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PENSIONS AND CONTEMPORARY
SOCIOECONOMIC CHANGE

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ABSTRACT

The paper discusses the consequences for the functioning of different pension systems of various types of socioeconomic changes, mainly demographic developments, variations in productivity growth and changes in real interest rates. Two of the pension systems have exogenous and four have endogenous contribution rates. I analyze both marginal and radical pension reforms for the purpose of making pension systems more stable, avoiding arbitrary redistributions between generations and dealing with increased heterogeneity of the population in terms of family structure and international mobility. The advantages of combining PAYGO and actuarially fair systems are pointed out.

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PENSIONS AND CONTEMPORARY SOCIOECONOMIC CHANGE

Contemporary pension systems in developed countries reflect economic, social and political conditions in the1930s and during the first decades after World War II. Recently, new socioeconomic changes have created both rationales and political forces for revisions of existing pension systems. Changes in demography, real wage growth and real interest rates are obvious examples. Increased heterogeneity and instability of the family, higher labor force participation of women, increased diversity of individual life-cycles, greater international mobility of labor and capital, and ambitions to encourage individual responsibility also have important implications for pension systems.

When discussing these issues, it is useful to set up a more elaborate classification of pension systems than the usual distinction between defined-benefit (DB) and defined-contribution (DC) systems. The choice of an appropriate taxonomy depends, of course, on the issues to be raised. One question that is focused on in this paper concerns the consequences of socioeconomic shocks on the intergenerational distribution of income and the sharing of income risk among generations. The distinction between pension systems with exogenous and endogenous contribution rates (tax rates) then becomes crucial. But the paper also deals with socioeconomic changes that are induced by the pension system itself via behavioral adjustments of individuals – and the feedback of these changes on the pension system. When dealing with such adjustments, highly relevant features of pension systems are the degree to which they are actuarial and funded, respectively – two aspects that are related but not the identical.[1]

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[1] Pension systems with exogenous contribution rates could possibly be called DC systems, and systems with exogenous benefit rules DB systems. But such a terminology would be quite different from that used

Six generic pension systems are classified in Section I, highlighting the distinctions mentioned above. The contribution rate is exogenous in two of these systems, while it is endogenous in the other four systems. Each of the six pension systems can be varied considerably, both by incorporating elements from other systems and by introducing restrictions on contributions or benefits. Section II turns to the consequences of socioeconomic changes for the intergenerational distribution of income and macroeconomic balance, while sections III and IV examine alternative pension reforms aimed at mitigating some of these consequence. A few of these reforms are "marginal" in the sense that certain rules of a pension system are modified, including both *ad hoc* policy measures and the introduction of various automatic adjustment mechanisms. Other reforms are "radical" since they imply shifts to different types of pension systems. Section V concludes.

As always when designing social insurance systems, it is necessary to strike a balance between conflicting considerations, such as distribution, risk sharing and incentives. But it is also important to be concerned with the balance between paternalism and individual freedom of choice (and hence individual responsibility). This also raises the more general question of the appropriate role of government in society as a whole, including the control of capital markets and temptations for governments to intervene in the management of firms.

I.   Classification of pension systems

I distinguish the six pension systems using the following notation:

τ = payroll tax rate
y = average labor income
N = number of employed individuals (workers)

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in the literature. There, a DC system is usually identified as an actuarially fair, fully funded system with individual accounts, while a DB system is identified as a system where pensions are tied to previous earnings (with lump-sum pensions regarded as a special case). See, for instance, Diamond (2000) and Thomson (1998).

R = number of retired individuals
B = fixed (lump-sum) pension benefit per person
$G_t = (y_t \cdot N_t)/(y_{t-1} \cdot N_{t-1})$ = rate of growth factor for labor income (tax base)
i = real interest rate on financial markets
$I = 1 + i$ = real interest-rate factor
w^j = real wage rate of individual j
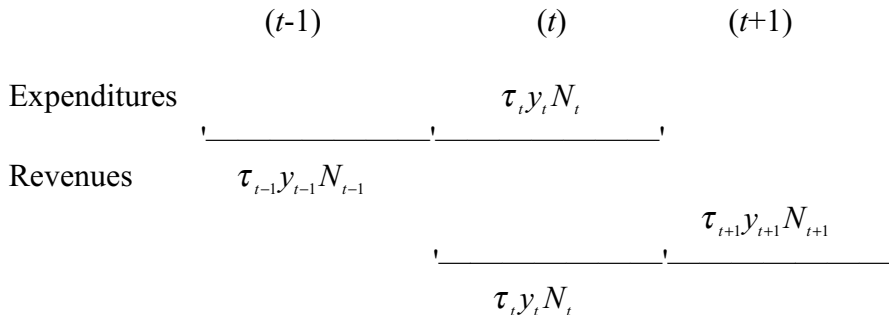h^j = hours of work of individual j.

I assume two overlapping generations, each living for two periods. For some purposes, however, it is important to divide each of these periods into several sub-periods ("years"). The schematic description below of revenues and expenditures of various pension systems should be self-explanatory. The revenues of the pension systems are denoted below the horizontal lines, the expenditures above the lines.

A. Exogenous contribution rate

(1) Fixed-fee system

In this pension system, there is a *fixed* contribution rate τ_t. Aggregate pension benefits in period t are determined by the revenues of the system in the same period, $\tau_t y_t N_t$. Hence, the budget is balanced by definition. The (endogenous) pension benefit to a representative individual and the (endogenous) implicit return on previously paid contributions by the individual depend on the number of contemporary workers N_t, their individual earnings y_t, and the number of retirees R_t.

$$(t\text{-}1) \qquad\qquad (t) \qquad\qquad (t+1)$$

Expenditures $\qquad\qquad\qquad\qquad\qquad \tau_t y_t N_t$
'_____'_____'

Revenues $\qquad \tau_{t-1} y_{t-1} N_{t-1}$

$$\tau_{t+1} y_{t+1} N_{t+1}$$
'_____'_____'
$$\tau_t y_t N_t$$

Each pensioner in period t gets $\dfrac{\tau_t y_t N_t}{R_t}$ $\qquad\qquad\qquad\qquad\qquad$ (1)

Implicit return factor: $\dfrac{\tau_t y_t N_t}{\tau_{t-1} y_{t-1} R_t} = G_t$ if $R_t = N_{t-1}$ and $\tau_t = \tau_{t-1}$. (2)

(2) Actuarially fair, fully funded system

As in the fixed-fee system, the contribution rate τ is exogenous and the pension benefit is endogenous. The return on the individual's forced saving is equal to the return in capital markets i on prefunded assets. There is intertemporal budget balance for each cohort.

$$
\begin{array}{ll}
\overbrace{\underbrace{\rule{4cm}{0.4pt}}_{\tau_{t-1}y_{t-1}N_{t-1}}}\;\; \overbrace{\underbrace{\rule{4cm}{0.4pt}}}^{I\tau_{t-1}y_{t-1}N_{t-1}} \\
\qquad\qquad \overbrace{\underbrace{\rule{4cm}{0.4pt}}_{\tau_t y_t N_t}}\;\; \overbrace{\underbrace{\rule{4cm}{0.4pt}}}^{I\tau_t y_t N_t}
\end{array}
$$

As is well known, a compulsory fully funded pension system will have an influence on the consumption of the individual only if he is liquidity constrained or unwilling to borrow, and hence unable to offset government-induced reallocations of his cash flow over the life cycle.

B. Endogenous contribution rate

(3) Lump-sum benefit system

This pension system provides the individual with an exogenously given *basic pension*, while the contribution rate τ is endogenously determined to ensure balance in the budget of the pension system.

$$
\begin{array}{ll}
\overbrace{\underbrace{\rule{4cm}{0.4pt}}_{\tau_{t-1}y_{t-1}N_{t-1}}}\;\; \overbrace{\underbrace{\rule{4cm}{0.4pt}}}^{B\cdot R_t} \\
\qquad\qquad \overbrace{\underbrace{\rule{4cm}{0.4pt}}_{\tau_t y_t N_t}}\;\; \overbrace{\underbrace{\rule{4cm}{0.4pt}}}^{B\cdot R_{t+1}}
\end{array}
$$

Balanced budget requirement: $BR_t = \tau_t y_t N_t$.

Implicit return factor[2]: $\left(B/y_{t-1}\right)/\tau_{t-1} = \tau_t y_t N_t \,/\, R_t \tau_{t-1} y_{t-1} = G$ if $R_t = N_{t-1}$

and $\tau_t = \tau_{t-1}$. (3)

B/y_{t-1} is the "replacement rate", which is inversely proportional to the individual's previous income.

Endogenous $\tau = \left(B/y_t\right)\cdot\left(R_t/N_t\right)$, (4)

where B/y_t = the " intergenerational income ratio" and R_t/N_t the "dependency ratio".

(4) Earnings-based system

In this system, the pension of an individual is determined as a fixed fraction (replacement rate) α of his previous earnings.

$$
\begin{array}{c}
\overset{\displaystyle \alpha y_{t-1} R_t}{\underset{\displaystyle \tau_{t-1} y_{t-1} N_{t-1}}{\rule{6cm}{0.4pt}}}
\end{array}
$$

$$
\begin{array}{c}
\overset{\displaystyle \alpha y_t R_{t+1}}{\underset{\displaystyle \tau_t y_t N_t}{\rule{6cm}{0.4pt}}}
\end{array}
$$

Balanced budget requirement: $\alpha y_{t-1} R_t = \tau_t y_t N_t$.

Implicit return factor [3]: $\dfrac{\alpha y_{t-1}}{\tau_{t-1} y_{t-1}} = \alpha/\tau_{t-1} = G_t$ if $R_t = N_{t-1}$ and $\tau_t = \tau_{t-1}$. (5)

Endogenous $\tau_t = \alpha \dfrac{y_{t-1}}{y_t}\dfrac{R_t}{N_t}$. (6)

(5) Contribution-based system

The pension in this system is a fixed fraction, γ, of contributions previously paid by the individual.

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[2] The return is the same as in the fixed-fee system, eq. (2), if the benefit is the same $\left(B = \tau_t y_t N_t \,/\, R_t\right)$.

[3] The return is the same as in a lump-sum benefit system if $\alpha = B\,/\,y_{t-1}$.

$$\frac{\gamma\tau_{t-1}y_{t-1}R_t}{\tau_{t-1}y_{t-1}N_{t-1}}$$

$$\frac{\gamma\tau \cdot w_t \cdot R_{t+1}}{\tau_t y_t N_t}$$

Balanced budget requirement: $\gamma\tau_{t-1}y_{t-1}R_t = \tau_t y_t N_t$.

Implicit return factor: $\gamma = G_t$ if $\tau_t = \tau_{t-1}$. (7)

Endogenous $\tau_t = \gamma\tau_{t-1} \cdot \dfrac{y_{t-1}R_t}{y_t N_t}$. (8)

(6) Fixed intergenerational income-ratio system

In this system, the pension of an individual is a fixed fraction, μ, of the average earnings of *contemporary* workers.

$$\frac{\mu y_t R_t}{\tau_{t-1}y_{t-1}N_{t-1}}$$

$$\frac{\mu y_{t+1}R_{t+1}}{\tau_t y_t N_t}$$

Budget balance requirement: $\mu y_t R_t = \tau_t y_t N_t$.

Implicit return factor: $\dfrac{\mu y_t}{\tau_{t-1}y_{t-1}} = G_t$ if $R_t = N_{t-1}$ and $\tau_t = \tau_{t-1}$. (9)

Endogenous $\tau_t = \mu \cdot \dfrac{R_t}{N_t}$. [4] (10)

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[4] An alternative version of this pension system could be a fixed after-tax income ratio between generations, with the pension set to $\mu(1-\tau_t)y_t$. The implicit return factor is now $\mu(1-\tau_t)y_t/(\tau_{t-1}y_{t-1})$, but with a balanced budget the return will be identical to the case in the text: $\tau_t N_t y_t/(\tau_{t-1}R_t y_{t-1}) = G_t$ if $R_t = N_{t-1}$ and $\tau_t = \tau_{t-1}$. The endogenous τ_t required for a balanced budget is now $\mu(1-\tau_t) R_t/N_t$.

To summarize, in a fixed-fee system the (endogenous) pension of the individual is unchanged if the number of pensioners (R_t) increases at the same rate as aggregate earnings of workers ($y_t N_t$); see eq. (1). The same condition guarantees that the (endogenous) contribution rate is constant in lump-sum benefit, earnings-based, and contribution-based systems; see eqs. (4), (6) and (8). In a fixed intergenerational income-ratio system, the (endogenous) contribution rate is constant if the number of retirees changes at the same rate as the number of workers, see eq. (10). In actuarially fair systems, neither the contribution rate nor the pension benefit is *directly* related to the number of pensioners or aggregate earnings of workers.

To highlight the incentive structure in different pension systems, it is useful to write aggregate contributions as $\tau_{t-1} y_{t-1} N_{t-1} = \Sigma \tau_{t-1} w_{t-1}^j h_{t-1}^j$. When the individual changes the number of hours he works h_{t-1}^j or influences his wage w_{t-1}^j by his own effort (including training), his contributions and pension benefit change in the same proportion in a contribution-based system (with individual, notional accounts). Such systems have been given a special name in the literature: "notional defined-contribution" (NDC) systems. I will prefer to call them "quasi-actuarial", since there is a close link between the contributions paid earlier by the individual and the benefit that he subsequently receives. (The term "quasi" refers to the fact that, in general, the return differs from the return in financial markets.) In fixed-fee, fixed intergenerational income-ratio and lump-sum benefit systems, the individual pension depends on *aggregate* contributions and earnings, but not on the individual's own contributions (or earnings). When the individual changes the number of hours he works h_{t-1}^j or influences his wage w_{t-1}^j, there is no effect whatsoever on the individual's own pension.

The distinction between an earnings-based system and a contribution-based system is not brought out in the two-period framework above. In general, the benefit received in earnings-based systems is tied to the individual's previous earnings rather than to his earlier contributions as in contribution-based systems. Nevertheless, the implicit return and the contribution rate are the same in both systems if $\alpha = \gamma \tau_{t-1}$. (This can be

confirmed from eqs. (5)-(8).) To highlight the distinction between the two systems, we have to partition the period of work into a number of subperiods, such as years. Only if the pension benefit is tied to the lifetime earnings of the individual, and the contribution rate τ is constant over time, will the implicit return and the endogenous contribution rate required for a balanced budget be the same in both systems. Again, this requires the calibration $\alpha = \gamma \tau_{t-1}$.[5]

II.   Effects of socioeconomic changes

Let us begin by looking at the effects of four types of socioeconomic change on the distribution of income between pensioners and workers, and hence the risk-sharing properties of different pension systems: (1) a reduction in the number of workers (N_t); (2) lower average labor income (y_t) or a slower rate of increase in labor income (y_t/y_{t-1}); (3) a greater number of retired individuals (R_t); and (4) lower interest rates (i).

I start with the "direct impact" on the income of workers and pensioners. By that term I mean the *ceteris paribus* effect of a change in one socioeconomic variable, with given rules concerning benefits and fees, and with constant values for the other variables. Since the paper is not based on a formal general equilibrium model, indirect effects, for instance on asset prices, are treated heuristically.[6]

Reduced number of workers
An actual or expected fall in the number of workers (reduced N_t) for a prolonged period is one important factor behind recent concerns about the viability of existing pensions

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[5] Assume that the individual works in two periods and is retired in a third period. Retired individuals are then supported by two subsequent generations -- one engaged in its second period of work and the other in its first period of work. Earnings of workers in periods t-2, t-1, and t are y_{t-2}, y_{t-1}, and y_t, respectively. The oldest generation, which starts work in the period t-2, consists of N_{t-2} workers, and the two subsequent generations which start work in periods t-1 and t, respectively, consists of N_{t-1} and N_t workers. In an earnings-based system, the implicit return factor is now $\alpha(y_{t-2} + y_{t-1}) / \tau_{t-2}y_{t-2} + \tau_{t-1}y_{t-1})$, while in a contribution-based system it is γ. If $\tau_{t-2} = \tau_{t-1} = \tau_t$, the return is the same in both systems if $\alpha = \gamma \tau_{t-1}$. The same condition assures that the endogenous contribution rate is the same in both systems.

[6] For formal general equilibrium analysis of pension systems, see Diamond (1977) and Bohn (1999).

systems. On a high level of abstraction, the consequences are rather similar regardless of whether such a decline is the result of emigration or a fall in the birth rate (in the past).

Under *fixed-fee* pension systems, pensioners have to bear the entire (direct) burden of adjusting to such a change because the aggregate amount of pension benefits is constrained by the exogenously given contribution rate *times* the tax base, while disposable income of individual workers is unaffected. The benefit received by the average pensioner, $(\tau_t y_t N_t)/R_t$, and the implicit rate of return on previous contributions, $(N_t/R_t)(y_t/y_{t-1})$, are both reduced in proportion to the fall in N_t. It is therefore reasonable to assume that the aggregate consumption of pensioners will fall in (about) the same proportion. Since there is no reason why individual workers would change their consumption, the aggregate consumption of workers would also be expected to fall in that proportion. If aggregate output decreases by the same percent as employment, there would be no disturbance to the macroeconomic balance.

In all of the *other* pay-as-you-go *(PAYGO)* systems mentioned above, workers have to bear the entire (direct) burden of adjustment since fewer workers have to finance the same (fixed or predetermined) aggregate pension payments as before. Neglecting conceivable consequences for aggregate employment (i.e., assuming the income and substitution effects on labor supply approximately cancel), τ_t has to be raised in proportion to the fall in the number of active individuals in order to balance the pension budget; see eqs. (4), (6), (8) and (10).[7] Workers' *aggregate* consumption tends to decrease as a result of both the fall in the number of workers and the reduction in after-tax income of each individual worker. Thus, if aggregate output happens to decline in proportion to the reduction in the number of workers, then aggregate demand is likely to fall more than aggregate supply. If so, there will be macroeconomic scope for reduced taxes and/or increased government spending.

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[7] The derivative of $\ln \tau_t$ with respect to $\ln N_t$ is minus one.

Clearly, there is no (direct) risk sharing in any of the PAYGO systems listed above in response to a fall in the number of workers.

The consequences for various pension systems are about the same if employment falls as a result of increased structural unemployment. In this case, however, the government would be in a worse financial position due to higher expenditures for unemployment benefits. It is also worth noting that a rise in structural unemployment may to some extent be caused by the pension system itself because payroll taxes tend to raise labor costs for workers that are exposed to minimum wages (via legislation or collective bargaining).

In the context of an *actuarially fair* (fully funded) pension system, by contrast, the income of both individual pensioners and individual workers will be unaffected. Thus, after a fall in N_t , both have sufficient income to continue consuming as much as before – as long as indirect effects are neglected. But there may be indirect effects. When pensioners start unloading financial assets, there are fewer potential buyers of these assets (than before) due to the fall in the cohort size of workers. As a result, asset prices would fall and interest rates rise – except in the special case of a small open economy with capital markets that are completely integrated internationally. [8] By this indirect route, pensioners may suffer from a fall in the number of workers also under an actuarially fair pension system, and not only in a fixed-fee PAYGO system. This argument assumes, however, that asset holders do not rationally (fully) anticipate future changes in the demand for and supply of assets in connection with future demographic change – a realistic assumption in my view. Since workers also hold financial assets, for instance in the context of a fully funded pensions system, some risk sharing with workers will take place via this indirect route , i. e., via falling asset prices.

Except for the case of a very large decline in asset prices when pensioners unload their securities, aggregate demand is likely to fall less than output in a society with an actuarially fair, funded pension system. If so, there would be domestic excess demand for

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[8] If the same demographic change occurs simultaneously in other countries, pensioners would also be exposed to lower assets prices in small open economies with fully integrated international capital markets.

goods and services, with increased inflation or deterioration of the current account of the balance of payments, or both. If pensions are not fully indexed to inflation, which they usually are not in fully funded systems, retirees will have to accept further downward adjustment of their per capita consumption. Pensioners may also be harmed by government attempts to combat the current account deficit with policy measures designed to reduce domestic aggregate demand. After all, the size of the current account of the balance of payment is often a policy target of the government – for good or bad reasons.

Determining the proportion of the reduction in consumption of workers and pensioners would require a quantitative general equilibrium model, which is outside the scope of this paper. In any event, the main point here is that even under an actuarially fair pension system, pensions may not be fully protected against the consequences of a drop in the number of workers – due to the eventuality of falling asset prices, a deterioration in the current account of the balance of payments and (without price indexation of assets) higher inflation.[9]

B. Reduced labor-income growth

The slowdown in the rate of growth of average labor income (a fall in y_t/y_{t-1}) since the early 1970s is another factor underlying today's concern about pension systems. This development might not be entirely regarded as an exogenous shock from the point of view of the pension system. To some extent, the slowdown has been induced by labor distortions due to marginal tax wedges associated with payroll taxes – resulting in negative substitution effects on both hours of work h^j and real wages w^j (the latter because of disincentives on investment in human capital and work intensity).

In the context of a PAYGO pension system, the direct distributional effects are rather similar to the case of a fall in the number of workers; y and N enter in the same way in most PAYGO systems. One important difference, though, is that *individual* workers are now directly exposed to reduced earnings. This holds regardless of whether the fall in

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[9] Such mechanisms are discussed in Barr (1999).

earnings is the result of lower wages, w^j, or shorter hours of work, h^j (for instance, via "work sharing").

Moreover, both a fixed-fee system and a fixed intergenerational income-ratio system incorporate (automatic) risk-sharing devices between workers and pensioners in the case of fluctuations in wages and hours of work, as opposed to the earlier discussed case of fluctuations in the number of workers. In fixed-fee systems, a fall in workers' average disposable income by $\Delta y\ (1-\tau_t)$ is accompanied by a fall in the average pension by $\tau_t \Delta y (N_t/R_t)$. Thus, income risk is shared between pensioners and workers in the proportion $[\tau_t /(1-\tau_t)]\cdot(N_t/R_t)$. In the case of a fixed intertemporal income-ratio system, a fall in average labor income is shared between representative agents in the two groups in the proportion μ. The consequences for macroeconomic balance are quite complex and depend partly on whether the fall in the real wage is related to a drop in productivity and hence output, and/or to a redistribution of income between labor and capital.

Again, the consequences are more complicated in an actuarially fair system. Since there is no direct impact on pensioners, individual workers have to bear the entire direct burden of a fall in real wages. Meanwhile, the reduction in wage rates implies that workers have fewer resources available to buy unloaded assets from pensioners. So asset prices may decline in this case as well, thereby reducing pensioners' resources for consumption – with the earlier reservation in the case of a small open economy with perfect capital mobility, or with rational expectations. If so, wage risk for workers is translated into asset risk for pensioners. As in the case of PAYGO systems, it is a complicated matter to determine the consequences for macroeconomic balance and inflation.

The slowdown in real-wage growth from the mid-1970s in most developed countries may very well be reversed in the future, for instance, as a consequence of the emerging IT revolution. This would strengthen the financial viability of existing PAYGO pensions systems. But the ratio between pensions and the wages of coexistent workers would fall in the future in the context of lump-sum benefit, earnings-based, contribution-based and

actuarially fair pension systems – with the possibility of distributional conflicts as a result.

C. Increased number of pensioners

Recent and predicted future increases in the number of retirees is a third important factor behind today's concern about pension systems. The consequences depend on how this change comes about – for instance, via immigration of elderly people, the aging of a particularly large cohort ("baby boomers"), early retirement, or higher longevity after retirement.

In the first case – immigration of elderly individuals – the crucial issue is how immigrants are treated relative to native-born citizens. [10] Suppose instead that the number of retired individuals increases as the result of aging of a particularly large *cohort,* which may be described as a parallel increase in N_{t-1} and R_t with N_t unchanged. In fixed-fee systems, per capita pensions will fall in proportion to the rise in R_t, (eq. (1)), while contribution rates would have to be raised in the same proportion in lump-sum benefit, earning-based, contribution-based and fixed intergenerational income-ratio systems (eqs. (4), (6), (8)). Again, there is no automatic risk-sharing mechanism. Assuming no differences in marginal propensities to consume, problems of macroeconomic balance would not be induced (except for conceivable labor supply effects of higher marginal tax rates).

If a rise in the number of pensioners is instead caused by an increase in the frequency of early retirement, the outcome would be a simultaneous rise in R_t and a fall in N_t. In reality, this type of change is often induced by the incentive structure of the pension

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[10] If they are treated in the same way, immigrants would be entitled to a domestic pension under three of the generic pension schemes listed: fixed-fee, lump-sum benefit and fixed intergenerational income-ratio systems. In fixed-fee systems, "domestic" pensioners would have to accept a fall in their per capita pension by the factor N_{t-1} / R_t, while in lump-sum benefit and fixed intertemporal income-ratio pension systems, payroll taxes would have to be raised by that factor. Thus, there are no automatic mechanisms for risk sharing between workers and pensioners in any of these systems when the number of pensioners increases via immigration of elderly people. Problems of macroeconomic balance will not arise as long as the marginal propensity to consume is the same for all groups concerned. Income flows in the context of other pension systems – earnings-based, contribution-based and actuarially fair systems – would be unaffected. Under these three systems, elderly immigrants will (in the real world) be financed by relatives or by social welfare payments. The latter, of course, would require a general tax increase.

system itself. In the context of a fixed-fee system, pensions would have to be reduced in proportion to the fall in the ratio N_t/R_t, while in lump-sum benefit, earnings-based, contribution-based and fixed intergenerational income-ratio systems, the tax rate would have to be raised in proportion to the rise in the ratio R_t/N_t.

In the context of an actuarially fair pension system, there will be no direct impact on the income flows. But when a large number of pensioners sell assets to workers, the former may face falling asset prices in the same way as in the case of a reduced number of workers. This would imply that pensioners will be hit indirectly in fully funded systems as well – except with fully rational expectations or in a small open economy with fully internationalized capital markets.

The situation becomes more complicated if the number of pensioners instead increases because of greater longevity after retirement, so that R_t increases relative to both N_{t-1} and N_t. In fixed-fee systems, pensioners would have to accept a reduction in yearly pensions in proportion to higher longevity. More precisely, there will be a reduction in yearly pensions by the change in the factor N_{t-1}/R_t. By contrast, under lump-sum benefit, earnings-based, contribution-based and fixed intergenerational income-ratio systems, τ_t would have to be raised in proportion to the increase in the ratio R_t/N_t, provided each pensioner is guaranteed the same annual pension as before. Again, there is no risk sharing between generations.

In principle, the situation is the same in the case of an *actuarially fair* system as in a fixed-fee system, if information about longevity is obtained exactly when a fixed annuity is determined (at the time of retirement); the annuity has to be reduced in proportion to greater longevity. However, if such information is not obtained until *after* the annuity has been determined, the pension provider has to cover the higher costs, while the annual income of pensioners is unchanged. But in reality, information about higher (expected) longevity is usually available *before* retirement, indeed, during the course of working life. The insurance provider is then able to propose higher contributions, and workers are likely to accept such proposals. It has been argued that similar adjustments are difficult to

achieve under PAYGO systems, because the link between what an individual pays and what he receives later on is usually rather weak. Since the fee in such a system functions as a tax wedge, higher fees may also be resisted by those who are anxious to avoid additional work distortions (Persson, 1998).

D. Lower real interest rates

The rise in real interest rates in recent decades, as compared to the 1950s and 1960s, is an important factor behind the increased popularity of actuarially fair, fully funded systems. Of course, we have no idea whether the average level of real interest rates will be even higher in the future, or if they will decline again. Since I have already discussed shocks that create problems mainly for PAYGO systems, I now examine an interest shock that creates problems for actuarially fair, fully funded systems, i.e., a *fall* in real interest rates. A fall that takes place after retirement will *either* create financial difficulties for the pension provider (if the annuity is *fixed*) *or* force retirees to accept lower pensions (if the annuity is *variable* in the sense that it is gradually adjusted to realized asset returns also after retirement). In the first case, pension providers may try to shift the consequences of interest-rate shock onto subsequent cohorts of pensioners.

At the level of an individual pensioner, an obvious difference between a fixed and a variable annuity is that in the latter case he has to accept higher income risk during the period of retirement. The reason, of course, is that with a variable annuity, the drawing down of previously accumulated pension capital takes place only gradually during the retirement period. The advantage to the individual is that he then has a further opportunity to enjoy the return on assets, such as shares, after having retired. A variable annuity also fulfills the role of reducing fluctuations in the *relation* (ratio) between replacement rates for consecutive cohorts of pensioners. The reason here is that the capital value of the annuity will not depend so much on the situation that happens to prevail on financial markets at the time of retirement. This gives rise to a genuine trade-off problem. While a fixed annuity provides greater income insurance in connection with uncertainty about longevity, a variable annuity furnishes *relative* income insurance in connection with uncertainty about asset prices at the time of retirement. The individual

may alternatively opt for "revolving" annuitization for a number of years before retirement, or a gradual shift (also before retirement) to less risky assets. But this means that the individual would miss out on the opportunity to enjoy the return on high-yielding assets after retirement in terms of accumulated pension capital.

So far I have only considered changes in real interest rates at or after retirement. If real interest rates have already fallen during the individual's working life, and are expected to remain low for quite a while, he would probably agree to pay higher yearly contributions to a fully funded system in order to boost his future pension.

Even though there are no direct effects (as long as there are no buffer funds), PAYGO pension systems are not immune to changes in real interest rates. Both contribution rates and pension benefits may be influenced indirectly (general equilibrium effects). The most obvious effect is that lower (higher) real interest rates would increase (reduce) real wage rates via a boost (retardation) of real investment.

III. Marginal reforms

A. Ad hoc adjustment

Under all of the generic pension systems discussed above, well-specified rules guarantee budget balance via adjustments in either fees or pensions. In reality, such adjustments often require explicit political decisions. This process may take considerable time, partly in order to resolve conflicts about the distribution of income. In the meantime, financial imbalances of the pension system easily emerge. The combination of financial imbalances and unexpected redistributions of income are likely to initiate demand for *ad hoc* changes in contributions and/or benefits. For example, after a fall in the number of workers or in real wages, workers may resist higher fees in lump-sum benefit, earnings-based and contribution-based systems (and in fixed intergenerational income-ratio systems after the number of workers has declined). Indeed, doubts are often expressed in the political debate as to whether workers will grant promised pension entitlements to the elderly after such disturbances. It is therefore tempting to speculate that workers may

want to force contemporary pensioners to share the burden of adjustment in such cases. If *ad hoc* changes in nominal pension benefits are not politically feasible, obvious alternatives are higher taxes on pension income or partial punctuation of price indexation of pensions.

Since pensioners constitute only a minority among voters, it is perhaps less likely that workers could be forced to share the burden of adjustment when this largely tends to fall on pensioners. (This occurs, for example, in the case of a fall in the number of workers in fixed-fee systems and in the case of a fall in real interest rates in actuarially fair systems, except if a fixed annuity has been set.) Policy actions for this purpose may be released, however, if pensioners are an important swing group in the political arena, and their voting behavior is particularly sensitive to the economic benefits offered.

Even though the benefits of contemporary pensioners have recently been cut to a considerable extent in some countries, and fees have been raised for workers, empirical evidence suggests that political authorities have mainly opted for a "third alternative": cuts in pensions for *future* pensioners (McHale, 1999). As an explanation, John McHale has hypothesized that today's workers are afraid of becoming exposed to even greater cuts in their own pensions in the future unless they agree to some cuts. But another explanation could be that the political price is higher if the government cuts *current* disposable income by means of higher fees or lower pensions today, than if it decides to reduce pensions *far ahead into the future*. After all, myopic behavior is not unheard of; indeed, reference to such behavior (often interpreted as time inconsistency) is one of the most common arguments for having compulsory pension systems in the first place.

When a pension system encounters problems because of a fall in the number of individuals of working age relative to the number of individuals above retirement age, immigration of young workers may be a solution. This presupposes, of course, that such immigration is not expected to result in serious tensions and conflicts in society.

B. Automatic adjustment mechanisms

The introduction of new types of automatic adjustment mechanisms within existing pension systems is an alternative to *ad hoc* policy interventions for dealing with socioeconomic shocks. One way of achieving this is to index pensions, more or less closely, to average wages of contemporary workers. This can be done by using the average wage each year as an accumulation factor for the pension claims that are acquired during working life, and/or by indexing annual pensions (after retirement) to the average wages of contemporary workers. A more explicit method consists of shifting to a "fixed intertemporal income-ratio" system (system no. 6 in the classification above). Such a reform would mean giving up ambitions to maintain strong quasi-actuarial elements in the pension system, such as in systems no. 5. But it would still be possible to make *relative* pensions among individual pensioners proportional to each individual's accumulated earnings or contributions; thus, some *relative* quasi-actuarial element could still be achieved.

Under lump-sum benefit, earnings-based and contribution-based systems, there may also be resistance among wage earners for having to bear the entire burden of adjustment to a rise in longevity after retirement. A technically simple way of doing this would be to make annual pensions a declining function of remaining life expectancy after retirement. For example, under the new pension system in Sweden, when annual pensions are decided at the time of retirement, the pension benefit will be inversely proportional to expected longevity after retirement. In this special case, the entire burden of adjustment will be borne by the retirees – hardly a risk-sharing device. Peter Diamond (2000) has questioned the wisdom of this element in the Swedish pension reform. Of course, risk sharing could be achieved by establishing a rule according to which workers and pensioners share the financial consequences (in a certain proportion) of increased longevity. Moreover, many individuals may realize already during their period of work that life expectancy at the age of retirement will increase over time. This means that they have the opportunity to save themselves or to postpone retirement.

A more crude way of making a pension system financially viable, regardless of the type of disturbance, would be automatic reductions in benefits and/or automatic increases in fees in response to an emerging or anticipated deficit in the pension budget.

A higher retirement age – the ordinary age as well as the lowest early retirement age – is a particularly natural response if the health of individuals above today's retirement age is expected to improve. (It may then be important to implement stricter rules for disability and unemployment insurance, since these systems in fact provide alternative routes to early retirement also for individuals without serious health problems).[11] However, a large fraction of the elderly would risk winding up in unemployment if the retirement age were increased considerably, mainly because of rigid wage and seniority wage scales. To avoid this, it would be necessary to accept increased downward flexibility of relative wages for the elderly, e.g. by ensuring that age-wage profiles are less steep, as well as by facilitating individual choice of hours of work. Some downward adjustment of wages of younger workers might also be necessary to prevent a higher retirement age from resulting in a temporary rise in youth unemployment via crowding-out effects. In most countries, union and government wage policies are obstacles to such solutions.

Since both health and preferences for work vary considerably among the elderly, there is, no doubt, a strong case for a *flexible* retirement age. But to avoid distorting work incentives, and to keep pension systems financially viable, there is also a strong case for combining such flexibility with actuarially fair adjustments of pensions under conditions of early retirement. Elderly individuals with health problems could then be referred to the sick insurance system. It is curious that today's pension systems and labor market arrangements are designed in ways that appear to turn higher longevity and better health among the elderly into serious *social problems*, rather than a blessing. This design is hardly an example of good "social engineering".

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[11] There are limits, of course, to what can be achieved by such a reform. Given current fees and benefit rules, the OECD has calculated that the statutory retirement age would have to be raised, within a few decades, to no less than 73-74 years in many developed countries to keep pension systems financially viable. See Thomson (1998), p. 48, fn. 10) and OECD (1988).

C. Shifting to a quasi-actuarial system (NDC system)

Lump-sum benefit systems and earnings-based systems have served as the most common pension schemes during the second half of the 20th century. While the former are completely non-actuarial, there is some indirectly positive relation between the individual's pension and earlier contributions in earnings-based systems. But this relation is very weak in most countries since pensions are often calculated on the basis of earnings during a limited number of years of work. It is not *technically* difficult to strengthen the link between benefits and previously paid contributions – also without pre-funding. One obvious technique would be to increase the number of earning years used as a basis for the size of individual's pensions. The most straightforward way, however, would be to shift to a contribution-based system with individual (notional) accounts, i.e., a NDC-system. A basic argument for this type of reform involves reducing the implicit tax wedge between contributions and benefits. Since the return on work is increased, there would be less risk of undermining the financial viability of the pension system via an induced reduction in the number of workers (N) or a reduction in earnings per worker (y) via a fall in hours of work (h^j) or labor productivity, reflected in a fall in real wages (w^j), or both. Under realistic assumptions, about a quarter of the tax wedge of a completely non-actuarial (lump-sum benefit) pension system may be removed by a shift from a non-actuarial to a quasi-actuarial, contribution-based pension system.[12]

It is virtually impossible, however, to create a *fully actuarially fair* PAYGO system in a dynamically efficient economy, i.e., an economy in which the real interest rate is higher than the growth rate. The obvious reason is that PAYGO pension systems, which pay a

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[12] Assume that an individual starts working at the age of 20, retires at 64 and lives for another twenty years thereafter. On average, a worker pays his contribution at age 42, and he receives his pension at age 74. Thus, as an approximation we may say that 32 years (74-42) elapses between the payment of the contribution and the enjoyment of the benefit. Let the contribution rate (τ) be 20 percent, so that if an individual earns $500 more (due to more hours of work or higher work intensity) he pays $100 as pension contributions. In a quasi-actuarial PAYGO system in which the return is 2 percent (the growth of the tax base), this contribution will be worth $188 after 32 years. If the real rate of return in financial markets is 5 percent and this is used as a discount rate, the capital value of these $188 at average working age is $40 ($188/(1.05)^{32}$). This means that the marginal tax wedge on work is 12 per cent (100-40)/500). Thus, a shift from a completely non-actuarial to a quasi-actuarial system will reduce the tax wedge from 20 percent to 12 percent in this case. The marginal tax wedge would be zero if the forced pension saving had instead been invested in a fund earning 5 percent per year (assuming that the funded system is started from scratch). See Lindbeck and Persson (2000), p.7.

higher return than the growth rate of the tax base, would wind up with an ever rising deficit. In other words, an actuarially fair PAYGO pension system is not financially stable, and hence not financially viable, in a dynamically efficient economy. In a dynamically *inefficient* economy, by contrast, it can be shown that an actuarially fair PAYGO system would automatically accumulate a fund of the same size as in a fully funded system (Hassler and Lindbeck, 1997). But then there is no point in choosing an actuarially fair system since the return on paid contributions would be higher in a traditional PAYGO system.

But is it possible, or even desirable to make a PAYGO system actuarially fair *just on the margin,* while maintaining budget balance by setting the average return equal to the growth rate of the economy? Intuition suggests that efficiency would be improved if the marginal return on pensions were set in such a way that the individual in the case of marginal decisions is indifferent between paying pension fees and investing on the capital market. The point would be that many economic distortions are associated with marginal rather than average tax wedges. It turns out to be technically possible to create such a system (Hassler and Lindbeck, 1997) Owing to intragenerational distributional considerations, however, such a system is politically difficult to implement, since it requires a lump-sum tax (a "poll tax") in order to balance the pension budget. Moreover, for a given tax rate, τ, it can be shown that the welfare gain of the increased efficiency of work would wind up entirely with the older generation. If the objective is to let all generations enjoy a welfare gain, the pension fee may be reduced, however (Hassler and Lindbeck, 1997).

IV. Radical reforms

A. Shifting to an actuarially fair, fully funded system
What then are the gains of shifting from a PAYGO to an actuarially fair, fully funded system? This depends crucially on how the claims of the old PAYGO-pensioners are met during a period of transition. If PAYGO pensioners are bailed out by *taxes* on a "transition generation", this generation will experience a sizeable income loss and a

related reduction in the return on their forced saving, while subsequent generations will experience higher income and an increased return on their pension saving – as compared to the alternative of retaining a PAYGO system. The transition generation would also be exposed to higher marginal taxes, resulting in lower economic efficiency of work. Subsequent generations would instead be able to enjoy smaller marginal tax wedges and hence increased work efficiency.

An alternative reform strategy would be to bail out PAYGO pensioners entirely by means of *government bonds* that are never amortized. This will considerably mitigate the income loss and the rise in the marginal tax wedge for the transition generation, while simultaneously limiting the gains for subsequent generations. Moreover, the larger the extent to which the transition is financed by bond issues rather than taxes on a transition generation, the less will national saving increase during the period of transition. Thus, there is a trade-off between ambitions to limit the deterioration of work incentives for a transition generation and to promote national saving in the near future.

Indeed, it is easy to show that the capital value of the gross income gain of shifting to a fully funded system is the same as the implicit debt to the PAYGO pensioners, provided all income streams are discounted by the market interest rate (Feldstein, 1995**;** Sinn, 1999; Lindbeck and Persson, 2000). All this may give the impression that the issue of shifting to an actuarially fair, fully funded pension system is only a problem of *intergenerational distribution* of income (wealth), and a trade-off between work incentives and of aggregate saving. There is more to it than this, however. In a world of uncertainty, we also have to look at the risk-return combination of alternative pension systems. The returns on PAYGO pension claims are not fully correlated with the return on the claims in the context of actuarially fair pension systems. First, the growth rate of the tax base of a PAYGO system (i.e., aggregate earnings) and the return on financial markets are not fully correlated, in particular, when pension funds have foreign assets. The political risk is also likely to differ. For instance, claims on funded systems with individual accounts probably provide stronger property rights than do pension claims in PAYGO systems. Moreover, in a fully funded system with individual accounts, there is a

particularly strong case for holding equities if the returns on these are in excess of what is required as compensation for risk – an extra return related to the celebrated "equity premium puzzle".

What all these points boil down to is that a combination of a PAYGO and a fully funded system provides a richer portfolio of "assets" than either of these pension systems in isolation. This seems to be the main rationale for a *partial* shift to a fully funded system. Of course, a complementary rationale could be to redistribute wealth to future generations at the expense of a transition generation, via higher taxes and increased national saving for a while – *if* our social preferences tell us that this would be distributionally fair.

The most problematic aspect of a (partial or total) shift to a compulsory, actuarially fair fully funded pension system is, in my view, how to minimize the risks that such a reform will in fact result in pronounced *politicization of the domestic economy*. There is a serious risk that future politicians will use government-controlled pension funds to allocate financial funds to "politically correct" industries and to those parts of the country where it is particularly important to buy votes. Politicians might also start using the voting rights in firms, based on share holdings, to exert influence *within* firms. It is naive to think that authorities can create government-controlled pension funds, i.e., nationalize a large part of share ownership, without a severe risk that some politicians – sooner or later – will use these funds to buy votes or to exert direct power over firms, or both. The only reliable way of mitigating these risks is to ensure that pension funds are privately owned and operated from the outset, and hence to allow individuals to choose fund managers. The higher administrative costs of decentralized as opposed to centralized fund management is a small price to pay for limiting the risk of politicization of the national economy. There are also devices to limit the administrative costs of decentralized management of compulsory pension funds (such as caps on fees, which would induce some fund managers to choose index funds).

B. Adjustment to increased heterogeneity

Real-world pension systems have always, at least to some extent, granted the heterogeneity of the population. An obvious example is overcompensation of early cohorts when PAYGO systems were introduced (to bring about a rapid increase in the living standard of the elderly and/or to create broad political support for the reform). Another example is redistribution in favor of low-income groups via a basic (lump-sum) pension or a guaranteed pension with means-tests on pension benefits. In most earnings-based pension systems in the real world (when pensions are tied to earnings during a limited number of years of work), females are also favored because of fewer years of work and a larger number of years after retirement. But there are also well-known regressive redistributional elements in most real-world pension systems, although it is difficult to say whether these effects are intentional or not. One example is redistributions in favor of individuals with a steep income profile over their life cycle (when the pension level is tied to earnings late in the individual's working life). Another example is redistributions to individuals with high expected longevity. In both cases, the arrangements tend to favor highly educated individuals with relatively high lifetime income (wealth).

In recent decades, it is only natural that new types of heterogeneity in the population have given rise to proposals for pension reforms. An obvious example is increased *instability of family structure*. Pension systems established in the early 20th century were careful to provide support for widows and their children, since death of the (usually male) income provider used to be a dominating factor behind the breakup of families. The strong trend toward labor-force participation of married women has reduced the need for special pension claims for widows. It does not seem reasonable that widows should receive pensions based on both their own previous income (or contributions) and widowhood. A delicate issue, however, is what should be regarded a reasonable length of time to phase out the latter type of pension claim. The huge increase in part-time work, also largely a result of increased labor force participation of women, also raises the issue of whether the benefit rules in contribution based and earnings based system should favor or disfavor part-time work of different length.

Today, family instability is rather caused by divorce and temporary cohabitation outside marriage. One way of adjusting pension systems to this new situation would be to give couples property rights to each other's pension capital, in the same way as the law stipulates such property rights for spouses regarding real estate and financial assets. After all, pension capital usually accumulates gradually over the working life of families, in a similar way as other assets. A delicate issue here concerns how other forms of cohabitation than marriage should be treated.

Increased heterogeneity is also reflected in higher *international mobility of labor*, which creates difficulties in "assigning" individuals to national pension systems. It will certainly become necessary to adjust pension rules in the future to deal with this issue and, in particular, whether pensions should be provided on the basis of an individual's country of origin or country of residence. Without some coordination of national rules, individuals may in some cases lose entitlements earned in one country, while in other instances they may end up with more favorable pensions by living part of their lives in one country and part in another country. In the first case, the pension system would impede international mobility of labor in the same way as non-transferable occupational pensions among firms or sectors reduce domestic labor mobility. In the second case, international labor mobility may, in fact, be subsidized. Shifts to quasi-actuarial or fully actuarial systems with individual accounts would mitigate, or even eliminate, such problems. Of course, ambitions to use pension systems as tools of redistribution would then be radically reduced. Increased international flexibility of the choice of residence of individuals also creates an increased need to unify the taxation principles for *private* pension policies including occupational pensions. In some countries, insurance contributions are deductible for tax purposes while subsequent pension benefits are taxed, whereas governments in other countries do just the opposite, which clearly distort residence decisions.

The heterogeneity of the population has also increased as a result of changes in the *traditional life cycle*, characterized by the linear sequence of education-work-retirement.

This sequence is currently being replaced by more complex and individually varied life cycles. The continuity of working life is often interrupted by education, retraining, periods of work in the home (for example, caring for children) and prolonged periods of leisure. This is an important background for contemporary proposals to replace existing welfare-state arrangements with compulsory saving accounts (possibly negative accounts early in life) and related *drawing rights* on claims accumulated before retirement.[13] Proposals of compulsory saving with drawing rights are based on the assumption that individuals can handle modest economic setbacks on their own by drawing on accumulated compulsory saving – for instance in connection with short periods of unemployment or health problems. However, people would be obligated to reserve a certain minimum balance in their accounts for old age. Thus, proposals of this type may be seen as efforts to encourage individuals to take greater responsibility for their own income protection in the event of moderate strain on their economic situation. Of course, when having to deal with major income losses, the system of drawing rights has to be combined with insurance; this point is also granted in most proposals. Another basic idea behind the scheme of drawing rights is to provide the individual with increased resources to shift between work, education and leisure over the life cycle. Work incentives would also be improved (via smaller tax wedges) and problems of moral hazard mitigated – two major problems of today's social insurance systems (evidenced by social insurance in the connection with unemployment, sick leave and early retirement).

As in the case of pension claims in quasi-actuarial and fully actuarial pension systems, it would be easy to allow the individual to keep his saving account and related drawing rights when moving among countries. Thus, compulsory saving accounts with individual drawing rights emerge an interesting response to greater heterogeneity among individuals ("individualization") in an increasingly internationalized labor market, as well as to increased ambitions to encourage individual responsibility.

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[13] An early proposal along these lines is Rehn (1961). More elaborate plans have been developed by Fölster (1999) and Orzag and Snower (1999).

V. Concluding remarks

As we have seen, the distributional consequences of socioeconomic changes and their effects on macroeconomic balance depend crucially on the detailed ("fine") structure of the pension system and on the exact nature of these changes.[14] It is clear that several problems of current PAYGO systems can be solved within the framework of the systems themselves. For instance, problems concerning financial viability and unexpected redistribution may be mitigated by *ad hoc* increases in fees, cuts in benefits (often by way of less favorable price indexation) or increased retirement age. At the same time, such interventions highlight the political risks inherent in government-operated pension systems. If more automatic risk sharing between generations is desired instead, an obvious move would be in the direction of what has here been called fixed intertemporal income-ratio systems, where the relation between pensions and the earnings of contemporary workers is fixed. The consequences of increased instability of the family can also be alleviated, for instance, by legislation requiring spouses to share each other's pension claims. If enhanced work incentives were called for instead, then the actuarial elements of the PAYGO system could be extended by strengthening the link between contributions and benefits for each individual, possibly by shifting to what has here been called quasi-actuarial systems. In the context of such a system, it is also technically easy to have a flexible retirement age without individuals being able to shift the costs of early retirement upon others. I have also mentioned that compulsory saving accounts with individual drawing rights, combined with compulsory insurance systems, provide an interesting alternative response to increased heterogeneity among individuals and to demands for placing greater responsibility on the individual for his own economic security.

I have emphasized that the negative impact of socioeconomic disturbances on pension systems can be mitigated by a *partial* shift to an actuarially fair, fully funded pension system because the return on pension claims are not completely correlated among

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[14] This type of observation has been made about welfare-state arrangements in general by Freeman (1995) and Atkinson (1999).

pension systems. Such a partial shift would provide individuals better balanced portfolios of pension claim than either a PAYGO or an actuarially fair system alone. This is an important point in a world with both different types of markets risks (risk in earnings versus risk in returns on capital markets) and different types of political risks (such as different strength of property rights in different types of pension claims). But a *complete* replacement of a PAYGO system with an actuarially fair, funded system cannot be motivated in this way. One way to motivate such a move would be to favor future generations at the expense of currently working generations.

The most severe problem inherent in a (partial or complete) shift to a fully funded system lies in finding ways to avoid politicization of the domestic economy. The only reliable way of achieving this is to let pension funds be privately owned and operated from the outset, and to allow individuals to choose fund managers – possibly combined with caps on the administrative fees to fund managers.

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