Risk and solvency of Notional Defined Contribution pension systems (NDC's)

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Abstract

The non-financial defined contribution or notional model combines pay-as-you-go (PAYG) financing with a pension formula that depends on the amount contributed and the return on it which is determined by the notional rate. The account is called notional because no pot of pension fund money exists as the system is PAYG financed. When the individual reaches the retirement age the accumulated capital is converted into an annuity that takes into account the life expectancy of the individual, the indexation of pensions and the technical interest rate, as in classical Financial Defined Contribution Systems (FDC). However, NDC systems cannot provide automatic financial equilibrium, as compared to the FDC systems, which are in equilibrium by construction.

The aim of this paper is twofold: to show to what extent the liquidity and solvency indicators of NDC systems are affected by fluctuations in the economic, financial and demographic conditions; and to explore the issue of introducing an optimal automatic balancing mechanism into the notional model to re-establish the financial equilibrium.

We present a 4 overlapping generations model with dynamic evolution of the main parameters affecting the pension equilibrium. New entrants and salary trajectories are stochastic processes.

Under this framework we study the liquidity and solvency ratios. The liquidity ratio compares the income from contributions with the expenditure on pensions (cash-flow point of view). The solvency ratio compares the current liabilities of the system with the Contribution Asset, a measure that is used in Sweden in order to calculate

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the PAYG assets. We show that, in the steady state, the pension system is both balanced and solvent. However, under a dynamic framework the pension system is not balanced or solvent in general.

With this in mind, automatic balance mechanisms (ABM) are introduced, through a correction of the notional rate, in order to re-establish the liquidity and/or solvency of the system. The notional rate of the system, which affects both pensioners and contributors, is altered by some time-dependent variable which is derived in order to attain a particular liquidity or solvency level. The goodness of the ABM is assessed by means of the variance of the new notional rate, as participants in a public pension system would prefer a less volatile return on their accumulated fund or less variation in the indexation of pensions. The study of the variance uses Monte Carlo simulation.

The main conclusion is that the sum of the variance of the notional rate affected by the ABM based on the solvency ratio is lower than the sum of the variance of the notional rate affected by the ABM based on the liquidity ratio in all different scenarios.

Keywords: actuarial analysis, risk, public pensions, retirement, solvency, stochastic processes.

References

[1] Auerbach, A.J. and R. Lee (2007), Notional Defined Contribution Pension Systems in a Stochastic Context: Design and Stability. *Berkeley Program in Law and Economics, Working Paper Series, UC Berkeley.*

[2] Boado-Penas, C. , Valdés-Prieto, S. and C. Vidal-Meliá (2008). An Actuarial Balance Sheet for Pay-As-You-go Finance: Solvency Indicators for Spain and Sweden. *Fiscal Studies*, 29, 89–134.

[3] Settergren and Mikula, B. D. (2005). The rate of return of pay-as-you-go pension systems: a more exact consumption-loan model of interest. *Journal of Pensions Economics and Finance*, 4, 115–138.

[4] Valdés-Prieto, S. (2000). The financial stability of Notional Accounts Pension. *Scandinavian Journal of Economics*, 102, 395–417.