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Inheritance Gains in Notional Defined Contributions Accounts (NDCs)

by

- Carmen Boado-Penas
- Carlos Vidal-Meliá

KEELE UNIVERSITY

VNIVERSITAT DE VALÈNCIA

Motivation of this paper

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.

Contents

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?**

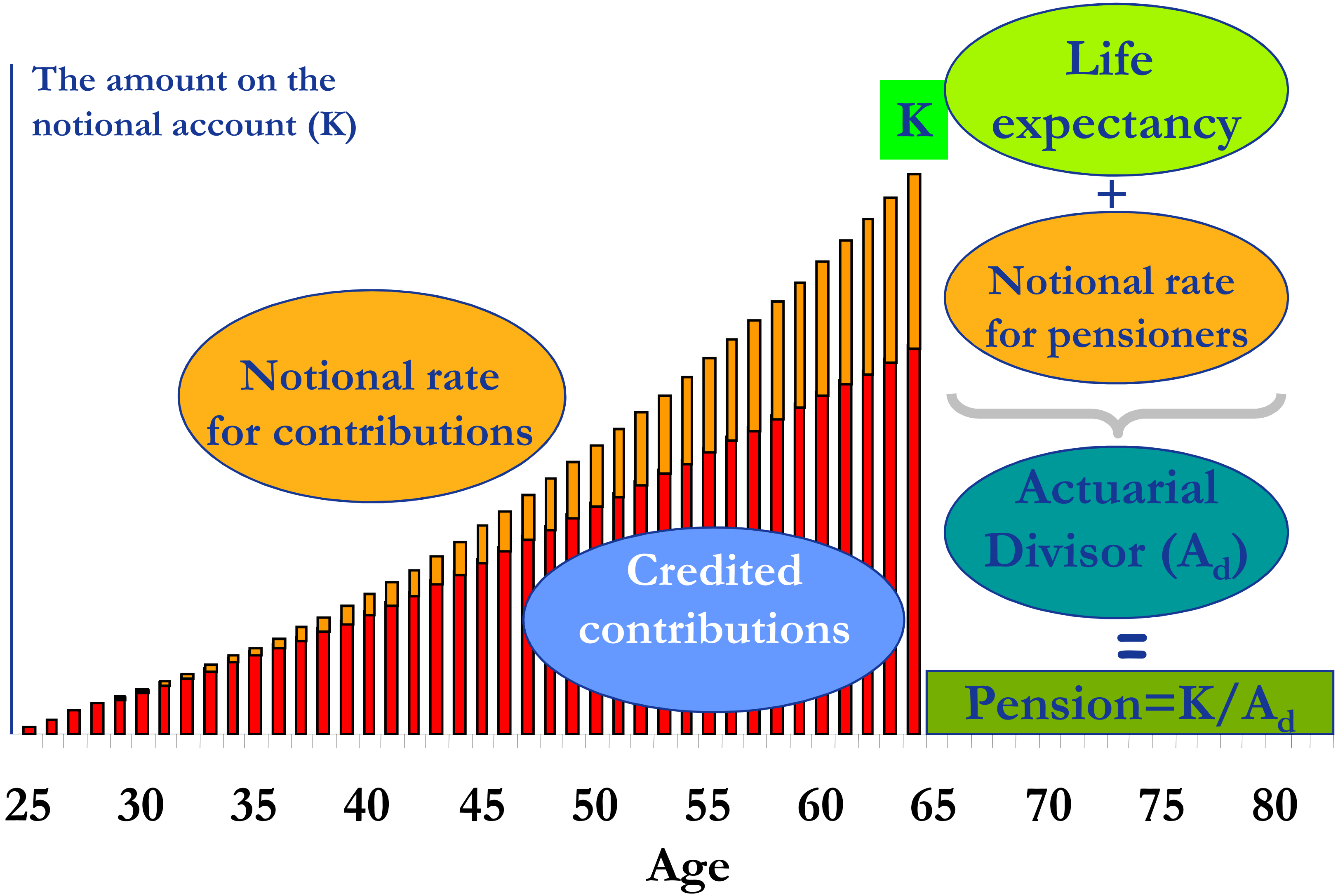
2. NDC pension systems and Inheritance Gains

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



2. NDC pension systems and Inheritance Gains

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

Where:

x_e : **age of entry in the labour market**

x_r : **age of retirement**

y_x : **salary at age x**

θ_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

	Italy	Latvia	Poland	Sweden
Rate of contribution	20%-33%	14%	12.22%	16%
Rate of return on contributions	5-year average GDP growth	Growth rate covered wage bill	Growth rate covered wage bill	Growth rate covered contribution per participant + ABM **+ Inheritance gains**
Retirement age	65 (man) 60 (woman)	62/62	65/60	65/65
Pension formula	Standard formula Survivor contingency 1.5% rate of return Ten-year revision mortality	Standard formula	Standard formula	Standard formula 1.6% rate of return Annual revision mortality
Rate for pensions	RPI	RPI	RPI+ 20% wage growth	RPI+ (wage growth-1.6%)

2. NDC pension systems and Inheritance Gains

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- 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.

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

Growth rate salary = g
Growth population = γ
$(1+g)(1+\gamma)=(1+G)$

3. The model

Age	Contributors		Wages	
	t=1	t	t=1	t
X_e	$N_{(x_e,1)}$	$N_{(x_e,t)} = N_{(x_e,1)}(1+\gamma)^{t-1}$	$y_{(x_e,1)}$	$y_{(x_e,t)} = y_{(x_e,1)}(1+g)^{t-1}$
X_{e+1}	$N_{(x_e+1,1)}$	$N_{(x_e+1,t)} = N_{(x_e+1,1)}(1+\gamma)^{t-1}$		
X_{e+2}	$N_{(x_e+2,1)}$	$N_{(x_e+2,t)} = N_{(x_e+2,1)}(1+\gamma)^{t-1}$		
…				
X_{e+A-1}	$N_{(x_e+A-1,1)}$			
$x_r = x_e + A$	$P_{(x_e+A,1)}$			

Growth rate salary = g
Growth population = γ
$(1+g)(1+\gamma)=(1+G)$

3. The model

w-x_r

After «w-x_e-A» years- STEADY STATE

$$\overbrace{\theta_t\,(1+G)^{(t-1)}\sum_{k=0}^{A-1} y_{(x_e+k,1)}\,N_{(x_e+k,1)}}^{\text{Income from contributions}} = \underbrace{\overline{P}_{(x_e+A,1)}\sum_{k=0}^{w-x_e-A-1} N_{(x_e+A+k,1)}\,(1+G)^{t-1-k}(1+\lambda)^k}_{\text{Spending on pensions}} =$$

$$\overbrace{\theta_t \sum_{k=0}^{A-1} y_{(x_e+k,t)}\,N_{(x_e+k,t)}}^{\text{Income from contributions}} = \underbrace{\overline{P}_{(x_e+A,t)}\sum_{k=0}^{w-x_e-A-1} N_{(x_e+A+k,t)}\left[\frac{1+\lambda}{1+G}\right]^k}_{\text{Spending on pensions}}$$

and

$$\theta_t=\theta_{t+1}=\dots$$

- 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**
- θ_t : **contribution rate at moment t**

Growth rate salary= g
Growth population = γ
$(1+g)(1+\gamma)=(1+G)$

3. The model

$$\overbrace{\theta_t \sum_{k=0}^{A-1} y_{(x_e+k,\,t)} N_{(x_e+k,\,t)}}^{\text{Income from contributions}} = \underbrace{\overline{P}_{(x_e+A,\,t)} \sum_{k=0}^{w-x_e-A-1} N_{(x_e+A+k,\,t)} \left[\frac{1+\lambda}{1+G}\right]^k}_{\text{Spending on pensions}}$$

$$\theta_a = \frac{\sum_{k=0}^{A-1} N_{(x_e+k,-A+k+t)}\, y_{(x_e+k,-A+k+t)} (1+G)^{A-k}}{\ddot{a}^{\lambda}_{x_e+A} N_{(x_e+A,t)}}$$

Including dead people

Accredited contribution rate

$\Rightarrow \theta_a = \theta_t$

- 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**
- θ_t **: contribution rate at moment t**

Growth rate salary= g
Growth population = γ
$(1+g)(1+\gamma)=(1+G)$

3. The model

Survivorship dividend at the retirement age, moment t:

Containing CAPITAL from deceased

$$D^{ac}_{(x_e+A,t)} = \underbrace{\frac{\overbrace{\theta_a \sum_{k=0}^{A-1} N_{(x_e+k,-A+k+t)} y_{(x_e+k,-A+k+t)} (1+G)^{A-k}}^{K^{ac}_{(x_e+A,t)}}}{N_{(x_e+A,t)}}}_{\overline{K}^{ac}_{(x_e+A,t)}} - \underbrace{\theta_a \sum_{k=0}^{A-1} y_{(x_e+k,-A+k+t)} (1+G)^{A-k}}_{K^{i}_{(x_e+A,t)}}$$

$$D^{ac}_{(x_e+A,t)} = \overline{K}^{ac}_{(x_e+A,t)} - K^{i}_{(x_e+A,t)}$$

Growth rate salary= g
Growth population = γ
(1+g)(1+γ)=(1+G)

3. The model

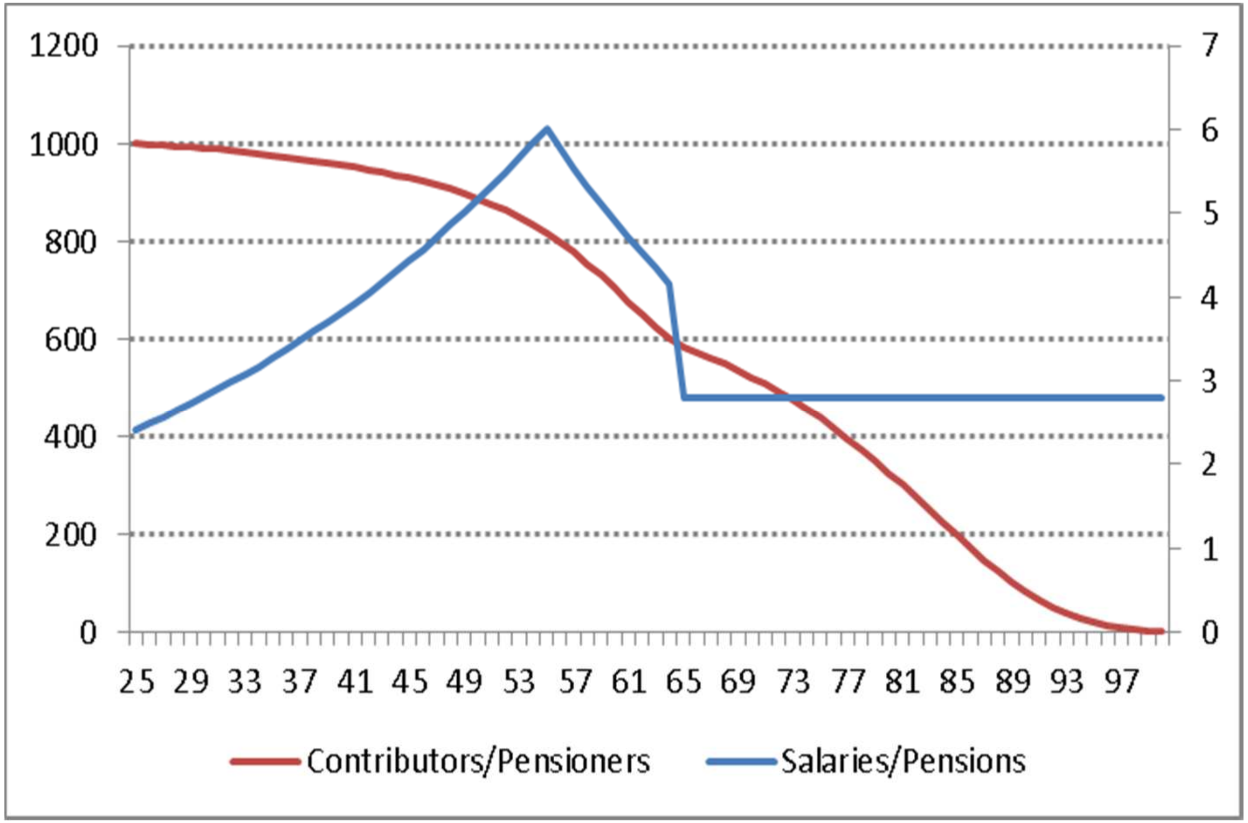
With NO Survivorship dividend

$$\underbrace{\overbrace{\frac{\theta_a \sum_{k=0}^{A-1} y_{(x_e+k,-A+k+t)}(1+G)^{A-k}}{\ddot{a}^{\lambda}_{x_e+A}}}^{P^i_{(x_e+A,t)}} \sum_{k=0}^{w-x_e-A-1} N_{(x_e+A+k,t)}\left[\frac{1+\lambda}{1+G}\right]^k}_{\text{Spending on pensions}} = \overbrace{\theta^*_t \sum_{k=0}^{A-1} y_{(x_e+k,t)} N_{(x_e+k,t)}}^{\text{Income from contributions}}$$

$$\theta_a = \theta^*_t \left(1+\frac{D^{ac}_{(x_e+A,t)}}{K^i_{(x_e+A,t)}}\right) \rightarrow \theta_a > \theta^*_t$$

4. An example

Time t after reaching the steady state



Assumptions:

g = 1%; γ= 0% ; λ =0%

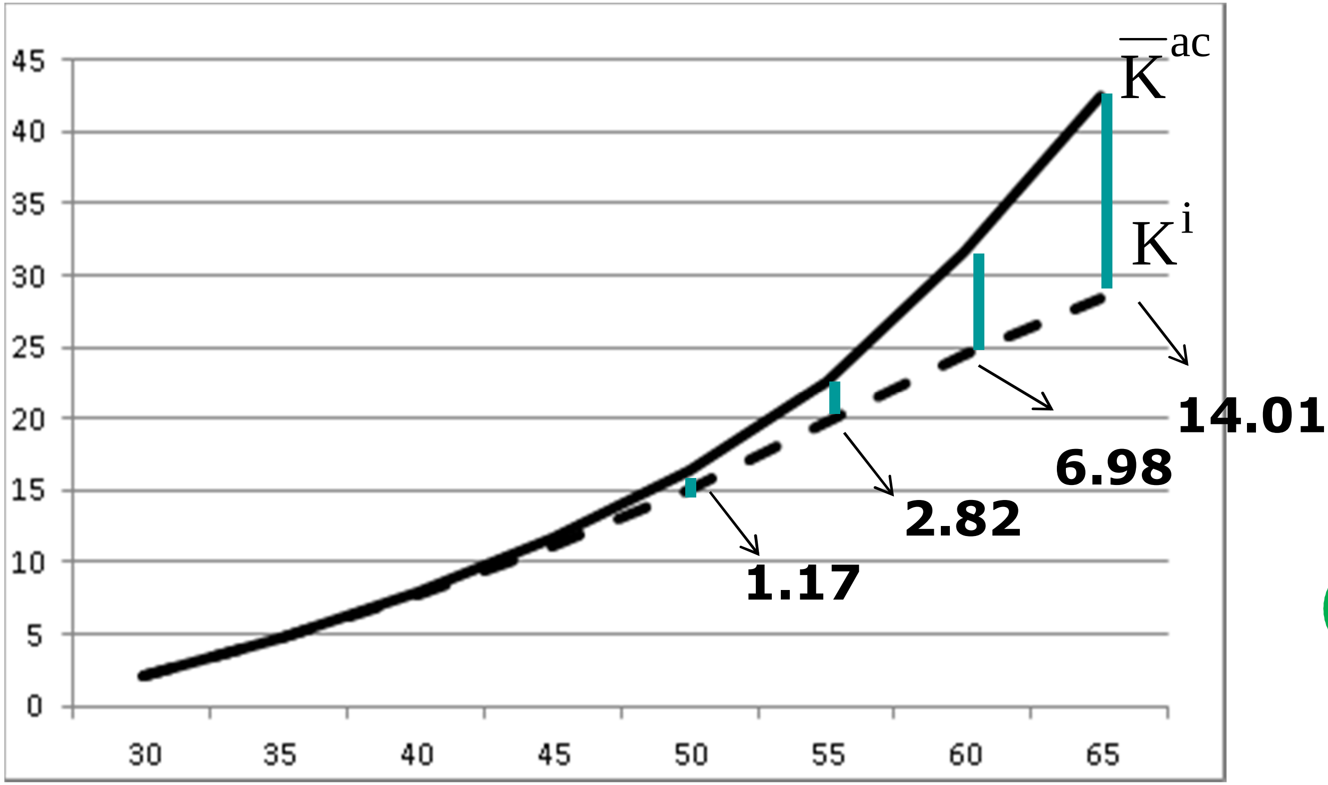
$$\theta_a = \theta_t = 17\%$$

4. An example

Assumptions:

g = 1%; γ= 0% ; λ =0%

Accumulated Dividend, moment t after reaching the steady state



Age

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

1.88

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

2.80

↑**49.39%**

4. An example

Assumptions	$\overline{K}_{65}^{ac}$	K_{65}^{i}	SD	P_{65} with SD	P_{65} no SD	% change
g = 1%; γ= 0% ; λ =0%	42.39	28.37	14.01	2.80	1.88	49.39
g = 1%; γ= 2% ; λ =0%	63.50	41.47	22.03	5.00	3.26	53.13
g = 1%; γ= 4%; λ=0%	98.63	63.00	35.63	9.05	5.78	56.56

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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