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Still a Better Bang for the Buck

An Update on the Economic Efficiencies of Defined Benefit Pensions

by William B. Fornia, FSA, and Nari Rhee, PhD

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EXECUTIVE SUMMARY

Over the past three decades, private employers have shifted away from defined benefit (DB) pensions that provide employees with a steady retirement income stream, towards defined contribution (DC) retirement accounts—such as 401(k) plans—in which individual workers manage their own investments. Since the 2008 financial crisis, public employers have faced pressures to make a similar change.

However, DB plans are inherently more cost-efficient than DC plans. A seminal NIRS study released in 2008, entitled "A Better Bang for the Buck," found that a typical large DB pension plan provides a given level of retirement benefit at about half the cost of a DC plan. In this updated comparison of DB and DC plan costs, we take into account key developments in the retirement benefits landscape with regard to fees, investment strategies, and annuities, while building an "apples to apples" comparison through a uniform set of demographic and economic assumptions. Highlights include the following:

1. A typical DB plan provides equivalent retirement benefits at about half the cost of a DC plan, and 29 percent lower cost than an "ideal" DC plan modeled with generous assumptions.

- A DB plan, modeled with the typical fees and asset allocation of a large public plan, has a 48 percent cost advantage compared to a typical individually directed DC plan.

- The DB pension costs 29 percent less than an "ideal" DC plan that features the same low fees and no individual investor deficiencies.

- Annuitizing DC account balances does not erase the DB pension cost advantage. Annuities offered by private insurance companies would only modestly decrease DC funding requirements at historical average interest rates, and would increase costs at 2014 interest rates.

2. DB plans have three structural cost advantages compared to DC plans: longevity risk pooling, the ability to maintain a well-diversified portfolio over a long investment horizon, and low fees and professional management.

- **Longevity risk pooling.** In order to provide lifelong income to each and every retiree. DB plans only have to fund benefits to last to average life expectancy. In a DC plan, an individual must accumulate extra funds in order to self-insure against the possibility of living longer than average. They can also buy a life annuity from an insurance company, but this comes at a cost.

- **Asset allocation.** DB pensions are able to maintain portfolio diversification—specifically, stay invested in equities—over time, while DC participants must shift to lower-risk, lower-return investments as they age. Thus over a lifetime, DB pensions earn higher gross investment returns than do DC accounts.

- **Low fees and professional management.** Due to economies of scale, DB plans feature low investment and administrative expenses as well as management of investments by professionals. An "ideal" DC plan can theoretically achieve the same fees and investment returns, for a given asset allocation, by removing individual choice. When we use more realistic assumptions—industry average fees and a modest "behavioral drag" on investment returns resulting from well-documented tendencies in individual investor behavior—we find that the DB plan has a large advantage in net investment returns.

3. Given the cost efficiencies inherent to DB plans, employers and policymakers should continue to carefully evaluate claims that "DC plans will save money."

- For a given level of retirement income, a typical individually directed DC plan costs 91 percent more—almost twice as much—as a typical DB plan.

- Consequently, shifting from a DB plan to a DC plan and maintaining the same contribution rate will generate significant cuts in retirement income. The consequences could be dramatic for employees, employers, and taxpayers.

I. INTRODUCTION

Over the past three decades, private employers have shifted away from defined benefit (DB) pensions that provide employees with a steady retirement income stream, towards defined contribution (DC) retirement accounts—such as 401(k) plans—in which individual workers manage their own investments. By and large, public employers have faced growing pressure since the 2008 financial crisis to make a similar change. Contrary to popular belief, however, DC retirement accounts are not inherently less costly than a pension, and switching from a DB to a DC system saves money only if it involves substantial benefit cuts.

In fact, DB pensions feature critical efficiencies that make them significantly less expensive to provide a given level of retirement benefit compared to DC plans. This was documented by the National Institute on Retirement Security (NIRS) in its 2008 study, "A Better Bang for the Buck: The Economic Efficiencies of Defined Benefit Pensions."[1] The study found that a typical large DB pension plan provides a given level of retirement benefit at about half the cost of a 401(k) style plan, because of three factors:

- The pooling of longevity risk in DB pensions enables them to fund benefits based on average life expectancy, and yet pay each worker monthly income no matter how long they live. In contrast, DC plans must receive excess contributions to enable each worker to self-insure against the possibility of living longer than average.

- DB pensions realize higher net investment returns due to professional management and lower fees from economies of scale.

- DB pensions are able to maintain portfolio diversification over time, while DC participants must shift to lower-risk, lower-return investments as they age. This means that over a lifetime, DB pensions earn higher gross investment returns than do DC accounts.

In summary, when it comes to providing retirement income, DB pensions are more efficient because they pool risks across a large number of individuals, invest over a longer time horizon, and have lower expenses and higher returns.

While these facts have not fundamentally changed since 2008, this study updates the comparison of retirement benefit funding costs based on an enhanced methodology that takes into account key changes in the DB and DC plan landscapes with regard to investment strategies and fees. We compare a typical large public sector DB pension to two kinds of DC plans—an individually directed DC plan with industry average fees and reduced investment returns based on typical investor behavior, and an "ideal" DC plan with fees well below industry average and asset class investment performance as strong as that achieved by professionals. Both DC plans are modeled with a target date fund (TDF) asset allocation pattern.

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All three plans—the typical DB plan, the individually directed DC plan, and the ideal DC plan—are modeled with the same underlying demographic and economic assumptions regarding employee wage growth, retirement age, life expectancy, target monthly retirement income, inflation, and projected rates of return for each asset class. We also assume that all plans receive consistent, adequate contributions required to fund target benefits. In addition, we study the cost impact of annuitizing the account balances in the DC plans.

Even with updated assumptions and methodology, we still find that DB pensions offer substantial cost advantage over DC plans.

- A typical DB plan, with advantages based on longevity risk pooling, asset allocation, low fees, and professional management, has a 48 percent cost advantage compared to a typical individually directed DC plan.

- A DB pension costs 29 percent less than an "ideal" DC plan with below-average fees and no individual investor deficiencies.

- Annuitizing DC account balances—that is, converting the account balance at retirement into an insurance contract for lifetime income—does not erase the DB pension cost advantage. This is because insurance companies use a more conservative asset allocation and charge much higher fees than a DB pension. Annuities purchased at historical average interest rates only modestly decrease DC benefit costs, while annuities purchased at 2014 rates would increase benefit costs.

In other words, a typical DB plan provides equivalent retirement benefits at about half the cost of a typical DC plan, and 29 percent lower cost than an ideal DC plan modeled with very generous assumptions.

Conversely, it would be 91 percent and 41 percent more expensive for an typical DC plan and an ideal DC plan, respectively, to deliver the same level of retirement income as a typical DB plan. Thus DB pensions continue to offer a significant cost advantage. While shifting from a DB pension to a DC plan offers a way to reduce the investment risk borne by employers and taxpayers, this comes with an unavoidable tradeoff—either increased benefit costs or, more likely, significant retirement benefit cuts that are larger than the savings realized by the employer.

II. DEFINED BENEFIT AND DEFINED CONTRIBUTION PLANS

Employers who offer retirement benefits can consider two basic approaches: a traditional defined benefit (DB) pension plan and a defined contribution (DC) retirement savings plan. The DB plan is designed to provide predictable retirement *income* throughout a worker's retirement years. Assets are pooled, and investments are managed by professionals who are responsible for acting in the best interest of participants. The DC plan, in contrast, is focused on accumulating retirement *wealth* expressed as a lump sum, with individual participants ultimately responsible for garnering adequate investment returns and managing their own accumulated wealth throughout their retirement years. This would entail estimating how much they can safely withdraw each year of retirement without running out of money, attempting to evaluate the best annuitization alternative in the open market, or some combination of the two.

Each type of plan has certain distinguishing characteristics that influence its cost to employers and employees.

How DB Plans Work

While employers have a large degree of flexibility in designing the features of a DB plan, there are some features all DB plans share. DB plans are designed to provide employees with a predictable monthly benefit in retirement. The amount of the monthly pension is typically a function of the number of years an employee devotes to the job and the worker's pay—usually at the end of their career.[2] For example, the plan might provide a benefit in the amount of 1.5 percent of final average pay for each year worked. Thus, a worker whose final average salary was $50,000, and who had devoted 30 years to the job, would earn a monthly benefit of $1,875 ($22,500 per year), a sum that would "replace" 45 percent of her final average salary after she stops working. This plan design is attractive to employees because of the security it provides. Employees know in advance of making the decision to retire that they will have a steady, predictable income that will enable them to maintain a fairly stable and predictable portion of their pre-retirement standard of living.[3]

Benefits in DB plans are pre-funded. That is, employers (and, in the public sector, most employees) make contributions to a common pension trust fund over the course of a worker's career. These funds are invested by professional asset managers whose activities are overseen by trustees and other fiduciaries. A typical DB pension fund's asset allocation policy—i.e., the share of holdings allotted to different asset classes such as stock, bonds, and treasuries—is based on a careful analysis of plan demographics and liabilities as well as short- and long-term financial market projections.[4] The earnings that build up in the fund, along with the dollars initially contributed, pay for the lifetime benefits a worker receives when she retires.

How DC Plans Work

DC plans function very differently than do DB plans. First, there is no implicit or explicit promise of retirement income in a DC plan. Rather, the level of retirement income that an account will provide depends on a number of factors, such as the level of employer and employee contributions to the plan, the investment returns earned on assets, whether loans are taken or funds are withdrawn prior to retirement, and the individual's lifespan.

While DC plan assets are also held in a trust, that trust is comprised of a large number of individual accounts. DC plans are typically "participant directed," meaning that each individual employee can decide how much to save, how to invest the funds in the account, how to modify these investments over time, and how to withdraw the funds during retirement.

Retirement experts typically advise individuals in DC plans to change their investment patterns over their lifecycle. In other words, at younger ages, because retirement is a long way off, workers should allocate more funds to stocks, which have higher expected returns but also higher risks. As one gets closer to retirement, experts suggest moving money away from stocks and into safer but lower return assets like bonds. This is to guard against a large drop in retirement savings on the eve of retirement, or in one's retirement years.

The high degree of participant direction makes DC plans very flexible in accommodating individuals' desires, decisions, and

control. Unfortunately, a substantial body of empirical and experimental research indicates that this flexibility tends to lead to adverse outcomes. First, too many workers fail to contribute sufficient amounts to the plans.[5] Second, individuals' lack of expertise in making investment decisions can subject individual accounts to extremely unbalanced portfolios with too little or too much invested in one particular asset, such as stocks, bonds, or cash.[6] One team of researchers thus concluded, "The likelihood of investment success increases as the participant's involvement in investment decisions decreases."[7]

Another important difference between DB and DC plans becomes apparent at retirement. Unlike in DB plans, where workers receive regular monthly pension payments, in DC plans it is typically left to the retiree to decide how to spend down their retirement savings. Research suggests that many individuals struggle with this task, either drawing down funds too quickly and running out of money, or holding on to funds too tightly and enjoying a lower standard of living as a result.[8] In theory, employers that offer DC plans could provide annuity payout options, but in practice they rarely do.[9]

The Changing Retirement Benefit Landscape

Changing Asset Allocation and Risk Management Strategies among DB Pension Funds

Changes in the financial and regulatory environments for DB pensions over the last several years have prompted funds to shift financial risk management strategies. Notably, while governmental and corporate DB pension funds had similar asset allocations until 2008, including the share of investments in equities, different regulatory and demographic considerations led to diverging asset allocation after 2008.[10] Given this divergence, and the concentration of DB pension benefits and assets in the governmental sector, this study models a typical public pension's asset allocation.[11]

In the private sector, corporations began introducing 401(k) plans in the 1980s. Then in the early 21st century, many firms began to close or freeze existing DB pension plans. The long bull market in stocks from the 1980s to 2000 enabled corporate pension sponsors to either maintain pension plans with modest cash contributions or use their pensions as a source of income. Plan costs increased after the financial bubble burst. Then, after the passage of the Pension Protection Act of 2006, private employers faced new pension funding rules. While intended to safeguard retirement benefits promised to private sector workers, these regulations made pension funding and reported liabilities more volatile which contributed to additional DB pension plan freezes and terminations.[12] Other accounting and regulatory actions over the decades have added to this trend.

With no new workers entering the system, closed corporate pension plans face a shorter investment horizon. This dynamic, combined with the pension expense volatility created by new funding and accounting rules, motivated many corporate DB pension sponsors to de-risk their portfolios by shifting from stocks to bonds and treasuries.[13]

Public pension plans, in particular state and local government pensions, also faced new challenges in the aftermath of the 2008 financial crisis. Almost every state legislature enacted plan changes to enhance sustainability, and most included measures to increase employee contributions and reduce benefits for at least some employees.[14] Very few of these changes included eliminating the core DB plan.

Particularly germane to this study are the investment policy decisions made by many public pension funds. First, in response to a desire for reduced volatility and the low interest environment, pension fund trustees have reduced plan exposure to U.S. stocks and traditional fixed income securities, and further diversified funds by increasing the share of global stocks and alternative investments such as real estate, private equity, and commodities. Second, the changing financial landscape has also prompted many public pension funds to lower their rate of return assumptions. The asset-weighted median investment return assumption dropped from 8 percent in 2011 to 7.75 percent in 2014.[15]

Efforts to Improve DC Plans

The DC landscape has changed as well. Experts and policymakers have focused on addressing key problems in 401(k)-type plans related to fees, investment options, investor behavior, and retirement income outcomes.

An incremental decrease in fees has transpired due to increased regulatory scrutiny of 401(k) and IRA fees, and growing use of lower-cost index funds.[16] The U.S. Department of Labor issued regulations in 2010 and 2012 concerning the disclosure of 401(k) fees. According to the Investment

Company Institute, the average 401(k) equity fund expense ratio, exclusive of fees paid by employers, declined from 77 basis points in 2000 to 58 basis points in 2013.[17]

Annuities have garnered increasing interest among policymakers and regulators as a way to convert DC account balances into a lifetime income stream. Individual investment accounts are framed in terms of lump-sum retirement *wealth*, while the challenge facing savers is securing adequate *income* to last through retirement. Annuities are financial products in which a third party (typically an insurance company) promises a stream of income in return for a lump sum. However, the availability of annuities as a 401(k) payout option is limited, and overall participation rates remain low. They tend to be expensive, due to today's low interest environment, insurer profit objectives, marketing and administrative costs, and adverse selection.

Growing use of target asset allocation funds. The consensus resulting from a decade of behavioral finance research is that 401(k) participants routinely make asset allocation and investment mistakes, such as buying and selling holdings at the wrong time, failing to regularly re-balance their portfolios, or taking too little or too much risk in their asset allocation. Target asset allocation funds address part of this problem through automatic re-balancing. One such type of fund, called Target Date Funds (TDFs) or lifecycle funds, has gained favor among policymakers, retirement experts, and large employers in the US.[18] TDFs gradually and automatically shift their asset allocation from risky stocks to less risky bonds as a worker ages, based on their target retirement year. TDFs accounted for 15 percent of 401(k) account balances, with heavier representation among younger workers, in 2013.[19] These funds now account for the largest share of new 401(k) contributions. However, they are not a panacea for individual investor error, and most participants do not use TDFs as intended.[20]

A Note on Hybrid Retirement Benefits

There is growing interest in "hybrid" retirement benefits that combine some of the features of DB and DC plans, and ostensibly offload some risks onto employees while maintaining some of the retirement security offered by traditional DB pensions. There are two main types. One type is a "side by side" or "stacked" hybrid, in which the core retirement benefit consists of a combination of a DB pension (typically with less generous benefits) and a DC plan. The other is a "blend" between DB and DC such as a cash balance (CB) plan. Under a CB plan, each employee has a notional account balance, as the employer credits each employee with a set percentage of her annual pay plus an interest rate that is either predetermined or tied to an index. A CB plan is legally a DB plan—benefits are guaranteed, albeit as a lump sum, and assets are pooled in a trust and managed professionally. However, CB plan benefits typically are less generous than a traditional DB pension, and generally participants do not obtain longevity protection.

Importantly, the relative costs of hybrid plans depend largely on benefit structure. To the extent that hybrid benefits emphasize DB-like characteristics, they can be more cost efficient. To the extent that they off-load risks onto individual workers, they will be less cost efficient.

III. METHODOLOGY

We compare the relative costs of DB and DC plans by constructing a model that first calculates the cost of achieving a target retirement benefit in a typical public sector DB plan. We calculate this cost as a level percent of payroll over a career. We then calculate the cost of providing the same retirement benefit under two different types of DC plans—an "ideal" DC plan modeled with generous assumptions and a more typical individually directed DC plan. Additional details on our methodology, and sensitivity analyses that account for the impact of alternative economic and demographic assumptions, can be found in the Technical Appendix to this report.

Demographic Assumptions

Our model is based on a group of 1,000 newly-hired employees. For the purposes of simplicity, we give all individuals a common set of features. All newly hired employees are female teachers aged 30 on the starting date of their employment. They work for three years and then take a two-year break from their careers for child rearing. They return to work at age 35 and continue working until age 62. Thus, the length of the career is 30 years. By their final year of work, their salary has reached $60,000, having grown by 4 percent each year.[21] For modeling purposes, we assume that prior to retirement, no one dies, and there is no turnover within our pool of teachers.

Target Benefits

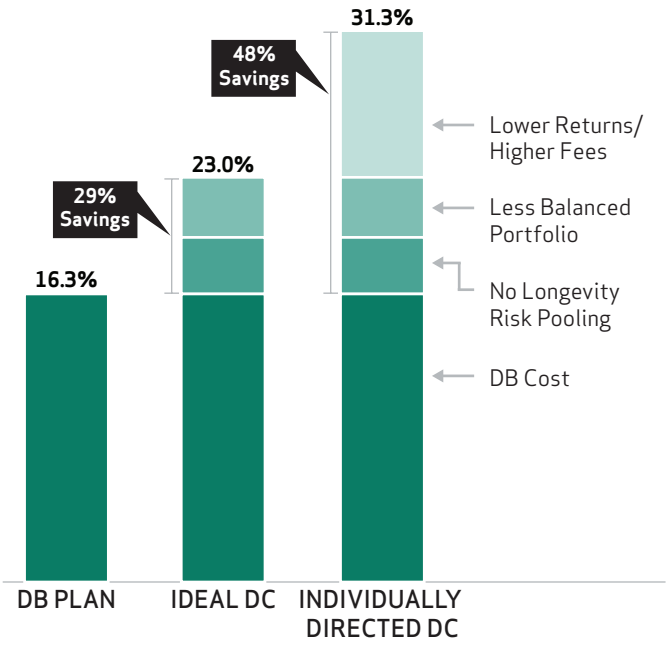
Next, we define a target retirement benefit that, combined with Social Security benefits, will allow our 1,000 teachers to achieve generally accepted standards of retirement income adequacy.[22] The target benefit is $32,036 per year or $2,670 per month. A cost of living adjustment is provided to ensure the benefit maintains its purchasing power during retirement. Thus, each teacher will receive a benefit equal to 53 percent of her final year's salary that adjusts with inflation, which we assume will be 3.0 percent per year. With this benefit and Social Security benefits, each teacher can expect to receive roughly 83 percent of her pre-retirement income—a level of retirement income that can be considered adequate, but not extravagant. We define certain parameters for life expectancy and investment returns. On the basis of all these inputs, we calculate the contribution—as a percentage of payroll—that will be required to fund our target retirement benefit through the DB plan over the course of a career. We do the same for the DC plans.

IV. FINDINGS: DB PLANS ARE STILL MORE COST EFFECTIVE

The cost of either a DB or DC plan depends, in the first instance, on the generosity of the benefits that it provides. However, for any given level of benefit, a DB plan will cost less than a DC plan. Conversely, on average a dollar invested in a DB plan will generate higher retirement income than a DC plan. *In other words, DB plans are more efficient.*

We find that the cost to fund the target retirement benefit under the DB plan comes to 16.3 percent of payroll each year. By comparison, we find that the cost to provide the same target retirement benefit is 31.3 percent of payroll under the individually directed DC plan and 23.0 percent under the ideal DC plan. As illustrated in **Figure 1**, the DB plan can provide the same benefit at a cost that is 48 percent lower than the individually directed DC plan and 29 percent lower than the ideal DC plan.

Figure 1:
Cost of DB and DC Plans as a Percentage of Payroll



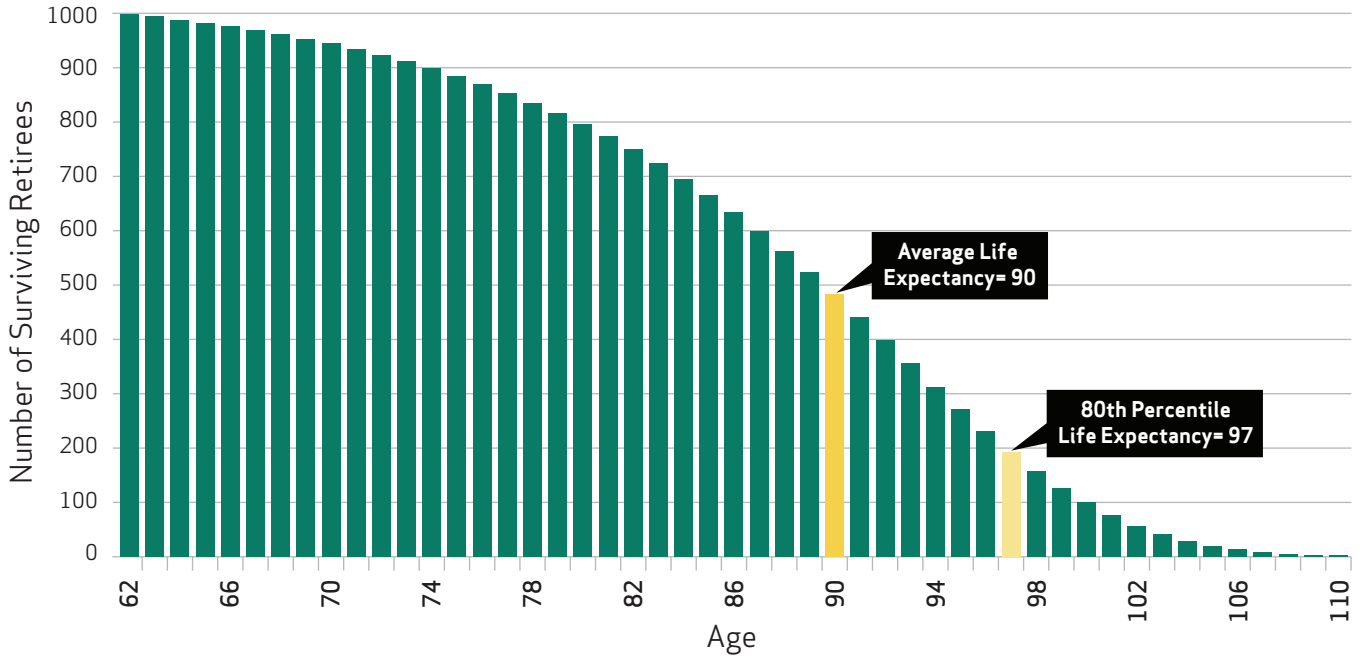
The DB cost advantage stems from differences in how benefits are paid out in each type of plan, how investment allocations shift in DC plans as individuals age, and how actual investment returns in DC plans compare with those in DB plans.

There are three primary reasons behind DB plans' cost advantage.

- First, because DB plans pool the longevity risks of a large number of individuals, these plans need only accumulate enough funds to provide benefits for the *average* life expectancy of the group. If individuals did this in a DC plan, they would face a 50 percent chance of running out of money in retirement. In order to reduce the risk of running out of funds to a reasonable level, individuals need to accumulate enough funds to last several years past average life expectancy. Even using only the 80th percentile life expectancy, which exposes participants to a one-in-five chance of running out of money, causes the DC plan to require significantly more funding.

- Second, because DB plans have a much longer investment horizon than individuals, they are able to take advantage of the enhanced investment returns that come from maintaining a balanced portfolio over a long period of time. The reason behind the longer investment horizon is that a mature DB plan has a mix of younger workers, older workers, and retirees, as younger workers continue to enter the plan. By contrast, individuals in DC plans must gradually shift to a more conservative asset allocation as they age, in order to protect against financial market shocks later in life. This means DB plans can ride out bear markets and keep a larger share of their investments in stocks and other assets that offer higher returns over the long term but fluctuate more in the short term compared to bonds and other fixed income securities. DB plans are also better positioned to take advantage of "illiquid" investments that offer premium returns—for instance, real estate and private equity. These factors allow DB pensions to ultimately earn higher gross returns based on asset allocation.

Figure 2: **Longevity of 1,000 Retired Female Teachers**



- Third, DB plans achieve even greater investment returns compared with typical individually directed DC plans based on lower fees and professional management. Superior returns can be attributed partly to lower fees that stem from economies of scale: assets are pooled in DB plans, where DC plans consist of individual accounts. In addition, because of professional management of assets, DB plans achieve superior investment performance compared to the average individual investor. DB investment managers have fiduciary duty and must meet the standard of prudence. In contrast, it is well-documented that individual investors make inappropriate decisions regarding both asset allocation and market timing—and thus tend to earn returns that lag behind market returns.[23] This effect is sometimes called "behavioral drag."

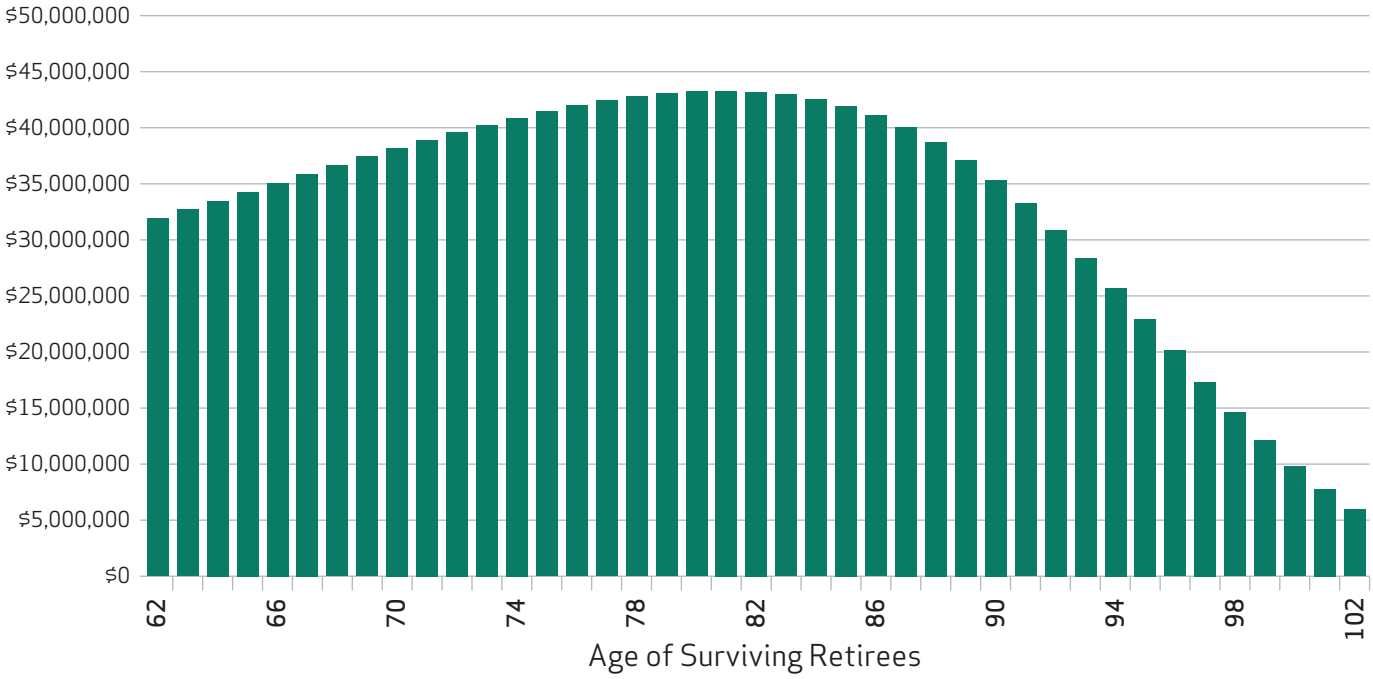
Longevity Risk Pooling

Longevity risk describes the uncertainty an individual faces with respect to their exact lifespan. While actuaries can tell us that, on average, our pool of female teachers who are 30 today and who will retire at age 62 will live to be 90, they can also predict that some will live only a short time, and some will live to be over 100.[24] **Figure 2** illustrates the longevity patterns among our 1,000 teachers. With each passing year, fewer retirees are still living. Age 90 corresponds to the year when roughly half of retirees are still alive.

In a DB plan, the normal form of benefit is a lifetime annuity, that is, a series of monthly payments that lasts until death. A DB plan with a large number of participants can anticipate the fact that some individuals will live longer lives and others will live shorter lives. Thus, a DB plan needs only to ensure that it has enough assets set aside to pay for the average life expectancy of all individuals in the plan, or in this case, to age 90. Based on our target benefit level, the DB plan needs to have accumulated approximately $500,000 for each participant in the plan by the time they turn 62. This amount is projected to be sufficient for every individual in the plan to receive a regular, inflation-adjusted monthly pension payment that lasts as long as they live. The contribution level required to fund this benefit over a career comes to 16.3 percent of payroll.

Total annual payments out of the DB plan will have a hump-shaped pattern as seen in **Figure 3**. The amount of benefits paid out will increase for a number of years, because the effect of inflation adjustments is greater than the effect of individuals gradually dying off. At age 82, the impact of retiree deaths overtakes the effect of the cost of living adjustments, and payments decline with each passing year. In the DB plan, every retiree receives a steady inflation-adjusted monthly income that lasts until her death.

Figure 3: **Total Payments under the Defined Benefit Plan**



Next, we contrast this situation with that in a DC plan. In the vast majority of cases, individuals must self-insure longevity risks (or purchase an annuity, as discussed below). This can be an expensive proposition.

Because an individual in a DC plan does not know exactly how long she will live, she will probably not be satisfied with a benefit sufficient to last only for the *average* life span, for if she lives past age 90, she will have depleted her retirement savings. For this reason, an individual will probably want to be sure that she has enough money saved to last for several years past average life expectancy.

We modeled the DC plan to provide income for the 80th percentile life expectancy, age 97. It corresponds to the age beyond which only 20 percent of individuals survive.[25] This is a conservative target. In fact, our mortality table indicates that it is likely that one lucky individual out of the 1,000 will celebrate her 111th birthday. It is not clear that most individuals will be satisfied with an 80 percent chance of not outliving their money, and in using this life expectancy, we understate the cost of the DC plan. **Figure 4** illustrates the payout pattern under the DC plan, where individuals withdraw funds on an equivalent basis to the DB plan until age 97—that is, in a series of regular, inflation-adjusted payments. After age 97, there are no more withdrawals. The money has simply run out.

Of course, those 20 percent of individuals who do survive beyond age 97 would want to avoid the possibility of having their retirement income reduced to zero. It is likely that individuals will respond to longer lives by gradually reducing their withdrawals from the plan to avoid running out of money. This means that those with very long lives will see their standard of living reduced significantly. At the same time, because it is difficult to exactly predict one's lifespan, some retirees who live past age 97 will reduce their withdrawals more than they actually need to. Finally, if a retiree dies before exhausting all of her retirement savings, the money in the account passes to her estate. The funds that were intended to be pension benefits become death benefits paid to heirs instead. **Figure 5** illustrates the combined effect of reduced withdrawals and estate payments.

The aggregate amount of money transferred to estates is substantial—totaling 24 percent of all assets accumulated in the plan in this illustration. While some individual heirs will benefit from these intergenerational transfers of wealth, such transfers are not economically efficient from a taxpayer or employer perspective. Because heirs did not provide services from which the employer/taxpayer benefited, providing additional benefits to heirs is economically inefficient. Moreover, these additional "death benefits" are not tied in any direct way to an individual employee's productivity during her working years.

Figure 4: **Total Benefit Payments under the DC Plan Based on Life Expectancy of 97**

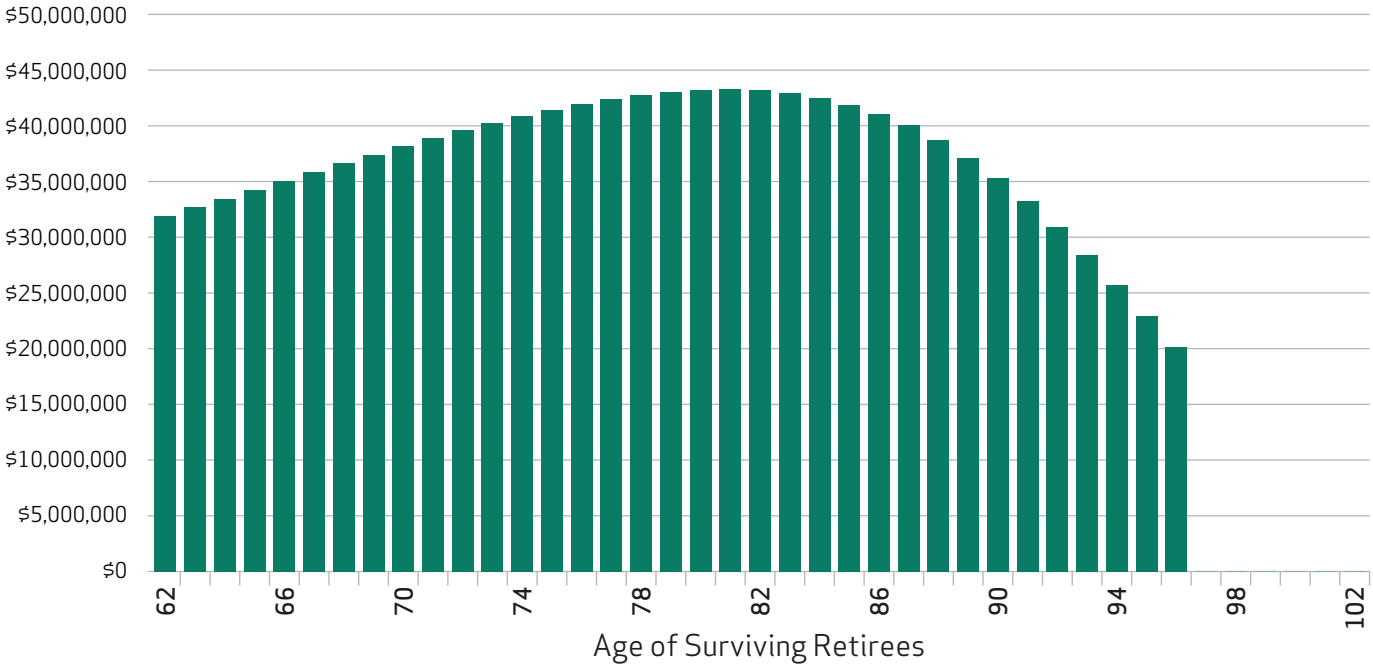
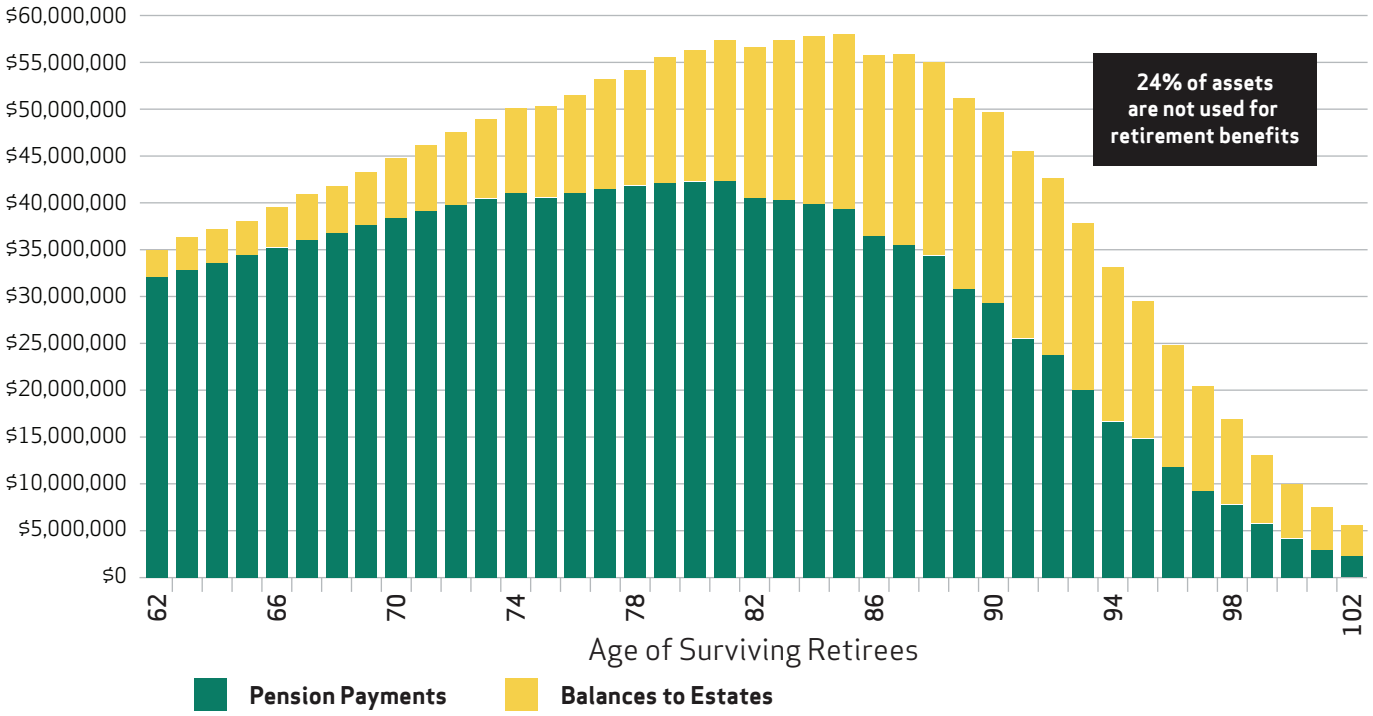


Figure 5: **Total Benefit and Estate Payments under the DC Plan Based on Adjusted Withdrawal Strategy**



In addition, although annuities purchased through private insurance companies may offer full protection against longevity risk, this protection comes at a significantly higher cost than the same protection provided by a DB pension. (See "Impact of Annuitizing DC Account Balances" on p.16.)

DB plans avoid this problem entirely. By pooling longevity risks, DB plans not only provide all participants in the plan with enough money to last a lifetime, but also accomplish this goal with less money than would be required in a DC plan. Because DB plans need to fund only the *average* life expectancy of the group, rather than the *maximum* life expectancy for all individuals in the plan, less money needs to be accumulated in the pension fund. Remember that the DB plan needs to accumulate about $500,000 for each participant in the plan by the time they turn 62 in order to fund the target level of benefit. In contrast, DC plans must accumulate at least $600,000 per participant, or nearly $100,000 more, in order to minimize the likelihood of that individual running out of funds. This additional amount extends retirement income from average life expectancy to the 80th percentile life expectancy. **In order to accumulate the additional amount necessary for DC plan participants to self-insure against this level of longevity risk, contributions to the plan would climb to 19.6 percent of pay, from 16.3 percent under the DB plan** (an increase of 20 percent). This assumes the same net investment returns. However, as we demonstrate below, two remaining factors contribute to DC plans having inferior returns compared to the DB plan.

Maintenance of Portfolio Diversification (Staying Invested in Equities)

A retirement system that achieves higher investment returns can deliver a given level of benefit at a lower cost. All else being equal, the greater the level of investment earnings, the lower contributions to the plan will need to be.[26] Prior research substantiates DB plans' significant advantage in investment returns, as compared with DC plans.

Part of the reason why DB plans tend to achieve higher investment returns as compared with DC plans is that they are long-lived. That is, unlike individuals, who have a finite career and a finite lifespan, a DB pension fund endures across generations; thus a DB plan, unlike the individuals in it, can maintain a well-diversified portfolio over time. This well-diversified portfolio will include investments which are expected to earn higher returns than a less diversified portfolio, which focuses on more secure but lower-returning asset classes.

In DC plans, individuals' sensitivity to the risk of financial market shocks increases as they age. The consequences of a sharp stock market downturn on retirement assets when one is in their late 50s are substantial, compared to when one is in their 20s with sufficient time to recover their losses.

For this reason, individuals are advised to gradually shift away from higher risk/higher return assets as they approach retirement. While this shift offers insurance against the downside risk of a bear market, it also sacrifices expected returns since more money will be held in bonds, cash, and similar assets that offer lower rates of return in exchange for more security. A reduction in expected investment returns will require greater contributions to be made to the plan in order to achieve the same target benefit.

Researchers find a large and persistent gap when comparing investment returns in DB and DC plans, although the gap has narrowed somewhat over time. A 2013 report from CEM Benchmarking finds that DB pensions outperformed DC plans in average by 99 basis points, net of fees, over the 17 years ending in 2013—largely due to differences in asset mix.[27] Watson Wyatt found that DB plans outperformed DC plans by an annual average of 76 basis points, net of investment expenses, from 1995 to 2011.[28]

These studies aggregate asset allocation and investment returns. This does not present much of a problem for DB plans, because asset allocation is relatively consistent across large funds that tend to be mature and have roughly similar demographic profiles. However, aggregated DC plan data tells us less about the "typical" investor because there is a large dispersion of asset allocations and returns among individual investors. In addition, aggregated data is of limited usefulness in determining long-term returns over a typical individuals' career and retirement years as their asset allocation shifts from equities to fixed income securities, as prescribed by the TDF or lifecycle investment strategy.

In order to estimate gross investment returns for the DB and DC plans over our teachers' working and retirement years, we start with asset allocation for each plan and then apply a uniform set of assumptions about the long-term returns for each asset class. The DB plan is assumed to have an asset allocation typical of a large public sector DB plan. In the ideal and individually directed DC plans, participants are expected to gradually shift out of higher risk/higher return assets in favor of lower risk/lower return assets.

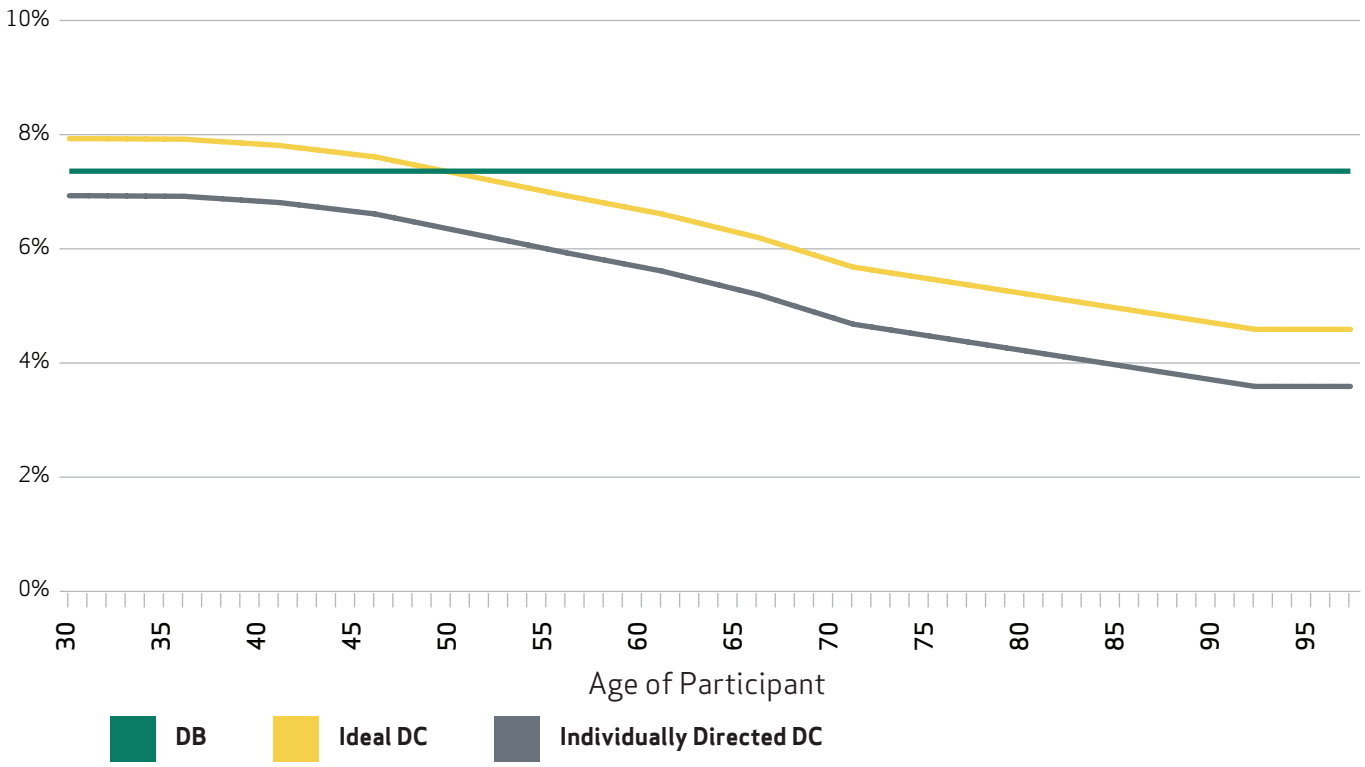
Figure 6 shows the expected net annual investment return by age for the DB plan and both DC plans. In our model, the well-diversified DB plan is expected to achieve investment returns of 7.36 percent per year, net of fees. The net returns for the ideal DC plan (modeled with the same expenses and investment skill assumptions as the DB plan, as we will later explain) show that while the typical TDF asset allocation glide path used for the DC plans in this study earns higher returns than the DB plan during the first half of a teacher's career, those returns drop below the DB plan when she is in her late 40s. To preserve her retirement wealth after she stops working, the teacher needs to reduce her exposure to equities even more. This results in a sacrifice of expected annual return of 2.8 percent by age 97. For detailed DB and DC asset allocation and projected gross investment returns, see Table A1 in the Technical Appendix.

We find that the shift in portfolio allocation has a modest, but nonetheless significant, effect on cost. Specifically, we find that the per-retiree amount that must be accumulated in the DC plan by retirement age now climbs to nearly $700,000. By comparison, the DB plan requires about $500,000. **After accounting for asset allocation in addition to longevity risk, contributions required to fund the target benefit now climb to 23.0 percent of payroll in the DC plans compared to 16.3 percent of payroll under the DB plan** (an increase of 41 percent). This summarizes the cost difference between the ideal DC plan and the DB plan. To arrive at the full cost difference for the individually directed DC plan, differences in investment expertise and expenses must also be taken into account.

Superior Net Returns Compared to Individually Directed DC Plan

In addition to asset allocation, another important reason why DB plans achieve higher investment returns than DC plans is that DB pension assets are pooled and professionally managed. Our model attributes a one percentage point "drag" on the investment returns in individually directed DC plans, based on fees and well-documented individual investor behavior.

Figure 6: **Expected Annual Investment Return (Net of Fees)**



Expenses paid out of plan assets to cover the costs of administration and asset management reduce the amount of money available to provide benefits. As a result, a plan that can keep these costs down will require lower contributions. By pooling assets, large DB plans are able to drive down asset management and other fees. For example, researchers at Boston College find that asset management fees average just 25 basis points (e.g., 0.25 percent) for public sector DB plans. By comparison, asset management fees for private sector 401(k) plans range from 60 to 170 basis points.[29] Thus, private DC plans suffer from a 35 to 145 basis point cost disadvantage, as compared with public DB plans. On their face, these differentials may appear small, but over a long period of time, they compound to have a significant impact. To illustrate, over 40 years, a 100 basis point difference in fees compounds to a 24 percent reduction in the value of assets available to pay for retirement benefits.[30]

TDF expenses vary depending on whether the underlying funds are actively managed or passively managed (e.g., index funds). A Morningstar survey found that new contributions to TDFs have been shifting towards the latter, and that asset-weighted expense ratio for TDFs in 2012 was 91 basis points, down from 1.04 percent in 2008.[31]

Administrative costs are largely driven by scale. Thus, a large DB plan or DC plan can have opportunities to negotiate minimized administrative expenses. A DC plan involves costs that do not exist in a DB plan, such as the costs of individual recordkeeping, individual transactions, and investment education to help employees make good decisions. However, DB plans, unlike DC plans, bear the administrative costs of making regular monthly payments after retirement.

But fees are only part of the story; differences in the way retirement assets are managed in DB and DC plans play a substantial role. As previously discussed, investment decisions in DB plans are made by professional investment managers, whose activities are overseen by trustees and other fiduciaries.

Research has found that DB plans have broadly diversified portfolios and managers who follow a long-term investment strategy.[32] We also know that the average individual in DC plans, despite their best efforts, often falls short when it comes to making sound investment decisions.

Furthermore, studies show that over the long term, individual investor level returns significantly lag behind the returns of any individual asset class or benchmark—largely due to inappropriate investment decisions.[33] For example, during the 2008 financial crisis, individual participants generally failed to re-balance their asset allocation, and those who did shift assets incurred significant losses by fleeing from equities near the bottom of the market.[34] In 2012 and 2013, investors pulled funds out of asset classes before they experienced price increases and into asset classes that were about to experience price drops.[35]

We assume no net disadvantage on the basis of fees or investor skill for the ideal DC plan compared to the DB plan. This is a generous assumption given real life experience with TDF use and with DC investor behavior in general.

We do, however, isolate the impact of expenses and fees from the impact of investment skill for the individually directed DC plan. We assume that a 40 basis point disadvantage in fees and an estimated 60 basis point disadvantage from individual investor "behavioral drag" total to a net 100 basis point (1.00 percent per year) disadvantage in individually directed DC plan investment returns. Although the data clearly support using a 125 basis point or more combined effect, we continue to use only a 100 basis point disparity, as was used in the 2008 study. The Technical Appendix explores the impact of other levels of disparity.

The 1.00 percent drag on individually directed DC plan returns compounds over time to create a significant cost disadvantage relative to the DB plan. In particular, we find that the amount which must be set aside for each individual at retirement age now climbs to about $800,000 (compared to the roughly $500,000 required in the DB plan). **Thus after accounting for differences in net returns due to investment expertise and fees—in addition to the longevity risk and asset allocation factors described above—the level of required contributions climbs again for the individually directed DC plan, this time to 31.3 percent of payroll, compared to 16.3 percent under the DB plan** (an increase of 91 percent).

Taken together, the economies that stem from investment pooling and longevity risk pooling can result in significant cost savings to employees and employers/taxpayers. **In our model, required contributions to fund a given level of retirement benefit are 48 percent lower in the DB plan compared with the individually directed DC plan, and 29 percent lower compared to the ideal DC plan.**

V. SUMMARY OF RESULTS: DB PLANS REDUCE COSTS BY NEARLY HALF

Our analysis clearly demonstrates that DB plans are far more cost-effective than DC plans. We find that to achieve roughly the same target retirement benefit that will replace 53 percent of final salary, the DB plan will require contributions equal to 16.3 percent of payroll, whereas the individually directed DC plan will require contributions to be almost twice as high as the DB plan—31.3 percent of payroll. Even the "ideal" DC plan, generously modeled with the same fees and investor skill as the DB plan—provides benefits at a substantially higher cost of 23.0 percent of payroll.

We find that due to the effects of longevity risk pooling, maintenance of portfolio diversification, and greater investment returns over the lifecycle, a DB plan can provide the same level of retirement benefits at about 29 percent lower cost than an ideal DC plan and about 48 percent lower cost than an individually directed DC plan.

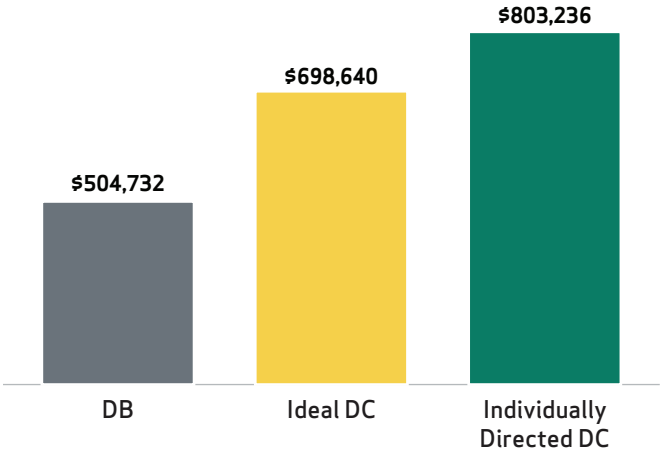
Table 1 breaks down the cost savings realized by the DB plan relative to the individually directed DC plan. First, the longevity risk pooling that occurs in the DB plan accounts for 10 percent cost savings. Second, DB plans' ability to maintain a more diversified portfolio drives another 11 percent cost savings. Third, superior net investments returns across the lifecycle generate an additional 27 percent reduction in cost compared to an individually directed DC plan—bringing the total cost savings to 48 percent.

Our results also indicate that DB plans can do more with less. That is, they can ensure that all individuals in the plan (even those with very long lives) are able to enjoy an adequate retirement benefit that lasts a lifetime, at the same time that they require less money to be contributed to a retirement plan and fewer assets to accumulate in the plan. We calculated the amount of money that would be required to be set aside for each retiree in each type of plan, to provide a modest retirement benefit of about $2,700 per month. As shown in **Figure 7**, at retirement age, the DB plan requires only about $500,000 to be set aside for each individual, whereas the ideal DC plan requires about $700,000 and individually directed DC plan requires about $800,000. The difference—about $200,000 and $300,000 for each and every employee under ideal DC plan and individually directed DC plan, respectively—illustrates that the efficiencies embedded in DB plans can yield large dollar savings for employers, employees and taxpayers.

Table 1: **Tallying DB Plan Cost Savings Compared to Individually Directed DC Plan**

Source	Savings
1. Longevity risk pooling	10%
2. Maintenance of portfolio diversification (staying invested in equities)	11%
3. Lower fees and professional management	27%
All-in cost savings in DB plan	**48%**

Figure 7:
Per Employee Amount Required at Age 62 DB Plan vs. DC Plan



Our findings indicate that DB plans provide a better bang for the buck when it comes to providing retirement income. We find that a DB plan can provide the same level of retirement income at almost half the cost of an individually directed DC plan. Even compared to an ideal DC plan with generous assumptions about fees and investor skill, a DB plan delivers the same benefit for 29 percent less cost. An analysis of the costs of providing benefits for a different population—male public safety workers—is provided in the Technical Appendix, and finds similar results. Hence, DB plans should remain a centerpiece of retirement income policy and practice, especially in light of current fiscal and economic constraints.

Impact of Annuitizing DC Account Balances

Although this is not common, some DC plans offer individuals the ability to purchase annuities at retirement. This has sometimes been cited as a solution to the longevity risk obstacle discussed previously, and would eliminate the risk of running out of money no matter how long an individual lives.

However, our analysis indicates that the purchase of annuities does not overcome the inherent shortfall of DC plans *vis-à-vis* DB plans. This occurs for three reasons. First, insurance companies have inherent costs that employer sponsored DB plans do not. These include profit margins, risk charges, marketing costs, administration costs, and other costs. Second, insurers have capital requirements which essentially mean that they typically invest in safer fixed-income securities, while ongoing DB plans can invest more heavily in equities and earn greater investment returns. And third, current interest rates are extraordinarily low, making annuity costs more expensive than during most historical periods. Fluctuating financial market conditions can result in wide disparities in annuity income among individuals retiring with similar accumulated account balances at different points in time.

Many experts believe that the current low interest rate environment will revert to normal, so we have modeled annuitization both at 2014 rates as well as at rates based on investment return 1.0 percent per year higher than currently available. **Table 2** compares the various alternatives.

Table 2. **Impact of Annuitization on DC Plan Funding Requirements**

Plan	Target Balance at Retirement	Required Contribution (Percentage of Payroll)
DB	$504,732	16.3%
Ideal DC (without annuities)	698,640	**23.0%**
Individually Directed DC (without annuities)	803,236	31.3%
Ideal DC with annuities – 2014 rates*	771,752	**25.4%**
Ideal DC with annuities – significantly improved rates	631,118	**20.9%**

*Average rates as of April 2014 from AnnuityShopper.Com, adjusted for projected mortality tables to age 62 female.

As can be seen from the table above, while annuities can completely resolve an individual's mortality risk, this insurance today comes at a significant cost. Many experts believe that the current low interest rate environment will not last forever. If this happens, annuities may become a more cost-efficient option, but the nature of third party private annuities will prevent them from becoming as efficient as well-managed DB plans.

VI. CONCLUSION

Despite notable changes in the retirement benefit landscape since 2008, including some improvement in DC performance and fees, DB pensions retain their cost advantage as a means of providing retirement benefits to workers. In this study, we compared the cost of providing equivalent benefits through a typical large public sector DB plan, an ideal DC plan, and an individually directed DC plan. Even compared to the ideal DC plan with no disadvantage in terms of fees and investor skill, the DB plan reduces costs based on longevity risk pooling and the maintenance of portfolio diversification. And when we examine the individually directed DC plan with more realistic assumptions regarding fees and investor skill, the DB plan realizes a hefty additional cost advantage due to its low expenses and professional management of assets.

The sources of cost savings in DB plans reflect, at a very basic level, the differences in how DB and DC plans operate. Group-based DB plans provide lifetime benefits and feature pooled, cost-efficient, professionally managed assets. These features drive significant cost savings that benefit employers, employees, and taxpayers. While well-designed DC plans can theoretically mimic some of these advantages—for instance, employers may select low-fee TDFs as a default investment option for their workers—DB plans would still retain their advantages of longevity risk pooling and long-term portfolio diversification. Using private annuities to convert DC account balances at retirement into a lifetime income stream does not close this gap because such annuities are expensive, especially when they include the kind of inflation protection offered by public DB plans.

When considering our results, it is important to keep in mind that in our effort to construct an "apples to apples" comparison, we made a number of simplifying assumptions that actually reflected more favorably on DC plans. For instance, we did not model any asset leakage from either the ideal or individually directed DC plan before retirement through loans or early withdrawals. We also assumed that individuals followed a sensible "Goldilocks-like" withdrawal pattern in retirement—not too fast, not too slow, but just right. We used conservative estimates of the difference in actual investment returns between DB and DC plans. And, we used 80th percentile life expectancy to project required accumulations in the DC plans, rather than "full" life expectancies.

Thus, if anything, our analysis underestimates the cost of providing benefits in a DC plan and thereby understates the cost advantages of DB plans.

Due to the built-in economic efficiencies of DB plans, employers and policymakers should continue to carefully evaluate claims that "DC plans will save money." As discussed, benefit generosity is a separate question from the economic efficiency of a retirement plan. While either type of plan can offer more or less generous benefits, DB plans have a clear cost advantage for any given level of retirement benefit. Consequently, shifting from a DB plan to a DC plan and maintaining the same contribution rate will generate significant cuts in retirement income. Considering the magnitude of the DB cost advantage, the consequences of a decision to switch to a DC plan could be dramatic for employees, employers, and taxpayers.

Finally, policymakers should consider proposals that can strengthen existing DB plans and promote the adoption of new ones. When viewed against the backdrop of workers' increasing insecurities about their retirement prospects and the economic and fiscal challenges facing employers and taxpayers, now more than ever, policymakers ought to focus their attention and energy on this important goal. The very features that make DB plans attractive to employees drive cost savings for employers and taxpayers. In this way, DB plans represent a rare "win-win" approach to achieving economic security in retirement that should be recognized and replicated.

TECHNICAL APPENDIX: CALCULATING THE COST SAVINGS EMBEDDED IN DB PLANS

Methodology

We calculate the cost, expressed as a level percent of payroll over a career, of achieving a target benefit in a typical DB plan and compare that with the cost of providing the same target benefit in a typical DC plan.

We begin by constructing a cohort of 1,000 newly-hired employees. For the purposes of simplicity, we give this cohort a common set of features. All newly-hired employees are age 30 on the starting date of their employment, and they are all female teachers. They work for three years and then take a two-year break from their careers to have and raise children. They return to work at age 35 and continue working until age 62. Thus, the length of the career is 30 years. By their final year of work, their salary has reached $60,000, having grown by 4 percent each year.

Modeling DB Plan Benefits and Costs

The DB plan provides a benefit in retirement equal to 1.85 percent of final average salary for each year worked. This represents the median benefit among DB plans covering public employees who are also covered by Social Security.[36] Final average salary is calculated on the basis of the final three years of one's career, which in this case is $57,722. Thus, the initial benefit in the DB plan is $32,036 per year or $2,670 per month.

The DB plan provides a cost of living adjustment that ensures the benefit maintains its purchasing power during retirement. Inflation is projected at 3.0 percent per year. Thus, each individual in our cohort will receive a benefit equal to 53 percent of her final year's salary that adjusts with inflation. This DB plan (in combination with Social Security) would allow an employee to meet generally accepted standards of retirement income adequacy, or roughly 83 percent of pre-retirement income.[37]

DB plans typically offer married participants the ability to receive joint-and-survivor annuity benefits, whereby when the retiree dies, her spouse can continue to receive a monthly benefit that will last the spouse's lifetime. But the retiree pays the cost of this survivor's benefit. That is, the monthly benefit that would be payable on a single-life basis will be reduced by an actuarially determined factor to account for the fact that payments may continue if the retiree dies before her spouse. Therefore, for simplicity, we model all benefit payouts on a single-life basis (and do the same for the DC plan), using the Generational RP-2014 Healthy Female Annuitants mortality table with projection under scale MP 2014 (hired in 2014 at age 30).[38]

In order to model the contributions that are required to fund these benefits, we start by establishing expected investment returns based on asset allocation. In order to construct the asset allocation for the DB pension, we drew on the latest available average public pension asset allocation data from surveys from a number of sources: Wilshire, Cliffwater, CEM Benchmarking, and NASRA/NCTR Public Fund Survey. In particular, these sources were used to set allocations to broad asset categories, such as domestic stocks, domestic bonds, global stocks, global bonds, private equity, real estate, other alternatives, and cash. For more detailed categories, we drew on proprietary data provided by CEM Benchmarking and discussions with Callan. The resulting asset allocations are listed in **Table A1**.

Our expected investment returns for each asset class are based on a weighted average of the rate of return projections in the 2014 Survey of Capital Market Assumptions conducted by Horizon Actuarial Services (**Table A1**).[39]

We estimate DB plan expenses of 45 basis points. A study from the Center for Retirement Research at Boston College found average expenses to be 43 basis points for public DB plans and 97 basis points for DC plans.[40] Census data from 2012 indicates 45 basis points for state-administered DB plans, inclusive of both investment and administrative expenses.[41]

Based on this methodology, the DB plan is expected to achieve nominal investment returns of 7.36 percent per year, net of

Table A1. **Plan Asset Allocation Assumptions and Projected Gross Returns**

Asset Class	Projected Long Term Returns	DB Plan	DC Plan Asset Allocation Glidepath by Age of Worker/Retiree										
			26	31	36	41	46	51	56	61	66	71	92
PUBLIC EQUITIES		**50.93%**	**89.20%**	**89.19%**	**89.16%**	**85.99%**	**79.95%**	**70.11%**	**61.37%**	**53.67%**	**43.26%**	**30.20%**	**0.00%**
US - Large Cap	8.5%	24.79%	54.05%	54.03%	54.10%	52.30%	48.60%	42.58%	37.29%	32.69%	26.49%	17.25%	–
US - Small Cap	8.9%	5.72%	8.31%	8.32%	8.28%	7.86%	7.27%	6.48%	5.67%	4.92%	3.80%	4.05%	–
Non-US - Developed	8.8%	13.94%	22.87%	22.88%	22.82%	21.95%	20.33%	17.82%	15.65%	13.64%	10.93%	8.28%	–
Non-US - Emerging	9.8%	6.47%	3.96%	3.96%	3.96%	3.89%	3.76%	3.22%	2.75%	2.41%	2.03%	0.62%	–
FIXED INCOME		**27.22%**	**9.63%**	**9.63%**	**9.67%**	**12.83%**	**18.85%**	**28.75%**	**37.56%**	**45.29%**	**55.74%**	**69.80%**	**100.00%**
US Corporate Bonds - Core	5.3%	12.91%	5.02%	4.89%	4.76%	7.23%	12.45%	21.38%	26.41%	28.04%	31.57%	39.20%	56.16%
US Corporate Bonds - Long Duration	5.9%	3.23%	–	–	–	–	–	–	–	–	–	–	–
US Corporate Bonds - High Yield	7.1%	3.46%	3.19%	3.20%	3.22%	3.21%	3.16%	2.95%	2.79%	2.63%	2.61%	–	–
Non-US Debt - Developed	4.8%	1.31%	1.00%	1.00%	1.00%	1.65%	2.40%	3.10%	3.85%	4.80%	6.20%	13.90%	19.91%
Non-US Debt - Emerging	6.6%	0.41%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.34%	0.35%	–	–
US Treasuries (Cash Equivalents)	4.1%	2.44%	0.06%	0.18%	0.33%	0.38%	0.42%	0.68%	3.66%	5.36%	7.45%	–	–
TIPS	4.6%	3.46%	0.02%	0.02%	0.02%	0.02%	0.08%	0.31%	0.52%	4.12%	7.57%	16.70%	23.93%
ALTERNATIVES		**21.88%**	**1.18%**	**1.19%**	**1.18%**	**1.18%**	**1.20%**	**1.15%**	**1.08%**	**1.04%**	**1.01%**	**0.00%**	**0.00%**
Private Equity	10.9%	8.25%	–	–	–	–	–	–	–	–	–	–	–
Real Estate	7.1%	7.09%	0.68%	0.68%	0.68%	0.68%	0.66%	0.60%	0.55%	0.52%	0.48%	–	–
Commodities	8.3%	1.88%	0.50%	0.51%	0.50%	0.50%	0.54%	0.55%	0.53%	0.53%	0.53%	–	–
Hedge Funds	7.5%	4.57%	–	–	–	–	–	–	–	–	–	–	–
TOTAL		**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**
GROSS RETURN		**7.81%**	**8.38%**	**8.38%**	**8.37%**	**8.26%**	**8.06%**	**7.72%**	**7.38%**	**7.06%**	**6.65%**	**6.13%**	**5.04%**
INFLATION ASSUMPTION	**3.0%**												

Totals may not add up exactly due to rounding.

fees. Readers should exercise caution in comparing this rate of return to expected returns reported by individual public pension funds, because funds tend to use higher inflation assumptions in their forecasting. We used an inflation assumption of 3.0 percent in this study for benefit increases as well as for capital market expectations.

On the basis of these inputs, we calculate the contribution that will be required to fund this benefit through the DB plan over the course of a career, and express this as a level percent of payroll. We find that the cost to fund the target retirement benefit, smoothed over a career, comes to 16.3 percent of payroll. Contributions could be made entirely by the employer or, given public sector regulations, may be split between the employer and employee.

Modeling DC Plan Benefits and Costs

Modeling the cost of the target retirement benefit in the DC plan requires some adjustments based on what we know about how DC plans differ from DB plans. First, because employees are not provided with an annuity benefit at retirement under the DC plan, we determine the size of the lump sum amount that an individual would need to accumulate by their retirement date in order to fund a retirement benefit equivalent to that provided by the DB plan (including inflation adjustments) for a period of 35 years, or to age 97. This represents the 80th percentile life expectancy of female teachers who are now 30 years old when they retire at age 62. It corresponds to the age beyond which 20 percent of individuals survive, and therefore still poses a significant risk to DC participants of outliving their savings. In fact, our mortality table indicates that one individual out of 1,000 will survive to 110.

Thus our model underestimates the cost of funding retirement benefits through a DC plan: one out of five individuals will experience a reduced standard of living, compared to what they would experience under a DB plan. These individuals would be likely to respond to a long life by gradually reducing their withdrawals from the plan to avoid the possibility of having their retirement income reduced to zero.

We assumed that the DC plan would be invested in a TDF, which automatically adjusts asset allocation from stocks to bonds as a worker approaches retirement. We estimated the asset allocation glide path of TDFs from Vanguard and Fidelity, from age 30 to age 71, based on data for multiple target date funds ranging from 2010 to 2045. These TDFs are set for target retirement dates spaced 5 years apart. Then we averaged the asset allocations from the two providers, which together represent the majority of assets in the TDF market.[42] See **Table A1** for the asset allocation trajectory.[43]

To model the impact of the shift to a more conservative portfolio allocation beyond age 71, we have individuals begin to shift their portfolio allocation to gradually reduce the share held in equities to zero and increase the holdings of cash and liquid investments, treasuries and agency debt, and corporate bonds to 100 percent by age 97. The investment/withdrawal strategy we model is not the result of an optimization rule; rather, it follows ad hoc rules.

Finally, in order to arrive at gross returns for each plan, we applied estimates of long-term returns for each asset class from a capital market assumptions survey.[44]

Withdrawals are designed to mimic DB plan payouts, at least in the early years of retirement, declining in later years. Work by William Sharpe and colleagues suggests that an optimal approach would integrate investment and withdrawal strategies. Specifically, they find that a constant withdrawal rate must be paired with a riskless investment strategy in order to be optimal for an individual.[45] However, a post-retirement asset allocation entirely concentrated in risk-free assets would dramatically drive up the cost of the DC plan. Thus our model's ad hoc investment and withdrawal strategies would tend to understate the cost advantage of DB plans.

We developed estimates of DC plan costs and expected returns based on a review of existing research. Again, the Center for Retirement Research study cited above found average expenses to be 95 basis points for DC plans.[46] Callan researchers recently found asset-weighted expenses for large institutional mutual funds in DC plans to be 85 basis points; this estimate does not include employer expenses, particularly administrative expenses.[47] The Teachers Retirement System of Texas, which conducted an in-depth retirement benefit design study, estimated total expenses of 47 basis points for its DB plan and 93 basis points for an individually directed DC plan based on plan administrative data.[48]

Although not inclusive of all expenses or exclusive to DC plans, it is worth noting that a Morningstar study reported an average of 91 basis points for TDFs in 2012.[49] Fees range widely for TDFs, and DC funds in general, depending on whether they are actively managed or rely on low-cost index funds. The fund expense ratio for a typical Vanguard TDF is about 16 basis points (not including any load or employer expenses). The typical Fidelity TDF is invested in over two dozen mutual funds, most of them actively managed, and has an expense ratio of about 77 basis points—again, not including employer expenses.[50] A Morningstar survey found that asset-weighted expense ratio for TDFs in 2012 was 91 basis points, down from 1.04 percent in 2008.[51]

We assumed that in an ideal DC plan, the plan sponsor would drive down expenses and that investments would effectively be limited to low-cost TDFs. Thus we assumed only 45 basis points, the same total costs as a DB plan. However, for the individually directed DC plan, we chose an optimistic estimate of 85 basis points for investment and administrative expenses, given that this is the asset-weighted fee average exclusive of employer expenses from the above-cited studies.

We also assumed that participants in an individually directed DC plan would earn lower returns than the DB or ideal DC plan, due to well-documented mistakes related to asset allocation and market timing decisions—for example, investing too much or too little in stocks, and reacting emotionally to market fluctuations by selling assets as prices fall and buying back into the market as prices rise.[52] In addition to behavioral finance studies, key studies indicate that individual investor returns lag behind market returns. This is not a significant problem for pension funds because they are managed by professionals who exercise discipline in the face of market fluctuations. However, investor-level data shows that individuals earn returns significantly below the returns posted by the funds in which they invest.[53]

Estimates of this gap vary depending on the market cycles captured in the time frame, but most studies that cover a long time frame show significant under-performance by individual investors. For instance, a Morningstar study found that investors lagged mutual fund returns by .95 percentage points in the 10 years ended 2012, and 2.49 percentage points in the 10 years ended 2013. The study also examined net flows in and out of each asset class, and found that funds tended to flow out before prices rose, and to flow in before prices fell.[54]

We optimistically assume a modest behavioral drag effect of 60 basis points for the individually directed DC plan, although a significantly larger effect is justified by the data cited above. Combined with higher fees, this means a lag of 100 basis points, or 1.00 percentage point, for net investment returns for the individually DC plan compared to the DB plan and ideal DC plan. This differential is assumed to persist from working years through retirement, so the return disadvantage compounds on top of the gradual shift in portfolio allocation. (We calculate the impact of each effect separately to avoid double counting.)

Our model does not include important additional differences between DB and DC plans, such as the "leakage" of assets from DC plans through loans or early withdrawals, two features which are rare in DB plans. Nor does it analyze the effects of ups and downs in financial markets and the impact that these have on investment returns and costs in both DB and DC plans over a career. Also, the fact that in DC plans some individuals will have "better luck" with investing than others means that individuals' retirement prospects will exhibit a wider dispersion than what is predicted by our model. The 2012 Texas TRS plan design study, for instance, estimated that participants in an individually directed DC plan would have a 66 percent chance of having less than 62 percent of the benefit offered by the DB plan with the same contributions.[55]

Sensitivity Analyses

Impact of Expense and Fee Differential

The analysis above assumed that due to the combined effect of higher expenses and drag on investment returns resulting from typical investor behavior, an individually directed DC plan would have a 100 basis point (1.00 percent) disadvantage compared to both the ideal DC plan and the DB plan. As discussed above, studies of individual investor level returns seem to indicate a higher differential, while some sources may assert a differential in overall net returns of less than 1.00 percent. Consequently, we have expanded our analysis to consider the impact of higher and lower disparities of 0.50, 1.25, and 1.50 percent. The findings are summarized in **Table A2**.

Table A2. **Impact of Different Expense and Behavioral Drag on Plan Funding Requirements**

Combined Excess Fees and Behavioral Drag	Plan	Target Balance at Retirement	Required Contribution (Percent of Payroll)
None	DB	$504,732	16.3%
None	Ideal DC	698,640	23.0%
1.00%	Individually Directed DC	803,236	31.3%
Alternate Scenarios			
0.50%	Individually Directed DC	748,137	26.8%
1.25%	Individually Directed DC	833,121	33.8%
1.50%	Individually Directed DC	864,702	36.6%

Impact of Lower- or Higher-than-Expected Returns

The analysis has assumed that each year's annual investment return is exactly that which is expected. In practice, returns will not be that stable, particularly in the years when significant assets are invested in equities. While the long-run returns are expected to average out to those assumed, there is a possibility that they would fall short. For a typical DB plan with a typical asset allocation, which is expected to return approximately 7.5 percent over thirty years, there is about a 25 percent probability that returns will fall below 6.0 percent and about a 25 percent probability that returns will exceed 9.0 percent. DC plans would have a similar deviation when invested significantly in equities. Once the individual retires and trims equity exposure, volatility declines.

The ramifications of higher or lower returns are complex. Let us analyze the event where returns from age 30 to 45 are as expected, but returns from 45 to 75 are either 1.5 percent higher or 1.5 percent lower than expected.

Under a DB plan, if returns average 6 percent for this period of thirty years, there would be a shortfall of $120,000 per retiree at age 75. This would create an unfunded liability which would require additional contributions. In practice, the DB plan would begin to fund for this unfunded liability shortly after it began at age 45. Using traditional actuarial funding methods, contributions would grow from 16.3 percent of pay from ages 30 to 45 up to 29 percent at age 62 and continue at this level beyond age 62.

On the other hand, if returns average 9 percent for this period of thirty years under a DB plan, there would be a surplus at age 75. This would result in reduced contributions. In practice, the DB plan would begin to reduce contributions shortly after the surplus begins at age 45. Using traditional actuarial funding methods, contributions would drop from 16.3 percent of pay from ages 30 to 45 to zero at age 62 and actually generate an offset to future contributions beyond age 62.

If returns are 1.5 percentage point lower than expected under a DC program, then four possible outcomes can occur. First, the individual could work longer to try to accommodate the target retirement benefit levels. Second, the individual can taper back their withdrawals during retirement, resulting in reduced income. Third, the individual can run out of money and hope for another source of income. Fourth, the individual can also change their asset allocation in hope of high returns which would help catch up for the shortfall, but we do not model this option because it is essentially a gamble with very different possible outcomes.

Table A3. **Comparison of Retirement Income Generated by a Fixed Contribution Rate**

Plan	Balance at Retirement	Monthly Benefit as Percentage of Final Pay
DB	$504,732	53%
Ideal DC	$496,902	38%
Individually Directed DC	$419,579	28%

In the individually directed DC case, an individual who had 1.5 percentage point inferior return beginning at age 45 would find at age 62 that they are short of their $800,000 needs by approximately $140,000. In order to meet their retirement needs, they would need to continue working to age 66. But unbeknownst to them, they still have nine years ahead of them of inferior returns. They could also merely reduce their annual withdrawals by 17 percent. The other extreme is that they simply keep their fingers crossed, but if returns continue as outlined above, they would run out of retirement funds at age 86 rather than age 97 as targeted. This means that instead of only a 20 percent likelihood of outliving their savings, there is a 63 percent likelihood.

If returns are superior by 1.5 percent under the individually directed DC plan, then the alternatives are much more palatable. The individuals can begin to reduce savings amounts, can retire earlier, can pay themselves a higher monthly retirement benefit, or can leave more to their heirs. This analysis will not address these fortunate alternatives.

Benefit Comparison with Constant Contributions

Our analysis has assumed that employers are targeting an acceptable level of retirement income, then solving to determine the contributions necessary to produce such an income level. This illustrated that a DB plan can produce a given level of benefits at a 48 percent cost reduction from individually directed DC plans. (This is an important consideration, given that discussions of retirement benefit targets are often absent from discussions of DB and DC plan costs.) But in the real world, employers rarely implement a DC plan and increase contributions. A more germane analysis would look at the reduced level of benefits that would result from switching from a DB pension to a DC plan while maintaining the same contribution rate. As **Table A3** shows, a fixed contribution rate of 16.3 percent of pay generates substantially lower retirement benefits in the ideal DC plan and the individually directed DC plan, compared to the DB plan.

Benefit Cost Comparison for Male Public Safety Workers

One workforce segment which very often is covered by DB plans is public safety. Police officers and firefighters throughout the US tend to have DB coverage, either through a statewide pension plan or a local plan. These workers generally retire from service at younger ages than other workers and are usually not covered by Social Security, and thus have higher benefit multipliers. As another test of the DB plan efficiency, we modelled a male firefighter retiring at age 55 after 25 years of service. This firefighter was assumed to have final earnings of $80,000 and a benefit of 2.5 percent of pay per year of service.

Our findings for male public safety workers, shown in **Table A4**, are very similar to those for female schoolteachers discussed above. The DB plan is 27 percent less expensive than the ideal DC plan and 46 percent less expensive than the individually directed DC plan.

Table A4. **Comparison of DB vs. DC Plan Costs for Teachers and Firefighters**

Model Parameters and Results	**Teacher**	**Firefighter**
Gender	Female	Male
Hire Age	30	30
Retirement Age	62	55
Service at Retirement	30 (excl. two year break)	25
Salary at Retirement	$60,000	$80,000
Benefit Multiplier	1.85% per year	2.50% per year
Covered by Social Security	Yes	No
Initial Monthly Benefit at Retirement	$2,670	$4,008
Median Life Expectancy at Retirement	90	87
80th Percentile Life Expectancy at Retirement	97	94
Balance Required at Retirement – DB Plan	$504,732	$810,930
Annual Contribution Required (as a Percentage of Payroll) – DB Plan	16.3%	26.1%
Balance Required at Retirement – Ideal DC Plan	$698,640	$1,132,456
Annual Contribution Required (as a Percentage of Payroll) – Ideal DC Plan	23.0%	35.9%
Balance Required at Retirement – Individually Directed DC Plan	$803,236	$1,326,386
Annual Contribution Required (as a Percentage of Payroll) – Individually Directed DC Account	31.3%	48.1%
DB Cost Savings as a Percentage of Ideal DC cost	29%	27%
DB Cost Savings as a Percentage of Individually Directed DC cost	48%	46%

ENDNOTES

1 B. Almeida and W.B. Fornia, 2008, "A Better Bang for the Buck: The Economic Efficiencies of Defined Benefit Pension Plans," National Institute on Retirement Security, Washington, DC.

2 The benefit factor could also be a function of a worker's earnings over their entire career (a so-called "career average plan.") Or, the factor could be a flat dollar amount: for example, the plan will pay a monthly benefit equal to $50 per year of service, so that a 30 year employee would have a benefit of $1,500 per month. "Flat dollar" plans are primarily seen among blue-collar workers in the private sector.

3 Inflation protection varies among DB pensions. Private DB pensions typically do not offer Cost of Living Adjustments, while public DB pensions usually offer some level of inflation protection.

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5 While not incorporated into our model, the lack of sufficient contributions can be a problem for DB plans and is a widespread problem for voluntary DC accounts. The median 401(k) contribution rate among participating workers peaked at 5.2 percent in the early 2000s, and stood at just 5 percent in 2010. (See Table 6, p. 44 in B.A. Butrica and K.E. Smith, 2012, "401(k) Participant Behavior in a Volatile Economy," CRR WP 12-24, Center for Retirement Research at Boston College, Chestnut Hill, MA.) In addition, 29 percent of private sector wage and salary employees who have access to a 401(k) type plan do not participate (U.S. Bureau of Labor Statistics (BLS), 2013 National Compensation Survey Employee Benefit Survey, BLS, Washington, DC, http://www.bls.gov/ncs/ebs/benefits/2013/ownership/private/table02a.htm.)

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11 See N. Rhee, 2013, "Pensionomics 2014: Measuring the Economic Impact of DB Pension Expenditures," National Institute on Retirement Security, Washington, DC, pp. 2-3.

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15 National Association of State Retirement Administrators (NASRA), 2011 (Oct.), "Public Pension Plan Investment Returns," *NASRA Issue Brief*, NASRA, Washington, DC; NASRA, 2014 (Apr.), "Public Plan Investment Assumptions," NASRA Issue Brief, NASRA, Washington, DC.

16 A GAO study found that "some sponsors faced challenges in understanding the fees they and their participants were charged." U.S. Government Accountability Office, 2012, "Increased Educational Outreach and Broader Oversight May Help Reduce Plan Fees," GAO-12-345, GAO, Washington, DC, n.p.

17 Investment Company Institute, 2014 (Jul.), "The Economics of Providing 401(k) Plans: Services, Fees, and Expenses, 2013," *ICI Research Perspective*, v20n4.

18 Department of Labor regulations released in 2007 (29 CFR Part 2550) eased the way for employers to assign TDFs as default investment vehicles in participant-directed DC plans.

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22 HR consulting firm Aon Hewitt and financial services firm Fidelity Investments both estimate that a typical worker will need to replace 85 percent of income to maintain their standard of living in retirement. (Aon Hewitt, 2012, "The Real Deal: 2012 Retirement Income Adequacy at Large Companies"; Fidelity, 2012 (Feb. 27), "How much do you need to retire?," https://www.fidelity.com/viewpoints/personal-finance/8X-retirementsavings.) Although rigorous studies generally place target replacement rates for middle income workers and households in the 70-80 percent range, most do not account for long term care costs in retirement. Notably, the Center for Retirement Research estimates that the target replacement rate for a dual-income couple in the middle third of the income distribution increases from 76 percent to 98 percent when long term care is included. (A.H. Munnell, A. Webb, F. Golub-Sass, and D. Muldoon, 2009, "Long-Term Care Costs and the National Retirement Risk Index," Issue Brief 9-7, Center for Retirement Research at Boston College, Chestnut Hill, MA.

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26 This analysis does not address the issue of underfunded DB plans, nor does it address another factor which is particularly important in the discussion of DC investments—the degree to which adequate contributions are made by employees and contributions and investment earnings remain in the plan until retirement. This is a concern in most DC plans, where employees can borrow from their retirement account or take money out before retirement age (with the attendant tax penalties). This problem of "leakage" from DC plans has been well-documented and is receiving more attention by researchers and policymakers. See C. Weller, and J. Wenger, 2008, "Robbing Tomorrow to Pay for Today: Economically Squeezed Families are Turning to their 401(k)s to Make Ends Meet," CAP Economic Policy Report, Center for American Progress, Washington, DC; and M. Fellowes and K. Willemin, 2013, "The Retirement Breach in Defined Contribution Plans: Size, Causes, and Solutions," HelloWallet.com.

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