Public Sector Pension Policies and Capital Accumulation in Emerging Economies*

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Abstract

In emerging economies pension programs of public sector workers tend to be more generous than pension programs of private sector workers. In this paper we study the adverse effects of these generous pension schemes on income and welfare, using a two-sector overlapping generations model. We argue that opportunity costs of running generous public pension schemes for civil servants are potentially large in emerging economies, where there is often severe lack of public investments in education and infrastructure. Calculating transitions to the post reform steady state, we find that welfare gains for the generation born before the reform can only be realized when freed up resources are reinvested into public education, but not when these freed up resources are used for tax cuts or for infrastructure investments.

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1 Technical Appendix: Public Sector Pension Policies and Capital Accumulation in Emerging Economies

1.1 Solving the Model

1.1.1 Household Choices

We assume that the government indexes public worker wages to private worker wages as follows

$$w_t^g = \xi w_t^p. \tag{1}$$

We typically restrict ξ to be sufficient large so that we can assume that the government can directly set the fraction of the workforce N_t^g it wants to employ. Then total human capital employed by the public sector is $H_t^g = H_t N_t^g$. All other workers $(1 - N_t^g)$ will work in the private sector, that is $H_t^p = H_t N_t^p = H_t (1 - N_t^g)$. We justify this by assuming that agents would prefer to work for the government if lifetime income from working in the public sector exceeds lifetime income from working in the private sector.

Households can invest in two assets, physical capital and government issued bonds. In equilibrium both assets have to pay the same rate of return due to non-arbitrage conditions. If we denote $R_t = (1 - \tau_{Kt}) q_t + 1 - \delta$ as the after-tax return on capital investment and $R_t^b = \left(1 + r_t^b\right)$ as the net return on bonds, we get

$$(1 - \tau_{Kt}) q_t + 1 - \delta = 1 + r_t^b = R_t.$$

If we assume full depreciation $\delta = 1$, which is quite reasonable, given that the length of one period is 30 years. Then the interest rate condition becomes

$$(1 - \tau_{Kt}) q_t = 1 + r_t^b = R_{t+1}. \tag{2}$$

The Lagrangian of the problem becomes

$$\begin{aligned} L(\cdot) &= \frac{1}{1-\sigma}\left[\left(c_t^j\right)^{1-\sigma} + \Theta G_t^{1-\sigma}\right] + (\pi\beta)\frac{1}{1-\sigma}\left[\left(c_{t+1}^j\right)^{1-\sigma} + \Theta G_{t+1}^{1-\sigma}\right] + \\ &\quad \lambda^j\left[\left(1 - \tau_{Lt}^{ssj} - \tau_{Lt}^j\right) w_t^j h_t + \frac{T_{t+1}^j}{R_{t+1} N_t^j} - c_t^j - \frac{c_{t+1}^j}{R_{t+1}}\right]. \end{aligned}$$

The optimal decision rules for savings and consumption are

$$
\begin{aligned}
i_t^j &= \frac{(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right) w_t^j h_t - \frac{T_{t+1}^j}{R_{t+1}N_t^j}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}, \\
c_t^j &= \frac{I_t^j}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}} = \frac{1}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}} I_t^j, \\
c_{t+1}^j &= \frac{(\pi\beta R_{t+1})^{\frac{1}{\sigma}}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}} I_t^j = \frac{(\pi\beta R_{t+1})^{\frac{1}{\sigma}}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}} I_t^j,
\end{aligned}
$$

where $I_t^j = \left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right) w_t^j h_t + \frac{T_{t+1}^j}{R_{t+1}N_t^j}$. We then obtain the investment decisions as

$$
\begin{aligned}
i_t^g &= \left(\frac{(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}\right) \frac{\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right)\xi\alpha_3 Y_t}{\left(1+\tau_t^{sspf}\right)\left(1-N_t^g\right)} - \frac{1}{\left(1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}\right)} \frac{\Psi^g\xi\alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}}, \\
i_t^p &= \left(\frac{(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}\right) \frac{\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right)\alpha_3 Y_t}{\left(1+\tau_t^{sspf}\right)\left(1-N_t^g\right)} - \frac{1}{\left(1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}\right)} \frac{\Psi^p\alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}}.
\end{aligned}
$$

1.1.2 Aggregation

Adding private and public investment we get an expression for aggregate saving

$$
\begin{aligned}
K_{t+1}+B_{t+1} &= I_t^g + I_t^p = N^g i_t^g + \left(1-N^g\right) i_t^p = \\
&= N_t^g \left[\begin{array}{c} \left(\frac{(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}\right) \frac{\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right)\xi\alpha_3 Y_t}{\left(1+\tau_t^{sspf}\right)\left(1-N_t^g\right)} \\ -\frac{1}{\left(1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}\right)} \frac{\Psi\xi\alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}} \end{array}\right] + \\
&\quad \left(1-N_t^g\right) \left[\begin{array}{c} \frac{(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}} \left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right) \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} \frac{Y_t}{\left(1-N_t^g\right)} \\ -\frac{1}{1+(\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}} \frac{\Psi^p\alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}} \end{array}\right],
\end{aligned}
$$

$$
K_{t+1}+B_{t+1} = N_t^g \left[\begin{array}{c} \left(\frac{\Gamma_{t+1}}{1+\Gamma_{t+1}}\right) \frac{\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right)\xi\alpha_3 Y_t}{\left(1+\tau_t^{sspf}\right)\left(1-N_t^g\right)} \\ -\frac{1}{\left(1+\Gamma_{t+1}\right)} \frac{\Psi\xi\alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}} \end{array}\right] + \left(1-N_t^g\right) \left[\begin{array}{c} \frac{\Gamma_{t+1}}{1+\Gamma_{t+1}} \left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^{j}\right) \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} \frac{Y_t}{\left(1-N_t^g\right)} \\ -\frac{1}{1+\Gamma_{t+1}} \frac{\Psi^p\alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}} \end{array}\right]
$$

where $\Gamma_{t+1} = (\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}$.

1.1.3 Steady State Equilibrium

Imposing steady state we use expression $R = \alpha_2 (1-\tau_K) \frac{Y}{K}$ from the firm's first order condition (**??**) and in addition we restrict government debt to be a fixed fraction of GDP so that $B = \Delta_B Y$. We then obtain

$$\begin{aligned} & \alpha_2 (1-\tau_K) \frac{Y}{R} + \Delta_B Y \\ = \; & N^g \left[\left(\frac{\Gamma}{1+\Gamma} \right) \frac{(1-\tau_L^{ssg} - \tau_L^g) \xi \alpha_3 Y}{(1+\tau^{sspf})(1-N^g)} - \frac{1}{(1+\Gamma)} \frac{\Psi \xi \alpha_3}{(1+\tau^{sspf})(1-N^g)} \frac{Y}{R} \right] + \\ & \left[\frac{\Gamma}{1+\Gamma} (1-\tau_L^{ssp} - \tau_L^p) \frac{\alpha_3 Y}{(1+\tau^{sspf})} - \frac{1}{1+\Gamma} \frac{\Psi^p \alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)} \frac{Y}{R} \right], \end{aligned} \tag{3}$$

where $\Gamma = (\pi\beta)^{\frac{1}{\sigma}} R^{\frac{1}{\sigma}-1}$.

From (**??**) we get an expression for output in terms of human capital

$$h_{t+1} = D \left[(H_t^{ge})^{\eta_1} + \chi_1 E_t^{\eta_1} \right]^{\frac{\gamma_1}{\eta_1}} h_t^{\gamma_2}.$$

In the steady state this becomes

$$H^{1-\gamma_2} = \left[D \left[(aN^g H)^{\eta_1} + \chi_1 (\Delta_E Y)^{\eta_1} \right]^{\frac{\gamma_1}{\eta_1}} \right]. \tag{4}$$

Given R, we have

$$K = \frac{(1-\tau_K)\alpha_2}{R} Y. \tag{5}$$

Since at steady state $K_{t+1}^G = K_t^G = K^G$, and using (**??**) in the law of motion for capital (**??**) we have

$$K^G = \frac{\Delta_G}{\delta_G} Y. \tag{6}$$

We use (6) in the production function for the public good (**??**) and get

$$G = Z \left[\left(\frac{\Delta_G}{\delta_G} Y \right)^{\eta_2} + \chi_2 \left[(1-a) N^g H \right]^{\eta_2} \right]^{1/\eta_2}, \tag{7}$$

that expresses the output of the public good G as a function of human capital H. Then the steady state output is given by

$$Y = A G^{\alpha_1} K^{\alpha_2} \left[H (1-N^g) \right]^{\alpha_3}. \tag{8}$$

The government budget constraint is

$$
\begin{array}{c}
R\Delta_B + \Delta_E + \Delta_G + \Delta_{C_g} + \mu\Psi^p \frac{\alpha_3}{(1+\tau^{sspf})} \\
+\xi \frac{\alpha_3}{(1+\tau^{sspf})} \frac{1}{(1-N^g)} N^g + \mu\Psi^g \xi \frac{\alpha_3}{(1+\tau^{sspf})} \frac{1}{(1-N^g)} N^g \\
= \\
\Delta_B + \left(\tau_L^{ssg} + \tau_L^g\right) \xi \frac{\alpha_3}{(1+\tau^{sspf})} \frac{1}{(1-N^g)} N^g \\
+ \left(\tau_L^{ssp} + \tau_L^{sspf} + \tau_L^p\right) \frac{\alpha_3}{(1+\tau^{sspf})} + \tau_K \alpha_2 + (1-\pi) RK.
\end{array}
\tag{9}
$$

Since we picked government debt to be exogenous, we need to specify a new endogenous variable out of the set of government policy variables which adjusts in the policy reform to clear the budget constraint. We pick either capital tax τ_K or labor tax τ_L. Equations $(3), (4), (5), (7), (8)$ and (9) determine the steady state variables $\tau_K, (\tau_L), K, R, Y, H$ and G.

1.2 Solving the Model for Transitions

In order to calculate transition paths we simplify the model further and drop bonds out of the system. In addition, we assume log-utility and full depreciation of public capital. The transition generation, that is, the generation that is born in the old steady state and gets surprised by the policy reform gets to keep its pension package. The new replacement rate of public pension only applies to the generation born after the policy change (grandfathering). The system then reduces to:$\Gamma_{t+1} = (\pi\beta)^{\frac{1}{\sigma}} R_{t+1}^{\frac{1}{\sigma}-1}$

$$
\begin{aligned}
K_{t+1} + B_{t+1} &= N_t^g \left[\begin{array}{c} \left(\frac{\Gamma_{t+1}}{1+\Gamma_{t+1}}\right) \frac{\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^j\right)\xi\alpha_3 Y_t}{\left(1+\tau_t^{sspf}\right)\left(1-N_t^g\right)} \\ -\frac{1}{(1+\Gamma_{t+1})} \frac{\Psi^g \xi \alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)\left(1-N_{t+1}^g\right)} \frac{Y_{t+1}}{R_{t+1}} \end{array} \right] + \left[\begin{array}{c} \frac{\Gamma_{t+1}}{1+\Gamma_{t+1}} \frac{\left(1-\tau_{Lt}^{ssj}-\tau_{Lt}^j\right)\alpha_3 Y_t}{\left(1+\tau_t^{sspf}\right)} \\ -\frac{1}{1+\Gamma_{t+1}} \frac{\Psi^p \alpha_3}{\left(1+\tau_{t+1}^{sspf}\right)} \frac{Y_{t+1}}{R_{t+1}} \end{array} \right], \\
H_{t+1} &= D\left[\left(aN_t^g H_t\right)^{\eta_1} + \chi_1 \left(\Delta_t^E Y_t\right)^{\eta_1}\right]^{\frac{\gamma_1}{\eta_1}} H_t^{\gamma_2}, \\
G_{t+1} &= Z\left[\left(\Delta_t^G Y_t\right)^{\eta_2} + \chi_2 \left((1-a) N_{t+1}^g H_{t+1}\right)^{\eta_2}\right]^{1/\eta_2}, \\
Y_t &= AG_t^{\alpha_1} K_t^{\alpha_2} \left(\left(1-N_t^g\right) H_t\right)^{\alpha_3} \\
R_t &= \frac{(1-\tau_{Kt})\,\alpha_2}{K_t} Y_t, \text{ and}
\end{aligned}
$$

$$
\begin{aligned}
& R_t \Delta_t^B Y_t + \Delta_t^E Y_t + \Delta_t^G Y_t + \Delta_{C_g,t} Y_t + \pi \Psi^p \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} Y_t \\
& + \xi \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} \frac{Y_t}{(1-N^g)} N^g + \pi \Psi^g \xi \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} \frac{Y_t}{(1-N^g)} N^g \\
= & \\
& \Delta_{t+1}^B Y_{t+1} + \left(\tau_{Lt}^{ssg} + \tau_{Lt}^g\right) \xi \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} \frac{Y_t}{(1-N^g)} N^g \\
& + \left(\tau_{Lt}^{ssp} + \tau_{Lt}^{sspf} + \tau_{Lt}^p\right) \frac{\alpha_3}{\left(1+\tau_t^{sspf}\right)} Y_t + \tau_{Kt} \alpha_2 Y_t + (1-\pi) \alpha_2 Y_t.
\end{aligned}
$$