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Tontine Pensions Could Solve the Chronic Underfunding of State and Local Pension Plans[1]

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1. Introduction

Tontines are investment vehicles that can be used to provide retirement income.[2] Basically, a tontine is a financial product that combines features of an annuity and a lottery (Forman & Sabin, 2015).[3] In a simple tontine, a group of investors pool their money together to buy a portfolio of investments, and as investors die, their shares are forfeited, often with the entire fund going to the last surviving investor. Over the years, this last-survivor-takes-all approach has made for some great fiction. For example, in an episode of the popular television series "M*A*S*H," Colonel Sherman T. Potter, as the last survivor of his World War I unit, got to open the bottle of French cognac that he and his fellow doughboys brought back from France (and share it with his Korean War compatriots).[4]

Of course, the *survivor principle*—that the share of each, at death, is enjoyed by the survivors—can be used to design a variety of financial products that would benefit multiple survivors, not just the last survivor. For example, in the 17th and 18th centuries, many European governments used multibeneficiary tontines to raise money (Cooper, 1972; McKeever, 2009). Similarly, elsewhere, we have described how tontines could be used to create so-called *tontine annuities*, *tontine pensions*, and *survivor funds* that would benefit many retirees (Forman & Sabin, 2016; Forman & Sabin, 2015; Sabin, 2010).

In this paper, we explain how tontine pensions could solve the chronic underfunding of large public pension plans like the California State Teachers' Retirement System (CalSTRS). CalSTRS is the largest educator-only pension in the world, with $225.3 billion in assets as of December 31, 2017 (California State Teachers' Retirement System, 2018a). One of the largest programs that CalSTRS administers is its traditional defined benefit retirement plan (California State Teachers' Retirement System, 2018b). Unfortunately, like so many other traditional

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[2] Tontines are named after Lorenzo de Tonti, the 17th-century Italian who came up with the idea (Milevsky 2015, p. 42).

[3] An annuity is a financial instrument (e.g., an insurance contract) that converts a lump sum of money into a stream of income payable over a period of years, typically for life. The person holding an annuity is called an annuitant.

[4] *M*A*S*H: Old Soldiers* (CBS television broadcast Jan. 21, 1980). Similarly, in the reality television show *Survivor*, contestants are stranded in a remote location, and the last "survivor" gets a million-dollar prize. *Survivor (2000–)*, IMDb, http://www.imdb.com/title/tt0239195/ (last visited Jan. 20, 2018).

defined benefit plans, the CalSTRS traditional defined benefit plan is underfunded; for example, as of June 30, 2016, it was just 61.9 percent funded, with an unfunded liability of $101.6 billion (Milliman, 2017, p. 14). While replacing the CalSTRS traditional defined benefit plan with a tontine pension would do nothing to reduce that $101.6 billion obligation, it would ensure that California would never again have to worry about underfunding attributable to future benefit accruals. One approach would be for California to freeze its current CalSTRS defined benefit plan and add a new tontine pension for all future benefit accruals. At retirement, beneficiaries would then receive the defined benefit plan benefits that they have already accrued, but they would not accrue any additional benefits under their traditional defined benefit plan; instead, future contributions would be made to the new tontine pension.

At the outset, part 2 of this paper explains how tontine pensions would work, and part 3 designs a model tontine pension for a large employer and then uses a computer simulation to see what kind of tontine pension benefits the participants could expect to receive. Finally, part 4 explains how a tontine pension could be used to replace an underfunded pension plan like the CalSTRS traditional defined benefit plan.

2. Tontine Pensions

After discussing the survivor principle, this part explains how to design a tontine fund, a tontine annuity, and finally, a tontine pension.

2.1 The Survivor Principle

In a simple tontine, members contribute equally to buy a portfolio of investments that is awarded entirely to the last surviving member (Cooper, 1972, pp. 1−2). Alternatively, each time a member of a tontine pool dies, her account balance could be divided among the surviving members of the pool. This latter type of tontine could be used to develop new financial products that would provide reliable, pension-like income for retirees. The key point is that variations on the survivor principle—that the share of each, at her death, is enjoyed by the survivors—can be used to create a variety of attractive retirement income financial products (Forman & Sabin, 2016; Forman & Sabin, 2015; Sabin, 2010; Milevsky & Salisbury, 2015; Goldsticker, 2007; Newfield, 2014).

At the outset, imagine that 1,000 65-year-old retirees each contribute $1,000 to an investment fund that purchases a $1,000,000 Treasury bond paying 4 percent interest coupons. The bond will generate $40,000 interest per year, which will be split equally among the surviving participants. A custodian holds the bond, and because the custodian takes no risk and requires no capital, the custodian charges a trivial fee. Assuming that all the investors live through the first year, they will each receive a $40 dividend from the fund ($40 = $40,000 / 1,000). If only 800 original investors are alive a decade after the tontine started (when the survivors are 75), then each will receive a $50 dividend ($50 = $40,000 / 800). If only 100 are alive two decades after that (when the survivors are 95), then each will receive a $400 dividend ($400 = $40,000 / 100). Later, when only 40 remain, each will receive a $1,000 dividend ($1,000 = $40,000 / 40). If the terms of the tontine call for liquidation at that point, then each of the 40 survivors would also receive a liquidating distribution of $25,000 ($25,000 = $1,000,000 / 40). Alternatively, the tontine could be designed so that the last survivor receives the entire $1,000,000.

Most retirees would likely prefer to have reasonably level benefits throughout their retirement years, rather than benefits that increase sharply at the very end of their lives. Accordingly, it would make sense to design tontine financial products with benefits that are level throughout retirement (like an immediate, level-payment annuity) or alternatively, that increase gradually throughout retirement (like an immediate, inflation-adjusted annuity). Of particular note, unlike these conventional annuities—which have to support insurance agent commissions and insurance company reserves, risk-taking and profits; an early death in a tontine only benefits other investors, not some opportunistic insurance company; and that should make tontines very popular.[5]

2.2 A Tontine Fund

In a simple tontine, when a member dies, the balance in her account (i.e., her contribution plus investment earnings) is distributed to the surviving members of the tontine pool as "mortality gains." In a simple tontine, those forfeitures are divided equally among the survivors. Unfortunately, that approach results in an unfair situation—for example, because it favors younger members who are likely to live longer and receive more distributions.

In a tontine fund with participants who have differing ages, genders and investment levels, the surviving members should *not* get equal portions of a dying member's balance. Instead, the distributions should be made in unequal portions, carefully chosen to provide fair bets for all investors. In short, a tontine fund should be governed by a *fair transfer plan* (FTP) that takes into account each member's life expectancy (i.e., death probability) and her investment level (Forman & Sabin, 2015, p. 776). In the following section we describe how such a fair tontine fund would be designed.

2.2.1 A Fair Transfer Plan

We can design a fair transfer plan (FTP) to build a tontine fund that provides fair bets for all investors. The concept is straightforward: members join the tontine fund by contributing a desired amount, and each time a member dies, her contribution (and investment earnings) is distributed to the surviving members according to a fair transfer plan. New members may join at any time, by making a contribution of a desired amount; however, no member may withdraw her contributions (or investment earnings), ever.[6] Structured in this way, a tontine fund could operate into perpetuity.

2.2.1.1 Tontine Funds Can Be Fair to Members of Different Ages

Tontine funds can easily be designed to be fair to members of different ages. For example, Table 1 illustrates a tontine fund with just four members of different ages. To keep this example as simple as possible, we assume that each member *i* has contributed $1,000 to the fund and that contributions do not earn any interest, and we use unisex life tables rather than gender-based life tables (Social Security Administration 2013). For example, member 4 in Table 1 is an 80-year-

[5] For example, Professor Suzanne Shu suggests that a tontine for one's fellow firefighters will be perceived as fairer than the typical commercial annuity that they could buy from an insurance company: with a commercial annuity, an early death seems to benefit the insurance company, but with a tontine, an early death benefits fellow firefighters. (Benartzi, 2010, p. 15).

[6] The situation is identical to a conventional life annuity: once the premium is paid, there is no refund of it, ever.

old who has a life expectancy (e_i) of 8.95 years, and a 5.2 percent chance of dying before reaching age 81 (i.e., a death probability, q_i, of 0.051906).

Table 1. A Tontine Fund With Four Members of Different Ages, Unisex

Member (i)	Age (x)	Life Expectancy (years) (e_i)	Death Probability (q_i)	Force-of-Mortality Probability (f_i)	Fair-Transfer-Plan Weight (w_i)
1	65	18.88	0.013181	0.013269	0.053815
2	70	15.22	0.020314	0.020523	0.086183
3	75	11.89	0.032111	0.032638	0.146795
4	80	8.95	0.051906	0.053302	0.713207

Source: Authors' computations based on data from Social Security Administration, November 2013, United States life table functions and actuarial functions at 2.9 percent interest for unisex in calendar year 2009 based on the Alternative 2 mortality probabilities used in the 2013 Trustees Report, personal communication.

Table 1 also shows a parameter known as the *force-of-mortality probability* (f_i). Here is the logic. Suppose that at time t a member of the pool dies. Pretend that we do not know which member has died at time t; we only know that some member has died. The force-of-mortality probabilities indicate the relative probability of death for each member of the pool. If, at the instant in time that a member has died, one member has a force-of-mortality probability with a value f, and another has a value $2f$, then the second member is twice as likely as the first to be the one who died. In Table 1, for example, member 4 (our 80-year-old) is quite clearly the member who is the most likely to die. These force-of-mortality probabilities (f_i) are relatively easy to compute from the death probabilities (q_i) in a mortality table (Forman & Sabin, 2015, p. 777, n.111).

Table 1 also shows another parameter that we call the *fair-transfer-plan weight* (w_i). Here is the logic. When a member of a tontine fund dies, she forfeits her entire contribution, and that contribution is divided among the surviving members, with each surviving member receiving some fraction of the decedent's account. More specifically, if member j dies, each surviving member i would receive some fraction of j's \$1,000 contribution: mathematically, the fraction that each member i would receive of member j's contribution (s_j) is equal to $w_i / (1 - w_j)$, for $i \neq j$. The fair-transfer-plan weights (w_i) are positive values that sum to 1, so the denominator ($1 - w_j$) is the sum of all fair-transfer-plan weights (w_i) except that of member j. Meanwhile, member j would forfeit her entire \$1,000 contribution. The fair-transfer-plan weights are calculated to provide fair bets for all investors. These fair-transfer-plan weights are relatively easy to compute from the force-of-mortality probabilities (f_i) (Forman & Sabin, 2015, p. 778, n.112).

For example, if member 4 (the 80-year-old) is, in fact, the one who dies next, then member 1 (the 65-year-old) would receive \$187.64 = \$1,000 × $w_1 / (1 - w_4)$ = \$1,000 × 0.053815 / (1 – 0.713207), member 2 (the 70-year-old) would receive \$300.51 = \$1,000 × $w_2 / (1 - w_4)$ = \$1,000 × 0.086183 / (1 – 0.713207), member 3 (the 75-year-old) would receive \$511.85 = \$1,000 × $w_3 / (1 - w_4)$ = \$1,000 × 0.146795 / (1 – 0.713207), and, of course, member 4 would

forfeit her $1,000.[7] We call the distributions to members 1, 2, and 3 *mortality-gain distributions*; meanwhile, member 4 has a mortality loss.

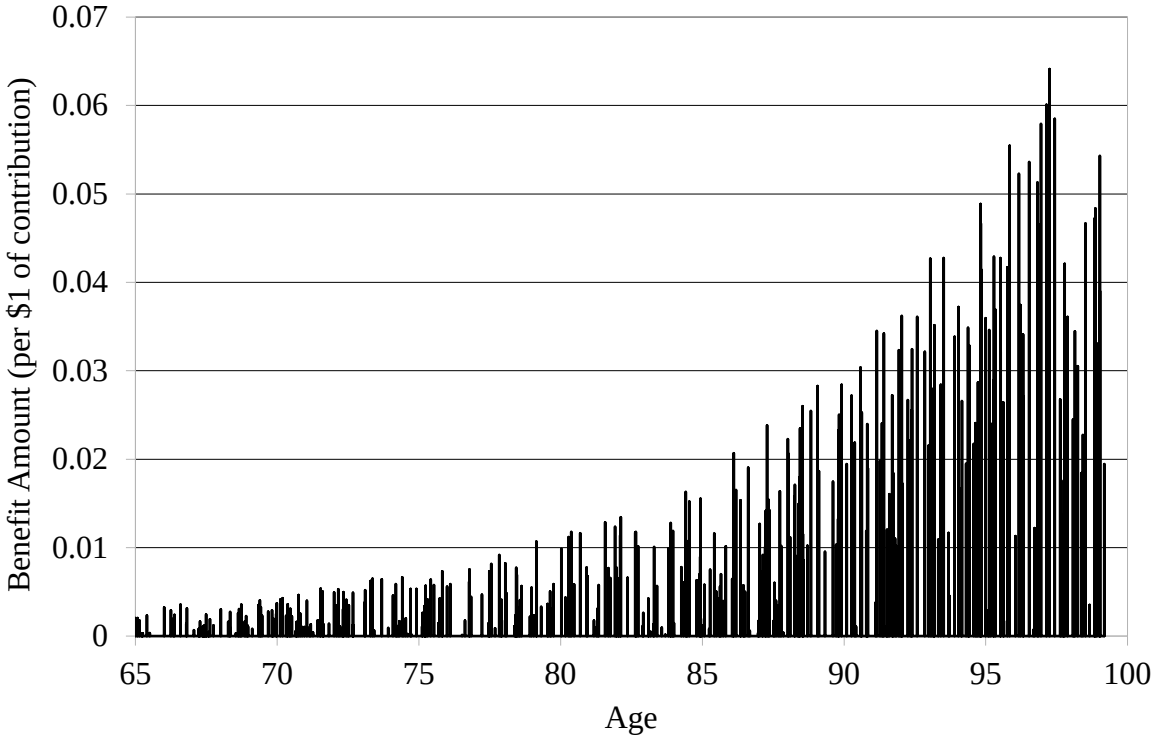
2.2.1.2 Tontine Funds Can Be Fair to All Investors

Tontines can also be designed to take gender into account, to take differing levels of contributions into account and to properly account for investment earnings (Forman & Sabin, 2015, pp. 780–786). To be sure, those who survive the longest would get better than average returns (i.e., mortality gains), while those who die young might not even recover their initial investments (i.e., mortality losses). On average, however, each member could expect to recover her initial contribution and any returns on that investment (less only a modest management and record-keeping fee).

For example, Figure 1 shows a computer simulation of how a tontine fund with around 220 members might work. This simulation was designed by creating a tontine fund where one new member joins each month. Each new member's gender was randomly selected, equiprobably male or female; each new member's age was exactly 65; that is, his or her 65th birthday coincided with the joining date; and each member's contribution was a randomly selected amount between $100 and $100,000. The number of members grows for several decades until it reaches an equilibrium of about 220 members, where, on average, one member dies each month, offsetting the new member who joins each month. Figure 1 shows the mortality gains that a typical long-lived male could expect after that equilibrium has been reached.

[7] Checking our answer, $187.64 + $300.51 + $511.85 = $1,000.

Figure 1. Normalized Mortality Gain From Fair Transfer Plans Versus Age for a Typical Long-Lived Male Member in a Simulated Tontine Fund



Source: Sabin, Michael J., 2010, Fair tontine annuity, p. 25, fig. 5.

More specifically, Figure 1 plots the mortality-gain distributions paid to one of the longer-lived male members in the simulation (normalized to a contribution of $1). The plot began at the member's joining age, 65, and ended at the time of his death. As the plot shows, benefits would be received at random times (i.e., at other members' deaths) and in random amounts (i.e., varying with the contributions of the dying member). The average value of his benefit would increase with age, since the member's own death probability (q_i) and, consequently, his fair-transfer-plan weight (w_i) would increase with his age.

2.2.2 Two Problems with a Tontine Fund

Two features of the tontine fund in Figure 1 stand out as serious negatives. First, mortality-gain distributions vary dramatically both in amount and timing, because they depend on when members die and on how much those dying members had contributed: in short, payouts are noisy. Second, a member's mortality-gain distributions start out slow and low but increase rather

dramatically at advanced ages, as the member's death probability (q_i) increases with age: in short, payouts are backloaded.

2.2.2.1 Reducing the Noisiness of a Tontine Fund

The noisiness of a tontine fund can be reduced by (1) making *monthly* mortality-gain distributions (rather than as each death occurs) and (2) having a large number of members in the fund. For example, Table 2 shows a sample monthly statement for a member of a 5,000-person tontine fund who had contributed $250,000 to a tontine fund and who lived through the month. This member would get a single end-of-the-month distribution of $1,041.67, rather than getting varying amounts throughout the month.

Table 2. Sample Monthly Tontine Fund Statement for a Living Member

Date	Amount ($)	Balance ($)	Description
03/31		250,000.00	
04/02	67.17	250,067.17	Proceeds from FTP
04/03	25.21	250,092.38	Proceeds from FTP
04/05	55.14	250,147.52	Proceeds from FTP
04/07	135.41	250,282.93	Proceeds from FTP
04/07	48.91	250,331.84	Proceeds from FTP
04/12	52.29	250,384.13	Proceeds from FTP
04/15	102.54	250,486.67	Proceeds from FTP
04/20	159.46	250,649.13	Proceeds from FTP
04/21	139.68	250,785.82	Proceeds from FTP
04/22	17.82	250,803.63	Proceeds from FTP
04/25	124.81	250,928.44	Proceeds from FTP
04/28	55.32	250,983.76	Proceeds from FTP
04/30	57.91	251,041.67	Proceeds from FTP
04/30	(1,041.67)	250,000.00	Payout of FTP proceeds

Source: Forman, Jonathan Barry, and Michael J. Sabin, 2015, Tontine pensions, *University of Pennsylvania Law Review* 163, no. 3:788, table 4. Copyright © 2015 by Jonathan Barry Forman and Michael J. Sabin.

2.2.2.2 Reducing Backloading in a Tontine Fund

Unfortunately, it is *impossible* to reduce the backloading that is inherent in a tontine fund. The longer a member lives, the more she would get, as her monthly mortality-gain distributions would generally increase with her age and her increasing death probability (q_i). In the following section, however, we show how we can solve this backloading problem by adding an *annuity-payback mechanism*, and we call the resulting product a tontine annuity.

2.3 A Tontine Annuity

A tontine annuity is constructed by adding two enhancements to a simple tontine fund. First, as already discussed, to reduce noisiness we would build in a monthly payment period; and second, to eliminate backloading we would add an annuity-payback mechanism.

2.3.1 The Annuity-Payback Mechanism

The approach we use to convert a tontine fund into a tontine annuity is to make *monthly tontine-annuity distributions* to surviving members that are designed to cancel out the age-related backloading that is inherent in simple tontine funds like the one in Figure 1. The resulting tontine annuity mimics an actuarially fair variable annuity.

It turns out that it is relatively easy to determine the proper amounts of these monthly tontine-annuity distributions. Here is the logic. The monthly payout of any actuarially fair annuity is simply equal to the account balance divided by the appropriate monthly annuity factor. The monthly annuity factor is the premium for an actuarially fair annuity that pays $1 per month for life. These monthly annuity factors can easily be calculated from a mortality table and depend only on the age of the annuitant and the assumed interest rate (Forman & Sabin, 2015, p. 791, n.140).

For example, assume that the hypothetical tontine fund member in Table 2 just turned age 65. Instead of paying her a monthly mortality-gain distribution of $1,041.67, a *tontine annuity* would make a monthly tontine-annuity distribution of $2,133 ($2,133.00 = $251,041.67 / 117.6939, where 117.6939 is the monthly annuity factor for the just-turned-65-year-old member in Table 2), and the tontine annuity would make similar monthly tontine-annuity distributions in subsequent months (Forman & Sabin, 2015, p. 792).

Alternatively, a tontine annuity could be designed to make inflation-adjusted monthly tontine-annuity distributions. That inflation-adjusted tontine annuity would make lower monthly tontine-annuity distributions in the early years but greater distributions for those who live to later years. For example, if inflation is assumed to be 3 percent per year, then the first monthly tontine-annuity distribution for the hypothetical 65-year-old in Table 2 would be just $1,651.72 ($1,651.72 = $251,041.67 / 151.9876, where 151.9876 is the inflation-adjusted monthly annuity factor for the just-turned-65-year-old member in Table 2), but distributions in subsequent months would be larger and would eventually exceed the payout level of the not-adjusted-for-inflation tontine annuity (Forman & Sabin, 2015, pp. 793–794).

2.3.2 Adding in Investment Income

In the simple tontine annuities that we have considered so far, we have assumed that contributions do not earn any interest. In the real world, however, each member's contributions would be invested, and the member's balance would grow (or shrink) according to its investment performance. Accordingly, account balances at the end of each month would tend to be higher, and monthly tontine-annuity distributions would also tend to be higher. For example, if the tontine annuity in Table 2 had earned $1,000 of investment interest in that month, the balance in the account at the end of the month would have been $1,000 higher, and consequently, the monthly tontine-annuity distribution would have been $8.52 higher—$2,141.52 ($2,141.52 =

$252,041.67 / 117.6939) rather than just $2,133 in our earlier example (Forman & Sabin, 2015, pp. 794–795).

2.3.3 Managing Tontine Annuity Investments

Investments in a tontine annuity would most likely be managed collectively for the entire pool. In theory, a tontine annuity could be managed by a discount broker, and no money would have to be set aside for insurance agent commissions or insurance company reserves, risk-taking or profits. We believe that discount brokers could offer these products with total annual costs perhaps as low as 0.30 percent of assets under management, depending on the nature of the underlying investments; and that means that retirees would get significantly more benefits than they do with today's high-fee variable annuities. For example, imagine a tontine annuity that invested entirely in an S&P 500 stock index fund. We know that most discount brokers offer an S&P 500 index fund with expense ratios of 0.10 percent of assets under management or less,[8] and we believe that the tontine annuity management and record-keeping functions could be performed for as little as 0.20 percent of assets under management, and that means that total costs could be as low as 0.30 percent.

2.4 A Tontine Pension

While tontine annuities would be attractive investments in their own right, they would likely be as underutilized as traditional annuities and other lifetime income products.[9] That is where "tontine pensions" come in.

In effect, a tontine pension would be like a defined contribution plan that only pays benefits in the form of an actuarially fair life annuity. At retirement, the balance in each participant's tontine pension account would be paid out to her in the same manner as if she had purchased her own tontine annuity with the employer contributions made on her behalf.

For example, an employer who wanted to provide a tontine pension for its employees would set up a defined-contribution-style pension plan, only instead of investing its contributions in stocks and bonds, the employer would invest in a tontine annuity for its employees. Each year, an employer could make contributions of, perhaps, 10 percent of its employees' salaries. Those contributions would be invested in a tontine annuity and allocated to the individual tontine pension accounts of the participants.

The difference is largely in the payouts. Rather than being able to receive lump-sum distributions (or periodic payments), each tontine pension plan participant would receive benefits based on the survivor principle. That is, the employer contributions for each participant, and the investment earnings on those contributions, would be held in a tontine annuity, and these "monthly tontine-pension distributions" would be the *only* kind of distributions made to retirees. More specifically, starting at the participant's normal retirement age (or later, if she so elected), the balance in her tontine pension account would be paid out to her in the same manner as if she had purchased her

[8] See, e.g., Fidelity Investments, 2018 (0.09 percent expense ratio).

[9] Individuals rarely choose to buy annuities voluntarily. There are many reasons for this low demand for annuities, but adverse selection is one of the most important reasons. Basically, those who voluntarily purchase annuities tend to live longer than those that do not, and consequently, annuities are not priced very well for those with normal life expectancies (Benartzi et al., 2011).

own tontine annuity with the employer contributions made on her behalf. No other form of distribution would be permitted, ever.

In short, a tontine pension would provide lifetime retirement income from a defined-contribution-like platform. Essentially, the tontine pension is like a fully funded defined contribution plan that *only* pays benefits in the form of an actuarially fair life annuity. Unlike a defined benefit plan—where the plan sponsor must purchase annuities for each retiring employee or otherwise bear the risks and costs of providing the promised annuity benefits, with a tontine pension, the plan sponsor would bear no investment or actuarial risks at all. The tontine pension would simply make distributions to retirees out of the funds accumulated in the underlying tontine annuity and in accordance with the fair-transfer-plan and annuity-payback protocols. Pertinent here, these monthly tontine-pension distributions could be designed to mimic immediate, level-payment annuities; immediate, inflation-adjusted annuities; deferred annuities; or joint and survivor annuities.

3. Modeling a Simple Tontine Pension

In this part we design a model tontine pension for a large employer and then use a computer simulation to see what kind of tontine pension benefits the participants could expect to receive.

3.1. The Parameters of the Simulation

Our computer simulation uses a pool of approximately 170,000 members (approximately 100,000 active employees and 70,000 retirees).[10] The parameters of the simulation are as follows:

- The employer hires 3,600 employees each year (300 each month).
- The employee's gender is randomly selected, equiprobably male or female.
- Each employee is hired on her 35th birthday and works continuously for the employer for 30 years until age 65, or earlier death.
    - Each employee is hired at a salary of $50,000 a year, and her salary increases 4.0 percent each year.
    - At retirement, each employee receives a tontine pension until death.
        - In this simple simulation, nobody is married (so no joint and survivor annuity benefits are needed).
    - The account balances of those who die are forfeited.[11]
- Every year, the employer contributes 10 percent of salary for every employee to the tontine pension.

[10] This section follows Forman & Sabin, 2015, pp. 808–815. The model assumptions are similar to those that CalSTRS relied upon in 2013. Ibid. For that matter, the model assumptions are also fairly similar to those that CalSTRS uses today. *See* Milliman, 2017, p. 63, table B1.

[11] If we had assumed that living workers could leave, their account balances would go with them to their new employer's plan, and vice versa, so we ignore them.

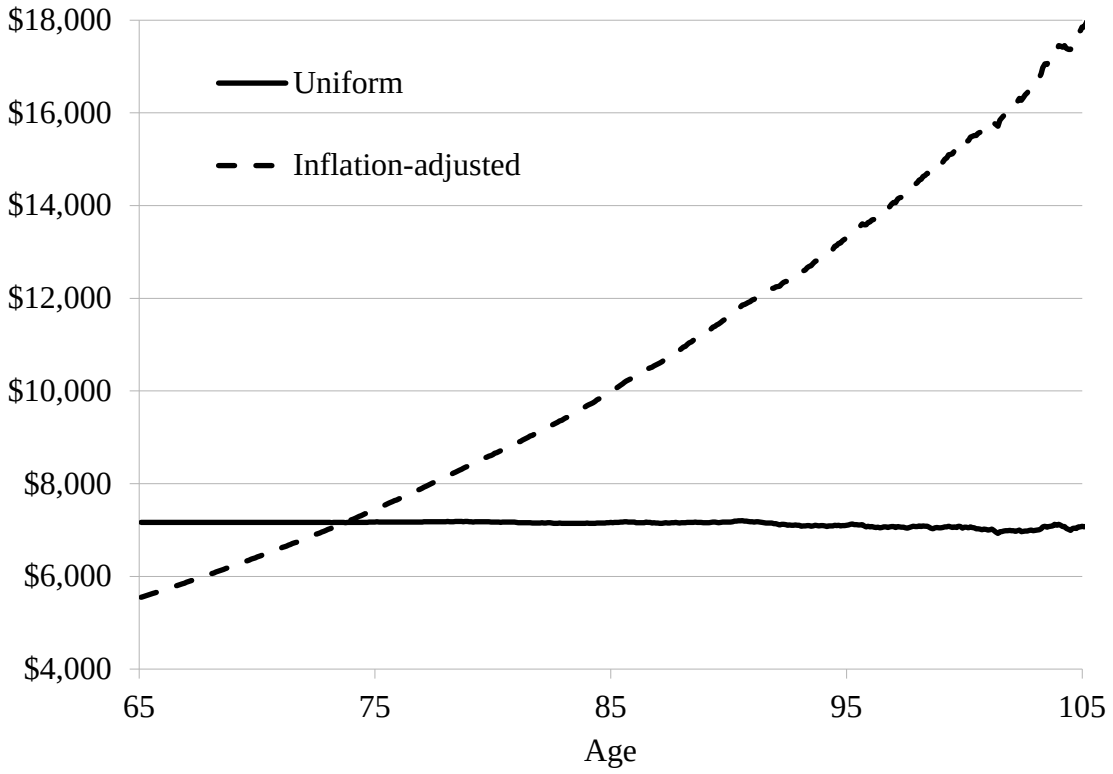
- Investment return: funds are professionally managed and earn 7.0 percent net of investment expenses each and every year, compounded annually.
- Inflation is 3.0 percent each year.
- Workers receive no payouts until age 65,[12] and then retirees receive either uniform (fixed) annuity-type payouts or alternatively, inflation-adjusted annuity-type payouts.
- The mortality model is based on the Social Security 2009 unisex mortality table.[13]
    - Therefore, at equilibrium, approximately 3,000 out of the 3,600 initial hires each year make it to age 65; approximately 100,000 are actively employed at any time; and there are approximately 70,000 retirees at any point in time.

3.2. Calculation of the Monthly Tontine-Pension Distributions

Given these assumptions, a surviving worker would have a final preretirement salary of $155,933 (at age 64), and she would have a starting retirement balance in her tontine pension account of $843,376 when she turned 65. Assuming that she wants to draw level monthly payments for the rest of her life, the first monthly tontine-pension distribution would be $7,166 ($7,165.84 = $843,376 / 117.6939). If she, instead, wanted inflation-adjusted payments, the first monthly tontine-pension distribution would be just $5,549 ($5,548.98 = $843,376 / 151.9876). Figure 2 plots the expected payouts from these uniform and inflation-adjusted tontine pensions over time.

[12] To make the simulation less complicated, only the retirement phase was simulated, i.e., the payouts to those age 65 and older. The account balance at age 65 was set equal to the expected value (i.e., the statistical average) of the account of a worker who survives to age 65. The number of workers surviving to retirement was set to its expected value from the Social Security Administration's 2009 unisex life table (Social Security Administration, 2013).
[13] Ibid.

Figure 2. Monthly Payout for a Typical Long-Lived Member



Source: Forman, Jonathan Barry, & Michael J. Sabin, 2015, Tontine pensions, *University of Pennsylvania Law Review* 163, no. 3:813, fig. 2. Copyright © 2015 by Jonathan Barry Forman and Michael J. Sabin.

3.3 Adequacy

It is relatively easy to determine how much of preretirement income this 30-year, 10-percent-of-salary tontine pension would replace. For example, multiplying the uniform monthly benefit of $7,166 times 12 months yields an annual tontine pension of $85,992 ($85,992 = 12 × $7,166), and it is easy to see that the tontine pension would initially replace of 55.1 percent of preretirement earnings in the first year of retirement (i.e., a "replacement ratio" of 55.1 percent [0.5514676 = $85,992 / $155,933]). Similarly, the inflation-adjusted monthly benefit should yield an annual tontine pension of around $66,588 ($66,588 = 12 × $5,549) and a replacement ratio of around 42.7 percent of preretirement earnings (0.4270295 = $66,588 / $155,933). In addition to these tontine pensions, however, our retiree would almost certainly receive Social Security benefits that would replace another 35 or 40 percent of her preretirement income (National Academy of Social Insurance, 2017, p. 6).

3.4 Tontine Pensions in the Real World

Our model tontine pension does a pretty respectable job of showing how a tontine pension could work in the real world. To be sure, the assumptions of the model are a little bit rigid. In the real world inflation is not always 3 percent per year, wages do not always go up by 4 percent per year, and investments do not always earn a 7 percent rate of return. In the real world, each of those parameters is highly variable, although their average values are probably pretty close to our assumed values. In general, that real world variability could easily result in retirees receiving smaller (or larger) monthly distributions from their tontine pensions. Of course, that variability in monthly distributions is no worse a problem for tontine pensions than it is for defined contribution plans or for variable annuities.

In any event, tontine pensions could easily be designed to provide for relatively smooth distributions even in the face of real world variability. For example, a tontine pension could be designed to smooth distributions over, say, 5 years. When the tontine pension administrator determined that a given monthly distribution would be higher than the average for the prior 5 years, the distribution could be split, with almost all of the distribution going to the participant's bank account immediately, and a small portion going into a "holding account" for that participant. In a later month when the tontine pension administrator determined that the distribution would otherwise be lower than the average for the prior 5 years, the holding account would be tapped to provide a larger distribution. The funds in the holding account could be invested along with all of the other assets held by the tontine pension, and presumably, at that member's death, the balance in that holding account, if any, could be paid to that member's estate.

4. Replacing the California State Teachers' Retirement System with a Tontine Pension

In this part, we consider how a tontine pension for a large employer would work. Given the strictures of the Employee Retirement Income Security Act of 1974 (ERISA) and federal securities regulation laws, we acknowledge that it may be a challenge for a private pension plan sponsor to create a tontine pension under current law (Forman & Sabin, 2015, pp. 818–822). On the other hand, public employers are exempt from most of ERISA's pension regulations.[14] Accordingly, we believe that a state government could easily create a tontine pension that would not run afoul of federal law. As we saw in Part 2.4, such a tontine pension would be fully funded and would make annuity-like payments to retirees for as long as they lived.[15]

As most states already have pension plans that cover most of their employees, what we are really talking about here is the prospect of replacing an existing state pension plan with a tontine pension. In particular, some states might want to replace their underfunded traditional defined benefit pension plans with tontine pensions. For our example, this part shows how California

[14] ERISA § 4(b)(1), 29 United States Code (U.S.C.) § 1003(b)(1) (exempting government plans).

[15] We recognize that many governments use their pension plans to provide disability benefits, and some also use their pension plans to provide retiree health benefits. However, for simplicity, in this paper, we have ignored both disability benefits and retiree health benefits.

could replace its underfunded California State Teachers' Retirement System (CalSTRS) defined benefit plan with a tontine pension.

4.1 Background on CalSTRS

CalSTRS is the largest educator-only pension in the world, with $225.3 billion in assets as of December 31, 2017 (California State Teachers' Retirement System, 2018a). One of the largest programs that CalSTRS administers is its traditional defined benefit retirement plan, where benefits are based on a member's years of service, age and highest compensation.[16] Members typically receive an annual retirement benefit (*B*) that is equal to 2 percent times the number of years of service (*yos*) times final average compensation (*fac*) ($B = 2\% \times yos \times fac$).

For the fiscal year that ended June 30, 2016, the CalSTRS traditional defined benefit pension had 438,537 active members with an average annual salary of $68,013 and 288,195 retired members and beneficiaries with an average annual retirement benefit of $46,608 (Milliman, 2017, p. 14). Also as of June 30, 2016, the CalSTRS defined benefit plan was only 61.9 percent funded, with an unfunded liability of $101.6 billion (ibid., p. 14). The normal cost rate, expressed as a percentage of total compensation, was forecast to be 19.316 percent (ibid., p. 54).[17] In addition, CalSTRS was forecast to need another 18.824 percent of compensation to amortize its $101.6 billion unfunded liability over 30 years (ibid., p. 54). Annual contribution rates are specified by state law and allocated among employees, employers and the State of California. Under current law, the contributions total to 34.467 percent of total compensation, which is 3.673 percent less than the sum of the normal and amortization costs, and thus CalSTRS is not currently on track to achieve full funding (ibid, p. 50).

4.2 Replacing the CalSTRS Defined Benefit Plan with a Tontine Pension

There are a variety of possible ways to replace a traditional pension like the CalSTRS defined benefit plan with a tontine pension. We do not mean to suggest that replacing the CalSTRS defined benefit plan with a tontine pension would be politically easy. We merely suggest that a tontine pension could provide an alternative way of providing lifetime retirement income to California teachers, and we reiterate that unlike traditional defined benefit plans—which are often underfunded, a tontine pension can never become underfunded.

4.2.1 Keep Current Employees in the Current Defined Benefit Plan, but Move New Employees to a Tontine Pension

The simplest approach would be for CalSTRS to keep the current defined benefit plan for all current employees but to close entry to that plan and require all new employees to join a newly created tontine pension (Forman, 1999, pp. 207–209). This is the simplest approach, but it also

[16] See, e.g., California State Teachers' Retirement System, 2018b. CalSTRS also administers a defined benefit supplement program, a cash balance benefit program and CalSTRS "Pension2" (California State Teachers' Retirement System, 2017).

[17] Under the entry-age normal cost accounting method, the normal cost is calculated to produce a level cost over each employee's career (i.e., a level percentage of payroll). The normal cost generally represents the expected cost of projected benefits attributable to work performed and pension benefits earned in the current plan year. Milliman, 2017, p. 17–19.

achieves change at a very slow rate, i.e., as new generations of workers gradually replace current workers.

Pertinent here, historically, the California courts have interpreted the U.S. Constitution's contract clause in a way that not only protects a public employee's accrued pension benefits,[18] but also guarantees the employee's right to keep earning pension benefits based on rules that are at least as generous for as long as she is employed (Monahan, 2012). While the California courts are currently reconsidering the extent to which public pensions can cut future pension benefit accruals (McNeil & Karns, 2018; Dolan, 2016; Diamond, 2017), regardless of how the courts come out, there is certainly no legal impediment to moving all new employees into a new tontine pension.

4.2.2 Freeze the Current Defined Benefit Plan, and Create a Tontine Pension for all Future Benefit Accruals

Another approach would be for CalSTRS to freeze its current defined benefit plan and add a new tontine pension for all future benefit accruals.[19] At retirement, beneficiaries would then receive the defined benefit plan benefits that they have already accrued, but they would not accrue any additional benefits under their traditional defined benefit plan; instead, future contributions would be made to a new tontine pension. Theoretically, CalSTRS would freeze its defined benefit plan and add a tontine pension with future retirement contributions set at, say, 19.316 percent of compensation (i.e., the current CalSTRS defined benefit plan's normal cost rate from Part 4.1). Going forward, such a plan would be roughly as generous as the current plan, and, in our opinion, that should be enough to withstand any legal challenge about the possible reduction in future benefit accruals.[20] Significantly, CalSTRS would never again have to worry about underfunding as a result of future benefit accruals. This way of replacing the CalSTRS defined benefit plan with a tontine pension could actually provide some reduction of the current $101.6 billion unfunded liability, since some of that liability is due to future benefit accruals. However, there is not enough detail in publicly available reports for us to calculate the reduction. Our guess is the reduction would be modest, so for simplicity we will say that the full $101.6 billion in unfunded liability would remain after the replacement and that that obligation would still need to be met by employees, employers and the State of California.

4.2.3 Other Approaches

While there may be faster ways to replace CalSTRS defined benefit plan with a tontine pension, the current plan's $101.6 billion unfunded liability is a serious obstacle. Given CalSTRS's

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[18] This is what ERISA's so-called anti-cutback rule does: it protects pension benefits that have already been earned, but it does not guarantee that an employee will receive any particular pension benefits in the future. ERISA § 204(h)(1), 29 U.S.C. § 1054(g)(1); 26 U.S.C. (a/k/a the Internal Revenue Code) § 411(d)(6).

[19] Along the same lines, the current defined benefit plan might simply start using a designated portion of future contributions to fund a newly created tontine annuity inside of the current CalSTRS defined benefit plan. Unlike the text approach, however, this approach would not actually require that those new contributions actually occur or be allocated and secured as separate future benefits for plan participants; that is, this footnote approach might leave open possible underfunding of future tontine pension benefit accruals.

[20] Alternatively, the plan sponsor could actually guarantee that no employee's future retirement benefits would ever be less than what she would have been earned if the predecessor defined benefit plan had not been frozen and replaced.

inability to reduce the already-accrued pension benefits of current participants, having a new tontine pension take over the liabilities of the currently underfunded defined benefit plan would almost certainly require the State of California to make its implicit promise to come up with $101.6 billion into an explicit promise (e.g, by issuing bonds), and we view that as highly unlikely.

5. Conclusion

In this paper, we showed how large employers could use tontine pensions to provide retirement income for their employees. More specifically, we developed a model tontine pension, and we used that model to show the retirement benefits that a typical worker could earn with a 10-percent-of-salary tontine pension. We estimated that over the course of a 30-year career, a typical retiree would earn a uniform tontine pension that would initially replace around 55 percent of her preretirement earnings or alternatively, an inflation-adjusted tontine pension that would replace around 43 percent of her preretirement earnings.

These tontine pensions would have two major advantages over traditional defined benefit plan pensions. First, unlike traditional pensions—which are frequently underfunded, tontine pensions would always be fully funded. Second, unlike traditional pensions—where the plan sponsor must bear all the investment and actuarial risks, with a tontine pension, the plan sponsor would bear neither of those risks. These two features should make the tontine pension a particularly attractive alternative for employers who care about providing retirement income security for their employees but who want to avoid the risks associated with having a traditional pension.

We also want to emphasize another feature of tontine pensions that we find particularly attractive. A tontine pension would closely resemble an actuarially fair variable life annuity, but it could be run by a low-fee discount broker. As no money would need to be set aside for insurance agent commissions or for insurance company reserves, risk taking and profits, we believe that a discount broker could manage a tontine pension for as little as 0.30 percent of assets under management. That means that a tontine pension would be able to provide significantly higher benefits to retirees than commercial annuities and many other retirement income products.

Finally, we showed that tontine pensions offer a possible solution to the chronic underfunding of traditional defined benefit plans. For example, we could replace an underfunded defined benefit plan with a tontine pension and never again have to worry about underfunding attributable to future benefit accruals. For example, CalSTRS could freeze its current defined benefit plan and add a new tontine pension for all future benefit accruals. While replacing the CalSTRS defined benefit plan with a tontine pension would do nothing to reduce CalSTRS's current $101.6 billion unfunded liability, it would ensure that California would never again have to worry about underfunding attributable to future benefit accruals.

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