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MIXED PENSION SYSTEMS SUSTAINABILITY

Roberta Melis
Alessandro Trudda

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TEL. +39-070-6756406; FAX +39-070- 6756402

CRENoS - SASSARI
VIA TORRE TONDA 34, I-07100 SASSARI, ITALIA
TEL. +39-079-213536; FAX +39-079-213002

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Via Is Mirrionis, 1
09123 Cagliari
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Mixed pension systems sustainability

Roberta Melis[1], Alessandro Trudda[2]

[1]Universitas Mercatorum
Via Appia Pignatelli n. 62 - 00178 Roma, Italy
CRENoS Centre for North South Economic Research
(r.melis@unimercatorum.it)

[2]Dipartimento di Scienze Economiche e Aziendali
Università di Sassari,
Via Muroni n. 25 - 07100 Sassari, Italy
(atrudda@uniss.it)

Abstract

This article addresses the issue of the sustainability of a public PAYG pension scheme. It presents a mixed model, with the introduction of a funded component to balance the PAYG part when the ratio contributors-pensioners is decreasing. The aim of the work is to manage the funding of a public pension system. Stochastic risk indicators are presented to assess the sustainability of the scheme. We find the optimal share to invest in funding as minimize the probability of default of the system. Finally we analyse how this share varies when there is a decreasing in the number of the contributors.

Keywords: sustainability, demographic risk, public pension system.

JEL: H55, J11.

1 Introduction

Since many years the problem of pensions occupies a fundamental role in the political agenda of many countries in the world. The public PAYG pension schemes have faced a crisis due from one hand to the aging population for which the pension must be paid for a long time, and from the other hand the stoppage in economic growth has slowed down the flow of contribution revenue. Also the delayed entry in the working world has contributed to this problem.

A pension scheme, in terms of the financing method, can be pay-as-you-go (PAYG) or funded. In a PAYG scheme no assets are set aside and contributions paid by the workers are used to finance the current pensions, whereas in a funded scheme, the contributions are invested into a fund and the accrued amount is used towords meeting the benefits upon retirement.

Over the past few years, a vast literature regarding demographic risks and the sustainability in public PAYG system has been developed. Feldstein 1996 [15]; 2005 [16]) study the reform of the Social Security in the USA. Pemberton (2000 [26]) analyzes the transition from PAYG to funded pensions. Sinn (2000 [29]) and Blake (2000 [8]) illustrate the characteristics and the differences between PAYG and funded system. Diamond 2002 [11], Diamond and Orszag 2005 [12] investigate the social security reforms and the social security policies in order to restore the long term sustainability. More recently Grech (2013) [19] analyses the sustainability of pension reforms in Europe; Holzmann (2013) [22] studies and compares pension reforms worldwide.

To be in balance a PAYG pension scheme needs an equilibrium between the contribution income and the pension expenditure. This balance has begun to fail due to the decrease in births and the increase in life expectancy. The situation will be worse when the generation of the baby boomers will be retires in the next decades.

As highlighted by Gabay and Grasselly (2012) [18] there are other factors to consider apart of the decreasing in the birthrate and the rising of the life expectancy . The high unumploiment rate and the slow grow rate of the economies in Europe affect the pension systems.

Numerous countries, in particular in Europe have implemented reforms in the public pension system in the last decades. In order to manage the crisis due to the aging population some Countries adopted some reforms like increasing the pensionable age, raising the contribution rates and limiting the generosity of retirement benefits; these reforms are usually called in the literature "parametric" (On this topic see Disney, 2000 [13] and Haberman and Zimbidis, 2002 [21]). Others countries, like Sweden, Italy, Latvia and Poland introduced Notional Defined Contribution NDC systems, which are still financed on a PAYG basis, but where the pension is linked to the contributions paid during the working life, with a notional account for each partecipant (see Auerbach and Lee, 2009 [3], Settergren and Mikula, 2005 [28], Gronchi and Nisticò, 2008 [20], Nisticò and Bevilacqua, 2013 [25] and Holzman et al., 2012 [23]). As highlighted in [13] and [21] these scheme are "actuarially fair" because there is a direct link between the contributions paid and benefits received. Bisetti and Favero (2014) [7] measure the Impact of longevity risk on NDC Italian pension system. Another possibility to reform public pension system is the privatization, but, as highlighted in Fajnzylber and Robalino [14], a transition process from PAYG to funding has high transition costs because a generation pays twice the pension.

In some countries like Sweden, Latvia and Poland the contribution of public pension schemes are divided between PAYG and funding, in particular NDC system. Angrisani 2008 [1] proposes a logical mathematical model to manage a pension system with a structural funded component. Melis and Trudda 2012 [24] study the sustainability of a PAYG pension fund with the introduction of a funded component. The model is applied to the pension fund of Italian Professional Orders. Devolder and Melis 2015 [10] study the financing of a public pension scheme in a stochastic framework. They introduce a funded component and develop a model to find the optimal share to invest in both systems, presenting a a two period actuarial overlapping generation model in a mean variance context.

In this paper we present a mixed model for a public pension scheme with the introduction of a funded component. For the PAYG part we adopt an NDC scheme, without the accumulation of resources, but with defined contribution. It is introduced a funded component and it is analysed how the financial sustainability varies with the partial accumulation of amount into a fund invested on capital markets.

The paper is organised as follow: Section 2 develop the model; Section 3 introduces risk indicators for public pension schemes; in Section 4 the model and risk indicators are applied to a public pension scheme; in Section 5 conclusions are drawn up.

2 The model

As highlighted in the introduction we consider the evolution of a PAYG pension system with the introduction of a funded component. The model describes a pension scheme for a social security system in a discrete time with an age structured population. Let $N(x,t)$ be the population aged x at time t, α is the entry age into the scheme, π is the age of retirement and ω is the extreme age.

The total contribution is calculated as follows:

$$C(t) = \gamma \sum_{x=\alpha}^{\pi} N(x,t) \cdot w(x,t) \tag{1}$$

where γ is the contribution rate, $w(x,t)$ indicates the average wage for a people aged x at time t. The population evolves as follows for each age:

$$N(x,t) = N(x-1,t-1) \cdot p_{x-1,1} = N(x-t,0) \cdot p_{x-t,t} \tag{2}$$

where $p_{x-1,1}$ is the probability that a member aged $x-1$ is alive after one year. If $N_{\alpha,t}$ the number of people aged α at time t, thus the cohort of the new entrants evolves as follows:

$$N_{\alpha,t} = N_{\alpha,t-1} \cdot (1+d) = N_{\alpha,0} \cdot (1+d)^t \tag{3}$$

where d is the rate of increasing of the new entrants.

The wage function $w(x,t)$ evolves as follows:

$$w(x,t) = w(x,t-1) \cdot (1+g) = w(x,0) \cdot (1+g)^t \tag{4}$$

where g is the annual growth of income.

The total pensions are calculated by the following equation:

$$P_t = \sum_{x=\pi}^{\omega-1} N(x,t) \cdot b(x,t) \tag{5}$$

where $b(x,t)$ is the average pension for people aged x at time t.

In order to simplify the exposition, but without loss of generality, disability pension and survivor benefit are not included in the pension calculation.

As already highlighted, in our model there is a funded component. Thus as in [10] the pension is the sum of two components, the first calculeted with the PAYG system and the latter calculated with the funding system:

$$b(x,t) = b_F(x,t) + b_P(x,t) \tag{6}$$

where $b_F(x,t)$ and $b_P(x,t)$ indicate the average pension for people aged x at time t in funding and in PAYG respectively.

Let us consider the generation retiring at time t. The funded component $b_F(x,t)$ is calculated by capitalizing on the contributions paid during the working life at the rate of return of the fund. Indicating with $A_F(\pi,t)$ the total amount accumulated for the funded component by a member of age π at time t we have:

$$A_F(\pi,t) = a\gamma \sum_{x=\alpha}^{\pi-1} w\left(x, t-(\pi-x)\right)(1+i)^{(\pi-x)} \tag{7}$$

where a is the share of the contributions invested in funding.

Indicating with $A_P(\pi,t)$ the total notional amount accumulated in the NDC system by a member of age π at time t we have:

$$A_P(\pi,t) = \sum_{x=\alpha}^{\pi-1} w\left(x, t-(\pi-x)\right)(1+j)^{(\pi-x)}. \tag{8}$$

How to calculate pension? For the PAYG component we have:

$$A_P(\pi,t) : \text{accrued contributions} \tag{9}$$

By multiplying the total contributory accrued amount by the transformation coefficient we obtain the value of the pension at time of retirement.

$$b_P(\pi,t) = \gamma \cdot (a) A_P \cdot CDT(\pi,t) \tag{10}$$

where $CDT(x,t)$ is the transformation coefficient for a member aged x at time t. For the sake of simplicity we ipothise that all people retire at the same age π.

After the retirement the pensions are indixed by inflaction:

$$b_P(\pi+1, t+1) = b_P(\pi, t) \cdot (1+g). \tag{11}$$

How to calculate b_F?

We calculate like the PAYG component.

$$b_F(\pi, t) = \gamma \cdot aA_F \cdot CDT(\pi, t) \tag{12}$$

The problem is to evaluate if:

1. $A_F > A_P$
2. To investigate what it happens on one hand for the public balance and on the other hand to the individual performance level.

$$b(x,t) = \gamma \cdot CDT(\pi, t)(aA_F + (1-a)A_P)$$

$$\begin{gathered} b(\pi,t) = \gamma \cdot CDT(\pi,t) \cdot \left[a \sum_{x=\alpha}^{\pi-1} w\left(x, t-(\pi-x)\right)(1+i)^(\pi-x) + \right. \\ \left. (1-a)\gamma \sum_{x=\alpha}^{\pi-1} w\left(x, t-(\pi-x)\right)(1+j)^(\pi-x) \cdot CDT(\pi,t) \right] \end{gathered} \tag{13}$$

We put aside a portion of the contributions into a fund and we say: what is the minimum component that needs to be capitalized so that the system is in balance.

The pension balance is:

$$C(t) - P(t). \tag{14}$$

If every year a component is capitalised, then we have that aC_t is invested into the fund, while $(1-a)$ is used to pay pensions. Then we have the recursive formula of the fund:

$$F(t) = F(t-1)(1+r(t)) + aC(t) \tag{15}$$

where $r(t)$ is the return rate of the amount invested in the fund.

Without the accumulation into the fund, the general formula for the evolution of the system will be:

$$Y(t) = Y(t-1)(1+\theta(t)) + C(t) - P(t) \tag{16}$$

where $Y(t)$ is the overall balance and $\theta(t)$ is the cost of public debt (positive or negative).

If we accumulate the amount $aC(t)$ into a fund, then the total balance will be:

$$Y(t) = Y(t-1)(1+\theta(t)) + F(t) + (1-a)C(t) - P(t) \tag{17}$$

Substituting formula 15 into 16 we obtain:

$$Y(t) = Y(t-1)(1+\theta(t)) + F(t-1)(1+r(t)) + aC(t) + (1-a)C(t) - P(t) \tag{18}$$

$$Y(t) = Y(t-1)(1+\theta(t) + F(t-1) + C(t) - P(t) \tag{19}$$

3 Risk indicators

To assess the financial stability of a pension system in the literature different risk indicators are used, as well as with pension funds and private insurance companies. The literature on public PAYG pension system has applied actuarial solvency analysis methodology to the public PAYG pension system management. Actuarial balance sheets have been introduce in the public pensions starting from the Swedish pension system. Billig and Ménard 2013 [6] analyse the methodologies used to implement actuarial balance sheets for social security pension systems. As highlighted from the authors, this instrument is often useful to assess the financial efficiency of the pension system and its result are relatively easy to explain. According to Vidal et al. [30] the ABM is a selection of predetermined measures set by law to be applied immediately as required by the solvency indicator (financial assets + contributions/pension liabilities) in order to re-establish the solvency or financial sustainability of PAYG systems, through successive applications (Settergren, 2001 [27], Vidal et al., 2009 [30]). It is an adjustment method of the pension benefits adopted to maintain the soundness of the pension financing. This kind of mechanism is useful to re-establish the financial equilibrium of a PAYG pension system without the intervention of the legislator. On this topic see also Alonso-Garcia et al. [2].

In actuarial and financial literature different risk measures are used to assess the solvency of a pension fund. One of these is the funding ratio, the proportion between the fund value and the present net value of future obligations of the fund:

$$F_r(t) = \frac{F(t)}{AL(t)} \tag{20}$$

where $AL(t)$ is the actuarial liability, the present net value of the future obligation of the fund. This ratio indicates the fraction of the actuarial liabilities covered by the funded component. The complement to 1 measures the amount that must be covered by PAYG, in case of partially unfunded pension schemes.

An useful indicator used to assess the financial health of an unfunded pension scheme is the liquidity ratio, which indicates the relationship between income from contributions and pension expenditures at a specific date (See [24] and [2]):

$$LR = \frac{C(t)}{P(t)} \tag{21}$$

If the ratio is below 1 the system is in a situation of financial instability and it must be monitored properly.

An indicator used for the Swedish pension system is the so-called balance ratio, which is a solvency ratio defined as:

$$SR(t) = \frac{TA(t)}{V(t)} = \frac{CA(t) + F(t)}{V(t)} \tag{22}$$

where $TA(t)$ is the total asset at time t, $CA(t)$ is the contribution asset at time t and $V(t)$ represents the liability to all partecipants in the pension system.

Angrisani in [1] highlights that the sustainability indicator (balance ratio) of the Swedish pension system requires a steady state hypothesis and proposes a logical mathematical model to manage a pension system with a structural funded component, valid also in the case of non-stable population.

4 Numerical application

This section presents a numerical example of the model above applied to a pension system. The fund is composed of 84.363 workers and 44.084 pensioners. The members of the fund are males and the population is proportional to the Italian public pension system (about $\frac{1}{100}$ of the the males members of the public pension system). The pension is calculated with the NDC pension system for people starting to work after 1996, while for people starting before 1996 pension was calculated using the mixed metod, so called pro rata [4]. Until 1996 the defined benefit DB formula is used and the pension is calculated by multiplying the pensionable earnings, i.e. the mean of the earnings obtained over the final years of work, revalued at a given rate, by the number of years of contributions accrued in the DB system.

The following assumptions are adopted:

- evolution of the population based on IPS55 male mortality tables;
- for new entrants fixed entry age $= 25$, retirement age $= 65$;
- the inflation rate is fixed at 1.5%;
- the contribution rate is fixed at 25%;
- the last transformation coefficients (2016) have been employed;
- salaries are appreciated at rate of inflation;
- benefits are calculated with the mixed method;
- the return on assets is fixed at 2%;

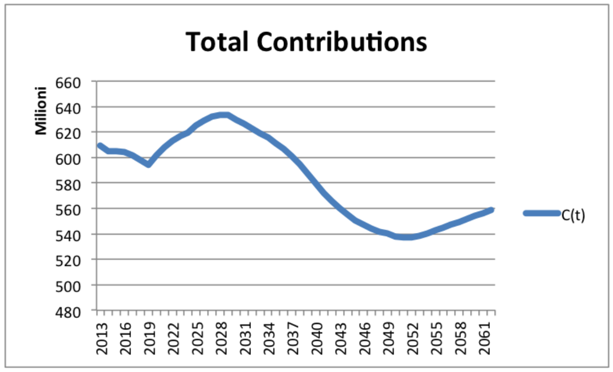

Figure 1: Total contributions received years 2013-2062

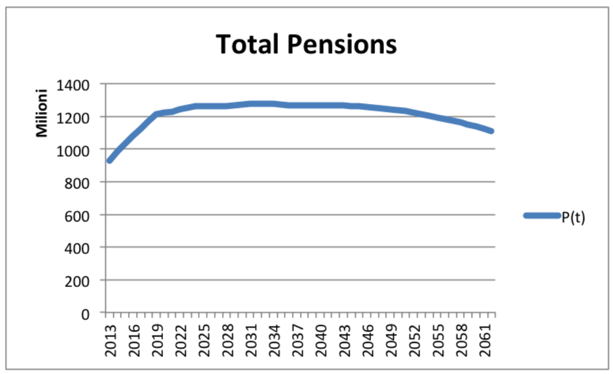

Figure 2: Total pension paid years 2013-2062

- the rate of cost of public debt is fixed at 1%;
- the notional rate is fixed at 1.5%.

The pension scheme balance is projected for 50 years.

The following figures summarises the results obtained.

5 Conclusions

In this paper we analysed the sustainability of a public pension system. We introcuced a funded component in order to improve the capability of the scheme to cover the pension liabilities in the long run. The model has been applied to a fund with the features of the Italian public pension system. For the public budget, if it is set aside part of the contributions, after a number of years it will get the balance of the system and a state of autonomy, without the intervention

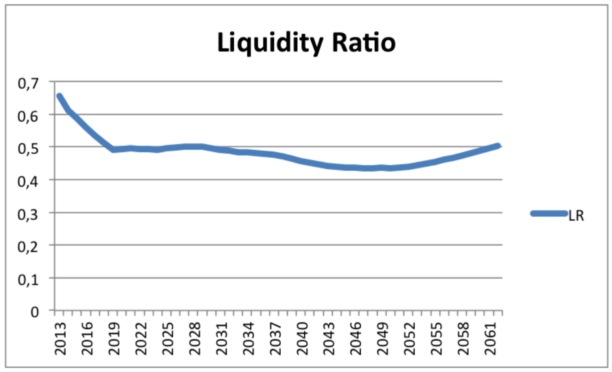

Figure 3: Ratio contribution received on total pension paid years 2013-2062

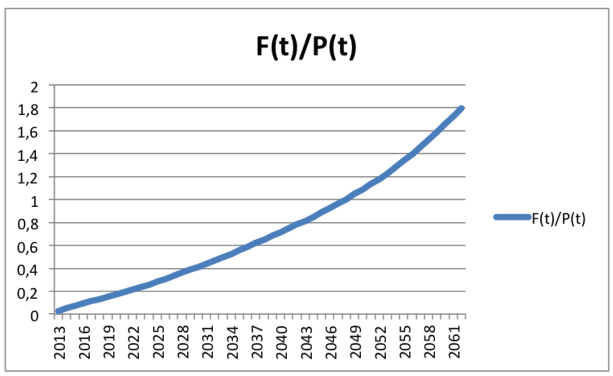

Figure 4: Ratio fund value on total pension paid years 2013-2062

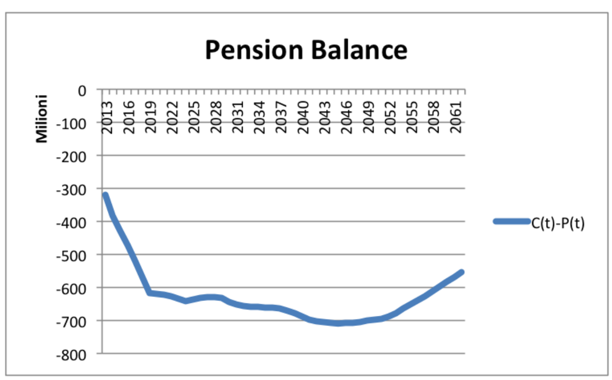

Figure 5: Pension balance - difference between total contribution received and pension paid years 2013-2062

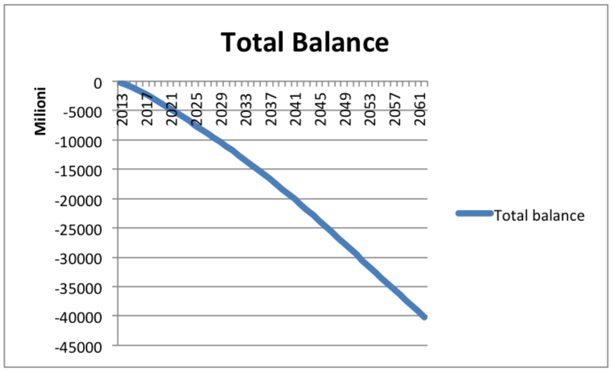

Figure 6: Overall balance without the accumulation into the fund - years 2013-2062

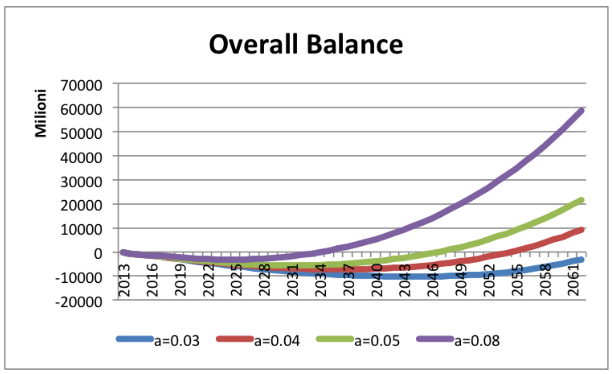

Figure 7: Overall balance with the accumulation of the fraction a of the annual contributions into the fund - years 2013-2062

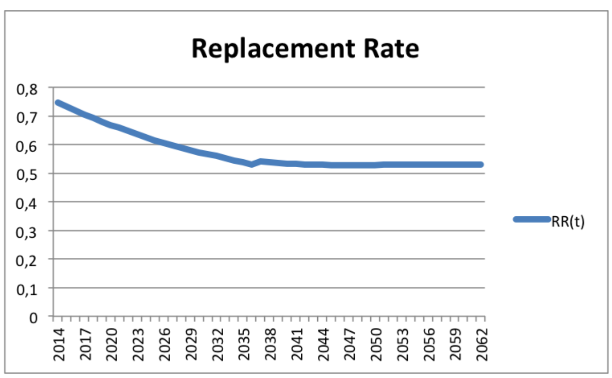

Figure 8: Replacement rate - years 2014-2062

of the state to cover the negative balance of social security. The minimum component to be allocated according to the assumptions used in the simulations of new inputs, interest rate and cost of debt is 4% of the contributions, which ensures an overall positive balance after about 40 years.

At the level of individual performance on the other hand, the replacement rate increases with the introduction of capitalization component, but not significantly.

We must emphasize that in the paper hypothesis we consider only full careers, ie 40 years of contribution, as the purpose of the study is to assess the impact of the introduction to the public system of a capitalization component. If you instead consider, given the unemployment and delayed entry into the working world, the replacement rate will be even lower, about 40%.

References

[1] Angrisani, M. (2008) The logical sustainability of the pension system, Pure Mathematics an Applications 19(1): 67-81.

[2] Alonso-Garcia, J., Boado-Penas, M. and Devolder, P. (2014) Automatic balancing mechanism for notional defined contribution accounts in the presence of uncertainty, Discussion Paper 2014/38, Institute de Statistique, Biostatistique et Sciences Actuarielles, Universit Catholique de Louvain.

[3] Auerbach, A.J. and Lee, R. (2009) Notional Defined Contribution Pension Systems in a Stochastic Context: Design and Stability, in Social Security Policy in a Changing Environment, Brown, J. and Liebman, J. Wise, D.A. eds., University of Chicago Press: 43-68.

[4] Baldacci, E. and Tuzi, D. (2003) Demographic Trends and Pension System in Italy: an Assessment of 1990s Reforms, Labour 17: 209-240.

[5] Belloni, M. and Maccheroni, C. (2013) Actuarial fairness when longevity increases: An evaluation of the italian pension system, The Geneva Papers 38: 638-674.

[6] Billig, A. and Ménard, J.C. (2013) Actuarial balance sheets as a tool to assess the sustainability of social security pension systems, International Social Security Review 66(2): 31-52.

[7] Bisetti, E. and Favero, C. (2014) Measuring the Impact of Longevity Risk on Pension Systems: The Case of Italy, North American Actuarial Journal 18(1): 87-103.

[8] Blake, D. (2000) Does it matter what type of pension scheme do you have? The Economic Journal, 110: F46-F81.

[9] Devolder, P. and Dominguez, I. and Miller, A. (2009) NDC Dynamic Equilibrium model with financial and demographic risks, www.actuaries.org.

[10] Devolder, P. and Melis, R. (2015) Optimal mix between pay as you go and funding for pension liabilities in a stochastic framework, Astin Bulletin 45(03): 551-575.

[11] Diamond, P. A. (2002) Social Security Reform, The Lindahl Lectures, Oxford University Press, ISBN: 0-19-924789-7.

[12] Diamond, P. A. and Orszag, P. R. (2005) Saving Social Security: The Diamond-Orszag Plan, The Economists Voice 2(1): 1-9.

[13] Disney, R. (2000) Crises in Public Pension Programmes in OECD: What Are the Reform Options? Economic Journal Features 110: 1-23.

[14] Fajnzylber, P. and Robalino, D. A. (2012) Assessing fiscal costs and pension distribution in transitions to defined contribution systems: A retrospective analysis for chile. In: Holzmann, R., Palmer, E., Robalino, D.A. (Eds.), Nonfinancial Defined Contribution Pension Schemes in a Changing Pension World - Volume 1: Progress, Lessons, and Implementation. The World Bank, Washington, DC, pp. 281-316.

[15] Feldstein, M. (1996) The Missing Piece in Policy Analysis: Social Security Reform, American Economic Review 86(2): 1-14.

[16] Feldstein, M. (2005) Structural Reform of Social Security, The Journal of Economic Perspectives 19(2): 33-55.

[17] Fehr, H. and Uhde, J. (2013) On the optimal design of pension systems, Empirica 40: 457-482.

[18] Gabay, D. and Grasselli M. (2012) Fair demographic risk sharing in defined contribution pension systems, Journal of Economic Dynamics and Control, 36(4): 657-669.

[19] Grech, A.G. (2013), Assessing the sustainability of pension reforms in Europe, Journal of International and Comparative Social Policy 29(2):143-162.

[20] Gronchi, S. and Nisticò, S. (2008), Theoretical Foundations of Pay-As-You-Go Defined-Contribution Pension Schemes, Metroeconomica, 59(2):131-159.

[21] Haberman, S. and Zimbidis, A. (2002) An Investigation of the Pay-As-You-Go Financing Method Using a Contingency Fund and Optimal Control Techniques, North American Actuarial Journal 6(2): 60-75.

[22] Holzmann, R. (2013) Global pension systems and their reform: Worldwide drivers, trends and challenges, International Social Security Review 66(2): 1-29.

[23] Holzmann, R., Palmer, E. and Robalino, D. (2012) Nonfinancial Defined Contribution in a changing pension world, Vol. 1, progress, lessons and implementation, The World Bank, DC, Washington.

[24] Melis, R. and Trudda, A. (2012) Solvency indicators for partially unfunded pension funds, Investment Management and Financial Innovations 9(4): 71-77.

[25] Nisticò, S. and Bevilacqua, M. (2013) Notional Defined Contribution (NDC) Pension Schemes and Income Patterns. Economics: The Open-Access, Open-Assessment E-Journal, Vol. 7, 2013-29.

[26] Pemberton J. (2000). National and international privatization of pensions, European Economic Review, 44 (10): 1873-1896.

[27] Settergren, O. (2001), The Automatic Balance Mechanism of the Swedish Pension System, Wirtschaftspolitishe Blätter, 4: 239-249.

[28] Settergren, O. and Mikula, B.D. (2005) The rate of return of pay-as-you-go pension system: a more exact comsumption model of interest, Journal of Pension Economics and Finance 4: 115-138.

[29] Sinn, H. W. (2000) Why a Funded Pension System is Useful and Why it is Not Useful, International Tax and Public Finance, 7: 389-410.

[30] Vidal-Meliá, C., Boado-Penas, M. and Settergren, O. (2009) Automatic balance mechanism in pay-as-you-go pension system, The Geneva Papers, 34(2): 287-317.

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