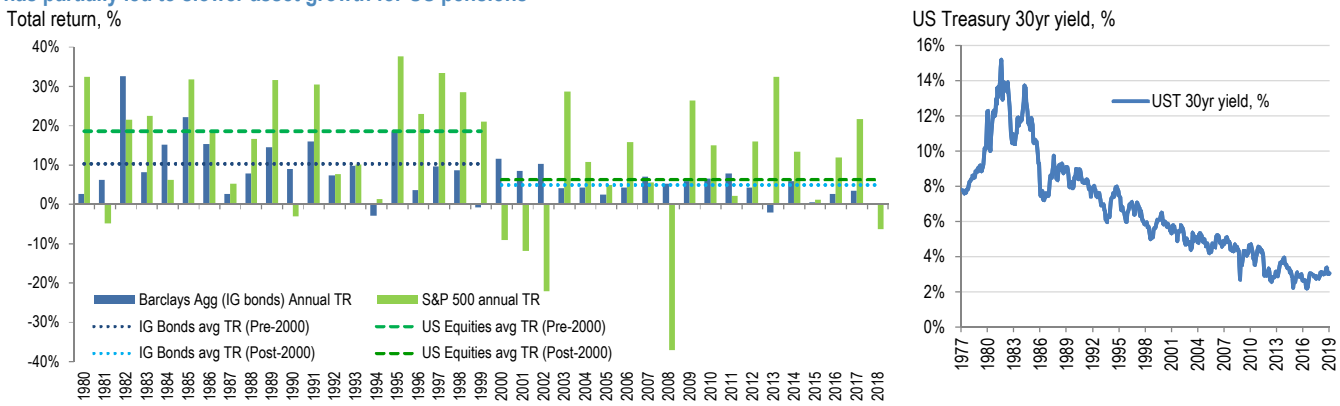
Section II: The 21st century, rise of underfunded pension obligations, and missed assumptions

At the turn of the century, a number of tailwinds quickly turned into headwinds. **The bursting of the dot-com bubble, financial crisis, quantitative easing, and zero interest rate policy by the Fed ultimately led to direct and indirect challenges for many US pensions.**

Lower investment returns and market corrections

The 21st century started with a boom and bust in the equity markets, as the dot-com bubble expanded and burst, in the early 2000's. This was followed by the financial crisis of 2008-2009, which saw the housing market collapse and significant declines in the equity markets. In the years that followed, average returns for the equity and bond markets were lower than prior decades, spurred by a number of factors, including near zero interest rates by Central Banks, quantitative easing, altered consumer behavior, slower economic growth, and other structural and economic shifts (Exhibit 2).

Exhibit 2: Spurred by economic, structural, and monetary policy changes, the US stock and bond markets saw lower returns after 2000, which has partially led to slower asset growth for US pensions



Source: Bloomberg, JPMorgan

Many pension funds now project lower economic growth, bond yields, and total returns. **However, rate of return targets in pension plans have not moved down at the same pace, leading to increasingly riskier asset allocation as plans struggled to meet 7-8% return targets (Exhibit 3).**

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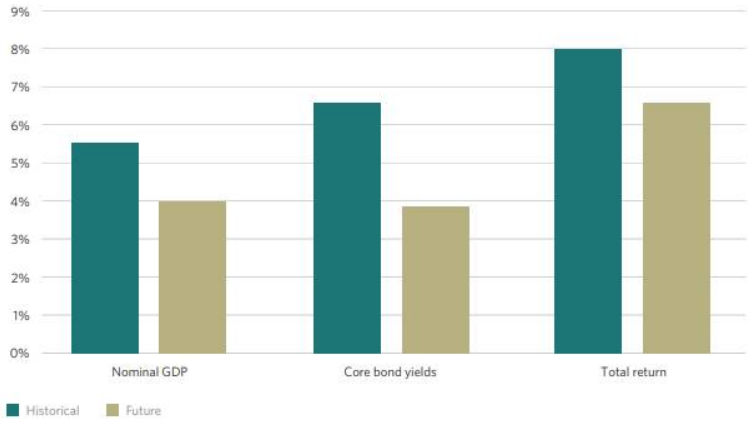
Exhibit 3: Quantitative easing, near zero interest rates by Central Banks, lower wage and spending growth, and overall slower economic growth has led many pension funds and managers to reduce their expected investment returns

Projected nominal GDP growth, bond yields, and total return



Source: Pew Charitable Trusts. Historical GDP based on annualized growth from 1988 to 2007, historical bond yields from January 1988 to December 2007. Total return based on Wilshire Trust Universe Comparison Service 20-year return from July 1995 to June 2015

Decreased assumed rates of return

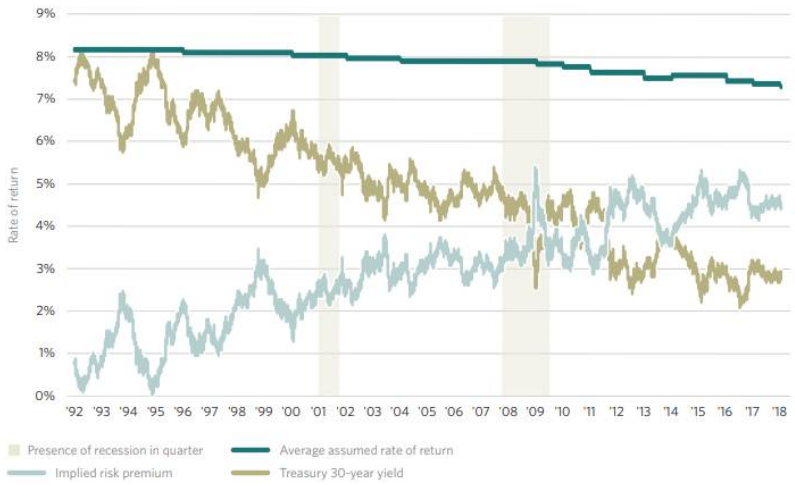
Discount rate refers to the level at which future pension obligations are discounted to their present value. For a vast majority of plans, this is also the targeted "rate of return" for the plan assets to match the liability growth. Generally speaking, the higher the discount rate, the lower the annual required contribution (ARC)

Prolonged lower investment returns also meant that many plans were consistently falling short of their discount rate / assumed rate of return. Plans soon began to lower their discount rates, which on average, remained in the ~8%'s throughout the 2000's, but have recently shifted to ~7.25% (Exhibit 4)

While the lower discount rate is a positive as it more realistically projects the growth of assets and accurate ARC payments, it also creates a one-time increase in pension obligations to reflect the lower expected future rate of return. Higher pension obligations also mean higher annual contributions, at a time when many plans could not keep pace with the increases.

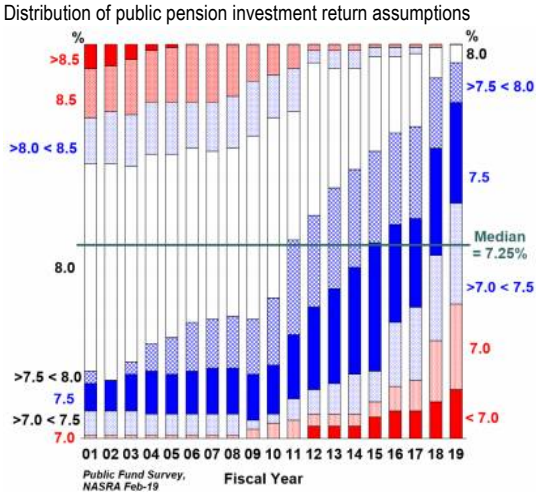
Exhibit 4: As investment returns remained low, many plans began to reduce their discount rate/assumed rate of return, falling from a median of ~8% throughout the 2000's to ~7.25% as of 2018

Rate of return, %



Source: Pew Charitable Trusts

Distribution of public pension investment return assumptions



Source: National Association of State Retirement Administrators

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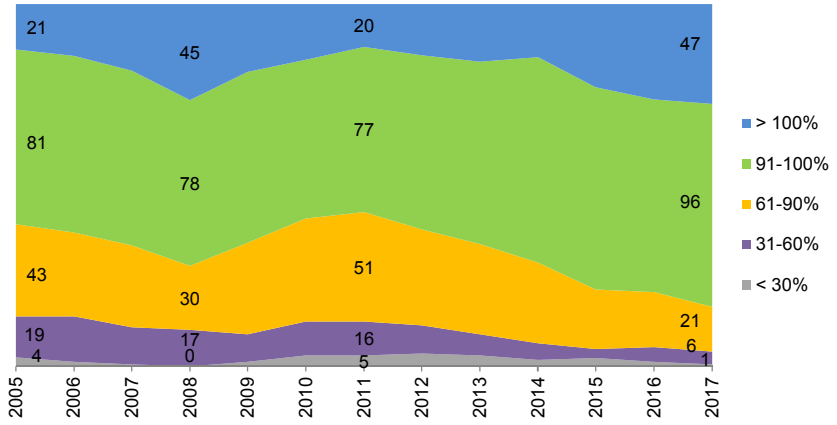
Underfunding from municipal sponsors

In 2009-2011, at the same time as many plans required higher contributions from members and municipal sponsors, municipalities were grappling with revenue shortfalls and growing expenditures. **The financial crisis, lower economic growth, and higher service needs over the period further strained the availability of capital to fund basic services while making full ARC payments. In some cases, pension funding took a backseat to basic services provided by the municipality (Exhibit 5).** The problem was further compounded as governments boosted funding in some areas (such as education, public safety, social services) that have observable benefits, instead of 'soft' pension liabilities, increasing the pension burden for future generations.

Annual required contribution ("ARC"), is the amount needed to be contributed by employers to adequately fund a public pension plan to 100% (or otherwise defined by the plan) in accordance to the amortization period (open, 30yrs, closed). This amount is mathematically calculated by actuaries on a 1-2 year basis based on a confluence of factors, including contribution amounts, returns, expected benefits paid, mortality tables, cost of living adjustments, and so forth.

Annual required contribution (ARC) payments are forecast to fully fund the pension plan by the end of the amortization period, assuming the plan meets the other assumptions such as rate of return, active/retiree ratio changes, etc. If contributions are not made, subsequent payments are likely to be higher, and the unfunded pension liability begins to accrue at a faster rate.

Exhibit 5: After the financial crisis, many pension plans made reductions in pension funding, and did not contribute 100% (or close to) of required contributions
Number of plans that have the representative employer contribution percentage of ARC



Source: Public Plan Data, individual pension CAFR's, JPMorgan

Demographics shift

From 1900 through 2014, average life expectancy has risen from age 47 to 79. The sizable increase in life expectancy is the result of advances in medicine, technology, and quality of life through the 20th and 21st century. As previously stated, with many public pension plans established in the early 1900's, when life expectancy was hovering around 50-60, pension plans underestimated the pension payment period for retirees.

At the same time as plans faced higher benefit payments than actuaries previously projected based on updated mortality tables, there was an unfavorable shift in US demographics (Exhibit 6). The shrinking base of workers entering the workforce (specifically public sector) placed an increasing burden on municipal sponsors which were called upon the shoulder a greater proportion of the pension liabilities. In fact, according to our estimates, the US public sector active to annuitants ratio will fall below 1.0x around 2027 or so (Exhibit 7).

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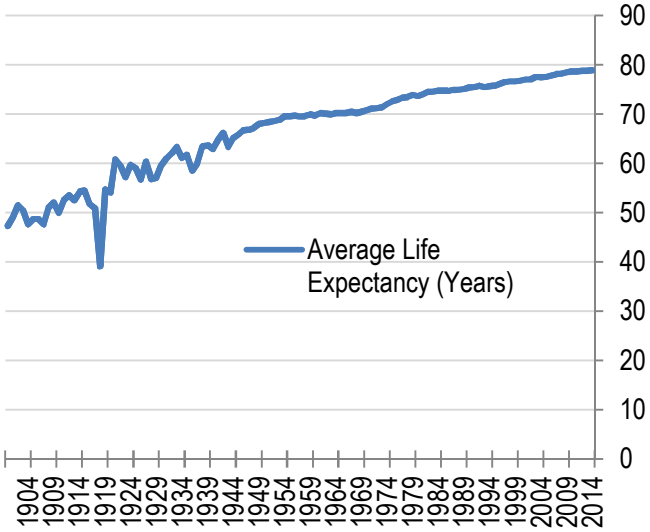
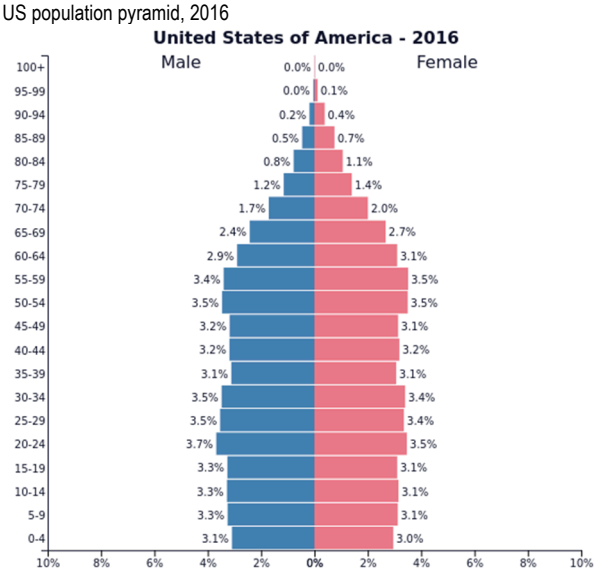
Exhibit 6: Life expectancy increased significantly during the 20th and 21st centuries, at the same time as the US begins to see a shrinking base of younger workers, placing further pressures on pensions

Average life expectancy, years



Source: US Department of Health and Human Services, JPMorgan

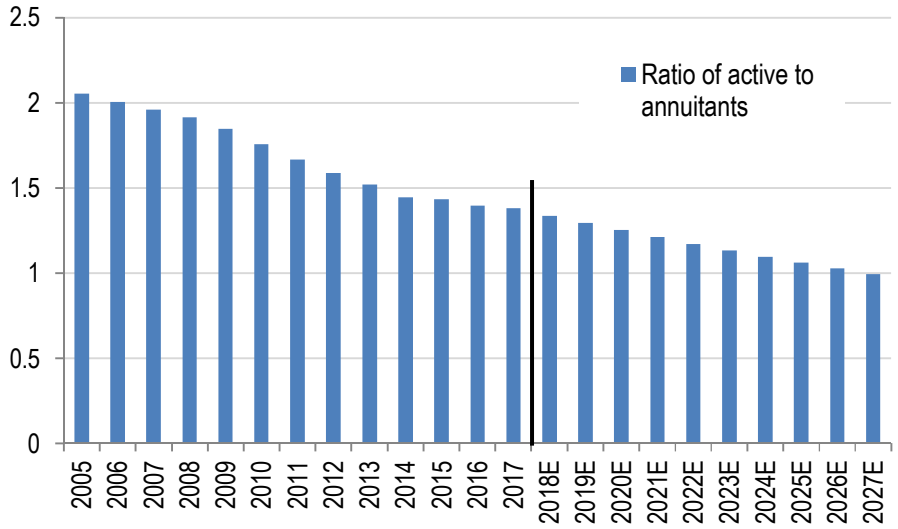
US population pyramid, 2016



Source: PopulationPyramid.Net

Exhibit 7: The aggregate average ratio of active to annuitants continued to decline, reaching 1.38x in 2017. We estimate the ratio will fall below 1.0x around year 2027

Ratio of active to annuitant members, x



Source: Public Plan Data, individual pension CAFR's, JPMorgan

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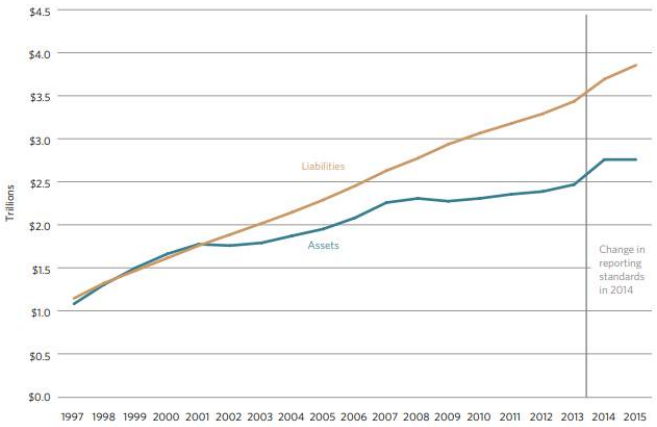
Section III: Signs of distress, playing catch-up, and legal challenges

As a result of the numerous challenges weighing on pension systems discussed in section II and other factors, pension assets and liabilities began to diverge, and funding ratios dropped entering the 21st century (Exhibit 8). The average of state funded ratios fell 17ppts from 102% to 85% in the four years including the 2001 recession. **At the start of the great recession in 2007, the average funded ratio fell by 14ppts, from 86% to 72% by the close of 2012. Required contributions, however, continued to rise, as a result of the broad decline in funding ratios and municipalities underfunding their ARC.**

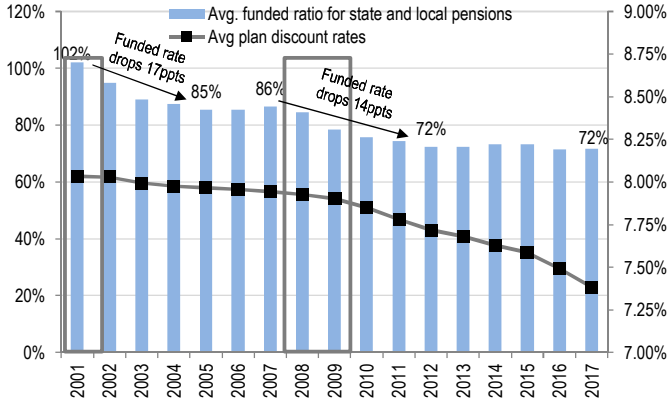
Exhibit 8: As a result of the numerous challenges weighing on pension systems discussed previously, plan liabilities and assets began to diverge in the early 2000's, with aggregate average funded status ~72% since 2012

Aggregate actuarial pension assets and liabilities, $tn's



Source: Pew Charitable Trusts

Avg funded ratio for state and local pensions, % Avg plan discount rates, %



Source: Public Plan Data, JPMorgan

Other Post-Employment Benefits ("OPEB") are the benefits other than pensions that a municipal employee receives as part of his/her retirement benefits. This can include life insurance, healthcare, and deferred-compensation arrangements

However, as pension, debt service, and other post-employment benefits ("OPEB") began to grow for many municipalities across the US, these costs ("fixed costs") began to make up a larger proportion of budgets and revenues. **By our calculations, fixed costs make up as high as 30% of own-source revenues for some states, with pensions continuing to be the main driver of expense growth in recent years** (Exhibit 9).

Furthermore, in the last decade, the rating agencies began to downgrade states, counties, and cities across the US due to high and rising pension obligations (among other reasons). **In some instances, the underlying fundamentals of the municipality were robust, but its credit ratings were nevertheless cut due to spiraling pension costs.**

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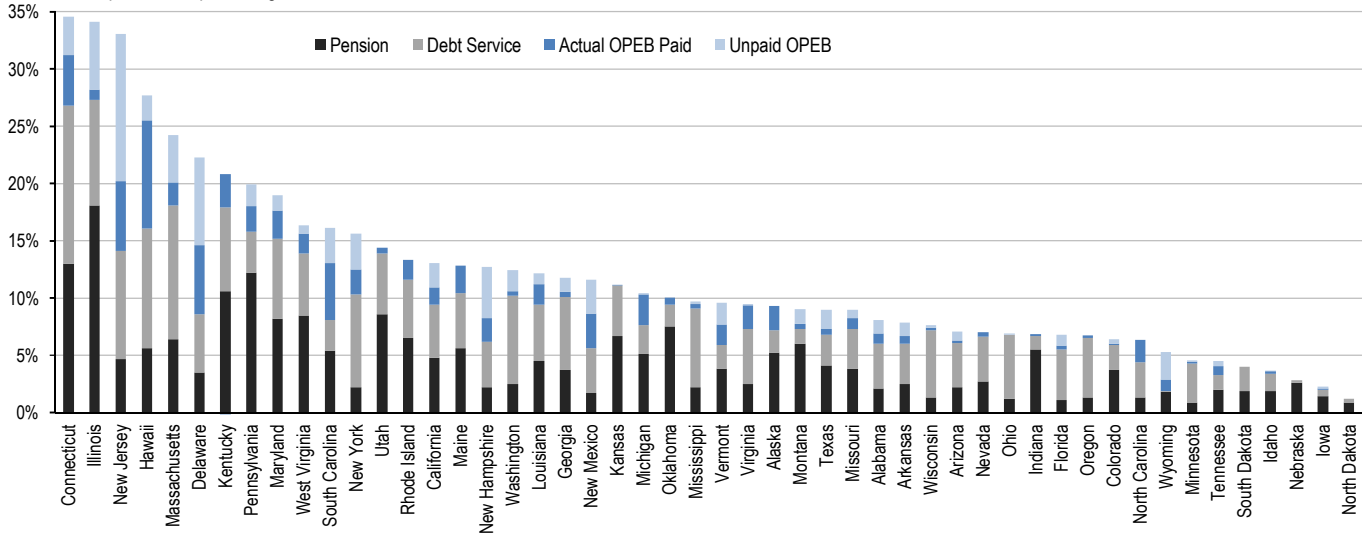
Exhibit 9: Fixed cost burdens for states continue to rise, outpacing the growth of tax revenue for many states. Fixed costs as a percentage of own-source (tax) revenue are estimated to be as high as 30% for some states, with pensions continuing to be the main driver of expense growth

Fixed cost expense as a percentage of own-source revenue, %, 2017



Source: 50 State CAFR's, Moody's, JPMorgan

In response to escalating pension costs, municipalities and pension plans began implementing a combination of:

1) Increasing taxes, fees, and acquisition of public assets,

2) Shifting asset allocation and other plan changes, as well as

3) Implementing structural and benefit reforms

As we discuss below, there are pros and cons to all three approaches, with pensions encountering unforeseen issues in all three paths

Higher taxes and contributions

Municipalities began to raise taxes and new revenue streams to explicitly tackle the growing pension deficit. This effort was more apparent in plans that faced the lowest funded ratios and long running ARC deficiencies.

To highlight some notable and recent examples:

New Jersey dedicates lottery revenues to fund pensions, New Jersey's FY19 budget enacting ridesharing services, short term rentals, e-cigs, and tobacco tax to continue its pension contribution ramp up, City of Chicago implementing 911 surcharge and water and sewer utility tax to make mandated pension payments, California cities seek tax increases for higher pension costs, City of Houston issuing $1bn of Pension Obligation Bonds to bolster pension funds, and Kentucky looking to legalize sports wagering to pay pensions, among others.

However, many municipalities hit roadblocks such as tax fatigue, legal caps on tax increases, weakening demographics/economic shifts, and timing of pension obligation bonds.

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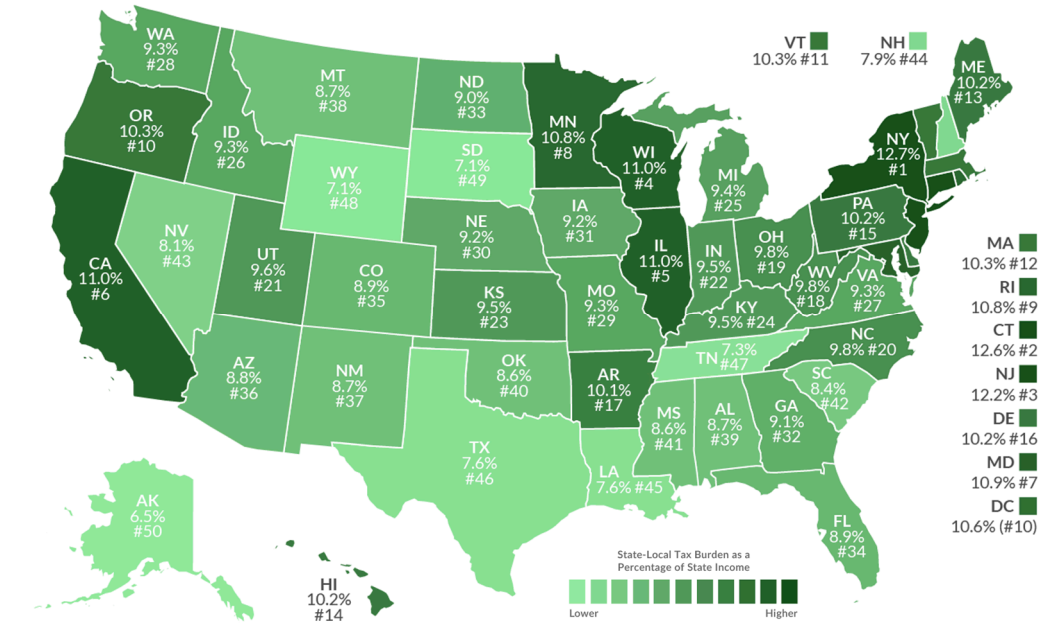
Tax Fatigue:

Many "high tax" states in the Northeast and West regions face populous and political resistance to higher taxes. In New Jersey, Democratic Governor Phil Murphy faces stiff resistance from Democratic Legislative leaders for his proposed millionaire's tax, which almost led to a state shutdown in 2018. Residents in a number of states face high tax burdens, effectively setting a limit on tax increases (Exhibit 10).

Exhibit 10: Many states have increased taxes to continue to fund rising expenditures and pension expenses,but residents in a number of states face high local and state tax burdens,effectively setting a limit on tax increases
State and local tax burdens as a percentage of state income, FY2012



Source: Tax Foundation

Legal caps on tax increases:

In other cases, municipalities are bound by local and state laws, which cap the amount of property tax increases (Article XIII A in the California Constitution, proposed in Texas), which many local cities, counties, and school districts rely on to fund budgetary needs, including pension costs. In other instances, constitutional provisions limit a State's ability to effectively structure tax increases to adequately fund pension liabilities. Illinois has a constitutional flat rate income tax structure, which some have criticized for being an obstacle in raising revenue to combat growing expenditures and pension costs.

Decline of economic area and demographics:

Some cities and counties began to see population loss and property value declines after anchor industries (such as manufacturing, finance) or large employers moved/relocated, which in some cases were further compounded by the financial crisis. While some regions have begun to rebound, others still grapple with a shrinking tax base, lower revenues, and increasing expenditures. For some of these

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municipalities, keeping up with pension and OPEB payments was not feasible, given the economic realities of the region.

Issuance of pension obligation bonds:

Pension Obligation Bonds are bonds issued by a municipality to pay its pension or OPEB liabilities. At its creation, many issuers deemed it an arbitrage opportunity as it allowed immediate investment of funds and pay down of pension liabilities, while locking in a *generally* lower bond yield

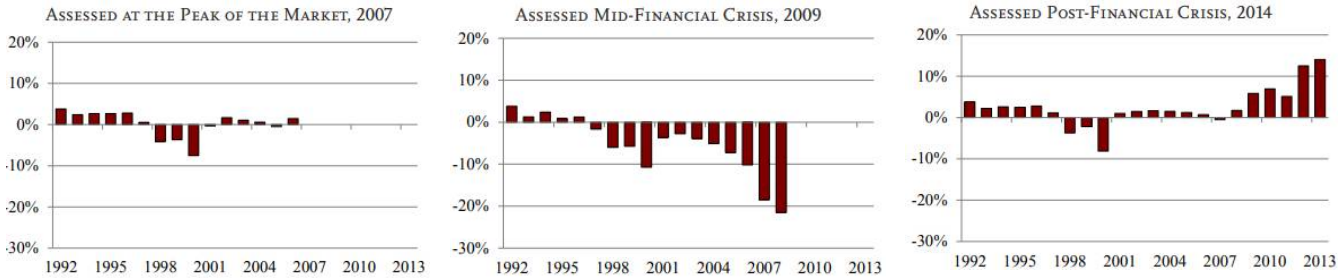
Many governments have issued pension obligation bonds ("POBs") to generate upfront funds to quickly invest/pay down pension liabilities, while paying back bonds at a generally lower rate. However, POB's remain controversial, as the conversion of a 'soft' pension liability to a 'hard/permanent' liability magnifies investment risk, and recent research suggests that market timing is a key factor in the success of POBs.

Entities that issued POBs at or just before market's peak have historically experienced subpar performance (Exhibit 11). As such, the prospect of POB issuance in the current environment has been met with some skepticism as global growth turns sluggish and given the maturity of the 10yr bull market in US equities. It's for these reasons that the **Government Finance Officers Association do not currently recommend POB's.**

Nevertheless, issuers continue to consider POBs as one of many tools at their disposal, with the City of Houston issuing $1bn of POB's as part of its broader pension reform plan in 2017, Illinois Governor proposing issuance of $2bn of POB's as part of his FY2020 budget, and former Chicago Mayor proposing issuance of $10bn of POB's.

Exhibit 11: Issuance of pension obligation bonds may be risky, with recent research suggesting that market timing is key, as POBs issued at or just right before market's peak have historically underperformed

Internal rate of return on POB's, by year issued



Source: Center for Retirement Research at Boston College "An update on pension obligation bonds". http://crr.bc.edu/wp-content/uploads/2014/07/slp_40.pdf

Transfer and sale of assets to fund pension liabilities:

Some municipalities have also explored selling or transferring assets to the pension funds to boost asset values and funded ratios. Assets allocated to pensions can be physical as well as specific revenue streams.

In 2010, the City of Pittsburgh attempted to sell its parking authority to replenish its pension fund, in an effort to avert a State takeover of its pension plan. The City of Chicago in 2013 contemplated privatizing Chicago Midway Airport to pay off liabilities and reduce the City's pension liability, and most recently, Illinois and New Jersey Governors have proposed in their latest FY2020 budgets and RFP's to explore the sale and transfer of state assets to fund pensions.

Examples of past completed privatizations include: The City of Allentown, which entered into a concession with Lehigh County Authority to operate its

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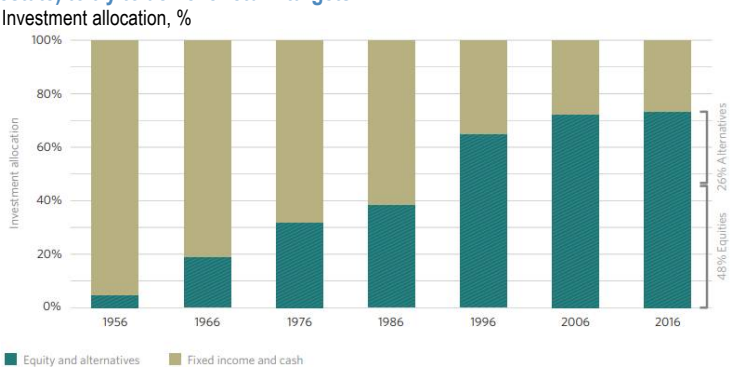
water/wastewater system to convert its sizable pension liability to long term LCA debt that will be repaid by water revenue. As well as The City of Alton, IL's sale of its regional wastewater system to Illinois American Water for $53.8mn, which will help the city fund its pension assets, as the pensions are on the verge of PAYGO funding status.

Some market participants are skeptical of transfers, as valuation of assets can prove to be complex and non-practical, and may lead to further underfunding of pension systems in the long run while short term contribution requirements are decreased. **That being said, in many cases, municipalities can create value from underutilized assets and generate dedicated revenue streams for pensions to further pay down liabilities and boost funded ratios.**

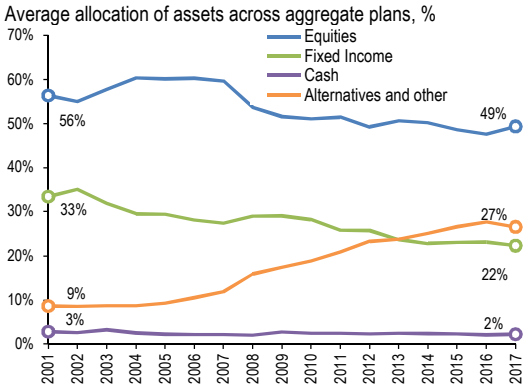
Asset allocation and other plan changes

As previously mentioned in Section II, many funds aggressively changed asset allocation mix within their pension funds as a means of combating lower investment returns, declining contributions, and increasing numbers of retirees. Plans began to shift their asset allocation, in an effort to boost investment returns, asset values, and diversify portfolios. As fixed income yields have fallen over the past few decades, plans have increasingly turned to alternative investments (hedge funds, private equity, infrastructure, real estate) to try to achieve return targets (Exhibit 12).

Exhibit 12: Over the past decade, plans have increasingly turned to alternative investments (hedge funds, private equity, infrastructure, real estate) to try to achieve return targets



Source: Pew Charitable Trusts, US Board of Governors of the Federal Reserve System, Financial Accounts of the United States



Source: Public Plan Data, individual pension CAFR's, JPMorgan

However, moving away from traditional investments and into products such as real estate carry a significant risk premium. In the two years including the 2001 recession, the five high volatility asset classes (equities, real estate, private equity, hedge funds, commodities, and Alternative Investments) returned an average of -3.3%, while fixed income and cash returned +6.6%. Similarly, in two years inclusive of the 2008-09 recession, the high risk asset classes returned -7.5% versus a +3.1% for the more conservative allocation described above (Exhibit 13).

That is not to say that pension funds can simply invest in fixed income and cash. **Over longer term horizons, allocation to equities have outperformed fixed-income.** In fact, since 1980, the S&P 500 Index has outperformed the Bloomberg Barclays Aggregate bond index in 28 of the 39 years, with an average annual total return of 12.6% compared to 7.7% of the Bloomberg Barclays Aggregate bond index.

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Exhibit 13: Risky assets lag significantly in recessionary periods but have outperformed over longer periods of time

Number of plans that have the representative employer contribution percentage of ARC

	Equities	Fixed Income	Real Estate	Private Equity	Hedge Funds	Commodities	Alt Misc	Cash
2001	-13.6%	9.7%	12.4%	-10.2%	0.7%	4.3%	-11.4%	5.8%
2002	-14.6%	7.8%	6.7%	-11.7%	2.2%	4.5%	-8.7%	3.2%
2003	6.3%	11.7%	8.5%	-3.5%	11.2%	11.8%	1.7%	2.0%
2004	22.2%	3.4%	14.7%	17.0%	9.1%	12.0%	11.3%	2.0%
2005	10.7%	7.0%	21.6%	21.5%	5.3%	11.8%	17.1%	2.9%
2006	15.8%	1.5%	20.8%	23.1%	8.9%	10.1%	24.4%	4.8%
2007	19.7%	6.9%	17.2%	22.8%	10.3%	13.6%	18.9%	6.1%
2008	-16.9%	4.4%	1.0%	7.0%	-3.9%	20.2%	7.0%	3.7%
2009	-14.4%	4.9%	-26.8%	-17.4%	-8.6%	-17.2%	-19.9%	-0.7%
2010	16.0%	13.1%	-1.9%	17.2%	13.6%	7.3%	12.2%	1.4%
2011	21.4%	7.1%	17.5%	19.2%	9.3%	13.6%	16.2%	0.9%
2012	2.3%	8.2%	10.0%	8.5%	1.5%	-0.4%	10.9%	0.9%
2013	20.9%	1.1%	11.4%	12.6%	9.7%	1.0%	10.1%	0.3%
2014	19.1%	6.0%	13.4%	19.4%	10.7%	9.7%	17.5%	0.6%
2015	1.8%	1.1%	12.2%	9.7%	1.9%	-4.6%	7.4%	0.4%
2016	0.0%	5.3%	11.8%	5.7%	-0.8%	0.6%	4.8%	1.0%
2017	20.5%	3.6%	8.2%	14.2%	6.6%	7.0%	14.2%	1.7%
Annual Average (2001-2017)	6.9%	6.0%	9.3%	9.1%	5.2%	6.2%	7.9%	2.2%
Standard deviation	14.4%	3.5%	11.2%	12.7%	6.1%	8.7%	11.7%	2.0%

Source: Public Plan Data, individual pension CAFR's, JPMorgan

While the returns suggest that a diversified strategy including both risky and low volatility asset classes is optimal, there is added risk to weaker funded pensions with outsized allocation to risky assets. Lower funded plans are significantly handicapped going forward as pressure builds to make up the shortfall in pension funding against lower revenues, increasing expenses, and weak investment returns (Exhibit 14).

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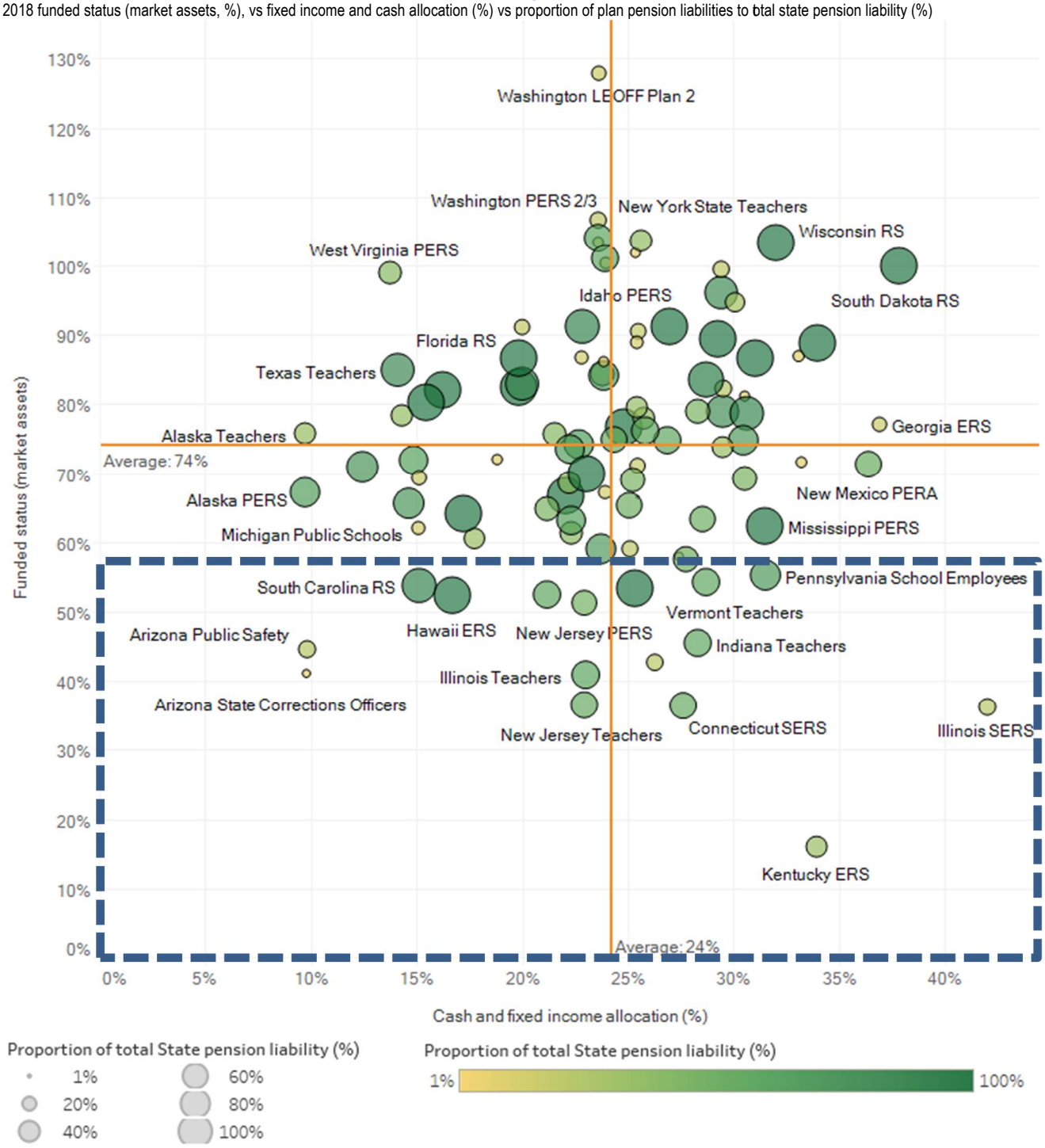
Exhibit 14: Funds with the combination of low funded status and lesser allocations to fixed-income and cash investments, are particularly exposed to recessionary risk. More broadly, we believe that credits with exposure to sizable plans that land in the lower quadrant of funded status and low vol assets could be more susceptible to spread widening in the next recession

2018 funded status (market assets, %), vs fixed income and cash allocation (%) vs proportion of plan pension liabilities to total state pension liability (%)



Source: Public Plan Data, individual pension CAFR's, JPMorgan. Note: Includes state level plans from the Public Plan Database. Alaska PERS, Alaska Teachers, Michigan SERS, and West Virginia Teachers plans are closed.

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Structural and benefit reforms

Another approach to mitigate growing pension liabilities has been to reform pension benefits, as reforms generally reduce employers' pension costs. **According to the National Association of State Retirement Administrators, since 2009, nearly every state has passed meaningful reform to one or more of its pension plans** (Exhibit 15).

Changes to pension benefits can significantly reduce long-term liabilities and improve plan financial/funded status over time. However, the benefits of such changes are often realized over a long horizon as it is very difficult (if not impossible) to change benefits for retirees and current members. As such, many pension reforms are heavily focused on changes to new employees and entrants, but such reforms often have a delayed and/or smaller impact on reducing the total liability and actuarial results.

Major categories of pension reform include:

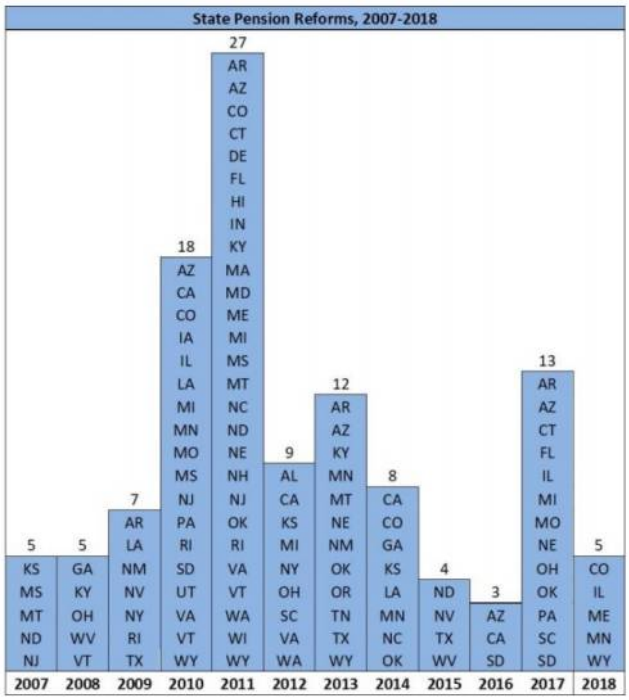
1) Changes to plan assumptions (amortization schedule, open/closed type plan, discount rates),

2) Modification of benefits to new members, current members, and retirees, including cost of living adjustments ("COLA"),

3) Increasing the retirement age, employee contribution percentage, or

4) Switching to 401k type defined contribution or cash balance plans, among others

Exhibit 15: Nearly every state has implemented pension reforms, and some of these changes have significantly reduced long term liabilities and improved plan funded status. However, such benefits are generally realized over longer periods of time
Number of states and year of pension reform implementation, 2007-2018



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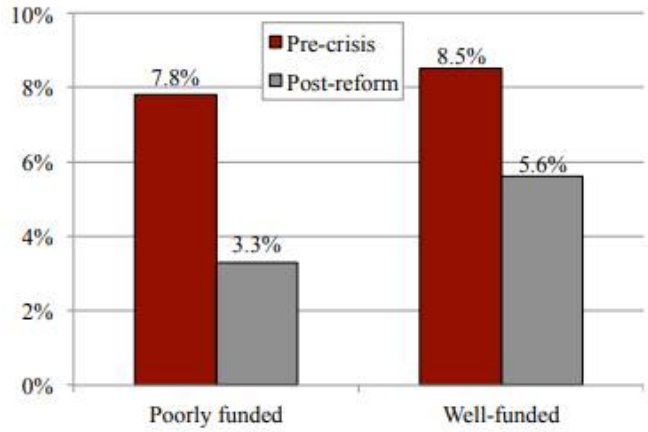
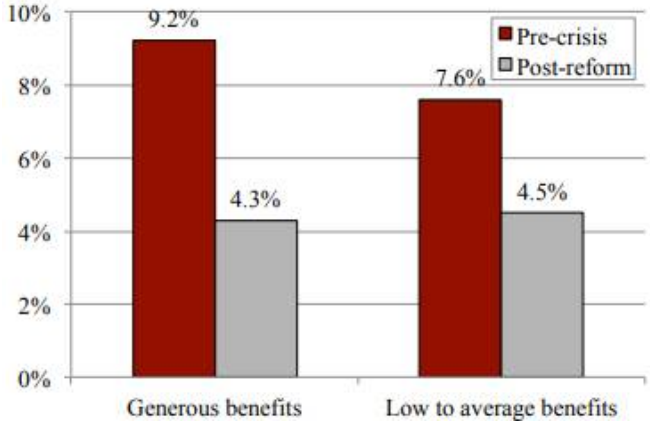
Employer normal cost as a percentage of payroll, %, by funded status



Employer normal cost as a percentage of payroll, %, by plan generosity



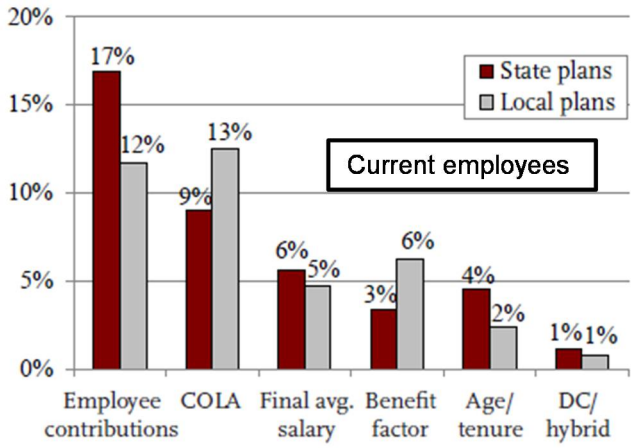
Source: National Association of State Retirement Administrators, Center for Retirement Research at Boston College. https://www.nasra.org//Files/Spotlight/Significant%20Reforms.pdf, https://crr.bc.edu/wp-content/uploads/2013/03/slp_30.pdf

A brief from the Center for Retirement Research found that higher employee contributions and COLA adjustments were the most common pension reforms effective for current employees, while an increase in retirement age, and calculations used for retirement payments were the most common changes for new employees. Nearly all states implemented some level of these reforms (Exhibit 16).

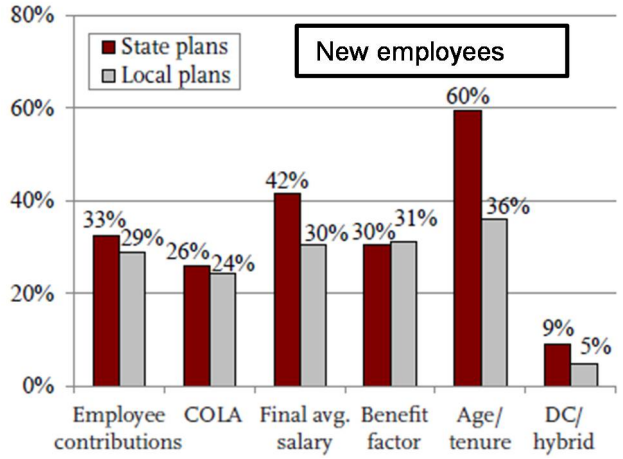
Another study found that a **state's appetite for pension reform was "largely in line with the size of the fiscal issues the state faced", with plans of lower funded statuses enacting reforms that were more substantial than plans that were better-funded.**

Exhibit 16: The Center for Retirement Research has found that higher employee contributions and COLA adjustments were the most common for current employees, while an increase in retirement age, and calculations used forretirement payments were the most common changes for new employees

Percentage of plans making benefit changes to current employees, by type of reform, 2009-2014



Percentage of plans making benefit changes to new employees, by type of reform, 2009-2014



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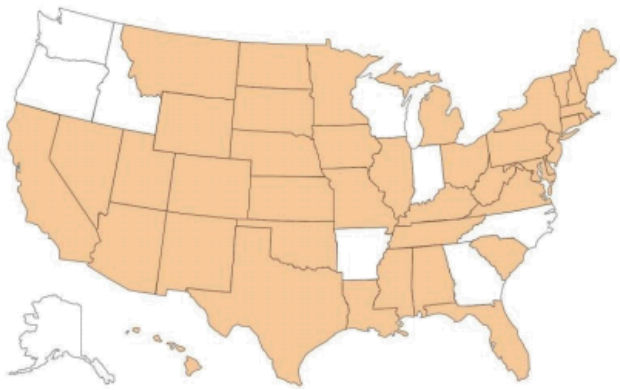
States that have increased employee contribution rates, 2009-2018

Figure 1. States that have increased employee contribution rates, 2009-2018

States that have reduced pension benefits, 2009-2018

Figure 2. States that Reduced Pension Benefits, 2009-2018



Source: National Association of State Retirement Administrators, Center for Retirement Research at Boston College

Hurdles and legal challenges to pension reform

The ability of a state to reform pensions is to a large degree a function of the level of protections afforded pensioners within a respective state. Some municipalities have experienced legal difficulty when restructuring pension benefits, particularly for current employees. This has often been the case in **states where pension benefits are protected by the state constitution.**

Benefit changes in states such as Illinois and California have been challenged, and ultimately struck down by the courts. In these instances, not only were the challenged enacted reforms rolled back, but the states and municipalities therein also faced a difficult negotiating position in attempting to implement future reforms.

While states have differing legal pension protections, as well as past and future benefit protections, the prospect of a long and arduous legal battle and rollback of benefits gives many employers pause before cutting benefits without prior negotiations with collective bargaining and labor unions (Exhibit 17).

Exhibit 17: Legal basis for protection of public pension benefits vary significantly across states, with state constitutional protection for past and future benefits providing the strongest protection for retirees, while Gratuity or having no expressed benefit protectionproviding the weakest protection for retirees

State's legal ability to enact pension reform increase given lessor legal protections

Legal basis	Benefit accruals protected			
	Past and future	Past and maybe future	Past only	None
State constitution	AK, IL, NY	AZ	HI, LA, MI	
Contract	CA, GA, KS, MA, NE, NH, NV, OR, PA, TN, VT, WA, WV	CO, ID, MD, MS, NJ, RI, SC	AL, AR, DE, FL, IA, KY, MO, MT, NC, ND, OK, SD, UT, VA	
Property	ME, WY	CT, NM	WI, OH	
Promissory estoppel[a]	MN			
Gratuity				IN, TX[b]

State's flexiblity to enact pension reform increases as breath of pension protections decline

Source: Center for Retirement Research at Boston College - State and Local Pension Reform Since the Financial Crisis (Jan 2017) http://crr.bc.edu/wp-content/uploads/2016/12/slp_54.pdf. Note: A) Promissory estoppel is the protection of a promise even where no contract has been explicitly stated. B) In Texas, this gratuity approach applies only to state-administered plans. Accruals in many locally-administered plans are protected under the Texas constitution.

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In most states, pension benefits are protected under the 'contracts clause', where the government and employee enter into a 'contract' at the start of employment. **Further, certain states** such as Illinois, New York, Alaska, and Arizona **have state constitutional protection for benefits – these are seen as the strongest warranty for retires.**

A step below this, some states have taken a 'property rights' interpretation for pension benefits, where benefits are seen as employee 'property'. According to the Center for Retirement Research, states generally have seen greater success for benefit reductions when pensions are protected as property rights, as the courts have found the amendments to be "an adjustment to the benefits and burdens of economic life" rather than "taking of private property without just compensation".

Lastly, a few states have adopted promissory estoppel or gratuity approaches. Promissory estoppel is "the protection of a promise even when no contract has been explicitly stated", and gratuity approach is one where pension benefits can be changed at any time by the state. **The gratuity approach is the weakest protection afforded to retirees and pensioners.** It is also important to note that for Indiana, this only applies to compulsory or mandatory plans, and in Texas, only to state-administered plans.

Due to these legal challenges and hurdles to reforming current employee benefits, reforms often become limited to new employees and less immediate benefit changes such as cost of living adjustments, which often result in lower savings than projected. Some states have made changes to current employees' core benefits, but after much litigation and negotiations with participants and collective labor units (Exhibit 18).

Exhibit 18: Some pension plans have made changes to current employees' core benefits, but after much litigation and negotiation with participants and collective labor units

Strength of protection Plan name	Explanation
Constitutional	
Detroit Police and Fire Retirement System[a]	Agreement reached after negotiations.
Detroit General Retirement System[a]	City bankruptcy prompted vote by plan participants.
Fort Worth Employees' Retirement Fund[a,c]	Reforms apply to future service, ongoing litigation.
Contract: Past and future accruals	
Vermont Teachers' Retirement System	Agreement reached after negotiations.
Contract: Past and maybe future accruals	
Baltimore Fire and Police Employees' Retirement System	Passed after litigation.
Rhode Island Employees' Retirement System[a]	Reached settlement after litigation.[b]
Rhode Island Municipal Employees' Retirement System[a]	Reached settlement after litigation.[b]
Contract: Past accruals only	
Arkansas Teacher Retirement System[a]	Reforms apply to future service.
Lexington Policemen's and Firefighters' Retirement Fund[a]	Accruals before retirement are not protected.
Miami Firefighters' and Police Officers' Retirement Trust	Non-vested employees are not protected.
Newport News Employees' Retirement Fund	Reforms apply to future service.
North Dakota Teachers' Retirement Fund[c,a]	No legal action.
Pensacola General Pension and Retirement Fund[a]	Reforms apply to future service.
South Dakota Retirement System	Reforms apply to future service.
Virginia Retirement System[d]	Accruals before retirement are not protected.
Property-based approach: Past accruals only	
Cincinnati Retirement System[a]	Reached settlement after litigation.
Milwaukee County Employees' Retirement System	Reforms apply to future service.
Ohio Public Employees Retirement System[a]	Accruals before retirement are not protected.

Source: Center for Retirement Research at Boston College

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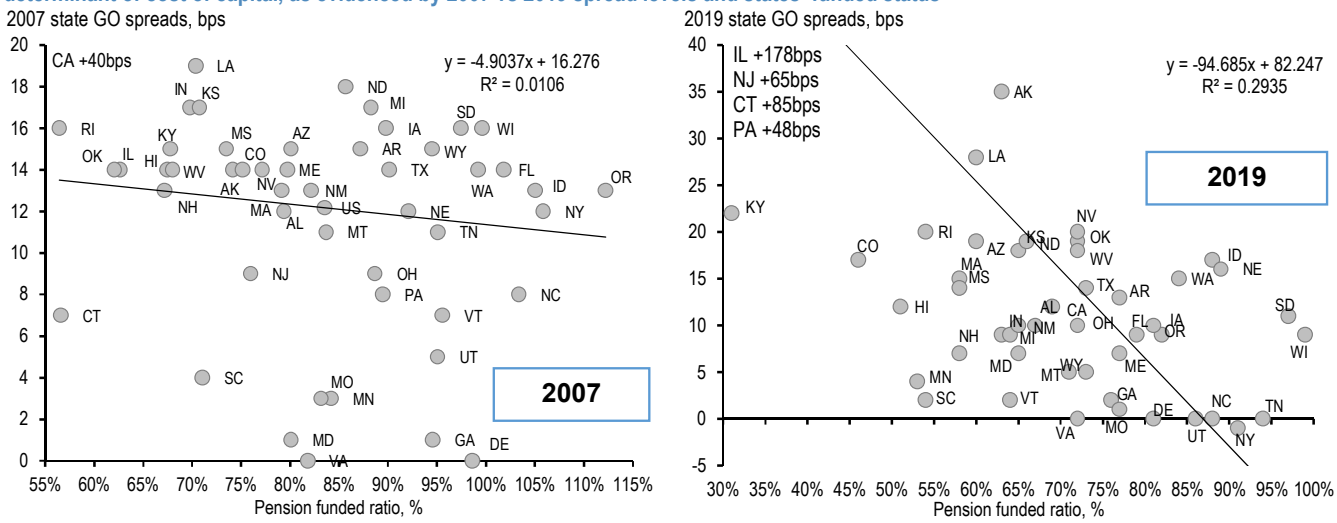
Section IV: Pension reforms and the way forward

Fortunately, many pensions appear to be turning the corner and on a sustainable path to fiscal and plan stability. Pension administrators and municipal sponsors across the country are keenly aware of the issues they face, as **investors and market have more carefully scrutinized pension risk and factored said risk into their analysis and decision making. This is evident to an increasing degree in state borrowing costs as reflected in credit spreads.** One of the primary considerations in establishing the cost to borrow in the debt markets is an entity's pension health, particularly when pension liabilities are threatening a government's ability to provide basic services (Exhibit 19).

Exhibit 19: Over the last decade, it is increasingly apparent that pension funding has become an important credit consideration and determinant of cost of capital, as evidenced by 2007 vs 2019 spread levels and states' funded status



Source: Pew, Thomson TM3, JPMorgan

While it's hard to generalize the "best" methods across the thousands of pension plans in the US, below are some of the effective practices and reoccurring themes we've observed over the years and through a number of plans:

Alternative plan structures: Closed, Defined Contribution, and hybrids

Defined benefit plans are primarily funded by the employer, with payouts based on salary, years of service, and/or other factors. Most US public pensions are defined benefit plans.

Defined contribution plans are "401k" style plans primarily funded by the employee.

An increasing number of pension plans are moving to defined contribution (401k style) constructs, as these shift the investment and funding risk to employees. Over time, this would reduce employer and municipal pension costs, as well as unfunded liabilities. Some defined benefit plans such as Alaska's Public Employees Retirement System (PERS) and Alaska's Teachers Retirement System (TRS), are closed to new members hired after a certain date (June 30, 2006 for the Alaska plans), with new hires only able to participate in a defined contribution plan.

Some, such as the State of Wisconsin, employ a 'hybrid' defined benefit and contribution plan, in which retirees receive a standard pension, but have no cost-of-living adjustments, and annuities are notched up or down depending on investment performance (smoothed out over five years), which shares downturn and recession risk between the employer and employee/retiree. **Furthermore, advocates point out that hybrid structures better**

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align employer/retiree interests and checks and balances, as both parties have a collective interest to keep assumptions realistic and plan governance diligent.

Realistic actuarial assumptions and discount rates

Due to compounding and long horizon nature of ARC computations, small changes in assumptions such as rate of investment return, amortization period, and amortization schedule, among others can have a significant impact on funded ratio projections, future ARC schedules, solvency tests, and so forth. We have observed that in the past, some plans have back loaded payments that masked 'true' required amounts to bring the plan to higher funded status and reduce near-term pension payments. **In these cases, employer/municipality could have paid 100% of ARC and unfunded liabilities would continue to increase.**

Furthermore, some plans have used a statutory contribution rate to fund pensions which were serially below the actuarial rate required to fully fund the pension liability. This practice is extremely limited today as GASB 67 and 68 (Please see our 06/29/2012, 12/19/2014, 05/01/2015, and 08/03/2018 publications) standardized government pension reporting, and use ARC to compute total pension liability.

Lastly, many plans have been hesitant to lower the rate of return/discount rate, even when it is clear that returns will be lower. The resistance to lower discount rates is obvious as it results in higher pension liabilities and the decline in funded ratio that comes with the decrease in the discount rate. **That being said, over the long term horizon, plans with a lower and more conservative rate of return are in a better position to achieve funded ratio targets.**

Limit overweighing on alternative/illiquid asset classes

Maintain a proper balance of risky and conservative assets is essential to insulating pension funds from capital market shocks. At times, large allocations to highly illiquid and/or alternative asset classes can induce underperformance in periods of heightened volatility. Conversely, overly conservative asset allocations could result in underperformance over longer periods of time.

Increase funding from employer/municipal sponsor, with consideration of alternative funding sources

Plans should strive to obtain as much funding as possible from employers and municipal sponsors, with a cautious consideration of alternative proposals to boost funded ratios or remedy funding deficits. As discussed in sections above, while the dedication of specific revenues, transfer of state assets, and issuance of pension obligation bonds can all aid municipalities to further pay down liabilities and boost funded ratios, many proposals may be poorly designed, overly complex in nature, or provide temporary fixes without addressing long-term issues.

Continued dialogue and cooperation with all stakeholders

Due to the arduous and conflicting nature of negotiating pension reform packages and benefit reductions for many plans, legislators and politicians have sometimes tried to/enacted reforms and benefit cuts with little to no input from the employees, retirees, and collective bargaining labor unions. We have seen time and time again that such changes have rarely gone without resistance, litigation, controversy, and in many cases, are struck down by the courts.

This ultimately leaves the municipal sponsors and administrators back to the negotiating table, but with an even more antagonistic populace of employees and labor unions.

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Section V: Metrics and salient factors for investors

While pension funding is not the sole determinant of municipal credit risk and spreads, it has become more relevant and is mandatory due diligence for investors. We have, and continue to see a continued divergence in credit spreads for states with weak funding levels as pension costs weigh on state and local finances. Further, recent criteria changes cited by S&P for special revenue credits and the Appeals Court upholding the District Court ruling that Puerto Rico Highway and Transportation Authority (PRHTA) that pledged revenue were not required to be transferred to PRHTA bond holders through the bankruptcy stay, tether a wider array of credits to the general credit worthiness of related municipality.

Next, we briefly highlight the five key drivers of relative pension health in order to provide investors with a blueprint for analyzing these risks and to isolate the impact of pensions on state and local government credits.

1. Funded ratio
2. Adherence to Annual Required Contributions payments
3. Pension plan demographics
4. State legal ability to reform pensions
5. Asset growth & investment allocation

Funded ratio:

A pension plan's first and by far most critical indication of health is its funded ratio. It represents an aggregate and encompassing result of all other aspects of the plan, since any changes will ultimately affect the pension assets or liabilities. As mentioned in the above section, in recent years, we have seen an **aggregate decline in average funded ratio, driven by higher market volatility and lower returns, underfunding of required contributions, and an increase of retiree pension and benefit payments.**

The general decline in funded ratios has been accompanied by a widening gap among state plans. **As of the latest Public Plan Data and 2018 information, there was a significant variance between the highest (128%) and lowest (16%) funded state pension plans.** Higher funded plans generally have more flexibility and larger buffer in the event of a market correction or temporary contribution shortfall, versus lower funded plans that have little if any margin for error.

Annual required contributions made:

As mentioned in the above section, the ARC is mathematically calculated by independent actuaries to provide a roadmap for the fund to reach fully funded status and stable pension health, provided that all other assumptions are met. Some municipalities, in the face of competing expenditures (public safety, education, essential services) for limited taxes and source capital, have elected (and continue) to defer full ARC funding. While one year of underfunding will only marginally

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increase the net pension obligation and subsequent years' ARCs, chronic underfunding equates to exponential growth of future ARC's and liabilities. As such, we caution investors due diligence around historical and recent ARC payment trends.

Plan demographics:

For a majority of plans, the ratio of active members to annuitants has been steadily declining, with the aggregate average ratio expected to decline below 1.0x in year 2027, as highlighted in the section above. This trend is driven by two main factors, an overall smaller base of younger workers (especially those entering government/municipal employment), as well as increasing retirement and benefit payments among the baby boomer generation.

While a decline in active to annuitants is not necessarily problematic, as Canadian and other developed country pension systems also wrest with this issue, it becomes challenging when combined with a large unfunded liability and larger dependency on employee contributions. **A lower ratio (of active to annuitants) also results in the need to spread rising amortized costs over a relatively smaller payroll base, increasing the cost of the plan as a percentage of employee payroll.**

State legal ability to reform pensions:

As highlighted in our section above, the ability of a state to reform pensions is to a large degree a function of the level of protections afforded pensioners within a respective state.

States generally protect public employee pension benefits through constitutional provisions, contractual-based language, or on a property rights basis. States with constitutional protections such as Illinois, New York, Alaska, and Arizona have less flexibility in modifying benefits of existing members, while states like Texas, where pension benefits are viewed as gratuities, can modify or amend such benefits at any time.

We believe that understanding each particular state's legal ability to successfully pass pension reform is crucial to the long term credit outlook.

Asset growth & investment allocation

As highlighted in our above section, pension plan allocation to higher risk and less liquid assets has increased in recent years. Poorly funded plans have elevated risk of higher allocations to riskier assets given increased pressure to make up for funding shortfalls. The risk of adverse performance consequences is heightened in late expansion cycles such as the current environment. Please refer to our 04/05/2019 publication for a broader discussion.

Combining the five risk factors above, we provide select pension metrics for all 50 states as of the most recent data (Exhibit 20).

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Exhibit 20: We present select pension metrics for all 50 states

State abbv	State	Funded ratio, % (Pew, 2017)	Annual Required Contribution made (%), 3yr Avg	Ratio of active to annuitants (x)	Legal basis for pension protection / reform score	Blended cash and fixed income allocation (%)
AL	Alabama	67%	100%	1.56	5	30%
AK	Alaska	63%	84%	0.41	1	10%
AZ	Arizona	60%	100%	1.41	2	11%
AR	Arkansas	77%	100%	1.23	5	15%
CA	California	69%	91%	1.35	3	24%
CO	Colorado	46%	75%	1.72	4	22%
CT	Connecticut	41%	100%	1.13	7	28%
DE	Delaware	81%	100%	1.31	5	31%
FL	Florida	79%	100%	1.16	5	20%
GA	Georgia	76%	100%	1.65	3	34%
HI	Hawaii	51%	98%	1.36	2	17%
ID	Idaho	88%	104%	1.52	4	27%
IL	Illinois	36%	80%	1.14	1	30%
IN	Indiana	63%	108%	1.38	10	28%
IA	Iowa	82%	102%	1.40	5	30%
KS	Kansas	65%	83%	1.52	3	23%
KY	Kentucky	31%	97%	1.06	5	29%
LA	Louisiana	60%	101%	0.78	2	17%
ME	Maine	77%	100%	1.14	6	20%
MD	Maryland	65%	98%	1.21	4	22%
MA	Massachusetts	58%	100%	1.40	3	21%
MI	Michigan	64%	103%	0.74	2	18%
MN	Minnesota	53%	82%	1.36	9	26%
MS	Mississippi	58%	108%	1.44	4	31%
MO	Missouri	77%	106%	1.22	5	25%
MT	Montana	71%	100%	1.23	5	26%
NE	Nebraska	89%	154%	1.73	3	29%
NV	Nevada	72%	101%	1.65	3	30%
NH	New Hampshire	58%	100%	1.34	3	22%
NJ	New Jersey	31%	50%	1.46	4	23%
NM	New Mexico	65%	90%	1.23	7	32%
NY	New York	91%	100%	1.25	1	24%
NC	North Carolina	88%	103%	1.42	5	34%
ND	North Dakota	66%	81%	1.68	5	25%
OH	Ohio	72%	114%	1.39	8	24%
OK	Oklahoma	72%	149%	1.26	5	26%
OR	Oregon	81%	100%	1.19	3	20%
PA	Pennsylvania	53%	98%	1.00	3	25%
RI	Rhode Island	54%	100%	1.08	4	25%
SC	South Carolina	54%	100%	1.39	4	15%
SD	South Dakota	97%	113%	1.47	5	38%
TN	Tennessee	94%	100%	1.33	3	29%
TX	Texas	73%	82%	1.93	10	22%
UT	Utah	86%	100%	1.10	5	23%
VT	Vermont	64%	116%	1.13	3	30%
VA	Virginia	72%	94%	1.71	5	16%
WA	Washington	84%	92%	3.54	3	24%
WV	West Virginia	72%	115%	1.12	3	14%
WI	Wisconsin	99%	100%	1.26	8	32%
WY	Wyoming	73%	86%	1.31	6	25%

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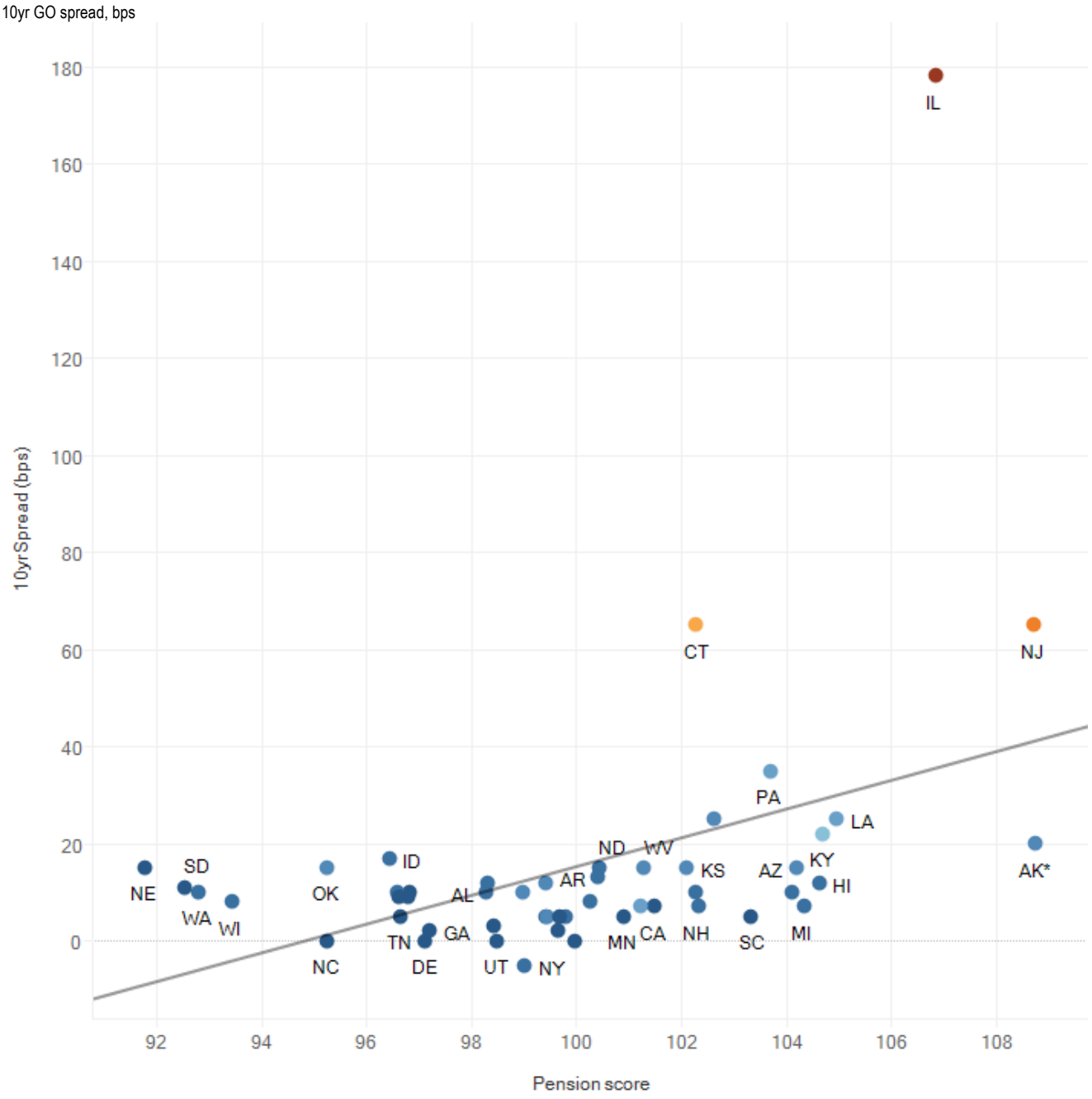

Source: Pew, Public Plan Data, Center for Retirement Research at Boston College, Individual state/pension CAFRs, JPMorgan. Spreads as of 4/02/2019. Reform data from the Center for Retirement Research at Boston College brief: (http://crr.bc.edu/briefs/state-and-localpension-reform-since-the-financial-crisis/) – lower legal reform score equates to less state reform flexibility/higher protections for pensioners. Blended cash and fixed income allocation proportionally accounts for each state plan's asset allocation. Alaska PERS, Alaska Teachers, Michigan SERS, and West Virginia Teachers plans are closed. Color denotes rating.

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