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Pension Reform, Private Saving, and the
Current Account in a Small Open
Economy

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Abstract

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

The macroeconomic implications of a pension reform that substitutes a high-return fully-funded system for a low-return pay-as-you-go system are discussed in an overlapping generations, neoclassical growth model. With forward-looking individuals, a debt-financed reform worsens the current account, while a tax-financed reform leaves the current account unchanged. With myopic individuals, a debt-financed reform leaves the current account unchanged, while a tax-financed reform improves the current account. Hence, tax-financing, which is equivalent to pre-funding, should be the preferred reform strategy in a small open economy with a weak current account position.

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I. INTRODUCTION

Pension system reforms are a fashionable topic in industrialized countries, developing countries, and transition countries alike. Many countries consider partly replacing existing pay-as-you-go (PAYG) systems with fully-funded (FF) systems. It is hoped that such reforms increase labor market efficiency, spur domestic capital accumulation, and counteract rising dependency ratios, even though the theoretical and empirical evidence is ambiguous. These pension reforms have a potential impact on a country's saving-investment balance and thus on the current account. On the one side, a PAYG system is based on intergenerational transfers while a FF system is based on saving. On the other side, a pension reform involves costs that need to be financed. The net effect on the saving-investment balance – and hence the current account balance – depends on whether individuals are forward-looking or myopic, and on whether the reform is debt-financed or tax-financed. This paper illustrates possible effects of pension reforms on the private as well as the aggregate saving-investment balance.

The literature on pension reform is vast. In the United States, the discussion is dominated by Auerbach and Kotlikoff (e.g. 1987) and their co-authors, as well as Feldstein (e.g., 1997) and his co-authors. These authors argue in favor of a FF system because they believe its return to be higher than the implicit return to the existing PAYG system. While Kotlikoff (1998) suggests to finance the transition via a consumption tax, Feldstein and Samwick (1996) suggest an increase in the payroll tax. For developing countries and transition countries, the discussion is dominated by the World Bank (e.g. Holzmann 1997 and James 1996). The World Bank argues for a 3-pillar pension system. The first pillar is PAYG and provides a minimum pension, the second pillar is FF and mandatory, and the third pillar is FF and voluntary.

Much of the existing literature discusses the relative merits of the alternative systems and analyzes various distributional issues. In many cases, the analysis is based on computable general equilibrium models calibrated to particular countries. Kotlikoff (1996), for example, analyzes the long-run impact of a payroll tax and consumption tax financed pension reform on output and the intergenerational distribution of gains and losses associated with a pension reform. He does so in a simulation analysis for the United States based on the assumption of positive population growth. Raffelhüschen and Risa (1995) apply a similar model for a small open economy to Norway. While these issues are at the heart of every pension reform, short-run issues related to the financing the reform and the reform's impact on a country's external balance also play a role. This holds in particular for small open economies that are subject to high external vulnerability.

¹ For a critical discussion of the World Bank approach see Kotlikoff (1999).

This paper adds to the literature by taking a different look at pension reforms. In contrast to much of the literature, the paper is not concerned with designing an optimal pension system from a social welfare point of view; this would require a much richer modeling framework. Rather, the focus here is on the short-run impact of a pension reform on domestic saving and the current account in a small open economy. Assessing this impact is of interest for policy makers who are implementing a reform that introduces a mandatory FF pillar and who are concerned with integrating the reform in their overall macroeconomic policy framework. The analysis is carried out with the help of a simple tractable model. Throughout the paper, it is assumed that the rate of return on FF saving is higher than the implicit rate of return on PAYG contributions.²

The paper's main findings are: Forward-looking individuals use private saving outside the mandatory pension system to achieve their utility maximizing intertemporal consumption profile given the parameters of the mandatory pension system. A reform that increases the average return of the mandatory pension contributions by increasing the share of the high-return FF pillar therefore lowers private saving outside the pension system in an effort to allocate the gain in lifetime income over all periods. The reform's impact on aggregate saving (and thus the current account) then depends on its financing. In the case of a debt-financed reform, the debt incurred in the PAYG pillar just equals the savings accumulated in the FF pillar. Hence, aggregate saving falls with private saving outside the pension system. In the case of a tax-financed reform, there is no PAYG pillar deficit and the increase in FF pillar saving just equal the fall in private saving outside the pension system. Hence, aggregate saving remains constant. Myopic individuals are assumed to have a constant marginal propensity to save. Private saving outside the mandatory pension system are not set to achieve an optimal intertemporal consumption profile. In this case, a debt-financed reform leaves aggregate saving constant since private saving outside the pension system do not change. A tax-financed pension reform improves aggregate saving because individual saving outside the pension system fall by less than FF pillar saving are increased.

The remainder of the paper is organized as follows. Section II reviews some of the motivations behind current pension reform considerations. Section III analyzes the macroeconomic implications of a pension reform in a simple overlapping generations, neoclassical growth model. Debt-financing and tax-financing are considered separately as

² Nevertheless, a pension reform is not automatically welfare improving because of the associated reform costs. There is an extensive theoretical discussion on whether a Pareto-efficient transition from a PAYG system to a FF system is possible. While there is no consensus, it appears as if a Pareto-efficient transition is highly unlikely as it is only possible in very special cases. See for example Fenge (1996) and Fenge and Schwager (1995). Sinn (2000) shows that a transition from a PAYG system to a FF system can only change the time-path of the excess burden imposed by the PAYG system compared to the FF system. However, since the excess burden is the price to be paid for the first generation's pension, it cannot be eliminated.

corner-cases. Section IV summarizes the paper's main findings and discusses them with respect to macroeconomic management.

II. MOTIVATIONS FOR A PENSION REFORM

Pension reforms are motivated by the expectation that they remove a variety of microeconomic distortions which could lead to higher growth. In addition, it is hoped that the expected higher rate of return on FF pension saving compared to PAYG pension saving alleviates demographic pressures on pension systems from increasing dependency ratios.

The PAYG payroll tax imposes an excess burden on workers by driving a wedge between the consumer wage and the producer wage (see Feldstein 1998, James 1996, and Hemming 1998). Since the implicit rate of return on the PAYG system is perceived as lower than the rate of return on saving, there is no fiscal equivalence between today's contributions and future pension benefits. As a result, labor supply is reduced. If a pension reform removes or reduces the labor market distortions associated with a PAYG system, aggregate labor supply may rise, and output would increase. Feldstein and Samwick (1996), for example, infer growth effects for the United States. One caveat should be kept in mind with respect to these results. Even the authors who believe in a positive growth effect require their alternative pension system to be mandatory. This implies that they assume myopic individuals.³ For myopic individuals, even a FF pension system may appear as an excess tax burden during their active period, so that a shift from a PAYG system to a FF system does not really remove the labor market distortions.

Proponents of an FF pension system also point to benefits from increased capital market efficiency (e.g. James 1998: 292). By moving from a PAYG system to an FF system, the depth of the capital market is dramatically increased. Competition among financial intermediaries intensifies, leading to a fall in the interest spread between lending and borrowing. In turn, both saving and investment rise. The resulting rise in capital accumulation has a positive growth effect. However, positive effects from increased capital market efficiency may not materialize in a small open economy where domestic investment is independent of domestic saving.⁴ Hence, even a dramatic increase in domestic saving does not necessarily raise investment (see also Kotlikoff 1999).

³ Alternatively, forward-looking individuals may choose not to save in anticipation of a minimum pension provided by the state irrespective of contributions. A mandatory pension system would solve this prisoners' dilemma.

⁴ This assumes that the Feldstein/Horioka (1980) phenomenon does not apply for the small open economy under consideration.

Proponents of a shift from PAYG to FF see only the PAYG system to suffer from a demographic risk (e.g. Feldstein 1997).⁵ The return on a FF system is projected based on almost static expectations that assign a very high weight to the current stock market experience. Hence, the return on the FF system is rather high. However, the FF system could suffer from the same demographic risks as a PAYG system, significantly lowering the FF rate of return (Brooks 2000, Hemming 1998, and Heller 1998). If future generations are smaller than current generations, the demand for capital of those future generations could be lower than the supply of capital by current generations. As a result, the price of capital falls and the return on FF pillar saving drops. Nevertheless, based on theoretical reasoning and empirical evidence, Hemming (1998: pp. 9) concludes that the rate of return on investment is most likely to exceed the implicit return on a PAYG system in most countries.

A pension reform that substitutes a FF pillar for a PAYG pillar is associated with transition costs that arise from the fact that the first generation received a free pension under the PAYG system. The full gains of a pension reform from a low return PAYG system to a high return FF system are only realized after the transition costs have been paid for.⁶ Two issues arise. First, which generation(s) are to pay for the transition costs? Second, how are the respective generations paying for the transition costs?

Since one reason for pension reforms is the falling demographic trend, per capita costs are smallest when they are shouldered by the first generation. However, allowing for endogenous factor prices, Bohn (1999) obtains the counter-intuitive result that retirement benefits should actually be increased for baby-boom generations while they should be lowered for baby-bust generations. The rationale for this result is that relatively small generations receive relatively higher wages in a neoclassical setting. This would suggest that the following generations should also bear some of the transition costs.

Feldstein (1997) argues that workers during the transition period do not need to provide twice for their retirement by supporting the current pensioners through the PAYG system and by saving for their own retirement in the FF pillar. Since the return on the FF pillar exceeds the return on the PAYG pillar, the increase in pension provision is significantly lower than double the current payroll tax.

In the literature, two ways of (tax-) financing a transition from a PAYG system to a FF system are discussed: (i) an increase in the consumption tax, or (ii) or increase in the payroll tax. For the United States, Kotlikoff (1998) shows that a pension reform is welfare improving only when financed by a consumption tax. It should be noted, though, that the welfare effect

⁵ However, Feldstein (1997) does acknowledge that an increase in the capital stock would also lower the rate of return on investment because of the decreased marginal product of capital.

⁶ This realistically assumes that a Ponzi game is not a feasible option for the government.

is actually the result of the tax reform from a payroll tax to a consumption tax and not of the pension reform itself. In countries with a significantly higher consumption tax rate than the United States, the results may not translate directly, since the consumption tax may have already reached or surpassed its optimum level. Another study for the United States suggests that the payroll tax would need to be raised by 1.5 percentage points for 70 years to pay off the transition costs (Gramlich 1996).

III. THE IMPACT OF A PENSION REFORM

The impact of a pension reform is analyzed in a neoclassical growth model with overlapping generations in the spirit of Ando and Modigliani (1963) and Diamond (1965). This framework is the standard workhorse for the analysis of pension reform (e.g. Auerbach and Kotlikoff 1987, Raffelhüschen and Risa 1995, Bohn 1999). Here, the model is adapted to a small open economy that reforms its pension system by increasing the weight given to the FF pillar.

A. The Framework

Individuals live for two periods. In their active period, they supply one unit of labor and consume and save out of current income. In their passive period, they consume their pension savings. There exists a mandatory government-run pension system that consists of a PAYG pillar and a FF pillar. Individuals can also save for retirement outside the pension system.

Individuals are assumed to have an intertemporal preference function of the CES-type. Specifically,

$$U = u(c_t, c_{t+1}) = \left[c_t^{\frac{\sigma-1}{\sigma}} + c_{t+1}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

where c_t is consumption in period t , c_{t+1} is consumption in period $t+1$, and σ is the elasticity of substitution between consumption in period t and consumption in period $t+1$.

Abstracting from inflation and normalizing prices to unity, the intertemporal budget constraint is given by

$$(1 - \tau)w_t + p_{t+1} \Pi_{t+1} = c_t + p_{t+1} c_{t+1} \quad (2)$$

where τ is the payroll tax for the pension system, w is the real wage income, $p_{t+1} = \frac{1}{1+r_t}$ is the real discount factor, and Π are the real pension payments from the PAYG pillar and the FF pillar.

The PAYG pillar budget is assumed to be balanced: all contributions from the active generation are paid out to the passive generation. The FF pillar invests its funds at the going market interest rate. Hence, pension payments are given by

$$\Pi_{t+1} = [n\lambda(1-\gamma) + (1+r_t)\gamma] \tau w_t \quad (3)$$

where $n = L_{t+1}/L_t$ is the growth factor of the active labor force which is one over the dependency ratio in $t+1$, λ is the growth factor of labor productivity, and γ is the share of the payroll tax that goes into the FF pillar.

A single good Y is produced in the economy according to a Cobb-Douglas technology using labor L and capital K , so that

$$Y_t = F(L_t, K_t) = e^{\lambda t} L_t^\alpha K_t^{(1-\alpha)} \quad \text{with } 0 < \alpha < 1 \quad (4)$$

where α is the wage share. The good Y can be used for consumption and investment.

For simplicity it is assumed that firms maximize their profits with respect to the current period only, taking the existing capital stock from last period as given.

The domestic small open economy can engage in intertemporal trade with the rest of the world. Abstracting from changes in international reserves, current account CA and capital account must off-set each other,

$$CA_t = X_t + r_t A_{t-1} = \Delta A_t = S_t - I_t \quad (5)$$

where X denotes net exports, A denotes net foreign assets of the domestic economy, and S and I are domestic saving and investment respectively.

Fixing the exchange rate at unity, the domestic interest rate is given by the international interest rate r_t^* , that is

$$r_t = r_t^* \quad (6)$$

The world interest rate determines the marginal product of capital in the domestic economy

$$r_t^* = r_t = \frac{\partial F}{\partial K_t} = (1-\alpha) \frac{Y_t}{K_t} \quad (7)$$

The capital stock in period t is thus given by

$$K_t = e^{\frac{\lambda t}{\alpha}} \left(\frac{1-\alpha}{r_t^*} \right)^{\frac{1}{\alpha}} L_t \quad (8)$$

and – abstracting from depreciation – investment I is given by

$$I_t = K_t - K_{t-1} \quad (9).$$

Assuming full employment, the wage follows as

$$w_t = \frac{\partial F}{\partial L_t} = \alpha \frac{Y_t}{L_t} \quad (10).$$

Substituting in for Y_t , and K_t , the wage can be written in terms of the factor price frontier. For a small open economy, the wage is exogenously determined by the world interest rate, if full employment is assumed (cf. Hornung et al. 1998, also Raffelhüschen and Risa 1995: 470)

$$w_t = e^{\frac{\lambda t}{\alpha}} \alpha \left(\frac{1-\alpha}{r_t^*} \right)^{\frac{1-\alpha}{\alpha}} \quad (11).$$

B. Optimal Saving

Forward-looking individuals maximize their life-time utility with respect to consumption in the active and in the passive period subject to their intertemporal budget constraint. All other parameters are exogenous to the individual's optimization problem. Consumption in each period results as

$$c_t = \frac{1}{1 + p_{t+1}^{1-\sigma}} E_t \quad (12)$$

$$c_{t+1} = \frac{p_{t+1}^{-\sigma}}{1 + p_{t+1}^{1-\sigma}} E_t \quad (13)$$

where $E_t = (1 - \tau)w_t + p_{t+1} \Pi_{t+1}$ is the present value of life-time expenditure.

Letting the superscript 1 indicates the active generation, while the superscript 2 indicates the passive generation, individual saving by members of the active generation outside the public pension system s^1 in t are given as a residual of disposable income and consumption expenditure in period t

$$s_t^1 = (1 - \tau)w_t - P E_t \quad (14)$$

$$\text{with } P = \frac{1}{1 + P_{t+1}^{1-\sigma}}$$

Substituting in for the present value of expenditure E yields

$$s_t^1 = \left[(1 - \tau) - P \left[(1 - \tau) + \frac{n \lambda (1 - \gamma) \tau + (1 + r_t) \gamma \tau}{1 + r_t} \right] \right] w_t \quad (15)$$

This level of private saving outside the pension system is the utility-maximizing provision for retirement income given the pension system framework. All following comparative static exercises are defined relative to this equilibrium.

If there were no mandatory pension system, individuals may choose a different saving portfolio. Assuming that PAYG pension saving and FF pension saving are both associated with a specific uncertainty, individual agents would choose an optimal portfolio so that the risk-weighted expected returns to both types of saving are equal.⁷ If the pension saving portfolio under a mandatory pension system does not fulfill this optimality condition, individual welfare can be increased by a pension reform that seeks to move towards this optimal portfolio.⁸ In fact, assuming that both the PAYG pension system and the FF pension system are associated with the same risk, eliminating the PAYG system completely would be utility maximizing because the PAYG system's implicit rate of return is assumed to be lower than the FF system's rate of return.⁹

⁷ A PAYG pension could also be supplied by private intermediaries.

⁸ This holds only under the assumption that no second-best solution arises.

⁹ This paper, however, does not analyze which pension system would be optimal from a welfare point of view, as this would require a much richer framework. Rather, the pension reform's implication for macroeconomic aggregates are at the focus of attention.

Myopic individuals are defined here as individuals who save less than their optimal saving given their underlying intertemporal utility function and the world interest rate. There are several ways of operationalizing this definition. For example, individuals could base their revealed saving behavior on a marginal propensity to save rule

$$s_t^1 = m(1 - \tau)w_t \quad (16)$$

$$\text{with } m(1 - \tau) < \left[(1 - \tau) - P \left[(1 - \tau) + \frac{n\lambda(1 - \gamma)\tau + (1 + r_t)\gamma\tau}{1 + r_t} \right] \right].$$

If the marginal propensity to save m is not a function of pension system parameters or other policy variables, private saving outside the pension system are determined only by disposable income which is a function of the payroll tax and the exogenous wage rate given by equation (11).

C. Demographic Change

If the dependency ratio of passive workers over active workers increases – which is equivalent to a fall in labor force growth n –, forward-looking individuals raise their saving outside the pension system

$$\frac{\partial s_t^1}{\partial n} = -P \frac{\lambda(1 - \gamma)\tau}{1 + r_t} w_t < 0 \quad (17).$$

An increase in the dependency ratio lowers pension payments from the PAYG pillar. Hence, the present value of life-time income falls. To smooth consumption over time, forward-looking individuals lower consumption in period t by increasing their saving outside the pension system. An equivalent increase in the payroll tax τ that would go completely in the FF pillar would also yield the consumption smoothing effect.

Myopic individuals would not react to an expected change in the dependency ratio, as their saving decision does not properly reflect an intertemporal optimization calculus. A social planner could compensate for this lack of adjustment by raising the payroll tax and allocate the additional tax revenue to the FF pillar.¹⁰

¹⁰ The social planner's optimization problem is identical to the optimization problem faced by the forward-looking individual.

Proposition 1:

Forward-looking individuals increase their saving outside the pension system, if they anticipate a rise in the dependency ratio. In this way, the reduction in life-time income through the fall in the implicit rate of return on the PAYG pillar is allocated over both periods in a utility maximizing way. If individuals are myopic, government should raise the payroll tax and invest the additional contributions in the FF pillar only.

D. A Debt-Financed Pension Reform

A pension reform from a PAYG pillar to a FF pillar can either be debt-financed or tax-financed. Debt-financing is politically attractive because it does not impose an additional burden on the current generation who is already adversely affected by the demographic trend. Instead, the transition costs are deferred to future generations.¹¹ To focus attention, the paper first analyzes a debt-financed pension reform. Second, the paper analyzes a tax-financed pension reform. Based on these two corner-cases, the macroeconomic implications of a pension reform are discussed.

The Impact on Private Saving Outside the Pension System

The reaction of private saving outside the pension system to a pension reform is a major determinant of the macroeconomic implications of a pension reform. Hence, individual private saving are analyzed first. The approach here is partial in the sense that possible changes in labor supply and their repercussions on individual saving are ignored.¹² From an empirical perspective, this might be justified in a European context where workers now demand a reduction in the retirement age even though dependency ratios are expected to increase.¹³

Forward-looking individuals regard the pension system as part of their retirement saving. Saving outside the pension system is determined so that the sum of all pension saving is utility maximizing. Individuals choose their saving outside the pension system conditional on the pension system parameters and the expected future dependency ratio. A pension reform

¹¹ However, in a present value sense, this leaves the transition costs unchanged (cf. Sinn 2000). Thus a pension reform constitutes no free lunch. Costs are simply redistributed over successive generations.

¹² See e.g. Raffelhüschen and Risa 1995 for a model with endogenous labor supply.

¹³ However, for the United States, empirical studies find a relationship between the pension system and life-time labor supply decisions. See e.g. Samwick 1998.

that increases the FF pillar weight and lowers the PAYG weight therefore leads to a change in an otherwise optimal saving behavior.¹⁴

After a pension reform that increases the FF pillar share, γ , forward-looking individuals lower their saving outside the pension system, if the implicit rate of return on the PAYG pillar is less than the rate of return on saving

$$\frac{\partial s_t^1}{\partial \gamma} = P \frac{n\lambda\tau - (1+r_t)\tau}{1+r_t} w_t \quad \begin{cases} \geq 0 & \text{if } n\lambda \geq (1+r_t) \\ < 0 & \text{if } n\lambda < (1+r_t) \end{cases} \quad (18).$$

In a situation where the implicit return on the PAYG pillar is less than the rate of return on saving, providing for retirement through a PAYG pillar is not individually rational. A pension reform that reduces this distortion in pension saving by increasing the FF pillar share raises the present value of life-time income as a low-return investment is replaced with a high-return investment. Intertemporal utility maximization requires that this increase in life-time income is allocated to consumption in both periods. Since the increase in life-time income is experienced in the second period, consumption smoothing requires a reduction of saving in the first period.

Myopic individuals with a constant marginal propensity to save do not change their saving behavior outside the pension system after a pension reform that increases the FF pillar share. The wage rate is determined by the world interest rate, and, by assumption, the marginal propensity to save is constant.

Proposition 2:

A debt-financed pension reform that aims at substituting a high-return FF pillar for a low-return PAYG pillar leads to a reduction of private saving outside the pension system, if individuals are forward looking. However, if individuals are assumed to be myopic, private saving outside the pension system remain unchanged, since disposable income in period t is unchanged.

¹⁴ Although individuals are assumed to be forward-looking, the model does not incorporate a Ricardian equivalence effect (Barro 1974, see also Leiderman and Blejer 1987). Full Ricardian equivalence has been rejected both theoretically and empirically. Partial Ricardian equivalence would dampen the effects of a debt-financed pension reform, but it would not eliminate or reverse them. Hence, the model abstracts from Ricardian equivalence for simplicity in exposition.

The Impact on the Sum of Private Saving Inside and Outside the Pension System

After a pension reform that increases the FF pillar share γ , forward-looking individuals only increase the sum of private saving outside the pension system and saving under the FF pillar $sf_t = s_t^l + \gamma \tau w_t$, if the implicit return on the PAYG pillar exceeds the return on saving. Else, the reaction depends on the relative return of the two pillars, the relative price, and the elasticity of substitution

$$\frac{\partial sf_t}{\partial \gamma} = P \frac{n\lambda\tau - (1+r_t)\tau}{1+r_t} w_t + \tau w_t \quad (19)$$

$$\frac{\partial sf_t}{\partial \gamma} \begin{cases} \geq 0 & \text{if } n\lambda \geq (1+r_t) \\ \geq 0 & \text{if } n\lambda < (1+r_t) \text{ and } \frac{n\lambda}{(1+r_t)} - 1 \geq \frac{1}{P} \\ < 0 & \text{if } \frac{n\lambda}{(1+r_t)} - 1 < \frac{1}{P} \end{cases} \quad (20).$$

A pension reform that shifts contributions from the PAYG pillar to the FF pillar is based on the assumption that the implicit rate of return on the PAYG pillar is lower than the rate of return on the FF pillar. In this case, the third condition applies, since P is positive

$$n\lambda < (1+r_t) \wedge \frac{1}{P} > 0 \rightarrow \frac{n\lambda}{(1+r_t)} - 1 < \frac{1}{P}.$$

As a response to the pension reform, the sum of private saving inside and outside the pension system falls, if individuals are forward-looking. The economic intuition follows again from consumption smoothing. The pension reform increases expected life-time income by increasing income in $t+1$. This gain is allocated over both periods by lowering saving in t .

If individuals are myopic, the sum of private saving inside and outside the pension system increases. Since the pension reform leaves disposable income unchanged, myopic individuals do not change their saving behavior outside the pension system. Hence, private saving inside and outside the pension system rise with the share of the fully-funded pillar.

Proposition 3:

A debt-financed pension reform that aims at substituting a high-return FF pillar for a low-return PAYG pillar leads to a reduction in the sum of FF pillar saving and private saving outside the pension system, if individuals are forward looking. However, if individuals are myopic, the sum of private saving outside and inside the pension system increases by the increase in the FF pillar saving as private saving outside the pension system remain unchanged.

The Impact on the Sum of all Pension Saving

After a pension reform that increases the FF pillar share γ , forward-looking individuals decrease the sum of all pension saving¹⁵ (outside the pension system, through the PAYG pillar, and in the FF pillar) ps_t , if the rate of return on saving is greater than the implicit rate of return on the PAYG pillar

$$ps_t = \left[1 - P \left[(1 - \tau) + \frac{n\lambda(1 - \gamma)\tau + (1 + r_t)\gamma\tau}{1 + r_t} \right] \right] w_t \quad (21)$$

$$\frac{\partial ps_t}{\partial \gamma} = P \frac{n\lambda\tau - (1 + r_t)\tau}{1 + r_t} w_t \quad \begin{cases} \geq 0 & \text{if } n\lambda \geq (1 + r_t) \\ < 0 & \text{if } n\lambda < (1 + r_t) \end{cases} \quad (22).$$

The pension reform leads to an increased average return on all pension saving. Optimizing, forward-looking individuals allocate this additional lifetime income over both periods by increasing consumption and saving in period t .

In the case of myopic individuals, the sum of all pension saving remains unchanged. First, pension saving through the mandatory pension system are unchanged, since the payroll tax is constant. Second, private saving outside the pension system are unchanged, since disposable income is constant.

Proposition 4:

A debt-financed pension reform that aims at substituting a high-return FF pillar for a low-return PAYG pillar leads to a reduction of the sum of all pension saving (outside the pension system, through the PAYG pillar, and in the FF pillar), if individuals are forward looking. However, if individuals are assumed to be myopic, the sum of all pension saving remains unchanged.

¹⁵ For convenience, PAYG contributions are also included in the term pension saving, although, technically speaking, they do not constitute saving. Alternatively, one could think of total retirement provisions.

The Impact on the Government Budget

For simplicity, the government is assumed to engage in no other activities but the pension system. The FF pillar is invested on the capital market. Hence, the government's budget constraint is given by PAYG pillar budget constraint

$$(1 - \gamma)\tau w_t L_t^1 = B_t L_t^2 + GS_t \quad (23)$$

where B is the pension payment from the PAYG pillar, L^1 is the active generation, L^2 is the passive generation, and GS is government saving.

Solving for government saving and using labor force growth and wage growth, the budget constraint can be rewritten as

$$GS_t = [(1 - \gamma)\tau \lambda n - b] w_{t-1} L_t^2 \quad (24)$$

where b is the replacement ratio for the PAYG pillar.

The total differential of the budget constraint is

$$\partial GS_t = [[(1 - \gamma)\tau \partial n + (1 - \gamma)n \partial \tau - \tau n \partial \gamma] \lambda - \partial b] w_{t-1} L_t^2 \quad (25).$$

If government saving are to stay constant, any change in one parameter needs to be matched by an offsetting change in other parameters. Given an anticipated dependency ratio in $t+1$, and a particular targeted pension benefit, government saving in the PAYG pillar are an increasing function of the payroll tax and a decreasing function of the FF pillar share

$$\frac{\partial GS_t}{\partial \tau} = (1 - \gamma)n \lambda w_{t-1} L_t^2 = (1 - \gamma)w_t L_t^1 > 0 \quad (26)$$

$$\frac{\partial GS_t}{\partial \gamma} = -\tau n \lambda w_{t-1} L_t^2 = -\tau w_t L_t^1 < 0 \quad (27).$$

Proposition 5:

Any increase in the dependency ratio needs to be offset by changing one or more of the other PAYG parameters:¹⁶ raising the share of the payroll tax that is dedicated to the PAYG pillar, raising the payroll tax, or lowering the replacement ratio.¹⁷ Otherwise, the PAYG pillar, i.e. the government, incurs a deficit that needs to be financed.

The Impact on the Aggregate Saving-Investment Balance in the Reform Period

Aggregate saving S is the sum of private saving outside the pension system of the active generation, private saving outside the pension system of the passive generation, saving in the FF-pillar, and the residual saving from the PAYG pillar¹⁸

$$S_t = L_t^1 s_t^1 + L_t^2 s_t^2 + \gamma_t \tau w_t L_t^1 - (1 + r_{t-1}) \gamma_{t-1} \tau w_{t-1} L_{t-1}^2 + GS_t \quad (28).$$

Taking the first derivative of aggregate saving with respect to the FF pillar share in period t yields¹⁹

$$\frac{\partial S_t}{\partial \gamma_t} = L_t^1 \frac{\partial s_t^1}{\partial \gamma_t} + \tau w_t L_t^1 + \frac{\partial GS_t}{\partial \gamma_t} \quad (29).$$

The increase in saving in the FF pillar $\tau w_t L_t^1$ is just equal to the fall in saving in the PAYG pillar given by (27). Hence, (29) reduces to

$$\frac{\partial S_t}{\partial \gamma_t} = L_t^1 \frac{\partial s_t^1}{\partial \gamma_t} \quad (30).$$

The change in aggregate saving depends only on the change in private saving outside the pension system. As was discussed above, forward-looking individuals lower their saving

¹⁶ It is assumed that technical change cannot be influenced by the government.

¹⁷ In addition, the retirement age – which is not modeled here – is another parameter that could be adjusted.

¹⁸ See also Walliser (1999) for a discussion of pension reform effects on aggregate savings in the U.S. context.

¹⁹ This assumes that a discretionary, unexpected pension reform in t has no impact on private savings outside the pension system in $t-1$, so that $\frac{\partial S_t^2}{\partial \gamma_t} = 0$.

outside the pension system, if the implicit rate of return on the PAYG pillar is less than the rate of return on saving. Therefore, aggregate saving fall in response to a pension system reform that is aimed at off-setting a negative demographic trend. If individuals are myopic, private saving – and therefore aggregate saving – may remain unchanged.

Proposition 6:

A debt-financed pension reform that aims at substituting a high-return FF pillar for a low-return PAYG pillar leads to a reduction of aggregate saving in the reform period, if individuals are forward looking. However, if individuals are assumed to be myopic, aggregate saving remain unchanged in the reform period, since private saving outside the pension system remain unchanged.

Domestic investment was assumed to be a function of the exogenous international interest rate (small open economy). Hence, it can be treated as an exogenous variable. Any change in aggregate saving therefore translates directly into a change in the current account position

$$\frac{\partial CA_t}{\partial \gamma_t} = \frac{\partial S_t}{\partial \gamma_t} = L_t^1 \frac{\partial s_t^1}{\partial \gamma_t} \quad (31).$$

Proposition 7:

A debt-financed pension reform that aims at substituting a high-return FF pillar for a low-return PAYG pillar leads to a fall in the current account balance in the reform period, if individuals are forward looking. However, if individuals are assumed to be myopic, the current account balance remains unchanged in the reform period, since aggregate saving remains unchanged.

The Impact on the Saving-investment Balance in the Period After the Reform

In period $t+1$, the pension system reform of period t has an impact on the saving-investment balance through the debt service that falls due for the partial financing of pension payments under the PAYG pillar in t . By design, contributions to the PAYG pillar fell short-off pension payments from the PAYG pillar in t . The accrued debt needs to be serviced and repaid or rolled over.

The government budget constraint for the PAYG pillar in $t+1$ is given by

$$(1 - \gamma) \tau w_{t+1} L_{t+1}^1 + (1 + r_t) GS_t = B_{t+1} L_{t+1}^2 + GS_{t+1} \quad (32).$$

Assuming that the PAYG parameters are set so that payroll tax contributions equal pension payments, the PAYG pillar deficit in $t+1$ equals outstanding debt plus interest payments. To focus attention, repayment is assumed to start only in the next generation

$$GS_{t+1} = (1 + r_t)GS_t \quad (33).$$

Aggregate saving in $t+1$ are then given by

$$\begin{aligned} S_{t+1} &= L_{t+1}^1 s_{t+1}^1 + L_{t+1}^2 s_{t+1}^2 + \gamma \tau w_{t+1} L_{t+1}^1 - (1 + r_t) \gamma \tau w_t L_{t+1}^2 + GS_{t+1} \\ &= n L_t^1 s_{t+1}^1 - L_t^1 (1 + r_t) s_t^1 + \gamma \tau \lambda n w_t L_t^1 - (1 + r_t) \gamma \tau w_t L_t^1 + (1 + r_t) GS_t \end{aligned} \quad (34).$$

Taking the first partial derivative with respect to the FF pillar share in t yields

$$\begin{aligned} \frac{\partial S_{t+1}}{\partial \gamma} &= n L_t^1 \frac{\partial s_{t+1}^1}{\partial \gamma} - L_t^1 (1 + r_t) \frac{\partial s_t^1}{\partial \gamma} \\ &\quad + \tau n \lambda w_t L_t^1 - (1 + r_t) \tau w_t L_t^1 + (1 + r_t) \frac{\partial GS_t}{\partial \gamma} \end{aligned} \quad (35).$$

The pension reform's impact on individual private saving can be assumed constant over time for both forward-looking and myopic individuals

$$\frac{\partial s_{t+1}^1}{\partial \gamma} = \frac{\partial s_t^1}{\partial \gamma} \quad (36).$$

Substituting in for the partial derivative of PAYG saving in t with respect to the pension system reform (equation 27) and collecting terms yields

$$\frac{\partial S_{t+1}}{\partial \gamma} = \left([n - (1 + r_t)] \frac{\partial s_t^1}{\partial \gamma} + [n \lambda - 2(1 + r_t)] \tau w_t \right) L_t^1 \quad (37).$$

The change in aggregate saving in $t+1$ as a result of a pension reform in t that increases the FF pillar share can be decomposed into two terms. The first term relates to the induced change in private saving outside the pension system, and the second term relates to the induced change in the PAYG pillar budget.

The first term is

$$[n - (1 + r_t)] \frac{\partial s_t^i}{\partial \gamma} \begin{cases} > 0 & \text{if } \text{sgn}(n - (1 + r_t)) = \text{sgn}\left(\frac{\partial s_t^i}{\partial \gamma}\right) \\ = 0 & \text{if } n - (1 + r_t) = 0 \vee \frac{\partial s_t^i}{\partial \gamma} = 0 \\ < 0 & \text{if } \text{sgn}(n - (1 + r_t)) \neq \text{sgn}\left(\frac{\partial s_t^i}{\partial \gamma}\right) \end{cases} \quad (38).$$

Given the underlying rationale for the pension reform, the population growth n is smaller than the return on saving $(1 + r_t)$. Private saving outside the pension system were shown to fall, if individuals are forward-looking. Hence, the reform induced changes in private saving outside the pension system have a positive impact on aggregate saving. Both generations lower their private saving outside the pension system. For the passive generation in $t+1$ this implies a fall in their dissaving. Since this passive generation is larger than the active generation, the fall in dissaving is greater than the fall in saving of the active generation in $t+1$. Together, this implies an increase in net private saving outside the pension system in $t+1$.

In the case of myopic individuals, private saving outside the pension system remained unchanged after the pension reform. Hence, the pension reform has no impact on private saving outside the pension system in the period after the reform, if individuals are myopic.

The second term is

$$[n\lambda - 2(1 + r_t)]\tau w_t \begin{cases} \geq 0 & \text{if } n\lambda \geq 2(1 + r_t) \\ < 0 & \text{if } n\lambda < 2(1 + r_t) \end{cases} \quad (39).$$

Again, given the underlying rationale for the pension reform, the implicit return on the PAYG pillar is less than twice the return on saving. Hence, the reform induced change in the PAYG pillar has a negative impact on aggregate saving in $t+1$. The increased FF pillar saving in $t+1$ are not sufficient to off-set the increased pension payments from the FF pillar in $t+1$ plus the debt service that falls due on the debt accrued in the PAYG pillar in period t .

Proposition 8:

A debt-financed pension reform in period t that aims at substituting a high-return FF pillar for a low-return PAYG pillar has an ambiguous effect on aggregate private saving in the post-reform period, if individuals are forward-looking, and the PAYG debt is fully rolled over. While the induced effect on private saving is positive, the induced effect on PAYG pillar saving is negative. However, if individuals are myopic, the net effect of a pension

reform in t on aggregate saving in the post-reform period is clearly negative, since private saving does not change in response to the reform, and PAYG pillar saving is negative.

Proposition 9:

A debt-financed pension reform in period t that aims at substituting a high-return FF pillar for a low-return PAYG pillar has an ambiguous effect on the current account balance in the post-reform period, if individuals are forward looking, and the PAYG debt is fully rolled over. However, if individuals are assumed to be myopic, the current account balance falls in the post-reform period.

E. The Impact of a Tax-Financed Pension Reform

The impact of a tax-financed pension reform on private saving by forward-looking individuals can be analyzed by accounting for the partial derivative of the payroll tax rate with respect to the FF pillar share

$$\frac{\partial s_t^l}{\partial \gamma} = - \left[1 - P \left[1 - \frac{[n\lambda(1-\gamma) + (1+r_t)\gamma] + [-n\lambda\tau + (1+r_t)\tau] \frac{\partial \gamma}{\partial \tau}}{1+r_t} \right] \right] \frac{\partial \tau}{\partial \gamma} w_t \quad (40).$$

Assuming the pension reform to be completely tax-financed, the partial derivative of the payroll tax with respect to the FF pillar share can be determined from the budget constraint of the PAYG pillar (23), setting $GS_t = 0$

$$\frac{\partial \tau}{\partial \gamma} = \frac{\tau}{(1-\gamma)} > 0 \quad (41).$$

Substituting (41) into (40), the partial derivative reduces to

$$\frac{\partial s_t^l}{\partial \gamma} = - \frac{\tau w_t}{(1-\gamma)} < 0 \quad (42).$$

Forward-looking individuals reduce their private saving outside the pension system by the reform-induced increase in FF pillar saving. The PAYG pillar contribution as well as the PAYG pillar pension benefits are not affected by a tax-financed reform. Hence, forward-looking individuals substitute the reform-induced increase in FF pillar saving for their private saving outside the pension system. This leaves their total pension saving as well as their utility-maximizing intertemporal consumption profile constant.

Myopic individuals with a constant marginal propensity to save out of disposable income also lower their private saving outside the pension system because the increase in the payroll tax lowers their disposable income.

Proposition 10:

A tax-financed pension reform in period t that aims at substituting a high-return FF pillar for a low-return PAYG pillar lowers private saving outside the pension system, independent of whether individuals are forward looking or myopic.

Forward-looking individuals keep total private saving inside and outside the pension system sf remain unchanged, if the pension reform is tax-financed. A tax-financed pension reform leaves the PAYG pillar budget balanced. The increase in the FF share, therefore, leads to an equivalent increase in the payroll tax. As mandatory saving are increased, individuals reduce their voluntary saving by the same amount. Total private saving and the intertemporal consumption profile are constant

$$\frac{\partial sf_t}{\partial \gamma} = \frac{\partial s_t^1}{\partial \gamma} + \tau w_t + \gamma w_t \frac{\partial \tau}{\partial \gamma} = 0 \quad (43).$$

For myopic individuals, the decrease in private saving outside the pension system that follows from the reduction of disposable income is smaller than the increase in FF pillar saving because only a share m is saved out of disposable income. The sum of FF pillar saving and private outside the pension system for myopic individuals is given by

$$sf_t^m = s_t^1 + \gamma(1 - \tau)w_t \quad (44).$$

Using (41), the first derivative with respect to the second pillar share is

$$\frac{\partial sf_t^m}{\partial \gamma} = \frac{1 - m}{1 - \gamma} \tau w_t > 0 \quad (45).$$

The sum of all pension saving $ps_t = s_t^1 + \tau w_t$ remains also constant, if individuals are forward-looking

$$\frac{\partial ps_t}{\partial \gamma} = \frac{\partial s_t^1}{\partial \gamma} + \frac{\partial \tau}{\partial \gamma} w_t = 0 \quad (46).$$

If the pension reform is tax-financed, total private saving inside and outside the pension system were shown to remain constant with forward-looking individuals. By design, the PAYG pillar contribution rate $(1-\gamma)\tau$ remains constant, since the pension reform was assumed to leave the PAYG pillar budget balanced

$$\frac{\partial(1-\gamma)\tau}{\partial\gamma} = (1-\gamma)\frac{\partial\tau}{\partial\gamma} - \tau = 0 \quad (47).$$

In the case of myopic individuals, total private saving inside and outside the pension system increase with the sum of FF pillar saving and private saving (45) as the PAYG pillar contribution remains constant (47).

Given that the PAYG pillar budget is balanced, equation (28) reduces to

$$S_t = L_t^1 s_t^1 + L_t^2 s_t^2 + \gamma_t \tau_t w_t L_t^1 - (1+r_{t-1})\gamma_{t-1} \tau_{t-1} w_{t-1} L_t^2 \quad (48).$$

Assuming again that the pension reform was unanticipated by the active generation in $t-1$, aggregate saving of forward-looking individuals do not change as a result of the tax-financed pension reform. Total private saving inside and outside the pension system remained unchanged, and there is no deficit in the PAYG pillar

$$\frac{\partial S_t}{\partial \gamma_t} = \left[\frac{\partial s_t^1}{\partial \gamma_t} + \tau_t w_t + \gamma_t w_t \frac{\partial \tau_t}{\partial \gamma_t} \right] L_t^1 = 0 \quad (49).$$

In the case of myopic individuals, aggregate saving increase because the increase in FF pillar saving is not fully offset by a reduction in private saving outside the pension system.

Proposition 11:

A tax-financed pension reform in period t that aims at substituting a high-return FF pillar for a low-return PAYG pillar leaves total private saving as well as aggregate saving unchanged, if individuals are forward-looking. Since domestic investment is exogenous, the current account remains unchanged. However, if individuals are myopic, total private saving as well as aggregate saving increase.²⁰ Since domestic investment is exogenous, the current account improves.

Proposition 11 is in a way merely a restatement of Proposition 1. The pension reform leaves the contribution rate to the PAYG pillar constant. Hence, the pension reform only increases

²⁰ Assuming a constant marginal rate of savings for myopic individuals, it can be easily shown that the decrease in private savings outside the pension system that follows from the reduction of disposable income is smaller than the increase in FF pillar savings.

mandatory saving by raising the contribution rate to the FF pillar. From a social planner's point of view, such a mandatory additional pre-funding is an optimal policy in the face of a negative demographic trend, if individuals are assumed to be myopic.

IV. SUMMARY AND CONCLUSIONS

The literature on the relative merits of a PAYG provision for retirement vs. a FF provision for retirement shows no clear consensus, although the FF system has received more support lately. Proponents of the FF system argue that its rate of return exceeds the PAYG system's implicit rate of return, especially since a marked increase in the dependency ratio is expected in the near future. Hence, a number of policy recommendations have emerged that range from pre-funding existing PAYG systems to switching over to a FF system.

The increase in the dependency ratio lowers the implicit rate of return on the PAYG pillar and therefore mandates a reduction in life-time consumption. Either consumption during the active period, consumption during the passive period, or consumption during both periods needs to be lowered. Given an existing pension system, forward-looking individuals increase their private saving, if they anticipate an increase in the dependency ratio. The increase in private saving is the result of a utility maximizing consumption smoothing over time. To the extent that individuals may behave myopic, an increase in the mandatory FF pillar saving is an optimal policy from the viewpoint of a social planner. This amounts to a pre-funding of the pension system that leaves the PAYG pillar unchanged, i.e. the PAYG pillar contribution rate remains constant.

A pension system reform that attempts to shift the weight from a PAYG pillar to a FF pillar is associated with transition costs. These transition costs arise because a reduction in the PAYG contribution rate leaves a financing gap for current PAYG pension payments. Of course, the transition costs are not costs in the true sense of the word. Under the PAYG system, the first generation of pensioners received pension payments without having had to contribute to the pension system. The last generation has to pay for the first generation's pension by providing for the second last generation's pensions and at the same time for their own pensions, too. In a way, the last generation must therefore shoulder a double burden.

The transition costs can either be debt-financed or tax-financed. Debt-financing initially allows for a constant payroll tax. However, the debt needs to be repaid eventually which requires either expenditure cuts or tax increases. While debt-financing has the advantage of distributing the transition costs over more than one generation, the transition from a PAYG system to a FF system still requires a reduction in consumption to offset the first PAYG generation's free pension.

A complete tax-financing of the transition simply amounts to a pre-funding of the PAYG pillar. The contribution rate to the PAYG pillar remains unchanged. If the PAYG system is to be reduced in absolute terms, the transition generation must settle for a reduced PAYG pension as the contribution rate of the next generation is lower than the contribution rate of the passive generation. Again, this reduced PAYG pension is the price the transition generation pays for the first generation's free pension.²¹

The impact of a pension reform on the domestic saving-investment balance and the current account depends on the type of financing as well as on whether individuals are forward-looking or myopic (Table 1). A debt-financed pension reform leads most likely to a small deterioration of the current account. If individuals are forward-looking, the shift from a low-return PAYG system to a high-return FF system leads to a reduction in private saving as the pension reform raises the pension income. Because of the income effect, the fall in private saving is greater than the increase in mandatory FF saving. Hence, the domestic saving-investment balance and the current account balance fall. If individuals are myopic, the pension reform leaves private saving constant. Since the increase in mandatory FF saving just equals the deficit in the PAYG pillar, the domestic saving-investment balance and the current account remain unchanged.

Table 1. The Impact of a Pension Reform on the Current Account During the Reform Period

	Forward-Looking Individuals	Myopic Individuals
Debt-Financed	Current account deteriorates	Current account is unchanged
Tax-Financed	Current account is unchanged	Current account improves

A tax-financed pension reform, which is equivalent to a pre-funding, leads most likely to a small improvement in the current account. If individuals are forward-looking, they reduce private saving by the amount that mandatory FF pillar saving are increased. If individuals are myopic, private saving are most likely reduced by less than the increase in the mandatory FF pillar saving; the reduction in private saving is the result of the fall in disposable income.

²¹ Requiring the current generation to save more for their retirement should not be considered an 'unfair' burden. Since the current generation has not adequately provided for their retirement through reproduction, it is only 'fair' to raise mandatory savings (cf. Sinn 1999).

The choice of financing can thus be looked at from a macroeconomic management point of view.²² If a country considering a pension reform has a strong current account position, debt-financing and tax-financing appear both feasible. However, if a country has a weak current account position, tax-financing is a more prudential approach. Depending on the size of the reform, full tax-financing may not be a viable option. Still, tax-financing should constitute a major part of total financing in order to minimize the negative impact of the pension reform on the current account.

Pension reforms are fashionable. While there are many theoretical arguments in favor of a FF system, the transition from a PAYG system to a FF system is costly. At least for a small open economy with full access to the international capital market, a pension reform cannot be guaranteed to lead to a significant welfare gain. If the anticipated increase in the dependency ratio is the major motivation for considering a pension reform, a simple mandatory pre-funding of the PAYG system may be all that is required. Such a pension reform can be expected to strengthen the domestic saving-investment balance and thus support the country's current account position.

²² For a more general discussion of financing a pension reform see Holzmann (1998).

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