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PENSIONS

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Abstract

This chapter discusses the different pension systems. Pension systems are a means of transferring purchasing power from the working phase to the retirement phase of the life cycle. Formal pension systems are organised in two ways. In the funded or the capital-reserve system, the agents save to accumulate a fund which finances an annuity to the survivors. In the pay-as-you-go system, the payment of the pensions to the retired population are financed by the contributions of the working population. It is shown that capital-reserve systems and pay-as-you-go systems, two variants of providing retirement income, may yield the same outcome or may yield allocations differing only in their second order effects. Capital-reserve systems are superior to pay-as-you-go systems in the definition of the future rights of the retired population. Pay-as-you-go systems are better suited to redistribute the burden of major shocks among the working generations and the retired generations.

Reforms fixing the individual rights of the retired population conditional on the state of the economy and the record of individual contributions are desirable. Alternatively, adapting the tax status of funded pension plans to the state of the economy in a well-defined way could improve the risk-sharing properties of the capital-reserve system.

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1. Saving for Retirement

Old-age pension plans are a means of transferring purchasing power from the working phase to the retirement phase of the life cycle. The wages earned while working constitute a claim on the output of the economy. By refraining from consuming part of this claim, output can be devoted to investment or consumption of collective goods.. The contributions to a pension fund are an example. Through the pension fund, these financial means are lent to firms for the acquisition of capital assets or to the

government for providing collective goods. In this way, the retired population derives a claim on the output of the economy, either by sharing in the income appropriated by the capital owners or by sharing in the taxes levied by the government to service the debt. This income finances consumption after retirement.

Alternatively, working children can share their claim on the output of the economy with their retired parents. In this way, the parents are given the opportunity to satisfy their consumption needs after retirement. In the extended family, the children care for their parents in the hope of being cared for by their children in old age. On a broader scale, in a formal pension plan part of the wages earned by the working population are transferred to the retired population. In this way, the retired generation obtains a claim on the output of the economy even when they are no longer involved in the production process.

Like private saving, old-age pension plans therefore smooth consumption over the life cycle. However, the transfer of purchasing power in a pension plan is conditional on the survival after retirement. Formal pension plans covering large populations redistribute income from the short-lived to the long-lived. In addition to the transfer of purchasing power, formal pension plans offer insurance against longevity. Old-age pensions insure against the risk that the retiree will outlive the amount saved for the provision of retirement income (Bodie, 1990a). In this way, those who have contributed for a pension but die before or live only for a short while after retirement contribute to and increase the retirement income of those who are blessed with a long life. The rate of return for the survivors in a pension plan exceeds the rate of return on saving, the difference being equal to the mortality rate. The reason is that the rights of those who die are transferred to the survivors. Restricting transfers to the survivors is motivated by the fact that only the survivors still have consumption needs. In contrast, the wealth accumulated through saving is bequeathed to the heirs. Due to the stochastic nature of the length of life, the bequest at the time of death has a random component. Using the techniques of insurance, formal pension plans can control for this random component. The exchanges between the young and the old generation are therefore better defined in the formal pension plans than in the extended family.

2. The Capital-Reserve System and the Pay-As-You-Go-System

Formal pension plans are organised in two ways. In the funded or the capital-reserve system, the agents save to accumulate a fund which finances an annuity to the survivors. At each point of time, the accumulated fund of a cohort of agents together with the contributions which are still due from the

surviving members of the cohort before retirement, will meet the future pension rights of the survivors in the cohort. In the pay-as-you-go system, the payment of the pensions to the retired population are financed by the contributions of the working population. When the former exceed the latter, the accounts are balanced either by a subsidy of the government financed by taxes or by running down reserves. A pay-as-you-go system can therefore be viewed as a plan of transfer payments from the working population to the retired population. The contributions made while working, provide the agent with a right to receive a pension while retired.

From this description, it is concluded that the distinguishing feature between the capital-reserve system and the pay-as-you-go system is the redistribution of income between generations which takes place in the latter but not in the former (Verbon, 1989; Marchand and Pestieau, 1991). However, this conclusion needs the following qualifications.

First, workers, capital owners and the taxing authorities have competing claims on the output. Depending on the organisation of the pension plan and the definition of the pension rights, the income of the retired population will depend on the solution of this basic conflict. If the pensions are linked to the income of the working population, as in the pay-as-you-go system, the old-age pensioners gain from an increase in the wage bill. But the interests diverge when both parties bargain over the share of the wage bill accruing to the old-age pensioners. If the pensions are linked to the income of the capital owners, as in the capital-reserve system, then the working generation increases its share at the expense of the retired generation.

Second, the transfers between generations in the formal pension plans are complemented by voluntary transfers or bequests. Abstracting from uncertainties, differences in transfer payments between young and old in the pension plans will be offset by changes in the bequests. This neutrality theorem of Barro (1974) is a variant of Ricardian equivalence of government fiscal actions and is based on the life cycle model of savings (Modigliani and Brumberg, 1954). In this model, a consumption profile has the discounted sum of lifetime after-tax income as one of its arguments. Two after-tax income profiles with the same present value result in the same consumption profile. Two pension plans leading to two different profiles of after-tax income but with the same present value do not change consumption. If consumption does not change, investment and the capital formation are not affected by the choice of the pension plan. Barro's neutrality result has been criticised by the fact that it may require negative bequests at the individual level in order to establish the neutrality of public actions. This will be the case when at the collective level the burden to the future generations of servicing the public debt is low.

3. Equivalence of Pension Systems Under Certainty

In the comparison of formal pension plans, consider an environment without uncertainty apart from the risk of longevity. In the capital-reserve system, the contributions to a pension plan grow with the interest rate which is linked to the marginal productivity of capital. Samuelson (1958) and Aaron (1966) have shown that the contributions to the pay-as-you-go system also earn a return which is composed of the growth rate of the population (Samuelson's 'biological' rate of interest) and the growth rate of wages.

Equivalence on the Golden Rule Path
Assume that in the capital-reserve system, the age profile of contributions and benefits of any two succeeding generations are obtained from each other by a parallel vertical shift reflecting the growth rate of wages. It then follows that in the steady state the two systems are equivalent if the interest rate is equal to the sum of population and wage growth rates. This can be established as follows. In the capital-reserve system, the capital which has been accumulated during the working life is equal to the discounted future liability of the pension fund at the date of retirement. Consider a pay-as-you-go system in which contributions and benefits of each individual are equal to those of the capital-reserve system. Compare in the pay-as-you-go system the own contributions of the retiring generation when they started working and the current contributions of the youngest generation. The contributions of the youngest generation have increased at a rate equal to the sum of the growth rate of the population and the growth rate of wages for a period equal to the length of the working life. By assumption, this sum is equal to the rate of interest. It follows that the current contribution of the youngest generation in the pay-as-you-go system is equal to the capitalized value of the contributions of the retiring generation as young workers in the capital-reserve system. By shortening the period for which they were contributing each time by one year, the same holds for each of the older working generations. Similarly, for each of the retired generations, the total transfer payments in the pay-as-you-go system are equal to the present value of the future transfer payments of the pension funds when the current retiring generation will be of the same age. In the pay-as-you-go-system, the older retired generations are less numerous and have a lower pension reflecting the lower wage earned in their working life. By assumption, the sum of these effects is matched by the effect of discounting the future liability of the pension fund in the capital-reserve system. Since at the retirement date, the capitalised contributions are equal to the present value of the liabilities in the capital-reserve system, it follows that the pay-as-you-go system which mimics the capital-reserve system breaks even.

If the interest rate is equal to the growth rate, the economy is at the golden rule. At the golden rule the consumption per head is maximised. The consumption per head is obtained as the difference between the production per head and the investment per head needed to keep the capital-labour ratio constant. The labour force is measured in efficiency units. Consumption per head is then a function of the capital-labour ratio. There is over-accumulation if the capital-labour ratio in the steady state is larger than the ratio in the golden rule. The golden rule is Pareto superior to any steady state with over-accumulation. This is established as follows. Let the capital stock fall by delaying investment until the capital-labour ratio has fallen to the one in the golden rule. Without investment, the consumption of the generations living in the transition can be increased. In the new steady state satisfying the golden rule, the consumption is larger than in the steady state with over-accumulation. The government debt is adjusted to obtain equality between private financial wealth and the sum of the government debt and the value of the capital stock.

There is under-accumulation if the capital-labour ratio in the steady state is smaller than the ratio in the golden rule. In this case, one cannot increase the capital-labour ratio without decreasing the consumption of the generations living in the transition. The steady state with under-accumulation is therefore Pareto efficient.

Equivalence off the Golden Rule Path
Restricting the analysis to Pareto-efficient situations, we conclude that the rate of return on saving in the capital-reserve system is at least as large as the one in the pay-as-you-go system. By and large, the interest rate has always exceeded the growth rate of the economy. From Aaron (1966) to Feldstein (1976), economists as well as politicians have concluded that for that reason the capital-reserve system is more efficient than the pay-as-you-go system.
In this comparison, it is implicitly assumed that government debt is the same in the two systems. In an economy with lump-sum taxation, the equivalence of the two systems is re-established when in the pay-as-you-go system the government debt is reduced by an appropriate amount (Bewley, 1981; Myles, 1995). The argument is based on the life-cycle model stating that the consumption profile is unaffected by a change in the after-tax income profile which does not change its present value. When compared to the capital-reserve system, the pay-as-you-go system has higher taxes before retirement but lower taxes after retirement. If the interest rate exceeds the growth rate of the economy, the two systems yield the same consumption profile for an average tax rate which is larger in the capital-reserve system than in the pay-as-you-go system. The tax rate is increased in the

capital-reserve system by increasing the taxes needed to service a larger government debt.

The same conclusion is obtained when it is assumed that the pay-as-you-go system mimics the capital-reserve system. If the interest rate exceeds the growth rate of the economy, it follows from the previous discussion that per retiring agent the contributions of the working generations in the pay-as-you-go system fall short of his or her accumulated savings in the capital-reserve system. The transfer payments to the retired generations in the pay-as-you-go system exceed the present value of the future liability to a retiring agent in the capital-reserve system. From the equality of the accumulated savings and the present value of future liabilities at the retirement date in the capital-reserve system, it follows that the pay-as-you-go system runs a deficit. When the government subsidy needed to restore the balance is equal to the tax saving from a lower government debt, the two systems are equivalent.

The conversion of a pay-as-you-go system to a capital-reserve system shows that, *ceteris paribus*, the government debt must be larger in the latter than in the former (Townley, 1981; Breyer, 1989; Verbon, 1989). In the transition period, the retired generations receive pension payments equivalent to those they would have received for the fraction of their working life that they contributed under the old system. No generation is therefore sacrificed. The gap needed to compensate these generations is closed by an increase in government debt which is taken up by the pension funds. But then, after the transition period, no generation will benefit from the higher rate of return of the capital-reserve system. The government subsidy which was needed under the pay-as-you-go system is replaced by an increase in the average tax rate to service the larger debt.

Although a consensus on the issue of the performance of pension systems has not been reached, we conclude that investment needed to raise the capital stock in a state of under-accumulation can be achieved only by reducing aggregate consumption at the outset. Consider an environment without uncertainty and without distortionary taxation. For a given rate of interest, the utility-maximising consumption profile is chosen within the intertemporal budget of each generation. An increase in the capital stock requires a higher investment rate and, therefore, an adjustment in the consumption profile. An adjustment of an optimal consumption profile is possible only by decreasing the lifetime utility. It then follows that increasing the capital stock is impossible unless at least one generation is made worse off.

From this conclusion it does not follow that the different definition of the rights of pensioners in the capital-reserve system and in the pay-as-you-go system is unimportant. The definition of the rights in each of the systems

and in their variants determines the risk borne by the retirees and the risk sharing between the agents in the economy. In addition, the allocation of pension rights provide different incentives to contribute to a pension system affecting both the level of contributions and the choice of the retirement age. Finally, market imperfections in the form of asymmetric information on survival risks, transaction costs, myopia and free riding must be taken into account.

4. Pension as Retirement Income Insurance

Through contributions during the working years, pension plans are designed to protect an economic agent against economic insecurity in retirement. In addition to the longevity risk, the following major sources of retirement income risk can be distinguished (Bodie, 1990a; Disney, 1996).

First, the replacement rate inadequacy reflects the risk that the retiree is unable to maintain the same standard of living after retiring as during the pre-retirement years. Consumption is smoothed by linking the pension to some measure of final earnings and the years of service. Occupational pensions of the 'defined benefit' form and pensions of civil servants belong to this type. In contrast, personal pensions of the 'defined contribution' form depend on the total contributions and investment earnings of the accumulation in the account of the employee.

Capital market uncertainty reflects the risk that the retirement income will be inadequate because of poor performance of the capital market. Inflation risk affects the purchasing power of retirement savings. Pay-as-you-go systems are insulated from these two previous sources of risk, since the pension benefits are related to the contributions of the wage earners. Wage income fluctuates less than rental incomes and wages are adjusted to inflation.

Finally, by the time the retirement age is reached, the individual risks that either the social insurance provisions in the pay-as-you-go system or the tax status of the pensions in the capital-reserve system have been changed.

In defining the rights of the retiree in an optimal pension plan, the reduction of economic insecurity in one direction will imply greater economic insecurity in another direction. The reason is that aggregate production varies from year to year so that the uncertainty on the production side must somehow be reflected on the consumption side. If none of the pension plans dominates the others, agents may participate in pension plans of different types and, in addition, accumulate private wealth for retirement. In particular, human capital and housing property are a hedge against inflation risk (Feldstein, 1983; Summers, 1983). The choice between the various pension instruments and private saving can be described using the

theory of portfolio selection (Augier, Chaveau and Loupias, 1995). The retirement income in the capital-reserve system depends on the stochastic rate of return of investments in physical capital and the tax status of pension plans. For the retirement income in the pay-as-you-go system, the stochastic rate of return depends on the wage growth, on the population growth and on changing social security provisions. The choice of the mix depends on the expected return and the systematic risk of each alternative. A pension plan with a greater exposure to economic insecurity will compensate the participant with a larger rate of return.

5. Optimal Risk Sharing

The final appraisal of the efficiency of a mix of pension instruments should depend on its potential to eliminate idiosyncratic risks at the individual level (Borch, 1962; Fisher, 1983; Townsend, 1994). Optimal risk sharing is achieved when changing consumption levels of individuals living at the same time can be explained by changes in their aggregate endowment. Other peculiarities, in particular whether an individual is retired or not, should have no further explaining power. As a result, the individual consumption levels should move together with the aggregate endowment. Otherwise, a reallocation of endowments is welfare improving. Consider an individual or a small group of individuals with a high income when the income of others is low in a bad state and with a low income when the income of others is high in a good state. Then this group should give to the others in the bad state in return for a gift in the good state. When chosen appropriately, such a reallocation which gives to everybody an income which is lower in the bad state than in the good state is welfare improving for risk averse agents. Everybody's income as a donor exceeds his or her income as a beneficiary in the reallocation of the endowments. The marginal cost of giving is therefore less than the marginal gain of receiving.

From the perspective of optimal risk sharing, the income received by the old age pensioners and the income of the working population should move together. For this reason, Musgrave (1981) proposed a pension plan which determines old-age pensions as a fixed proportion of labour income per worker. Assume that workers transfer a fixed proportion of their income to old-age pensioners, that the ratio of old-age pensioners to workers is constant over time and that the share of labour income in total income is fixed. This definition of pension rights in a pay-as-you-go system is well suited to achieve optimal risk sharing when the growth rate of income is uncertain.

Note that in a capital-reserve system, capital market risk and inflation risk could be eliminated by the government issuing bonds with a risk-free real rate of return. But from the perspective of optimal risk sharing, insulating the retired population from economic insecurity by shifting aggregate risk completely to the working population is inappropriate. Instead, Merton (1983a) proposed the issuing of bonds with a rate of return linked to the growth rate of per capita consumption. If wages and consumption are perfectly correlated, the proposals of Musgrave and Merton are equivalent.

By the equality of the accumulated savings and the present value of future liabilities within each cohort at the time of retirement, the capital-reserve system excludes intergenerational transfers. In contrast, intergenerational transfers required by optimal risk sharing can take place in a pay-as-you-go system operating under a softer budget constraint. It is not guaranteed that the opportunities of a softer budget constraint will be used to improve intergenerational risk sharing. The government may yield to the demands of pressure groups which oppose the welfare improving adjustments. But the risk of government failure in the process of intergenerational risk sharing does not imply that the Pareto inefficient status quo without intergenerational transfers is the best choice.

The previous argument in favour of the pay-as-you-go system takes the tax status of pension plans as given. However, the tax status of pension plans has redistributive consequences. By choosing an appropriate tax status and by adjusting taxation to the state of the economy, a capital-reserve system may improve intergenerational risk sharing as well.

6. Limits to Insurance

Moral Hazard
The link between the benefits of the retiree and the contributions in the working period affects the willingness to contribute in a pension scheme. The high fertility rates in the informal pension schemes is an example. A mandatory pay-as-you-go system which offers a basic (flat rate) pension financed by a payroll tax implies a distortionary tax affecting the choice of the labour input. With distortionary taxes, the pay-as-you-go system and the capital-reserve system may no longer be equivalent (Breyer, 1989; Homberg, 1990; Breyer and Straub, 1993). This conclusion depends on the level of government debt in each of the systems and on the distortionary effects of taxes needed to service the debt. In addition, if one wants to guarantee a minimum income to the retired belonging to the lower income classes for redistributive purposes, then these transfer payments have to be financed by distortionary taxes. Finally, the rights of the pensioners can be defined

proportionally to the contributions and to the years of service in the pay-as-you-go system as well as in the capital-reserve system.

Linking retirement income to the years of service raises problems in the case of early retirement. The optimal retirement date will vary both with the disutility of working and with the worker's productivity at an older age. Since the latter depends on a variety of random factors, from an insurance point of view it is desirable to adjust the retirement date accordingly without changing retirement income. But since the factors determining the retirement date cannot be measured in an objective way, early retirement demanded by the worker or induced by the employer will result in abuses. In the second best, the retirement income should therefore depend on the years of service (Diamond and Mirrlees, 1986).

Adverse Selection

Like any insurance contract, pension plans face the problem of adverse selection arising from the asymmetric information about the survival probability. Individuals who privately know that their survival probability is below average may prefer to save in assets instead of life insurance. For them, the rate of return on life insurance is lower since the terms of life insurance policies are based on the average survival probability of the particular group to which the insurance policy is sold. Since the individuals with a lower survival probability do not buy life insurance, the cost to the others increases. The unattractive annuity rates prevent the full development of a market for annuities. Adverse selection can be circumvented by compulsory schemes, in which good and bad risks are pooled (Eckstein, Eichenbaum and Peled, 1985). Employer pension plans and publicly organized pension plans are examples.

7. The Arguments for Publicly Organised Pension Plans

The arguments for state intervention in the provision of retirement income are income redistribution, market failures, paternalism and efficiency (Diamond, 1977). Pay-as-you-go systems, unlike capital-reserve systems, usually need the authority of a government. In comparing the relative performance of each system, the need for government intervention on the grounds of these arguments have already been dealt with. We add some comments.

In the absence of mandatory social insurance, the lower income classes may not have an incentive to save for retirement income. Welfare assistance cares for people without income. People with a low income during their working life have therefore little to lose when they do not save for retirement income. Unless they accept a dramatic cut in their consumption as workers,

they will be unable to increase their retirement income by retirement savings above the lost welfare benefit. This free-rider problem is resolved by a mandatory scheme. A redistributive public pension plan will reduce the cost to the low incomes and their willingness to participate in the labour market.

In addition, people may be myopic and not save enough for retirement. Information on how much to save and where to invest the savings is costly to obtain. People may therefore accept the coercion of a mandated plan which provides the necessary discipline and offers a reasonable and trustworthy solution to an intricate problem. Adverse selection already requires pooling and does not leave much choice in tailoring a retirement policy to individual preferences. Many do not know or are unsure about their true preferences. The operating expenses of a public scheme are much lower than those of the life insurance industry with large selling costs. All these are additional arguments in favour of government intervention in the provision of retirement income.

8. The Demographic Problem

Demographic ageing threatens the financial viability of pay-as-you-go systems. The creation of social security schemes operating on a pay-as-you-go basis in most European countries after the Second World War forced young generations to make transfers to aged generations with the promise of being refunded when their own retirement would come. This operation was easy in an environment of demographic and economic growth. The transfer from the young to the aged population is painful in the current setting with demographic ageing (Marchand and Pestiau, 1991).

In order to bring the problem of demographic ageing in the right perspective, it is important to distinguish between the higher lifetime expectancy and the fall in fertility rates. Starting from the capital-reserve system, an increase in the survival probability after retirement requires higher contributions to provide adequate income after retirement for the same retirement age. The same carries over to the pay-as-you-go system. Without changing the contribution rate of the working generations, either the replacement rate must be reduced or the average retirement date has to be increased. The main causes of the falling activity rates of the aged are early retirement and the rise of unemployment among the aged. Changing early retirement incentives by penalising the retired who voluntarily quit the labour force or the firm which induces involuntary unemployment may be needed. But consumption smoothing and risk sharing requires adjustments in all the available instruments to achieve the equilibrium between contributions and liabilities in any pension system.

As explained above, a fall in population growth will increase the deficit of the pay-as-you-go system which adjusts its contribution and replacement rates to those of a capital-reserve system operating in the same environment. Without corrective measures, this will increase the public debt in the pay-as-you-go-system. The fall in the labour force is due to the declining birth rate which run at high levels from 1946 to the mid 1960s. The fertility rate fell partly because of an increased female participation in the labour force. Since demographic changes are gradual and to some extent predictable many years in advance, it possible to plan ahead by smoothing the contribution rates and by building up reserves in the pay-as-you-go system (Hagemann and Nicoletti, 1989; Marchand and Pestieau, 1991). Transfer payments between countries experiencing differently paced demographic shocks or early repayment of the public debt in countries with large public debt are examples. But note that such measures can be taken in combination with alternative measures affecting the activity rates of the aged and the young in the population and the migration rates. In addition, a fall in the labour force will lower the costs of education of children unless fewer children are provided with more human capital.

From the equality of the accumulated contributions and future liabilities of each retiring cohort, it is often claimed that a capital-reserve system offers better protection against demographic changes. But irrespective of the pension system, the dissaving of a large retiring generation exceeds the saving of the smaller succeeding generation. In the transition, the desired consumption claims may be satisfied only if the output is adjusted by changing the capital-labour ratio after an adjustment of the government debt. Otherwise, the income distribution problem between generations may cause inflation eroding the purchasing power of retirement income.

9. Concluding Remarks

The basic conflict between the working generations and the retired generations in the division of output cannot be resolved in an easy way. The mode of financing retirement income will affect the outcome of this basic conflict. But, in evaluating the relative merits of each system, compensating effects should be taken into account. As has been shown, two variants of providing retirement income may yield the same outcome or may yield allocations differing only in their second order effects. Any reform of an existing pension scheme should therefore be modest in the setting of its goals. It should not disappoint people by promises which it cannot deliver because of unforeseen compensating effects. As a consequence, any reform should be gradual as well. Although the outcome may not differ very much

in the long run after agents have adjusted their behaviour, the outcome may imply dramatic changes for the generations living in the transition to the new equilibrium as they are unable to adjust their behaviour.

Capital-reserve systems are superior to pay-as-you-go systems in the definition of the future rights of the retired population. Although income security after retirement is desired by each individual, it is not optimal from the risk-sharing point of view to insulate one group of the population from the collective risks which have to be borne by the society as a whole and which have to be shared between generations. Pay-as-you-go systems are well suited to redistribute the burden of major shocks among the working generations and the retried generations. But reforms fixing the individual rights of the retired population conditional on the state of the economy and the record of individual contributions are desirable. Alternatively, adapting the tax status of funded pension plans to the state of the economy in a well-defined way could improve the risk-sharing properties of the capital-reserve system.

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