Workers and Retirees Could Pool Risk with Tontine Annuities, Tontine Pensions, and Survivor Funds

Professor Jonathan Barry Forman ("Jon")


Nashville, TN
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Overview

• What is a tontine?
• How can tontines generate monthly retirement income?
  – Survivor funds
  – Tontine annuities
  – Tontine pensions
What is a Tontine?

• Tontines are investment vehicles named after 17th century Neapolitan banker Lorenzo de Tonti

• Investors pool their money
  – Each year they are alive, members get investment income
  – As members die, their shares are forfeited to the surviving members (“mortality gains”)
  – Unless the fund is divided earlier, the entire fund goes to the last survivor
Example 1:
A Last-survivor-takes-all Tontine

• On the TV show, M*A*S*H, Colonel Sherman T. Potter, as the last survivor of his World War I unit, got to open the bottle of cognac that he and his buddies got in France – and share it with his Korean War compatriots
Example 2: A Short-term Tontine Fund

- Suppose ten 65-year-old men invest in a fund

\[ 10 \times $1000 = $10,000 \]
Pooling Longevity Risk with a Tontine

- A few years later, one man dies

- The 9 survivors are each eligible for . . .

  \[ \$1111 = \frac{\$10,000}{9} \]

  - Meanwhile, the dead man forfeits his $1000,
  
    - But he doesn’t care; he’s dead!
Pooling Risk with a Tontine

• A few years later, another one bites the dust

• The 8 survivors then split the $10,000
  – Each gets $1250
    • $1250 = $10,000 ÷ 8
    • They get even more if the fund earned interest
Example 3: A 10-year Tontine (with interest)

• Imagine 1000 65-year-old men each contribute $1000 to a simple investment fund that buys a $1 million, 10-year, zero-coupon bond, paying 5% interest

• In 10 years, the fund would grow to ~ $1.6 million & each investor (or her heirs) would get ~ $1600

  \[ - \$1600 = \frac{\$1.6 \text{ million}}{1000} \]
A 10-year Tontine (with interest)

• A tontine would also divide that $1.6 million—*but only among the survivors*
  – If 800 men survived the 10 years (to age 75), each would get ~ $2000
    • $2000 = $1.6 million ÷ 800
    • That’s ~ $400 more for each survivor
    • In effect, the survivors earn ~ 7% (not 5%)

• We call this type of short-term tontine a “survivor fund”
Tontines for Retirement Income

• Tontines could also be designed to provide *monthly retirement income* (for life)

• Examples include:
  – “Tontine annuities” &
  – “Tontine pensions”
Example 4: A Fair Tontine Fund

- Imagine a simple tontine with 4 investors of different ages & each contributes $1000.
- When one dies, each *survivor* gets $333.33:
  \[ $333.33 = \frac{$1000}{3} \]
- Unfortunately, this simple approach can be unfair because it favors younger investors— who are likely to live longer & so get more distributions than older investors.
What Would Be Fair?

• Let’s make the tontine a fair bet for everyone
• First, imagine that our 4 investors are ages 65, 70, 75 & 80
  – Start with their death probabilities \((q_i)\)
    • The probability of dying within one year
    • These come from a life expectancy table
Create a Fair Transfer Plan

• Second, use these death probabilities \((q_i)\) to derive *fair-transfer-plan weights* \((w_i)\)

• Third, use the fair-transfer-plan weights \((w_i)\) to divide the accounts of those who die
  – The result is a *fair transfer plan* (FTP)
## Fair Transfer Plan Table

<table>
<thead>
<tr>
<th>Member</th>
<th>Age</th>
<th>Life Expectancy (years)</th>
<th>Death Probability</th>
<th>Fair-Transfer-Plan Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>18.88</td>
<td>0.013181</td>
<td>0.053815</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>15.22</td>
<td>0.020314</td>
<td>0.086183</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>11.89</td>
<td>0.032111</td>
<td>0.146795</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>8.95</td>
<td>0.051906</td>
<td>0.713207</td>
</tr>
</tbody>
</table>

- e.g., 65-year-old member 1:
  - has the longest *life expectancy* ~ 19 years
  - has the lowest *death probability* ~ 1.3%
  - therefore, she has the smallest *fair-transfer-plan weight* ~ 5%
A Fair Result

• For example, suppose member 4 (the 80-year-old) is, in fact, the first to die
• Her $1000 would be distributed as follows:
  – 65-year-old member 1 would get $187.64
  – 70-year-old member 2 would get $300.51
  – 75-year-old member 3 would get $511.85
  – At death, member 4 would lose $1000.00
The Logic

• Younger investors get less now, but they should live longer & collect more payments
  – In short, a fair tontine fund can fairly accommodate members of different ages
  – It’s a fair bet!

• Tontine funds can also be fair to members with different contribution levels

• Tontine funds could also be perpetual, with new investors coming in all the time
The Math

• If member $j$ dies, each surviving member $i$ would get a portion of $j$’s contribution equal to $w_i/(1 - w_j)$, for $i \neq j$.

• So when member 4 (the 80-year-old) dies, member 1 (the 65-year-old) gets

$$187.64 = 1000 \times \frac{w_1}{1 - w_4}$$

$$= 1000 \times \frac{0.053815}{1 - 0.713207}$$
Example 5: A Fair Tontine Fund Simulation

• A fair tontine fund with 220 members who
  – joined at age 65;
  – equi-probability male or female;
  – each member’s contribution was a randomly selected amount between $100 and $100,000

• The next figure shows the mortality gains that a typical long-lived male could expect
Example 5: Payouts to a Long-living Male in a Small Tontine Fund
The Figure Illustrates Two Problems

• 1) Tontine funds are noisy; &
• 2) Tontine funds are backloaded
• We can solve both problems by constructing a tontine annuity
1. We Can **Reduce Noisiness** with Monthly Payouts & More Investors

- We can reduce noisiness
  - By making *monthly distributions*
    - rather than making distributions at the time of each member’s death; &
  - By increasing the number of investors
2. We Can *Eliminate* Backloading with a *Self-payback* Mechanism

- Retirees want level payments
  - Not backloaded payments
- Each month, we would reduce a living member’s account balance by repaying a portion of her initial contribution
- These “*self paybacks*” result in level-payment *tontine annuities*
Example 6: Creating a Tontine Annuity

• Imagine a fair tontine fund with
  – 5000 members
  – monthly distributions, and
  – varying investment levels

• Consider a man who invested $250,000
  – The next two slides show some typical monthly statements
Example 6: Sample Monthly *Tontine Fund* Statement for a Living Member

<table>
<thead>
<tr>
<th>Date</th>
<th>Amount</th>
<th>Balance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/31</td>
<td>250,000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04/02</td>
<td>67.17</td>
<td>250,067.17</td>
<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/03</td>
<td>25.21</td>
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<td>04/12</td>
<td>52.29</td>
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<td>250,803.63</td>
<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/25</td>
<td>124.81</td>
<td>250,928.44</td>
<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/28</td>
<td>55.32</td>
<td>250,983.76</td>
<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/30</td>
<td>57.91</td>
<td>251,041.67</td>
<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/30</td>
<td>(1041.67)</td>
<td>250,000.00</td>
<td>Payout of FTP Proceeds</td>
</tr>
</tbody>
</table>
Example 6: Sample Statement for a Member Who Died during the Month

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<tr>
<td>04/12</td>
<td>(250,331.84)</td>
<td>0</td>
<td>Forfeited to FTP</td>
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Example 7: Now, Add Self Payback to Create a **Tontine Annuity**

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<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/30</td>
<td>(2133.00)</td>
<td>248,908.67</td>
<td>Tontine-annuity Distribution</td>
</tr>
</tbody>
</table>
Here’s the Self-payback Math

• Monthly payout equals the account balance divided by a monthly annuity factor

• e.g., the payout for 1st month of retirement (age 65) equals $2133

\[ 2133.00 = \frac{251,041.67}{117.6939} \]
## Example 8: Now, Add Interest

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<tr>
<td>04/30</td>
<td>57.91</td>
<td>251,041.67</td>
<td>Proceeds from FTP</td>
</tr>
<tr>
<td>04/30</td>
<td>1,000.00</td>
<td>252,041.67</td>
<td>Interest for the month</td>
</tr>
<tr>
<td>04/30</td>
<td>(2141.50)</td>
<td>249,900.17</td>
<td>Tontine-annuity Distribution</td>
</tr>
</tbody>
</table>
Tontine Annuities Would Have High Yields & Low Fees

• Approximates an actuarially-fair annuity
  – i.e., with no insurance agent commissions or insurance company profits or reserves
    • Would provide much higher benefits than commercial annuities
  – Could be run by a discount broker
    • costs as low as 0.30% (30 basis points)
      – 0.10% expense ratio for an S&P 500 index fund
      – + 0.20% for tontine recordkeeping
  – Could be regulated & protected like a pension
The “Annuity Puzzle”

• Underutilization is a problem for tontine annuities & traditional annuities
  – Demand for annuities is low

• The solution is broad coverage
  – That is where employer-created *tontine pensions* come in
Example 9: *A Tontine Pension*

- We modeled a 10%-of-pay tontine pension
  - Employer hires 3600 employees each year
    - Workers start at 35; retire at 65
    - Starting pay = $50,000; 4% annual pay increase
  - 3% annual inflation
  - 7% rate of return on investments
  - Unisex life expectancy tables
- At maturity: 100,000 actives & 70,000 retirees
Benefits from a 10% -of-pay Tontine Pension

• A worker who lives & works from 35–64 & retires at 65 would have:
  – *Final salary* = $155,933
  – *Starting retirement account balance* = $843,376

• **Level tontine pension** = $7166/month
  – $85,992/year
  – *Replacement ratio* = 55.1%
    \[
    0.551468 = \frac{85,992}{155,933}
    \]
A Final Example: Replacing CalSTRS

- CalSTRS traditional defined benefit plan
  - \( B = 2\% \times \text{years of service} \times \text{final average pay} \)
    - normal cost ~ 19% of compensation
  - Only ~ 62% funded
    - unfunded liability ~ $97 billion (another 15% of compensation) (as of June 30, 2016)

- Partial solution:
  1) Freeze the defined benefit plan; &
  2) Add a tontine pension for all future accruals
Advantages of Tontine Pensions

• Unlike traditional defined benefit pensions
  – Tontine pensions are always fully funded
  – Sponsors face no actuarial or investment risks

• Tontines would be popular
  – e.g., a tontine for a team of firefighters will be perceived as fairer than a commercial annuity
  • With a commercial annuity, an early death seems to benefit the insurance company, but with a tontine pension, an early death benefits fellow firefighters
Appendix:
A1. Another Example

• Charge different prices for tontine shares, depending on age
  – For example, a 55-year old allocating $10,000 to the tontine might pay $200 per share and receive 50 shares
  – While a 75-year old allocating $8,000 might pay $40 per share and receive 200 shares.

A2. Pooled Annuities & Tontines

• Pooled annuities are a lot like tontines
  – e.g., TIAA’s College Retirement Equities Fund (CREF)
  – Annuities use mortality gains to increase lifetime income for the survivors
  – With pooled annuities, investors bear all the risks: There is no insurance company guarantee
A3. Longevity Risk

• Risk of outliving your retirement savings
  – 65-year-old American man: 50% chance of living to 83; 20% chance of living to 91
  – 65-year-old American woman: 50% chance of living to 86; 20% chance of living to 94
  – 65-year-old American couple: 50% chance that at least one will live to age 90; 30% chance that at least one will live to 94

• Retirements can last for 30 years or more
A4: Tontine Pensions Could Provide Inflation-adjusted Benefits

• The Example 9 worker who lived & worked from 35–64 & retired at 65 would have:
  – Final salary = $155,933
  – Starting retirement account balance = $843,376
  – Level pension = $7166/month
    • $85,992/year; initial replacement ratio = 55.1%

• The worker could instead get an inflation-adjusted pension starting at $5549/month
  ~ $66,588/year; replacement ratio ~ 42.7%
A4: Comparison of *Level vs. Inflation-adjusted* Monthly Benefits from a 10-percent-of-pay Tontine Pension

<table>
<thead>
<tr>
<th>Age</th>
<th>Uniform</th>
<th>Inflation-adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>$4,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>70</td>
<td>$6,000</td>
<td>$6,000</td>
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<tr>
<td>75</td>
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</tr>
<tr>
<td>105</td>
<td></td>
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</tr>
</tbody>
</table>
About the Author

• Jonathan Barry Forman (“Jon”) is the Kenneth E. McAfee Centennial Chair in Law at the University of Oklahoma College of Law, 300 Timberdell Road, Norman, OK 73019; jforman@ou.edu; 405-325-4779; http://www.law.ou.edu/directory/jonathan-forman.

• He teaches courses on tax and pension law & is the author of:
  – Survivor Funds, 37(1) PACE LAW REVIEW 204 (Fall 2016) (with Michael J. Sabin), http://digitalcommons.pace.edu/plr/vol37/iss1/7/