The Scandinavian Journal of Economics

Formerly *The Swedish Journal of Economics*

Vol. **96** 1994

No. 3

TAX POLICY IN SMALL OPEN ECONOMIES

The Scandinavian **Journal of Economics**

(formerly The Swedish Journal of Economics) **September 1994**

The Scandinavian Journal of Economics is published four times a year, in March, June, September and December by **Blackwell Publishers**, 108 Cowley Road, Oxford OX4 1JF or 238 Main Street, Cambridge, MA 02142, USA.

Information for Subscribers. New orders and sample copy requests should be addressed to the Journals Marketing Manager at the publisher's address above. Renewals, claims and all other correspondence relating to subscriptions should be addressed to the Journals Subscriptions Department, Marston Book Services, PO Box 87, Oxford OX2 0DT. Cheques should be made payable to Basil Blackwell Ltd.

Subscription prices 1994	UK/Europe	North America*	Rest of the World
Institutions	£96.00	US$156.00	£105.00
Individuals	£48.00	US$ 80.00	£ 54.00

*Canadian customers/residents please add 7% for GST.

US Mailing. Second class postage paid at Rahway, New Jersey. Postmaster: send address corrections to The Scandinavian Journal of Economics, c/o Mercury Airfreight International Ltd Inc., 2323 E-F Randolph Avenue, Avenel, NJ 07001.

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Advertising. For details contact the Advertising Manager, Ludo Craddock, 15 Henry Road, Oxford, OX2 0DG, UK. Tel./fax 0865 722964.

ISSN 0347-0520

Printed and bound in Great Britain by Page Bros, Norwich on acid-free paper.

Scand. J. of Economics 96(3), 403–424, 1994

Taxation, Pensions and Saving in a Small Open Economy*

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Abstract

An overlapping generations model of a small open economy is used to explore several policy options aimed at reducing the burden of income taxes and pay-as-you-go (PAYG) contributions on labor income so as to improve the incentives to supply labor. Including the return of funded collective (FC) pension plans in the tax base turns out to be counterproductive. Cutting PAYG benefits, in contrast, succeeds in improving efficiency in general and labor-market incentives in particular. Under specific variants of the FC plan, reducing PAYG benefits even proves to be Pareto-welfare improving.

I. Introduction

Many industrialized countries face the prospect of rising public spending on public pensions and health care, in part due to aging of the population; see Bös and von Weizsäcker (1989). This prospect has contributed to concerns about the efficiency effects of pension schemes. Especially in the countries of Northern and Western Europe, which levy high marginal tax rates on labour income, these issues are heavily debated.[1] From a normative point of view, both equity and efficiency issues are relevant. Pay-as-you-go (PAYG) pensions typically redistribute substantial amounts

*An earlier version of this paper was presented at the conference on Tax Policy in Small Open Economies in Reykjavik, April 1993. We are grateful to the participants and two anonymous referees for helpful comments.

[1] Marchand and Pestieau (1991) discuss some of the issues involved; see also Hagemann and Nicoletti (1989) and Huijser (1990).

of wealth across generations, especially in the face of demographic shifts; see Nelissen (1987). Furthermore, increasing contributions to PAYG systems aggravate labor-market distortions.

An important question is whether a (partial) switch from PAYG to funded pension systems can alleviate these unfavorable effects on the labor market without generating undesirable effects on the intergenerational distribution of income. In the context of stylized models, Homburg (1990) and Breyer and Straub (1993) have shown that, if labour supply is endogenous, an unfunded pension scheme based on a payroll tax is generally not Pareto-efficient. By employing a computable general equilibrium model for Germany, Raffelhüschen (1993) demonstrated that a Pareto-improving transition from a PAYG scheme to a funded pension scheme is feasible in a closed economy if lump-sum transfers are used to compensate the elderly during the transition period. When examining some options to improve the efficiency of the pension sector in the small open economy of the Netherlands, we demonstrate that a Pareto-improving transition to a funded system is possible without relying on explicit lump-sum transfers.

We use an applied general equilibrium model with overlapping generations for a small open economy, based upon the closed-economy model developed by Auerbach and Kotlikoff (1987).[2] Economic agents optimize intertemporally and are endowed with perfect foresight. The Auerbach-Kotlikoff model distinguishes three sectors: households, firms, and the government. Our model also includes a foreign sector and a pension sector. Besides a pure PAYG scheme, in which the pension benefits paid to the older generations are financed by contributions from younger generations, and a pure funded scheme, in which each generation saves for the benefits it receives during retirement, we distinguish a third scheme, which amounts to a mix of the two pension schemes mentioned above. We call this system the funded collective (FC) scheme. The specification of the various pension institutions is based on the situation in the Netherlands. However, similar retirement schemes also exist in most other OECD countries.[3] Like other computable general equilibrium models with overlapping generations, each generation is modelled by a representative household. Hence, we focus on the inter- rather than the intragenerational distribution of income and wealth.

The remainder of this paper is structured as follows. Section II discusses the pension fund sector, while the household sector is explored in Section III. Section IV provides a brief overview of the rest of the model.[4] Sections

[2] See also Auerbach et al. (1989) and Keuschnigg (1991) for AGE models with overlapping generations for an open economy.

[3] See Davis (1991).

[4] See Broer and Westerhout (1993) for a more detailed description of the model.

V and VI describe the policy simulations. Conclusions are drawn in Section VII.

II. The Pension Sector

We consider two kinds of pension plans, which are modelled in accordance with actual pension institutions in the Netherlands. One of these plans is public and employs PAYG financing. Hence, it is called the PAYG scheme. It provides a flat minimum benefit, which is linked to the (after-tax) minimum wage, to residents who are 65 years and older. The contributions to this scheme are levied not only on labor income but also on capital income of those below 65 years of age. Residents aged 65 years or older are exempt from PAYG contributions.

The other retirement scheme involves capital funding and represents the private pension provisions that employers and employees negotiate in collective labor contracts. Accordingly, this scheme is called the funded collective (FC) scheme. Occupational schemes ensure that those who earn more than the minimum wage can maintain their standard of living after retirement by supplementing the minimum PAYG benefit. The rights to FC benefits are accumulated during working life. In particular, the benefit depends on the number of hours worked when younger than 65 years. FC benefits supplement the public PAYG scheme. Therefore, they are based on final pay (i.e., the wage prevailing at the age of 64) only in so far as this pay exceeds a threshold linked to the PAYG benefit. In the same way, workers accumulate neither pension rights nor pay contributions below a threshold — the so-called franchise. In particular, FC contributions are levied only on the labor income above the franchise. At present, the capital income of pension funds operating under the FC scheme is not subject to taxation. Contributions to the FC scheme are deductible for both the income tax and PAYG contributions but benefits are subject to income taxation.

Both the PAYG and the FC retirement plans are based on the defined-benefit principle. Hence, contributions rather than benefits absorb unanticipated shocks. As a result, intergenerational transfers may occur in both plans. Related to this, participation in these pension schemes is generally compulsory.[5] Besides relying on the PAYG and FC schemes, individuals can provide for retirement in a third way, i.e., through voluntary, individual, saving. Here the defined-contribution principle

[5] Participation in the FC scheme could be regarded as semi-obligatory: councils of employees and employers rather than governments determine the feature of collective pensions in collective bargaining.

applies: retirement benefits are directly related to the discounted value of individual contributions.[6]

For the purpose of the PAYG and FC schemes, each household's economic life can be divided into two distinct periods. During the first n_y years of their economic life, households contribute to both the PAYG and the FC schemes. They receive benefits from both schemes during the second period of $n_T - n_y$ years.[7] Generations that are in the first n_y years of their economic lives are called 'young' generations, while those in the last $n_T - n_y$ years of their lives are the 'old' generations. The generation reaching working age in year t_0 is defined as generation t_0. Following Auerbach and Kotlikoff (1987), we set n_T at 55 and n_y at 45.[8]

The Pay-As-You-Go Scheme

The PAYG scheme does not accumulate any financial wealth. The budget restriction facing the PAYG scheme amounts to:

$$y_{\text{PAYG}}(t) \sum_{i=t-n_T+1}^{t-n_y} N(i) = \pi_l^y(t)[p_l(t) - w(t)(p_l(t) - f^y(t))]L^y(t) + \pi_k^y(t) \sum_{i=t-n_y+1}^{t} [r(t)(B(t,i) + D(t,i)) + \text{Div}(t,i)]N(i) + \pi_p(t)r(t)A_p(t) \quad (1)$$

where $N(i)$ represents the number of households of generation i. The l.h.s. of (1) stands for aggregate PAYG benefits. All old generations collect the same per capita PAYG gross benefit, y_{PAYG}, which is linked to wages net of taxes and PAYG contributions:

$$y_{\text{PAYG}}(t) = \varepsilon(t)\frac{1 - t_l(t) - \pi_l^y(t)}{1 - t_l(t)} p_l(t) \quad (2)$$

where p_l represents the gross wage rate, which is the same for all generations. t_l stands for the tax rate on labor income and pension benefits. The PAYG contributions levied on labor income of the young are denoted by

[6] Indeed, in the absence of lifetime uncertainty, individual savings for retirement can be viewed as a pension scheme based entirely on the defined-contribution principle.

[7] In contrast to the *statutory* retirement age (i.e., the age at which benefits are first paid), the *actual* retirement age (i.e., the age at which the individual stops working) is endogenously determined (see Section III).

[8] We do not take the consumption of children into account. For an alternative approach, see Auerbach et al. (1989).

π_l^y.[9] In the Netherlands, per capita PAYG benefits (on an after-tax basis) amount to 70% of the labor income (net of taxes and PAYG contributions) of an employee who earns the minimum wage and works a full workweek.[10]

The r.h.s. of expression (1) corresponds to aggregate contributions to the PAYG scheme. The labor income of young generations (net of contributions to the FC scheme) constitutes the first source of PAYG contributions. L^y represents aggregate labor supply of the young. w and f^y involve the FC scheme and denote the contribution rate to this scheme and the franchise, respectively. The second source is the personal capital income received by young generations. r is the world interest rate, while $B(t, i)$ and $D(t, i)$ denote private bonds and government bonds held at time t by generation i and Div (t, i) stands for dividend income received by these households. In the Netherlands, the contribution rates applying to labor and capital income are the same (i.e., $\pi_l^y = \pi_k^y$).

At present, other incomes do not contribute to the PAYG scheme. In particular, the elderly are exempt from PAYG contributions. The third term on the r.h.s. of (1) is included to explore the possibility of levying contributions on the capital income of the FC scheme (see Section V). π_p stands for the PAYG contribution rate applying to the FC scheme while its financial wealth is denoted by A_p.

We assume that the PAYG scheme applies the defined benefit principle, i.e., contributions rather than benefits absorb shocks that unbalance the PAYG budget. Hence, the parameter ε linking benefits to wages is set exogenously and the contribution rate $\pi_l^y = \pi_k^y$ adjusts endogenously to meet the budget constraint (1).

The Funded Collective Scheme

The FC scheme differs from the PAYG scheme in that benefits paid to the old generations are not flat but depend on the pension rights that each generation has accumulated while young. In particular, per capita benefits paid by the FC scheme at time t to generation t_0, $y_p(t, t_0)$, are determined according to:

$$y_p(t, t_0) = [p_l(t) - f^o(t, t_0)]\, ac \sum_{\tau=t_0}^{t_0+n_y-1} l(\tau, t_0) \quad t_0 \leq t - n_y. \tag{3}$$

[9] These contributions are levied on labor income up to a ceiling of about 20 per cent above the modal income. Since the representative households of each generation earn an income below this ceiling, they pay PAYG contributions on their marginal labor income.

[10] Hence, $\varepsilon(t) = 0.7(\bar{l}/l_{\max})(p_{l_{\min}}(t)/p_l(t))$, where $p_{l_{\min}}$ is the minimum wage and $l_{\max}$ and $\bar{l}$ denote the maximum supply of labor (168 hours per week) and labor supply corresponding to a full work week (38 hours), respectively ($l_{\max}$ being the unit in which labor is measured).

For each unit of work $l(\tau, t_0)$ in year τ, a young household of generation t_0 accumulates the right to an annuity. After statutory retirement, this annuity pays a share ac of (before-tax) final pay in excess of a franchise f^o. The annuity is indexed to wages as FC benefits rise with the average wage level in the economy. In the Netherlands, ac is 0.0156. Accordingly, after 45 (n_y) years of full labor-market participtiion, a household has earned the right to an aggregate pension benefit of 70 per cent of (gross) final pay for a full work week.

In the Netherlands, the full work week equivalent of the franchise amounts to 10/7 times the PAYG benefit (see expression (2)):

$$f^o(t, t_0) = [\phi_2 \phi_1(t_0 + n_y - 1) + (1 - \phi_2)\phi_1(t)] p_l(t) \quad t_0 \leq t - n_y \tag{4}$$

$$\phi_1(t) = \frac{10}{7} \frac{l_{\max}}{\bar{l}} \frac{y_{\text{PAYG}}(t)}{p_l(t)}. \tag{5}$$

Under the 'franchise' system ($\phi_2 = 1$), the franchise is determined by the parameter ϕ_1 in the last year before statutory retirement. Hence, old generations suffer an income loss if the PAYG benefit is reduced by lowering ε (see equation (2)). Under the alternative 'integrated' system ($\phi_2 = 0$), in contrast, the franchise is determined by the parameter ϕ_1 in the current year. Consequently, if ε is cut, benefits from the FC scheme rise to ensure that overall pension benefits are not affected.

Just as the PAYG scheme, the funded plan applies the defined-benefit principle. Benefits are given by expression (3) and premiums adjust endogenously to ensure intertemporal budget balance. In particular, the funded scheme adopts a strategy of premium smoothing, i.e., the contribution rate, $w(t)$, is set at a level that the pension fund expects to be able to maintain forever:

$$A_p(t) + w(t) \sum_{\tau=t}^{\infty} R_p(\tau, t)[p_l(\tau) - f^y(\tau)] L^y(\tau)$$
$$= \sum_{\tau=t}^{\infty} R_p(\tau, t) \sum_{i=\tau-n_T+1}^{\tau-n_y} y_p(\tau, i) N(i) \tag{6}$$

where the discount factor $R_p(\tau, t)$ is defined as

$$\prod_{s=t}^{\tau} (1 + r_p(s))^{-1},$$

the discount rate $r_p(t)$ as $[1 - t_p(t) - \pi_p(t)]r(t)$ and where t_p stands for the tax rate on pension fund capital income. Currently, the discount rate equals the world interest rate because the investment income of pension

funds is subject neither to income tax nor PAYG contributions (i.e., $t_p = \pi_p = 0$). Expression (6) shows that contributions are proportional to labor income of the young generation in excess of the franchise, f^y, which is determined by:

$$f^y(t) = \phi_1(t) p_l(t). \tag{7}$$

Note that all generations face the same contribution rate. Hence, for a particular generation, the present value of pension benefits may differ from the present value of contributions. Indeed, intergenerational transfers are a common feature not only of the PAYG scheme but also of the FC plan because they are both benefit defined.

III. The Household Sector

Households maximize lifetime utility subject to a lifetime budget constraint. We assume that lifetime utility is time separable and exhibits a nested CES structure:

$$U(t, t_0) = (1 - 1/\gamma) \sum_{\tau=t}^{t_0+n_T-1} (1+\beta)^{t-\tau} u(\tau, t_0)^{1-1/\gamma} \quad \gamma > 0 \tag{8}$$

$$u(t, t_0) = [(\theta_v(t, t_0)\, v(t, t_0))^{-\rho} + c(t, t_0)^{-\rho}]^{-1/\rho} \quad \rho > -1. \tag{9}$$

Here γ denotes the intertemporal elasticity of substitution while β stands for the rate of time preference. $U(t, t_0)$ represents lifetime utility of generation t_0 as of period t, u stands for utility per year, v the consumption of leisure, and c the consumption of (produced) commodities. $\theta_v(t, t_0)$ denotes the household's preference for leisure and is defined as $\theta_0(1+\theta)^{t-t_0}(1+\alpha)^{t_0}$. In order to model balanced growth, we assume that α is equal to the rate of labor-saving technical progress.[11] With positive θ, the preference for leisure rises over the life cycle. The intratemporal elasticity of substitution between leisure and other commodities is given by $1/(1+\rho)$. Households leave no bequests. Thus, with produced goods as the numeraire, generation t_0 faces the following intertemporal budget constraint:

$$\sum_{\tau=t}^{t_0+n_T-1} R_h(\tau, t, t_0)[p_v(\tau, t_0)\, v(\tau, t_0) + c(\tau, t_0)] \leq W(t, t_0) \tag{10}$$

[11] See also Auerbach et al. (1989). An alternative is to assume separability between consumption and leisure; cf. King, Plosser and Rebelo (1988).

where W denotes lifetime wealth, p_v represents the price of leisure and $R_h(\tau, t, t_0)$ corresponds to the discount factor for generation t_0, defined as

$$\prod_{s=t}^{\tau} (1 + r_h(s, t_0))^{-1}.$$

$r_h(t, t_0)$ stands for the rate of return on nonhuman wealth at time t that applies to generation t_0. This rate of return differs between young and old generations as these generations face different PAYG contribution rates:

$$r_h(t, t_0) = [1 - t_k(t) - \pi_k^y(t)] r(t) \quad t_0 > t - n_y \tag{11}$$
$$r_h(t, t_0) = [1 - t_k(t)] r(t) \quad t_0 \leq t - n_y$$

where t_k stands for the tax rate on interest income. In addition, an arbitrage condition between equity and bonds must hold. Since only the young pay PAYG contributions on interest income, they face a stronger incentive to demand equities, which yield part of their return in capital gains on which neither income taxes nor premiums are levied. Hence, we assume that all equity is held by the young. The arbitrage condition between equity and bonds is thus:

$$(V(t+1) - V(t))/V(t) + (1 - t_d(t) - \pi_k^y(t)) \operatorname{Div}(t) = (1 - t_k(t) - \pi_k^y(t)) r(t) \tag{12}$$

$\operatorname{Div}(t)$ represents aggregate dividends, $V(t)$ the value of equity in the representative firm and $t_d(t)$ the dividend tax rate. As the FC fund does not pay income taxes and PAYG contributions on its interest income, we assume that the wealth of the FC pension scheme is held exclusively in bonds.[12]

Lifetime household wealth is defined by

$$W(t, t_0) = A(t, t_0) + \sum_{\tau=t}^{t_0+n_T-1} R_h(\tau, t, t_0)[p_v(\tau, t_0)\, l_{\max} + T(\tau, t_0)]$$
$$+ \sum_{\tau=\max(t, t_0+n_y)}^{t_0+n_T-1} R_h(\tau, t, t_0)(1 - t_l(\tau)) y_{\text{PAYG}}(\tau) + P_R(t, t_0).$$

Here T stands for lump-sum transfers provided by the government. A stands for nonhuman wealth, which can be held in the form of government debt, D, firm debt, B, or equity (held only by the young) V: $A = D + B + V$. The r.h.s. of (13) shows that wealth consists of financial wealth, human

[12] Actually, pension funds in the Netherlands hold relatively small stocks of equity; cf. Davis (1991).

wealth, PAYG wealth, and after-tax pension rights accumulated in the past, $P_R(t, t_0)$:

$$P_R(t, t_0) = \sum_{\tau=\max(t, t_0+n_y)}^{t_0+n_T-1} R_h(\tau, t, t_0)[1-t_l(\tau)][p_l(\tau)-f^o(\tau, t_0)] \times ac \sum_{s=t}^{\min(t_0+n_y-1, t-1)} l(s, t_0). \tag{14}$$

The supply of labor follows from the consumption of leisure, $l(t, t_0) = l_{\max} - v(t, t_0) \geq 0$, and is endogenous also for old generations. Hence, in contrast to the statutory retirement age, the actual retirement decision is endogenous. The price of leisure, $p_v(t, t_0)$, differs across old and young generations. For old generations, the opportunity cost of leisure simply amounts to the wage net of taxes.

$$p_v(t, t_0) = [1-t_l(t)]p_l(t) \quad t_0 \leq t-n_y \tag{15}$$

The expression for the price of leisure that young generations face is more complicated:

$$p_v(t, t_0) = [1-t_l(t)-\pi_l^y(t)][p_l(t)-w(t)(p_l(t)-f^y(t))] + ac \sum_{\tau=t_0+n_y}^{t_0+n_T-1} R_h(\tau, t, t_0)[1-t_l(\tau)][p_l(\tau)-f^o(\tau, t_0)] \quad t_0 > t-n_y. \tag{16}$$

In additon to taxes, young generations pay retirement contributions to both the PAYG and the funded pension plans. The contributions to the funded plan are deductible for the labor income tax and the PAYG contributions on labor income. The pension premiums cut the cost of leisure by reducing the net wage. However, more leisure also reduces pension rights being accumulated in the funded scheme. The last term on the r.h.s. of (16) represents the value of pension rights corresponding to one additional unit of work. This term raises the opportunity cost of leisure.

To explore intergenerational welfare implications, we compute the compensating variation (cv), both for generations alive at the time of implementation of the policy measure and for all generations that are born at that time and thereafter. We define $\mathrm{cv}(t_0)$ as the income that must be provided to households of generation t_0 in order to keep their lifetime utility at its benchmark level. Next, we measure efficiency by the aggregate compensating variation, which is the average of the generational compensating variations, discounted at the world interest rate, or

$$\mathrm{cv} = \sum_{i=2-n_T}^{0} \mathrm{cv}(i) + \sum_{i=1}^{\infty} \prod_{s=1}^{i} (1+r(s))^{-1} \mathrm{cv}(i).$$

IV. The Rest of the Model

Firms

The production function of the representative firm exhibits constant returns to scale and is of the nested CES type. It features labor, capital, and raw materials as arguments. Denoting net output by y, input of raw materials by M, investment by I, employment by L,[13] and the capital stock by K, the net production function reads:

$$y(t)=[\zeta_M M(t)^{-\rho_y}+\zeta_H H(t)^{-\rho_y}]^{-1/\rho_y}-\left[0.5\,c_1\frac{I(t)}{K(t)}\right]I(t) \quad \rho_y>-1 \tag{17}$$

$$H(t)=[\zeta_K K(t)^{-\rho_H}+\zeta_L(L(t)(1+\alpha)^t)^{-\rho_H}]^{-1/\rho_H} \quad \rho_H>-1. \tag{18}$$

The last term on the r.h.s. of (17) represents internal investment adjustment costs. The firm maximizes its market value, which can be derived from (12) by summation:

$$V(t)=\sum_{\tau=t}^{\infty} R_f(\tau,t)(1-t_d(\tau)-\pi_k^y(\tau))\,\mathrm{Div}(\tau) \tag{19}$$

where

$$R_f(\tau,t)=\prod_{s=t}^{\tau}[1+(1-t_k(s)-\pi_k^y(s))\,r(s)]^{-1}.$$

Since all shares are held by young generations, the net interest rate is that applying to young generations. Capital evolves according to the capital accumulation equation:

$$K(t)=I(t-1)+(1-\delta)K(t-1) \tag{20}$$

where δ denotes the rate of capital depreciation. Investment can be financed by issuing new bonds or retaining earnings. We assume that firms keep debt in constant proportion to the value of their equity (50 per cent).[14]

[13] Employment equals aggregate labor supply, which is the sum of labor supplies of young and old generations.

[14] In addition, there is a nonnegativity constraint on dividends. This constraint is not binding in the simulations presented here, so that dividends are determined residually. For a more detailed discussion of firm behaviour and, in particular, of how the composition of financial funds affects capital costs, see Broer and Westerhout (1993).

The Government

Government behaviour is largely exogenous. The government faces the following intertemporal budget constraint:

$$\sum_{\tau=t}^{\infty} R_g(\tau, t)[G(\tau)+T(\tau)-T_T(\tau)]=D(\tau) \tag{21}$$

where $R_g(\tau, t)$ represents the government discount rate, defined as

$$\prod_{s=t}^{\tau}(1+r(s))^{-1}.$$

T and T_T denote aggregate transfers to households and tax receipts, respectively. We assume that the government adopts a policy of tax smoothing, i.e., it responds to a shock by making a once-and-for-all adjustment in one of its instruments, such that per capita government debt converges to a constant in the new steady state.

The Foreign Sector

The economy imports consumption goods, investment goods, and raw materials from abroad. The foreign good is a perfect substitute for the domestic commodity. The only non-traded good is labor. Equity claims are not traded internationally. Private and government bonds are perfect substitutes for foreign bonds. Foreign debt, A_e, is related to net exports, TB, through the following intertemporal budget constraint:

$$A_e(t)=\sum_{\tau=t}^{\infty} R_g(\tau, t)\, TB(\tau) \tag{22}$$

Calibration

The model is calibrated on the Dutch economy in 1989. Hence, the model incorporates population growth, n, and labor saving technical progress. The values of the intertemporal elasticity of substitution, the intratemporal elasticity of substitution, and the rate of time preference are comparable to Auerbach and Kotlikoff (1987). The values of the remaining parameters and the model's exogenous variables are chosen in such a way as to reflect the Dutch economy in 1989. Employment and aggregate labor supply in the initial steady state equilibrium are calibrated to the level of actual employment. The values of various parameters and exogenous variables of the model are displayed in Table 1, which also contains a glossary of the main symbols.

Table 1. *Glossary and calibration of the model*

L		labor supply
K		capital stock
S/Y		saving as a percentage of GNP
I/Y		investment as a percentage of GNP
TB/Y		trade balance as a percentage of GNP
CA/Y		external current account as a percentage of GNP
A_e		foreign debt
p_l		gross wage rate
$\text{cv}(t_0)$		compensating variation of generation t_0
CV		aggregate compensating variation
w		FC contribution rate
π_k^y		PAYG contribution rate on interest and dividend income of the young
π_l^y		PAYG contribution rate on labor income of the young (net of FC contributions)
π_p		PAYG contribution rate on interest income of FC scheme
t_p		tax rate on interest income of FC scheme
t_d	0.25	tax rate on dividend income of households
t_k	0.25	tax rate on interest income of households
t_l	0.25	tax rate on labor income
n	0.01	rate of population growth
a	0.02	rate of labor-saving technical progress
r	0.055	world interest rate
$\bar{l}$	0.23	labor supply corresponding to a full work week
$l_{\max}$	1.00	maximum supply of labor
β	0.009	rate of time preference
γ	0.25	elasticity of intertemporal substitution
θ	0.025	rate at which preference for leisure rises over the life cycle
ρ	0.11	parameter of intratemporal substitution between leisure and commodities
ε	0.137	net replacement rate PAYG benefits
ac	0.0156	rate at which FC pension rights are accumulated
ρ_H	1.00	parameter of substitution between labor and capital
ρ_y	1.00	parameter of substitution between raw materials and value added
c_I	10.0	parameter of adjustment costs
δ	0.12	rate of depreciation of capital

V. Widening the Income Tax and PAYG Premium Base

Sections V and VI explore a number of policy options designed to reduce the burden of the income tax and PAYG contributions on the labor income of the young. Section V focuses on measures that broaden the tax and PAYG contribution bases, whereas Section VI analyses a cut in PAYG benefits.[15] All policy shocks are implemented in year 1 and are unantici-

[15] For policy simulations of other measures that broaden the tax and PAYG contribution bases, see Broer et al. (1993).

pated. Before the policy shock occurs, the economy exhibits balanced growth. All variables are measured relative to the benchmark of the initial steady state. Hence, a decline in a particular variable is to be interpreted as a drop compared to the initial growth path — a path that would have materialized if the policy shock had not occurred.

By adjusting the PAYG premium rate, $\pi_l^y(t) = \pi_k^y(t)$, the PAYG budget is continuously balanced. The government budget, in contrast, may feature surpluses or deficits as the government smooths the tax rate on labor and pension income, t_l, over time so as to meet the intertemporal budget constraint (21). Also the FC fund may be unbalanced as it smooths the pension contribution rate, w, over time so as to meet the intertemporal budget constraint (6). The once-and-for-all adjustments in t_l and w are presented underneath Tables 2, 3 and 4, which show the results of the various policy simulations. The tables themselves contain the time paths of $\pi_l^y(t) = \pi_k^y(t)$. Figure 1 displays the compensating variations for different generations for the three policy experiments.

The interest income of pension funds is currently subject to neither income tax nor PAYG contributions (i.e., $t_p = \pi_p = 0$). This is contrast to the interest income that the young generations earn on their individual saving (i.e., t_k, $\pi_k^y > 0$, see expression (11)). One way to widen the bases of both the income tax and the PAYG scheme is to treat the interest income from collective saving in the same way as interest income from individual saving (i.e., $t_p = t_k$, $\pi_p = \pi_k^y$). This section describes the economic consequences of this policy option contained in Table 2. Since the FC fund applies the defined-benefit principle, it maintains pension benefits as a

Table 2. *Subjecting the interest income of pension funds to income tax and PAYG contributions*[a]

	year	1	10	20	30	40	50	200
L	%	−0.19	−0.27	−0.26	−0.22	−0.18	−0.16	−0.15
K	%	0.00	−0.26	−0.30	−0.28	−0.24	−0.22	−0.21
S/Y	D%	0.00	−0.08	−0.09	−0.08	−0.07	−0.05	−0.04
I/Y	D%	−0.10	−0.03	−0.00	0.01	0.02	0.02	0.02
TB/Y	D%	0.10	−0.07	−0.07	−0.04	−0.00	0.03	0.05
CA/Y	D%	0.10	−0.05	−0.09	−0.10	−0.09	−0.07	−0.06
A_e	%	0.00	−0.04	0.53	1.12	1.54	1.76	1.77
$\pi_l^y = \pi_k^y$	D%	−0.17	−0.16	−0.16	−0.16	−0.16	−0.16	−0.16
p_l	%	0.17	0.02	−0.04	−0.05	−0.05	−0.06	−0.05
$\mathrm{cv}(t_0)$	Δ%	0.04	0.05	0.06	0.06	0.06	0.06	0.06
$\mathrm{cv}(1-t_0)$	Δ%	0.04	0.01	−0.02	−0.04	−0.08	−0.16	

CV: 12.21 (%) t_l: −0.64 (D%) w: 6.70 (D%).

[a]All variables are expressed either as percentual deviation of the variable from the baseline (%), or as absolute deviation of the variable from the baseline (D%), or as absolute deviation of the variable from the baseline in terms of household's lifetime wealth (Δ%). For the definition of the variables, see Table 1.

Table 3. *Reducing PAYG benefits under franchise FC system*[a]

	year	1	10	20	30	40	50	200
L	%	0.54	0.56	0.61	0.63	0.64	0.63	0.62
K	%	0.00	0.25	0.34	0.37	0.38	0.38	0.37
S/Y	D%	0.17	−0.03	−0.07	−0.05	−0.04	−0.04	−0.05
I/Y	D%	0.02	−0.02	−0.03	−0.03	−0.04	−0.04	−0.04
TB/Y	D%	0.16	−0.02	−0.02	0.01	0.02	0.02	0.01
CA/Y	D%	0.14	−0.01	−0.04	−0.02	−0.01	−0.00	−0.01
A_e	%	0.00	−0.62	−0.26	−0.15	−0.17	−0.25	−0.26
$\pi_l^y = \pi_k^y$	D%	−0.69	−0.69	−0.70	−0.70	−0.70	−0.70	−0.70
p_l	%	−0.48	−0.28	−0.24	−0.23	−0.23	−0.23	−0.23
$CV(t_0)$	Δ%	−0.08	−0.09	−0.09	−0.09	−0.09	−0.09	−0.09
$cv(1-t_0)$	Δ%	−0.08	−0.13	−0.18	−0.22	−0.28	0.83	

CV: −47.79 (%) t_l: −0.14 (D%) w: 1.56 (D%).
[a]All variables are expressed either as percentual deviation of the variable from the baseline (%), or as absolute deviation of the variable from the baseline (D%), or as absolute deviation of the variable from the baseline in terms of household's lifetime wealth (Δ%). For the definition of the variables, see Table 1.

Table 4. *Reducing PAYG benefits under integrated FC system*[a]

	year	1	10	20	30	40	50	200
L	%	0.33	0.45	0.52	0.57	0.59	0.60	0.59
K	%	0.00	0.17	0.26	0.32	0.34	0.35	0.34
S/Y	D%	−0.23	−0.18	−0.14	−0.12	−0.10	−0.09	−0.10
I/Y	D%	0.01	0.01	0.02	0.02	0.02	0.02	0.02
TB/Y	D%	−0.23	−0.09	0.00	0.05	0.08	0.10	0.09
CA/Y	D%	−0.24	−0.19	−0.16	−0.14	−0.12	−0.11	−0.11
A_e	%	0.00	1.30	2.11	2.55	2.74	2.76	2.68
$\pi_l^y = \pi_k^y$	D%	−0.68	−0.68	−0.68	−0.68	−0.68	−0.68	−0.68
p_l	%	−0.29	−0.25	−0.23	−0.23	−0.23	−0.22	−0.22
$cv(t_0)$	Δ%	−0.03	−0.04	−0.04	−0.04	−0.04	−0.04	−0.04
$cv(1-t_0)$	Δ%	−0.04	−0.10	−0.15	−0.20	−0.27	−0.28	

CV: −38.98 (%) t_l: −0.08 (D%) w: 2.07 (D%).
[a]All variables are expressed either as percentual deviation of the variable from the baseline (%), or as absolute deviation of the variable from the baseline (D%), or as absolute deviation of the variable from the baseline in terms of household's lifetime wealth (Δ%). For the definition of the variables, see Table 1.

ratio of wages (i.e., the parameter ac in expression (3) is unaffected). Accordingly, the higher tax and PAYG premiums paid on the interest income from collective saving are shifted unto labor; given a fixed world interest rate, the higher 'collective' burden on this interest income reduces the after-tax return on FC saving. With the FC fund maintaining the pension rights of the retired, FC pension premiums on the young need to increase. At the same time, the widening of the tax and PAYG contribution bases allow for a reduction in the rates of income tax and PAYG contributions.

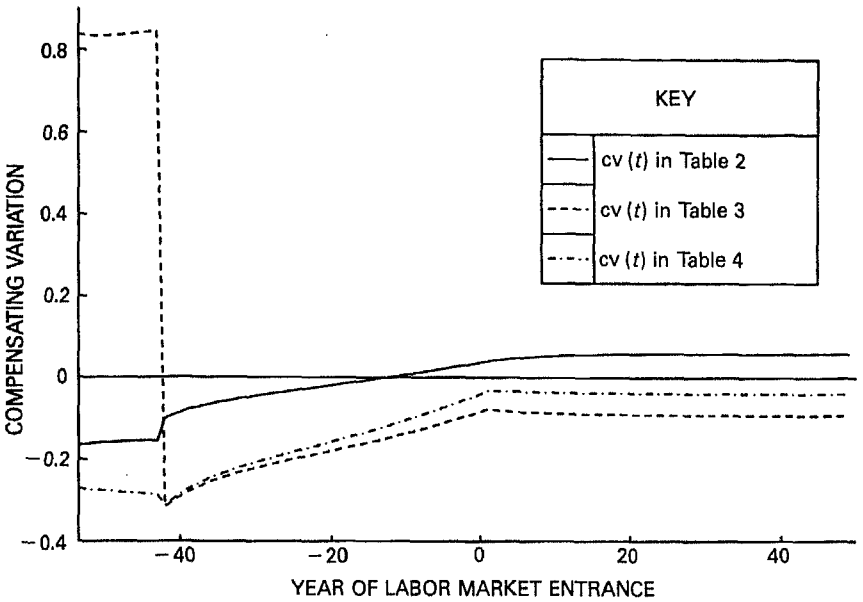

Fig. 1. Welfare effects (percentage of wealth).

The Intergenerational Distribution

The effects on the intergenerational distribution are assessed on the basis of compensating variations (see Figure 1). Those who are retired when the government introduces the tax on the interest income of pension funds benefit (see the last line of Table 2). While their (gross) pension rights (as a percentage of gross wages) are maintained, these generations benefit from both lower income tax rates and higher gross wages. In particular, since both PAYG and FC benefits are indexed to wages, the old gain from the higher wage level originating in the fall in labor supply (see below). Moreover, the old pay income tax on their FC benefits (see expressions (14) and (16)) while the PAYG benefit is linked to the wage net of income tax and PAYG contributions (see expression (2)). Accordingly, the retired share in the benefits from lower tax and PAYG premium rates.

Also the generations that are rather close to retirement at the time of the policy shock experience a welfare gain (see the next to last line of Table 2). The higher net pension benefits (as a result of wage indexation and lower taxes and PAYG premiums) offset the higher FC pension premiums they pay during only a short period before retirement. While older generations gain, the younger generations lose. In particular, those who have just entered the labor force or have not yet been born in year 1 suffer a welfare

loss. Whereas these younger generations benefit from the lower PAYG contributions and income tax rate on their labor income, they suffer from higher FC contributions. Moreover, these generations are harmed also by the reduction in the capital stock, which reduces the marginal productivity of their labor. Accordingly, the young bear the costs associated with the broader tax and PAYG contribution bases.

Efficiency and the Labor Market

This policy option reduces efficiency, which is measured by the aggregate compensating variation (see the line underneath Table 2). The reason is that the policy reform does not succeed in improving labor-supply incentives despite the fall in rates of PAYG contributions and income taxes. The additional FC pension contribution levied on a marginal hour of work does not correspond to more accumulation of individual pension rights. Rather, it reflects the additional PAYG premiums and income tax paid by pension funds. The negative impact of a larger "tax" component in FC premiums on the opportunity cost of leisure more than offsets the positive impact of the lower income and PAYG premium rates on that cost. Intuitively, the taxes and PAYG premiums collected on pension funds are fully borne by labor income in the form of higher pension premiums while labor income has to share with retirement incomes the benefits from lower income tax and PAYG premium rates. The resulting drop in the cost of leisure encourages the young to consume more leisure, thereby decreasing labor supply (see the first line of Table 2).[16]

The reduction in labor supply further reinforces the redistribution away from the young toward the old. The reason is that lower labor supply boosts the wage rate. This benefits the elderly because both PAYG and FC pensions are indexed to wages. The higher pension benefits require higher pension contributions, which harms the young who pay these contributions.[17]

The time path of labor supply looks as follows (see the first line of Table 2). After an initial decline, labor supply drops further. This is explained by capital decumulation, which reduces the reward of working by depressing gross wages (see below). After two decades, however, labor supply starts to recover although it remains below its benchmark value. The partial

[16]The anticipation of a decline in wages as a result of capital decumulation (see below) also reduces the return on collective saving as workers expect lower FC pension benefits.

[17]Moreover, the young, who own the domestic capital stock, are hurt by the fall in the value of the domestic capital stock, which originates in the reduction in labor supply and the associated higher wage level. Furthermore, the decumulation of capital decreases future wage levels, thereby cutting future labor incomes and, with pensions indexed to wages, expected retirement incomes.

recovery of labor supply is due to the intergenerational redistribution away from younger toward older generations, which causes the population to become poorer as time goes on. On account of the associated adverse income effects, the demand for leisure gradually declines, thereby stimulating labor supply.

Capital Accumulation

The adverse effects on labor supply harm capital accumulation by depressing the return on domestic investment (see the second and fourth lines of Table 2). At the same time, lower PAYG contributions on interest income raise the required return on equity. In the presence of adjustment costs, capital decumulation occurs only gradually. Hence, after their initial rise on account of the drop in labor supply, gross wages, which reflect labor productivity, exhibit a downward trend (see the ninth line of Table 2). The gradual decline of gross wages explains why, after its initial decline on account of higher FC premiums, the opportunity costs of leisure fall further as time elapses.[18]

Saving

While initial saving is barely affected, the saving ratio falls as time goes on (see the third line of Table 2). The weaker saving performance can be explained by the intertemporal reallocation of disposable income over the life cycle. In particular, the higher FC premiums are paid during the first part of the life cycle while households benefit from lower income tax rates and lower PAYG contributions not only when young, but also when retired. Consequently, young households save less in order to smooth consumption over their life cycle. Initially, this effect is offset by the stimulus to saving exerted by the expectation of capital decumulation and the associated fall in future wage and retirement incomes. Moreover, the government saves more because it anticipates lower future tax collections on account of lower labor supply and wages.

The External Accounts

Initially both the trade and current account improve as saving is virtually unaffected and the investment ratio falls (see the fifth and sixth lines in Table 2). Within a decade, however, the external accounts turn into deficit reflecting the decline in the saving ratio. The weaker saving performance

[18] Note, however, that the expectation of the fall in wages discourages labor supply of young generations already initially. The reason is that lower future wages reduce expected FC pension benefits, which are indexed to wages. This expectation decreases the opportunity cost of leisure (see expression (16)), thereby making work less attractive.

causes the current account to remain in deficit. The trade account switches back into surplus after year 40. At that time, the economy pays substantial debt service on its larger stock of (net) foreign debt.

VI. Reducing PAYG Benefits

In the preceding section we examined whether the PAYG contributions on labor income can be reduced by broadening the contribution base of the PAYG system. However, an alternative way to mitigate the PAYG burden on labor income is to cut PAYG benefits. We now investigate an unanticipated reduction in PAYG benefits of 10 per cent (i.e., the parameter ε in expression (2) is decreased by 10 per cent) under two alternative specifications of the FC plans.[19] First, it is assumed that FC plans operate a franchise system, i.e., $\phi_2 = 1$ in expression (4); see Table 3. Accordingly, FC schemes raise pension benefits to compensate for the lower PAYG benefits only for those generations that are not yet retired at the time the government implements the cut in PAYG benefits. Second, we analyse the case where FC plans adopt an integrated system, i.e., $\phi_2 = 0$ in expression (4); see Table 4. In that case, they offset the lower PAYG benefits for all generations.

Franchise FC System

Efficiency. Efficiency increases for two reasons. First, the cut in retirement incomes of the very old amounts to a lump-sum tax without efficiency costs. The revenues from the capital levy are employed to mitigate the distortionary collective burden on labor income. The second reason for the efficiency gain is that, for younger generations, the policy shock raises the weight of the FC scheme at the expense of the PAYG scheme in the overall system of retirement provision. The FC scheme is more efficient than the PAYG scheme because it provides a link between labor supplied and the accumulation of pension rights, thereby improving labor-supply incentives.

The intergenerational distribution. The old generations, that collect PAYG benefits in year 1, suffer a welfare loss (see Figure 1). All other generations gain. In fact, the generations who start to collect PAYG benefits immediately after the government reduces PAYG benefits benefit the most.

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[19] On a balanced-growth path, the parameter $\phi_1(t)$ defined in equation (5) is constant over time. Hence, the "franchise" and "integrated" sytems produce equivalent results until the unanticipated policy shock occurs.

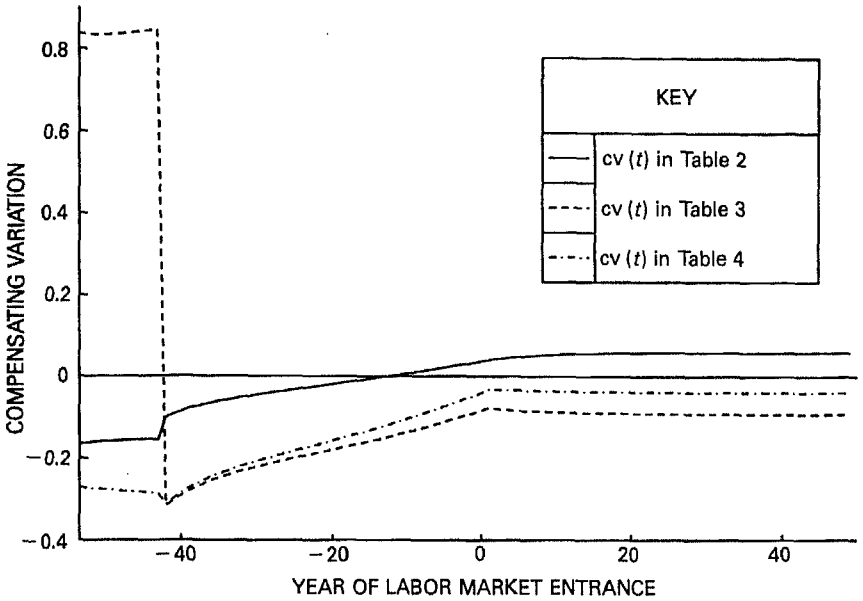

Fig. 1. Welfare effects (percentage of wealth).

The Intergenerational Distribution

The effects on the intergenerational distribution are assessed on the basis of compensating variations (see Figure 1). Those who are retired when the government introduces the tax on the interest income of pension funds benefit (see the last line of Table 2). While their (gross) pension rights (as a percentage of gross wages) are maintained, these generations benefit from both lower income tax rates and higher gross wages. In particular, since both PAYG and FC benefits are indexed to wages, the old gain from the higher wage level originating in the fall in labor supply (see below). Moreover, the old pay income tax on their FC benefits (see expressions (14) and (16)) while the PAYG benefit is linked to the wage net of income tax and PAYG contributions (see expression (2)). Accordingly, the retired share in the benefits from lower tax and PAYG premium rates.

Also the generations that are rather close to retirement at the time of the policy shock experience a welfare gain (see the next to last line of Table 2). The higher net pension benefits (as a result of wage indexation and lower taxes and PAYG premiums) offset the higher FC pension premiums they pay during only a short period before retirement. While older generations gain, the younger generations lose. In particular, those who have just entered the labor force or have not yet been born in year 1 suffer a welfare

households pay the additional FC contributions only when young but benefit from lower PAYG contributions also when old (as PAYG benefits are indexed to wages *after* PAYG contributions, see expression (2)). Accordingly, disposable income collected when old rises relative to that received when young. In anticipation of the relatively high retirement incomes, households save less in order to smooth consumption.

The external accounts. The current account reflects the time path of the saving ratio. The trade balance is in surplus both immediately after the shock and in the new steady state. The initial surplus reflects the decline in consumption due to the adverse income effect suffered by old generations. The eventual surplus corresponds to the servicing of net foreign debt.

Integrated FC Scheme

The intergenerational distribution. Under the integrated FC system, the cut in PAYG benefits turns out to be Pareto improving and hence clearly enhances efficiency; all generations, including the oldest, benefit (see Figure 1). In fact, the oldest generations gain the most. The integrated FC scheme protects these generations from the cut in PAYG benefits by raising FC benefits. At the same time, the old generations escape the higher FC contributions that are required to finance the additional FC benefits because these contributions are levied only on young generations.

The generations that gained from the cut in PAYG benefits under the franchise system still benefit under the integrated scheme. However, the size of the benefit falls compared to that under the franchise system. The reason is that these generations pay higher FC contributions under the integrated plan in order to compensate the oldest generations for the cut in PAYG benefits.

Macroeconomic impacts. Labor supply expands less under the integrated system than under the franchise system. Intuitively, the higher FC premiums required to maintain retirement benefits for the oldest generations reduce the marginal benefits from work, thereby harming the incentives to supply labor. The investment performance and the time path on the capital stock reflect the weaker stimulus to labor supply; the capital stock still expands — but less than under the franchise system. Under the integrated system, saving and the external current account are weaker than under the franchise system. Intuitively, the older generations are better off under the integrated system which stimulates consumption. Moreover, consumption smoothing causes younger generations to save less; these generations pay higher FC pension premiums only when young. Hence, they reduce consumption by less than the additional FC contributions

required under the integrated plan in order to smooth consumption over their life cycle.

VII. Conclusions

We have explored several policy options aimed at reducing the burden of income taxes and PAYG contributions on labor income. Including the return of collective pension funds in the tax base turns out to be counterproductive. Cutting PAYG benefits under the franchise system, in contrast, succeeds in improving efficiency in general and labor-market incentives in particular. However, this policy option harms the oldest generations. This is in contrast to reducing PAYG benefits if the FC plans operate an integrated system which proves to be Pareto-welfare improving. Hence, the presence of an integrated FC scheme changes the well-known result that a PAYG cut is not Pareto-welfare improving as generations alive during the transition face welfare losses. The integrated FC plan in effect provides for intergeneration redistribution protecting the older generations. Moreover, the FC improves intratemporal efficiency by linking retirement benefits to hours worked, thereby mitigating the disincentives to labor supply originating in the income tax and the PAYG scheme. In a model with heterogeneous households *within* generations, however, changing the composition of retirement benefits away from PAYG to FC benefits may no longer be Pareto improving. In particular, households with low labor incomes due to a low earning capacity may suffer from tightening the link between retirement benefits and labor-market performance. Including heterogeneous households within generations is an important subject for future research. In future work, we also plan to extend the model with a nontradables sector in order to explore the impact on the real exchange rate and the size of the nontradables sector.

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