Inheritance Gains in Notional Defined Contributions Accounts (NDCs)

by

- Carmen Boado-Penas
- Carlos Vidal-Meliá
In Financial Defined Contribution (FDC) systems, the pension balances of deceased persons are normally inherited by the individual’s survivors.

In DB pay-as-you-go pension systems if somebody dies before the retirement age his/her survivors do not get anything.

A Notional Defined Contribution (NDC) pension system is a pay-as-you-go scheme that deliberately mimics a FDC system.

- What will happen if someone dies before receiving any benefit under this model?
- What will happen to the notional capital accumulated by the individual?
Aim of this paper

To analyse whether a survivorship dividend SD (inheritance gains) should be included as an extra return in the notional rate of NDC’s.

To quantify the effects of not considering the survivorship dividend.
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1. Introduction
2. NDC pension systems and Inheritance gains
3. The model
4. An example
5. Main conclusions

Next steps in the research
1. Introduction

From the NDC’s pension schemes only Sweden applies a Survivorship Dividend.

The survivorship dividend, SD, at a specific age, measures the portion of the accredited account balances of participants resulting from the distributions, on a birth cohort basis, of the account balances of participants who do not survive to retirement.

- Should it be applied to all the NDC’s systems?
- What is the effect of the possible applications of a SD on future pensioners?
- Is there any financial-actuarial basis to SD?
- What happens if SD is not applied?
A **notional account** is a virtual account reflecting the individual contributions of each participant and the fictitious returns that these contributions generate over the course of the participant’s working life.

When the individual retires, he or she (henceforth, he) receives a **pension** that is derived from the value of the accumulated notional account, the expected mortality of the cohort retiring in that year, and, possibly, a notional imputed future indexation rate.

The notional model combines PAYG financing with a pension formula that depends on the amount contributed and the return on it.
2. NDC pension systems and Inheritance Gains

The amount on the notional account (K)

Age

Notional rate for contributions

Life expectancy

Notional rate for pensioners

Actuarial Divisor (A_d)

Credited contributions

Pension = K / A_d

Inheritance Gains in NDC’s
2. NDC pension systems and Inheritance Gains

\[
K = \text{Notional Capital} \\
\sum_{x=x_e}^{x_r-1} \theta_x y_x \prod_{i=x}^{x_r-1} (1 + r_i) = P_{x_r} \ddot{a}_{x_r}^{\lambda}
\]

Where:

- \(x_e\) : age of entry in the labour market
- \(x_r\) : age of retirement
- \(y_x\) : salary at age \(x\)
- \(\theta_x\) : contribution rate at age \(x\)
- \(P_{x_r}\) : pension at \(x_r\)
- \(\ddot{a}_{x_r}^\lambda\) : life annuity at \(x\)
## 2. NDC pension systems and Inheritance Gains

<table>
<thead>
<tr>
<th></th>
<th>Italy</th>
<th>Latvia</th>
<th>Poland</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rate of contribution</strong></td>
<td>20%-33%</td>
<td>14%</td>
<td>12.22%</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Rate of return on contributions</strong></td>
<td>5-year average GDP growth</td>
<td>Growth rate covered wage bill</td>
<td>Growth rate covered wage bill</td>
<td>Growth rate covered contribution per participant + ABM + Inheritance gains</td>
</tr>
<tr>
<td><strong>Retirement age</strong></td>
<td>65 (man) 60 (woman)</td>
<td>62/62</td>
<td>65/60</td>
<td>65/65</td>
</tr>
<tr>
<td><strong>Pension formula</strong></td>
<td>Standard formula Survivor contingency 1.5% rate of return Ten-year revision mortality</td>
<td>Standard formula</td>
<td>Standard formula</td>
<td>Standard formula 1.6% rate of return Annual revision mortality</td>
</tr>
<tr>
<td><strong>Rate for pensions</strong></td>
<td>RPI</td>
<td>RPI</td>
<td>RPI+ 20% wage growth</td>
<td>RPI+ (wage growth-1.6%)</td>
</tr>
</tbody>
</table>
2. NDC pension systems and Inheritance Gains

- NDC’s have stronger immunity against political risk than traditional DB PAYG systems.
- NDC’s create no false expectations about the pensions to be received in the future.
- NDC’s encourage actuarial fairness and stimulate the contributors’ interest in the pension system.

Some characteristics shared with the traditional DB PAYG or capitalized system. (demographic change, problem of the minimum retirement age...)

Inheritance Gains in NDC’s
Growth rate salary = $g$
Growth population = $\gamma$
$(1+g)(1+\gamma)=(1+G)$

### 3. The model

<table>
<thead>
<tr>
<th>Age</th>
<th>Contributors</th>
<th>Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_t$</td>
<td>$N(x_e,1)$</td>
<td>$N(x_{e,t}) = N(x_e,1) (1 + \gamma)^{t-1}$</td>
</tr>
<tr>
<td>$X_{e+1}$</td>
<td>$N(x_{e+1},1)$</td>
<td>$N(x_{e+1,t}) = N(x_{e+1},1) (1 + \gamma)^{t-1}$</td>
</tr>
<tr>
<td>$X_{e+2}$</td>
<td>$N(x_{e+2},1)$</td>
<td>$N(x_{e+2,t}) = N(x_{e+2},1) (1 + \gamma)^{t-1}$</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{e+A-1}$</td>
<td>$N(x_{e+A-1},1)$</td>
<td></td>
</tr>
</tbody>
</table>

$x_t = x_e + A$

Inheritance Gains in NDC’s
3. The model

Inheritance Gains in NDC's

Growth rate salary = \( g \)
Growth population = \( \gamma \)

\[(1+g)(1+\gamma)=(1+G)\]

After \(<w-x_r-A>\) years - STEADY STATE

Income from contributions

\[\theta_t (1+G)^{t-1} \sum_{k=0}^{A-1} Y(x_e+k,1) N(x_e+k,1) = \overline{P}(x_e+A,1) \sum_{k=0}^{w-x_e-A-1} N(x_e+A+k,1) (1+G)^{t-1-k} (1+\lambda)^k = \]

Spending on pensions

Income from contributions

\[\theta_t \sum_{k=0}^{A-1} Y(x_e+k,t) N(x_e+k,t) = \overline{P}(x_e+A,t) \sum_{k=0}^{w-x_e-A-1} N(x_e+A+k,t) \left[ \frac{1+\lambda}{1+G} \right]^k \]

Spending on pensions

and

\[\theta_t = \theta_{t+1} = \ldots\]

\( x_e \): age of entry in the labour market
\( x_r = x_e + A \): age of retirement
\( Y(x,t) \): Salary at age \( x \), moment \( t \)
\( N(x,t) \): People alive at age \( x \), moment \( t \)
\( \overline{P}(x,t) \): average pension at \( x \) in \( t \)
\( \theta_t \): contribution rate at moment \( t \)
3. The model

\[
\sum_{k=0}^{A-1} \theta_t \cdot y(x_c + k, t) \cdot n(x_c + k, t) = \sum_{k=0}^{w-x_c-A-1} P(x_c + A, t) \cdot n(x_c + A + k, t) \cdot \left[ \frac{1 + \lambda}{1 + G} \right]^k
\]

\[
\sum_{k=0}^{A-1} \theta_a \cdot n(x_c + k, -A + k + t) \cdot y(x_c + k, -A + k + t) \cdot (1 + G)^{A-k} = \frac{a_x}{\lambda} \cdot n(x_c + A, t)
\]

\[
\theta_a = \theta_t
\]

\[x_c: \text{age of entry in the labour market}\]
\[x_r = x_c + A: \text{age of retirement}\]
\[y(x, t): \text{Salary at age } x, \text{ moment } t\]
\[n(x, t): \text{People alive at age } x, \text{ moment } t\]
\[P(x, t): \text{average pension at } x \text{ in } t\]
\[\theta_t: \text{contribution rate at moment } t\]
Survivorship dividend at the retirement age, moment t:

\[
D_{(x_e+A,t)}^{ac} = \sum_{k=0}^{A-1} N_{(x_e+k,-A+k+t)} Y_{(x_e+k,-A+k+t)} (1+G)^{A-k} \nabla_{(x_e+A,t)}^{ac} - \sum_{k=0}^{A-1} Y_{(x_e+k,-A+k+t)} (1+G)^{A-k} \nabla_{(x_e+A,t)}^{i}
\]

\[
D_{(x_e+A,t)}^{ac} = \nabla_{(x_e+A,t)}^{ac} - K_{(x_e+A,t)}^{i}
\]
3. The model

With NO Survivorship dividend

\[
\theta_a = \frac{D^{ac}(x_e + A, t)}{K^i(x_e + A, t)} \Rightarrow \theta_a > \theta^*_t
\]
4. An example

Time $t$ after reaching the steady state

Assumptions:

$g = 1\%; \gamma = 0\%; \lambda = 0\%$

$\theta_a = \theta_t = 17\%$
4. An example

Inheritance Gains in NDC's

Assumptions:
g = 1%; γ = 0% ; λ = 0%

Accumulated Dividend, moment $t$ after reaching the steady state

$K_{ac}$

$K^i$

$P_{(x_c + A, t)}$ No SD

1.88

$P_{(x_c + A, t)}$ with SD

2.80

$\uparrow 49.39\%$
### Assumptions

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>$\overline{K}_{65}^{ac}$</th>
<th>$K_{65}^{i}$</th>
<th>SD</th>
<th>$P_{65}$ with SD</th>
<th>$P_{65}$ no SD</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>$g = 1%$; $\gamma = 0%$; $\lambda = 0%$</td>
<td>42.39</td>
<td>28.37</td>
<td>14.01</td>
<td>2.80</td>
<td>1.88</td>
<td>49.39</td>
</tr>
<tr>
<td>$g = 1%$; $\gamma = 2%$; $\lambda = 0%$</td>
<td>63.50</td>
<td>41.47</td>
<td>22.03</td>
<td>5.00</td>
<td>3.26</td>
<td>53.13</td>
</tr>
<tr>
<td>$g = 1%$; $\gamma = 4%$; $\lambda = 0%$</td>
<td>98.63</td>
<td>63.00</td>
<td>35.63</td>
<td>9.05</td>
<td>5.78</td>
<td>56.56</td>
</tr>
</tbody>
</table>

For an individual who is now 65 and belongs to the initial group with $x_r-x_e$ working years.
5. Main conclusions

**Financial actuarial basis**

The survivorship dividend has a strong financial-actuarial basis which suggests that the aggregate contribution rate to apply is the same as the one accredited to the individual contributor.

In the countries that have not distributed the survivorship dividend this becomes a hidden way of accumulating financial reserves in order to compensate for the increase in longevity.
6. Next steps in the research

Sensitivity analysis:

- Different earning profiles.
- Different individual working lives.
- Different mortality tables.
- Application of the SD to NDC system that currently do not apply it.
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Thank You!

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