

A simple model of Japanese public pension and the risk management

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1 Introduction

We consider the risk management of public pension system. Longevity risk for social security system is one of worldwide problems even in emerging economy countries. We formulate a simple model of public pension whose control variables are premium, benefit, beneficial age and governmental subsidy to the pension fund. Decision makers of the system are premium payers and beneficiaries, which implies 8 decades planning period. In this model, demographic change is assumed deterministically by longevity, fertility given by NIPSSR[3] assumptions. The budgetary balance of pension system is formulated for stochastic process of per capita income and rate of return using Ornstein-Uhlenbeck process or binomial model in discrete setup. We take idea of economic theory of go-as-you-pay pension in [2] and individual annuity theory in [1] but in this paper we want work to Japanese pension system framework [4] and the data.

The risk management is using hedging technique of put option to cover the deficit of benefit amount in the target year. We calculate three economic scenarios including deflation economy and high-inflation economy in discrete modeling. Furthermore we simulate different fertility and longevity scenarios.

The paper is organizes as follows. In section 2 the simple model of pension is described by using per capita income growth for premium and benefit. The growth model of per capita income and rate of return are assumed to be mean-reversion processes. Pension reserve process are formulated in SDE and control problem to grantee the target year's benefit payment. We list up several constraints for robust public pension system. In section 3 using the japanese government program we calculate budgetary balance of pension by simulation. In section 4 risk management of pension is calculated by hedging strategy of binomial option pricing. In last section we sum up conclusions.