ON LONGEVITY AND
PENSION PLAN FINANCE

Jan B. Kuné

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ABP Pension Scheme; P.O. Box 4874, 6401 JP Heerlen, Netherlands
Phone 00.31.45-5792005; Fax 00.31.45.5797017, E. jan.kune@abp.nl
University of Amsterdam, Department of Economics, Roetersstaat 11, 1018 WB Amsterdam, Netherlands
Phone 00.31.20.5255020; ~~E. j.b.kune@uva.nl~~

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Abstract

The present paper is composed of two parts. The first part deals with the algebra of pension plan finance. It is shown that the finances of a pension scheme are very sensitive to the economic assumptions made, like investment returns and inflation. They are far more sensitive to economic conditions than to actuarial conditions like mortality rates and other decrement rates.
The second part deals with some basic characteristics of both pension finance systems pay-as-you-go and capital reserve. The major question mostly asked is whether funding does matter and if so, which conditions have to be fulfilled. Funding generally does not transfer the pension burden over time, opposed to frequent usual thinking. Apart from stimulating national savings and investments the major advantage of funding is that it provides the best way of securing pension liabilities and an adequate mechanism for solving the distributional problem of national product between the retired and non-retired by the ownership of (part of) the capital stock.

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WHAT EXECUTIVES SHOULD KNOW ABOUT LONGEVITY WITH RESPECT TO PENSION PLAN FINANCE

In determining the costs of a funded pension plan, apart from the problem of the appropriate valuation of the assets – a question of major interest but not pursued in this paper –, various assumptions have to be made about a range of factors in respect of the future economic and demographic environment affecting the growth (or decline) of the plan's liabilities. Particularly the pensions that will be payable to the participants at retirement age are to be assessed. They depend e.g. on the age and gender distribution of participants at date, their present earnings, the number of working years, the number of pension years (*longevity*) and the expected increase in earnings level, the latter being of utmost relevance when the benefit level is a function of income close to retirement date. A forecast of future earnings includes (1) wage increases due to merit and productivity gains and (2) the rate of general price/wage inflation. Furthermore, in an inflationary environment the benefits to retirees probably will at least in part be compensated for loss of their purchasing power.

Another most critical factor in establishing the liabilities and costs of a pension plan are the investment returns including the change of the assets' value itself.

Decrement rates in respect of mortality, disability, unemployment and withdrawal (turn-over), nuptiality rates, change in age and gender distribution and the outlays for administration are also of relevance for pension plan costs. They can be considered as the 'purely' actuarial assumptions, as opposed to the economic assumptions about rate of earnings growth and rate of return on capital.

Finally, the interest rate used for discounting future benefits is a factor of predominant relevance. In most countries usually a discount rate somewhat below the long-term bond yield is employed.

It should be emphasized that no actuary believes (like anybody else) that future capital return, earnings growth, price inflation, disability and withdrawal can be predicted with much confidence. Therefore, any kind of projections should generally be made with much caution.

In paragraph 1 a simplified model how a funded system of finance works is introduced and is compared with pay-as-you-go based pension finance. In the second paragraph economic aspects of pension plan financing are discussed.

1. The algebra of pension plan finance

Two main types of pension finance systems exist, capital reserve or funding and the pay-as-you-go system. The mathematics of both is pointed out and compared.

1.1 FUNDING

In the case of a funded scheme employees pay part of their (labour) income into a fund of financial assets from which eventually the pensions are paid out. Cohorts or groups of individual participants break even over their life cycle or, in other words, funded pension schemes are designed to be actuarially fair. They are intended to be non-redistributive (DC-plans) or redistributive for a defined group only (DB-plans). The retirement pensions are paid out of current capital income, originating from investment revenues and by selling assets – more accurately, the physical or real capital goods as productive capacity hidden behind these assets – to the younger generations. A funded system relies more on the development of the international capital market as opposed to the dependency of a pay-as-you-go based system on the domestic labour market.

To analyse the sensitivity of actuarial calculations to the choice of the real rate of return and the lengths of the contribution paying period and of the retirement period a simplified model of a pension plan is used.
An 'average' or representative participant to the plan is taken into account. At age *a* he enters the plan and after *T* working years, during which contributions are paid, he retires when e.g. 65 years old. Finally he dies when *65+p* years of age. Earnings at age *a*, denoted by S_a, are expected to grow at a constant exponential rate *g* with no merit increases. Income at retirement age, hence, is given by $S_{65} = S_a.e^{g.T}$. Contributions are accumulated in a pension fund, which earns investment income at a constant rate *r*. Future income is discounted at the same rate. On retirement age a pension equal to *α* percent of last pre-retirement income becomes payable. Pension benefits are indexed to prices (*w*). The parameter *α* primarily depends on the yearly accrual rate and the length of service time.
The problem is to find the contribution rate *Pr*, which will finance such a scheme.

Premium calculation (1.1.1)

Define S_{65} to be the last preretirement income of an average participant to the scheme, S_a the income of a worker joining the scheme and *α* the pension outcome as a percentage of final income.
At any time the actuarial liability (required capital) in respect of the representative retired participant, 65+t years of age, amounts to K_{65+t} (0≤t≤p),

Now,

$$\frac{dK_{65+t}}{dt} = K_{65+t} \cdot r \; - \; \alpha S_{65} e^{wt} \qquad (1)$$

The solution of this first order differential equation is,

$$K_{65+t} = C \cdot e^{rt} - e^{rt} \cdot \int \alpha \cdot S_{65} e^{wt} \cdot e^{-rt} \, dt \tag{2}$$

The constant C follows from $K_{65+p} = 0$

Hence, the required capital at age 65+t amounts to,

$$K_{65+t} = C \cdot e^{rt} - \frac{\alpha S_{65} \cdot e^{wt}}{w - r} \tag{3}$$

Now it follows,

$$K_{65} = \frac{\alpha S_{65}}{w-r} \left\{ e^{(w-r)p} - 1 \right\} \tag{4}$$

Accumulation of capital, K_t after t years of contribution payment results in,

$$K_t = \int_0^t Pr \cdot S_a \cdot e^{gu} \cdot e^{r(t-u)} du = \frac{Pr \cdot S_a \cdot e^{rt}}{g-r} \left\{ e^{(g-r)t} - 1 \right\} \tag{5}$$

Note that $S_{65} = S_a \cdot e^{gT}$

Hence,

$$K_T = \frac{Pr \cdot S_{65}}{g-r} \left(1 - e^{(r-g)T} \right) \tag{6}$$

Equating both expressions (4) and (6) gives as a result the funding contribution rate,

$$Pr^{funding} = Pr = \alpha \cdot \left(\frac{g-r}{w-r} \right) \cdot \frac{e^{(w-r)p} - 1}{1 - e^{(r-g)T}} \tag{7}$$

This is a very useful and interesting expression, enabling us to find out rather easily the basic relationships between contribution rate, rate of interest, rate of wage increase, indexation rate, pension result, length of retirement period and length of contribution paying period.

The effect of variations in the length of the retirement period and the real rate of interest (1.1.2)

To comment on the sensitivity of actuarial premium calculations to the choice of the real interest rate (*r*-*g*) and the length of the retirement period (*p*), expression (7) will be used to compute $Pr^{funding}$ for various values of (r-g) and p. Results are given in Table 1. Table 1 is divided into five sections with length of the retirement period of 10, 13, 15, 20 and 30 years respectively. The retirement age varies from 60 years to 72 years and the real interest rate deviates from a very low minus1 percent to a comfortable 6 percent. The pension result is always 70 percent of final income.

Table 1. The effect of variations in the length of retirement period and the real rate of interest on the contribution rate under funding (standard male participant, varying age of retirement)

age of retirement	length of retirement period (years; p)	real interest rate: (r-g)	-1%	0%	1%	2%	4%	6%
			contribution rate $Pr^{funding}$ (%)					
60	***10***		24.9	20.0	15.9	12.5	7.6	4.4
65			22.3	17.5	13.5	10.4	5.8	3.2
70			20.3	15.6	11.7	8.7	4.6	2.3
62	***13***		31.4	24.6	19.1	14.6	8.4	4.6
67			28.3	21.7	16.3	12.2	6.5	3.3
72			25.9	19.4	14.2	10.3	5.1	2.4
60	***15***		38.4	30.0	23.3	17.9	10.3	5.8
65	('current situation')		34.4	26.3	19.8	14.8	8.0	4.1
70			31.3	23.3	17.2	12.4	6.3	3.0
60	***20***		52.5	40.0	30.3	22.8	12.6	6.8
65			47.0	35.0	25.8	18.8	9.8	4.9
70			42.8	31.1	22.3	15.8	7.6	3.5
60	***30***		82.9	60.0	43.3	31.2	16.0	8.2
65			74.8	52.5	36.9	25.8	12.4	5.8
70			67.6	46.7	31.9	21.6	9.7	4.2

Note: assuming a pension result of 70 percent of final income, full indexation (*w=g)* and entry age 25 years

For simplicity's sake the rate of wage increase is assumed to be equal to the indexation rate of current pensions (w=g). From the table we observe that – given a retirement age of 65 years, a life expectancy of 80 years, hence a retirement period of 15 years, reflecting the current situation in most countries – a rate of return on capital 2 percentage points higher than the rate of growth of wages, thus (r-g) = 2, gives rise to a required contribution rate of 14.8 percent. When the difference is 1 percent the contribution rate increases to 19.8 percent. When the difference is zero, the contribution rate will be about 26.3 percent and so forth.
Other variants are obtained by considering different rates of income increase and indexation rate of current pension payments and different lengths of the contribution paying period.

It appears that a real rate of return only one percentage point different from the one assumed (whatever that might be), has considerable consequences for the resulting contribution level. Note that – starting from a retirement age of 65 and a real rate of return of one percent – a tremendous extension of life expectancy by five years (from 15 to 20 years of length of retirement period) increases the contribution level from 19.8 percent to about 25.8 percent, slightly less than the impact one percentage point underestimate of the real interest rate has on the premium level. The premium level rises from 19.8 percent to 26.3 percent. A two percentage point underestimate is equivalent to almost a doubling of the retirement period: 34.4 percent vis-à-vis 36.9 percent.

Or, in other words, it appears that contribution levels under funding are much more sensitive to capital returns than to longevity or the length of the retirement period.

Clearly with high retirement age (about 70 years) combined with short periods of retirement (about 10 years) contribution rates – even with minor real interest rates – are quite affordable. Otherwise, a low retirement age (about 60 years) together with long periods of retirement (20 to 30 years) – given a minor real interest rate equal to or less than 2 percent – gives rise to unsustainable contribution rates of 30 to 40 percent of income or more. With high real capital returns (4 percent or more) even the aggregate of low retirement age and long pension period are far from problematic at least from a pension finance point of view.

Indexation of current pensions (1.1.3)

In paragraph 1.1.2 it is assumed that current pensions are fully indexed. Indexation is not provided without considerable costs being incurred. Now indexation is released. Table 2 is composed of three parts with real interest rate of 1, 2 and 4 percent respectively. The length of the retirement period (*p*), differs from 10 years to 30 years.

Holding the real rate of interest (r-g) at the level of the given 1, 2 and 4 percent respectively, Table 2 shows the values of the contribution rate necessary to finance non-indexed pensions from the age of 65 onwards for various combinations of r and g and length of retirement period.

Table 2. The effect of variations in the length of retirement period and the real rate of interest on the contribution rate under funding (standard male participant, retirement age 65 years)

length of retirement period (years; p)	real interest rate (r-g)	contribution rate $Pr^{funding}$ (%) with and without indexation				
		fully indexed (w=g)	no indexation (w=0)			
	1%		**r=5%, g=4%**	**r=4%, g=3%**	**r=3%, g=2%**	**r=2%, g=1%**
10		13.5	11.2	11.7	12.3	12.9
15		19.8	15.0	16.1	17.2	18.4
20		25.8	18.0	19.6	21.4	23.5
30		36.9	22.1	24.9	28.2	32.1
	2%		**r=6%, g=4%**	**r=5%, g=3%**	**r=4%, g=2%**	**r=3%, g=1%**
10		10.4	8.6	9.0	9.4	9.9
15		14.8	11.3	12.1	12.9	13.8
20		18.8	13.3	14.4	15.7	17.2
30		25.8	15.9	17.7	20.0	22.6
	4%		**r=8%, g=4%**	**r=7%, g=3%**	**r=6%, g=2%**	**r=5%, g=1%**
10		5.8	4.9	5.1	5.3	5.6
15		8.0	6.2	6.6	7.0	7.5
20		9.8	7.1	7.6	8.2	9.0
30		12.4	8.1	8.9	9.9	11.0

Note: assuming 40 years of contribution paying from 25 to 65 years of age and a pension result of 70 percent of final income

It appears that in all three main scenarios – with given values for (r-g) of 1, 2 and 4 percent respectively –, when the rate of earnings growth is higher, the more the contribution rates can be decreased if current pensions are not indexed. In the first scenario (1 percent real interest rate and 15 years spent in retirement) the contribution rate falls from 19.8 percent (full indexed pension) to values between 18.4 percent and 15.0 percent respectively for a non-indexed pension, if earnings increase rises from 1 percent to 4 percent.

When the retirement period doubles to 30 years the contribution rate in the same way decreases from 36.9 percent to values between 32.1 percent and 22.1 percent, which results likely can be considered as unsustainable. On the other hand, with higher levels of the real rate of interest (up to 4 percent) contribution rates are becoming more and more affordable irrespective the length of the retirement period.

Further simplification (1.1.4)

When the interest rate is equal to the rate wage increase, which also equals the indexation rate (*r=g=w*), somewhat simpler expressions for the actuarial liability (required capital) and the accumulated capital at the age of retirement are obtained. Analogously we find,

Required capital:

$$K_{65+t} = C \cdot e^{rt} - e^{rt} \cdot \int \alpha \cdot I_{65}\, dt = C \cdot e^{rt} - e^{rt} \cdot \alpha \cdot I_{65} \cdot t \tag{8}$$

As $K_{65+p} = 0$, it follows that $C = \alpha \cdot I_{65} \cdot p$

Hence,

$$K_{65+t} = \alpha \cdot I_{65} \cdot e^{rt} \cdot (p-t) \tag{9}$$

Accumulated capital:

$$K_t = Pr \cdot I_a \cdot \int_0^t e^{ru} du + C = Pr \cdot I_{65} \cdot e^{-gT} \cdot e^{rt} \cdot t \tag{10}$$

Similarly after T years of contribution payments

$$K_T = Pr \cdot I_{65} \cdot T \tag{11}$$

Equating $K_{65} = K_T$ yields,

$$Pr^{funding} = Pr = \alpha \cdot p / T \tag{12}$$

where α is the replacement rate, the number of retirement years is p and the length of the working period is T years.

1.2 PAY-AS-YOU-GO FINANCING

Under a pay-as-you-go system pensions are paid out from contribution payments (predominantly out of domestic labour income) only. Instead of the life-cycle reallocation of a cohort's aggregated income there is a cross-sectional income redistribution from workers to pensioners on the basis of an implicit social contract: each generation finances the pension income of the previous generation on the understanding that its own pension income will be financed by the next generation, with the inherent risk that future generations can break, at least in part, the contract. Pay-as-you-go systems can bring about systematic income redistribution or, in other words, individual people generally will not break even over their life cycle. Pay-as-you-go based pension plans are normally implemented through the state's power to levy contributions.

To find the pay-as-you-go contribution level we equate the amount of required pension payments to the

amount of contributions to be paid in period [t, t+1].
Define $\overline{S}^{ave}_{65.plus}$ to be the average income in the last preretirement year of all pensioners, $\overline{S}^{ave}_{w}$ the corresponding average income of all workers and $\overline{S}^{ave}_{w,t}$ average workers' income in year t. By L^p_t we denote the number of pensioners which is growing at rate *κ* and L^a_t is the number of workers with growth rate *λ*.

Total amount of pension payments on t,

$$L^p_t \cdot \alpha \cdot \frac{\overline{S}^{ave}_{65.plus}}{\overline{S}^{ave}_{w}} \cdot \overline{S}^{ave}_{w,t} \;; \qquad L^p_t = L^p_0 \cdot e^{\kappa t} \qquad (g = w) \tag{13}$$

total amount of contributions on t,

$$Pr^{payg}_t \cdot L^a_t \cdot \overline{S}^{ave}_{w,t} \;; \qquad\qquad L^a_t = L^a_0 \cdot e^{\lambda t} \tag{14}$$

Hence, the contribution rate under pay-as-you-go,

$$Pr^{payg}_t = \alpha \cdot \frac{\overline{S}^{ave}_{65.plus}}{\overline{S}^{ave}_{w}} \cdot \frac{L^p_0}{L^a_0} \cdot e^{(\kappa - \lambda)t} \tag{15}$$

Assuming $\frac{\overline{S}^{ave}_{65}}{\overline{S}^{ave}_{w}} = 1$ and a stable demography – both the working population and the retired population grow at rate n – it can be shown that,

$$\frac{L^p_t}{L^a_t} = \frac{\int_0^p e^{nt}dt}{\int_p^{p+T} e^{nt}dt} = \frac{e^{np}-1}{e^{np}(e^{nT}-1)} \tag{16}$$

Hence,

$$Pr^{payg} = \alpha \cdot 1 \cdot \frac{e^{np}-1}{e^{np}\cdot(e^{nT}-1)} \quad ; \qquad \text{n} \neq 0 \tag{17}$$

If population growth is zero (n = 0), then

$$Pr^{payg} = \alpha \cdot p/T \tag{18}$$

Note that in this stationary demography (zero growth) the contribution rate under pay-as-you-go (18) equals the contribution rate under funding (12). Furthermore it can be shown that in a stable demography (non-zero growth) the contribution rates under funding and pay-as-you-go are identical if *r*+*n* = *g*, reflecting the well-known Aaron-condition.
It should be observed that the Aaron-condition holds from the view of the individual participant to the scheme, but not necessarily so from a macro point of view. This question is pursued in J.B. Kuné [2000].

The effect of variations in the length of the retirement period, the length of the working period and the growth rate of population (1.2.1)

To comment on the sensitivity of pay-as-you-go premium calculations to the choice of the length of the contribution paying period (T) and of the retirement period (p) and the growth rate of population (n), expression (17) will be used to compute Pr^{payg} for various values of T, p and n. Note that under a pay-as-you-go scheme an identical linkage exists between the contribution rate and the average change in population growth under equilibrium conditions. The rate of population growth functionally replaces the real rate of return under a funding system. Results are given in Table 3.

Table 3 is also divided into five sections with length of the retirement period of 10, 13, 15, 20 and 30 years respectively. The retirement age varies again from 60 years to 72 years and the growth rate of population differs from –1 percent to 2 percent.

Table 3. The effect of variations in the length of retirement period, the length of the working period and the growth rate of population on the contribution rate under payg (standard male participant)

age of retirement	length of retirement period (years; p)	contribution rate Pr^{payg} (%)			
	growth rate population:	**2%**	**1%**	**0%**	**-1%**
60	***10***	12.5	15.9	20.0	24.9
65		10.4	13.5	17.5	22.3
70		8.7	11.7	15.5	20.3
62	***13***	14.6	19.1	24.6	31.4
67		12.2	16.3	21.7	28.3
72		10.3	14.2	19.4	25.9
60	***15***	17.9	23.3	30.0	38.4
65	('current situation')	14.8	19.8	26.3	34.4
70		12.4	17.2	23.3	31.3
60	***20***	22.8	30.3	40.0	52.5
65		18.8	25.8	35.0	47.0
70		15.8	22.3	31.1	42.8
60	***30***	31.2	43.3	60.0	82.9
65		25.8	36.9	52.5	74.3
70		21.6	31.9	46.7	67.6

Note: assuming a pension result of 70 percent of final income ($w=g$); entry age 25 years

Changes in population growth alter the ratio of the number of retirees and contribution payers and thereby the required contribution rate. Thus, whenever the growth in population is 1 percent yearly – and together with a retirement age of 65 years a length of the retirement period of 15 years, reflecting the current situation in most countries –, the contribution rate under a pay-as-you-go system is also about 19.8 percent, equal to the contribution rate under funding and a real interest rate of 1 percent (Table 1 and 2). When there is zero population growth, the premium rate is 26.3 percent and when the population growth is minus 1 percent, the pay-as-you-go contribution rate will be 34.4 percent and so forth.

Clearly with a stationary or even shrinking population retiring at young ages combined with long periods of retirement results in very high and allegedly unsustainable levels of pay-as-you-go contributions. Those results can be compared with contribution rates under funding with disastrous capital returns.

Concluding remarks

At a rather simple level the predominance of economic assumptions over the actuarial ones in contribution calculations can be clearly established. The costs of a funded pension scheme appear to be very sensitive to the set of economic assumptions chosen (in particular capital returns), far more sensitive to these than to the actuarial assumptions made (e.g. longevity).

When the real rate of return at any intermediate age of the 'average' participant is to be assessed one percent-point higher than assumed on entry age, the accumulated contributions or accrued benefits at date – in other words: the actuarial or past-service liability – will increase by one percentage point too. Consequently, an additional increase in contribution rate will be necessary, reaching a highest value just before retirement age. An alternative response might be reducing the quality of benefits e.g. by deleting or mitigating the indexation provision or adjusting the pension formula more directly in some manner.

2. The economics of pension plan finance

Any judgement about the sustainability of future pension payments – irrespective of whether they are of the basic type or supplementary type, personal or on a collective basis, funded or pay-as-you go financed –, depends on the productive capacity available in the future to finance all hidden and revealed liabilities in respect of pension obligations and a multitude of other obligations of national interest[1].

The estimates of pay-as-you-go financed pension liabilities do not inform us about a nation's future productive capacity on a macro level. On the other hand they definitely are a useful measure of the adjustments required to ensure that pension schemes remain solvent. Evidently, the pension burden on any society is dependent upon the amount of future payments in respect of all old-age income provisions, but above all on the expected size of the future national product. More accurately, the costs of a pension scheme or the true measure of the *pension burden* for the society as a whole are the resources or benefits forgone, the resources that are no longer available (for consumption of the non-retired and for investment purposes), as they are being used for supporting the elderly. A doubling e.g. in the size of the aged will, ceteris paribus, simply double the burden of support on the national economy. Or, in other words, the larger the ratio of pension rights to GDP, the higher the share of future national product to be committed to pension expenditures.

2.1 REDISTRIBUTION OVER TIME

On a personal or micro level the economic function of setting up a pension scheme is to transfer resources from one's working or younger age period to his old-age years, thereby creating a claim on future national product. Saving or consumption forgone during the working period is balanced by consumption in the retirement period. On a macro level or for a society as a whole this is not possible, '... ruling out the case where current output is stored in holes in people's gardens'. No generation generally can store (for its own retirement purposes) the commodities that it has produced itself[2]. Apart from (durable) infrastructural facilities some consumer goods can be stored and saved for consumption later, examples are durable goods

1) Note that an aging society (opposed to a younger society) generally holds a larger capital stock, hence a higher capital intensity (or capital-labour ratio), a declining capital productivity and a rising labour productivity and higher real wages. Therefore, an enhanced capacity is created to finance old-age pensions. The younger generation acquires the ownership of assets – behind which the physical capital stock hides - from the aged.
In view of an aging society we may distinguish three situations with an absolutely or relatively declining labour force, accompanied by,

a. a reduction in the stock of capital – with constant capital intensity - thereby (in the short term) disengaging resources which can be transferred to the aged. In this case net investments are negative or, in other words, dissavings of the elderly exceed savings of the youngsters. An aging society can indeed 'live on its capital' for some time. The society receives a near-term consumption dividend. As far as the allowable rate of capital stock reduction does not exceed capital depreciation, redundant capital can be disengaged rather easily by diminishing or halting gross investments. On the other hand, when allowable disinvestment exceeds capital depreciation practical problems arise in respect of the (physical) feasibility of consuming part of the existing capital stock. Ultimately capital equipment can be sold abroad, thereby acquiring foreign currency by which consumer goods can be bought;
b. a reduction in net investments but they remain positive – the capital stock and the capital intensity are still increasing - thereby augmenting in the medium term the volume of consumption for the whole population. In this case savings of the younger population still exceeds dissavings of the elderly, but to a diminishing extent;
c. no reduction in net investment, leading to a further increase in the capital intensity of production. Consequently, today less consumption goods can be produced. On the other hand, the higher capital intensity gives rise to a larger labour productivity and a larger future resource base. High flexibility of the economy, viz. a high elasticity of substitution between capital and labour and a high elasticity of savings to the interest rate, makes that a larger part of the capital stock – made redundant as a result of the declining labour force - can be absorbed by an increase in the capital intensity.

2) Storage of durables to some extent and up to certain time horizon can be of relevance and should not be ignored. ICT (information and communication technology) seems to be in an intermediate position.

like housing facilities, transport facilities, clothes, books and some good wines. But many others, particularly services, can not and, hence, must be produced simultaneously with their consumption. Thus, for a society as a whole there can be, ceteris paribus, no redistribution of pension assets and purchasing power over time to a substantial degree. The consumption expenditures of the elderly, today and in the future, always have to be provided for out of current production in the same time period, irrespective of whether the pensions are funded or not. Or, in other words, the goods and services the retirees consume are always part of the current output of the currently present working population equipped with the present capital stock.
From an economic point of view it can be held that the costs in respect of any retirement income system, defined earlier as the resources or benefits foregone, are always equal irrespective the way they are financed. The particular mechanism of pension finance does not violate this basic finding. The pension burden on future generations thus is determined by the pensions to be paid out and not by the way in which they are financed.

Fallacy of composition(2.1.1)

It is often argued that the origin of all future pension problems, if any, is the failure to start and maintain funded pension schemes rather than pension plans that are pay-as-you-go financed. If public and supplementary pension plans had accumulated sufficient assets – so the argument goes – paying future pension expenditures would be less or not a problem at all. This 'solution' however will not change the basic mechanism redistributing production among different groups of population, e.g. the retired and non-retired. Or, in other words, basically the competition over resources raised by the pensions (to be) paid to the elderly is not removed by the transition from pay-as-you-go to funding. Rather, it is switched from old-age pensioners soliciting a share of labour income to claims over the return on the capital stock. The ownership of (part of) the capital stock in our view is of utmost relevance in securing pension entitlements and solving the distributional problem.

On a personal or micro-level – and on a cohort or meso-level as well – funding clearly is the only feasible way to create an old-age pension. During one's working years actuarially fair contributions are paid in order to receive a pension income in the years of retirement, provided from capital revenues and the proceedings from selling pension assets. Such personal savings plans may considerably benefit from tax incentives.
On a macro-level, as a rule pay-as-you-go or any funding principle can be chosen. As observed the way of pension financing does not affect in its essentials the distribution across time of the resources to be transferred to the elderly. The question arises where does this misunderstanding and confusion come from? The tendency to generalize from the individual to the economy is one of the major shortcomings of much of the debate over retirement costs because it often results in what economists call the *fallacy of composition*. It is a fallacy of composition to assume that because something is true for an individual it is (necessarily) true in aggregate. This appears not to be the case. For instance, '... if I stand on my seat in the theatre I will get a better view, but if everybody does so, nobody will get a better view'[3].

3) Cf N. Barr [1998], p. 214

2.2 DOES FUNDING MATTER?

More emphasis on funding is generally recommended to cope with the adverse consequences of population aging in the next century in the western world.

From a welfare point of view the crucial question arises, 'does funding matter?' or, in other words, under which circumstances does funding make a real difference to the performance of the economy? Evidently a major difference between funding and pay-as-you-go is that funding is generally leading to an additional flow of saving during the period of growing up – and under circumstances also in an aging economy with economic growth –, thereby creating a resource base, which enables higher levels of production and consumption for both future workers and retirees[4].

From a theoretical point of view the condition of optimal savings has to be fulfilled. If savings accumulated to provide for an old-age pension income, together with all other sources of saving, would yield over-accumulation, the pay-as-you-go share in pension financing should be increased in order to attain what economists call the 'golden rule'-level. Similarly, if in the steady-state equilibrium stage, the economy would be undercapitalized, public and private pension arrangements should rely more heavily on funding. The test for this latter condition is that the total return to capital exceeds the sum of growth of population and output per worker.

Conditions to be fulfilled (2.2.1)

The idea of stimulating economic growth by building up a larger capital stock by pension saving is based on four major assumptions.

First, additional pension saving increases, at least in part, total national saving, as long as there are no offsetting reactions by households, firms or government. For instance, savings within a public fund may be offset by increased spending in other government programs, leading to dissaving to a certain extent and savings within private complementary schemes might be offset by reduced savings in other forms. If pension savings simply replace other savings, it makes little real difference.

Secondly, the savings will lead to investments that increase the capital formation and the productive capacity of a country. Or, in other words, investments do not fall short of the savings level. But this is not an automatic process; economies do not behave like well-oiled equilibrium machines. If savings fall behind, this can result in increased hoardings and decreased national income levels (the Keynesian model) or in a (larger) surplus on the current account of the balance of payments (the neo-classical model). If pension savings lead to new productive investments – which would not otherwise have occurred – then funding can make a real difference. The second condition unfortunately was not or at best only partially fulfilled in e.g. The Netherlands during the last few decades, where investments fell behind national savings, leading to a large surplus on the current account of the balance of payments. Note that for a small open economy assets abroad can be beneficial[5].

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4) Higher levels of future national product evidently will nor alter the spending on old-age pensions in relative terms, but paying for pensions out of a larger economic 'pie', still leaving higher incomes (a grown 'slice' out of the future bigger economic pie) for the non-retired population in absolute terms, is much more comfortable.

5) A large amount of foreign assets enables a country to maintain the consumption of the population with goods produced abroad. It has to be pointed out that major difficulties will arise on the meso and micro level, as foreign accounts are to a large extent owned by companies and banks and not by individuals or organizations of individuals. Thus, (Dutch) pension funds should invest on a wider scale abroad, e.g. in the newly industrialized economies.

Third, the capital stock is smaller than according to the 'golden rule'-level or, in other words, national savings are below their optimal level and are expected to persist for a long time period ahead. It can be argued that savings nowadays in many countries, if not most, on a macro-level are below their optimal level. There appears to be a structural shortage of capital supply worldwide, particularly in the transitional economies and many developing countries and this shortage may increase further in the coming decades.
Fourth, increased pension saving must be the best way to stimulate productivity. If increasing the national saving rate were a main reason to fund pension plans, there could be found other and maybe even better ways to accomplish this goal[6]. The government, for example could run a surplus on its budget, thereby creating government savings or use various kinds of incentives stimulating private savings. If there is an alternative policy to promote savings and productivity either more efficiently or with less risk, then it might be the preferred policy. Other fiscal policy measures may provide the government with more direct means of stimulating both public and private saving, thereby avoiding increasing public deficits – and possibly also a lower aggregate savings ratio - due to a smaller amount of tax receipts[7].

When the four conditions referred to are fulfilled, the question whether funding matters and could be part of the solution to the problems caused by e.g. adverse demographic developments (and deteriorating ecological conditions) can be answered in the affirmative[8]. A higher degree of funding in financing the national pension system will enhance national welfare. Funding will be preferential to the extent that it causes national product to be higher. It will be clear that the costs of population aging can not be avoided. On the other hand by increasing investments now – the economic costs of it or the benefits forgone are the reduced current consumption expenditures of the present generations – one is anticipating the difficulties that could otherwise (with no-funding) arise in an economy with a lower national product. This favours future generations.

A further expansion of funded occupational supplementary pension plans can be considered as an adequate, but not a unique mechanism to promote savings.
Note however that pension finance systems are not created, at least not in the first place, because of the impact

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6) Pension savings might be unstable in some way or other. In a steady state economy with a stable age distribution of the population and with zero income growth, saving by the working population exactly balances dissaving by the retired. Aggregate net savings are zero, as with a pay-as-you-go based pension system. Thus, at first sight there is no real difference between both pension finance systems. In an equilibrium stage a funded system does not make a (major) contribution to the growth of the capital stock. In an aging population aggregate pension saving will be negative and in a growing population – a period during which pension funds are building up - pension savings are positive. Funding may be preferential and more favourable nevertheless. In the built-up phase to steady state the aggregate saving ratio and capital formation are increased. After several decades the increased dissaving among retirees will approximately offset the amount of savings of the younger population and the aggregate saving ratio will return to its previous lower level. The capital stock however is larger and thereby the production per worker. Or, in other words, the economy has settled to a new steady state with a higher level of income and production.

7) Ideally the contribution level should reflect the liabilities that are being incurred and send the correct and timely signals. This is definitely not a characteristic of the pay-as-you-go system, but such a missing link can be established also without building up a fund. The government can levy higher taxes or contributions thereby reducing borrowing and diminishing the size of public debt. Decreasing interest payments on public debt can compensate future increases in contribution rates of pay-as-you-go pension plans. This principle (of *notional funding*) underlies the financing practice in respect of the basic pension scheme (AOW) in The Netherlands. From a fiscal point of view the policy of reducing the public debt/GNP ratio (in advance of coming demographic pressure) is 'equivalent' to accumulating a fund.

8) Note that on the micro-level decisions in respect of financing pensions are taken with a view to interests of employers and employees only. Pension schemes should be and actually are an instrument for providing old-age pensions, not for increasing the volume of national savings (nor for improving the functioning of financial markets or for being an instrument for labour market policy). Thus, the national concern (achieving the optimal savings level) and participants' interest (providing for adequate old-age pension provisions) do not automatically match; generally speaking they do not. These interests may be reconciled by well-chosen economic and fiscal policy measures, e.g. adequate tax treatment. Countervailing policy measures of the government in respect of savings might be necessary.

they might have on the performance of the national economy. Foremost, they are designed as mechanisms to adequately provide for pension incomes to the elderly. On the other hand, the two purposes do not necessarily exclude each other, they can be compatible.

Apart from the impact funding can have on the size of future productive capacity, pension saving might be particularly preferential to people as more security can be obtained compared with pay-as-you-go. Or, in other words, the major (economic) difference between funding and pay-as-you-go goes beyond the macro-economic issues of savings and investment. In the next paragraph we pay attention to the merits of funding as an adequate and efficient mechanism and device to strengthening the security of old-age income provisions and providing a solution for the distributional problems involved.

2.3 SECURING PENSION CLAIMS

The argument that funding and pay-as-you-go are equivalent in real economic terms has its own drawbacks as it ignores the basic nature of the economic process and of social and financial institutions in solving the distributional problem in respect of old-age.

The notion of a large volume of material goods and services being transferred from their producers – the de facto working labour population – to the elderly is artificial and over-simplified.

As pointed out before, to consider workers and pensioners as groups with opposed interests is incorrect from an economic point of view[9]. Evidently national product is the result of the joint input of labour and of capital and as a consequence output is divided between capital and labour – under equilibrium conditions - according to their marginal product, i.e. wage rate and profit rate. This basic distributional aspect is ignored in much of the social security literature. Particularly, at least on a macro-level, the (role of the) ownership of the capital stock is frequently overlooked.

The crucial issue in respect of accrued pension rights is that it constitutes a claim on future output in exchange for foregoing a part of present output. Pensioners need a firm and solid claim on national product in order to be able to consume the goods and services currently being produced. Under funding the retired population has at its disposal such a claim arising from their identifiable ownership of productive capital as a resource base of their own. A higher labour force participation of the elderly gives also rise to such a resource base.

The long-term viability of funded and pay-as-you-go schemes (2.3.1)

Capital earnings are received by the owners of the capital assets, i.e. pension funds and many older people on a personal basis. Apart from the expropriation of capital goods in revolutionary times as well as in times of war, the ownership of the capital stock will be a more secure basis for retirement income than the willingness and ability of the current labour force for paying pension contributions under a pay-as-you-go system. If pay-as-you-go contributions alone could satisfy promised pension payments ad infinitum one could be content alike without any funding system. But this promise can not be guaranteed; one can simply not count on it for ever. Economic and social institutions like the ownership of goods and assets, embodied in pension entitlements and other social security benefits, therefore are of much more relevance for the sustainability of old age income plans than levying taxes and contributions from labour income or capital income as there are

9) From a social and psychological point of view there certainly can and will be opposed interests, as future generations of retirees receive high pension incomes and are (very) wealthy as well.

many risks involved. Workers can evade contributions and taxes on capital income are very difficult or not at all to enforce effectively due to the high mobility of the financial capital. Pensioners are thought to be better able to fight for their share of national product as owners of capital than as lobbyists for pay-as-you-go financed pensions. Furthermore, under funding the debate (and hence the concern) on how the number of contributors and their average contribution base are developing is weakened.

Both pay-as-you-go and funding are basically acting as a mechanism for transferring resources between pensioners and other age groups. The primary point of interest when comparing funded and pay-as-you-go based pensions is how pension entitlements are secured, and only in the second place how they are financed. Or, in other words, funding is not a unique mechanism for financing pensions, but funding can be considered as a unique mechanism for solving and controlling the distributional problem in respect of old age pensions in an aging society, particularly at an unwished time of deteriorating economic performance. Nonetheless, risks remain[10].

The nature and basic value of pension rights under both systems is fundamentally different. The real value of claims under both systems depends on the availability of future resources as well as on a variety of other future developments in the world. Under funding this value is dependent on e.g. inflationary processes, capital returns and the (market) price of assets[11]. Under pay-as-you-go the claim value depends on the ability and the willingness of workers and tax-payers to finance pension outlays[12]. They can actually refrain from paying higher contributions, but they can not take away retirees' pension assets.

A funded scheme offers an economic claim on future national product, whereas a pay-as-you-go based scheme offers at best a moral claim (on future national product) or not even that: it basically offers an expectation on future benefits rather than a promise of future benefits and the claim is basically dependent on the political and bargaining strength of the elderly population and on the state power to levy contributions for the public pension system. Though the main argument for nonfunding rests on the quality of the pension promise made by the state, the state let alone the managers of a pay-as-you-go system are in a position to ultimately commit themselves to maintain the present pension level in the coming decades.

Securing old-age social security (2.3.2)

Is has been shown conclusively before that national product can be divided among different age groups using

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10) From the points of view of security, equity and efficiency generally a multi-pillar system is recommended, a mixture of the publicly managed and tax/contribution financed first pillar and the privately managed fully funded second and third pillar. The second pillar can be mandatory and the third pillar will be voluntary. A well developed fourth pillar (continue working) is also very useful. Or, in other words, don't put all your eggs in the same basket.
The Netherlands pension system is of the three pillar type. The first and second pillars are substantial and the third pillar is of slight but rapidly increasing relevance. A fourth pillar practically does not exist.

11) The spectacular growth in pension fund assets in the last few decades – and the further growth in the near future – may have simply increased asset prices, rather than increased the real capital stock. If the process goes into the reverse direction at some point of time in the 21st century, asset prices may fall just when pensioners want to sell their assets to the younger generations. On the other hand funding and the concurrent widespread ownership of individual and collective pension capital accounts may even contribute to a larger political engagement for adequate and responsible monetary and fiscal policies.

12) In respect of the long-term viability in pay-as-you-go schemes there are two major elements involved. In the first place the need for a constant renewal of the insured population. This may be ensured by making participation compulsory within a designated area which is sufficiently large and socio-economically coherent. The second element concerns the actors in the schemes' management. Managers should not be involved in defending special occupational or sectoral interests, but dedicated to supporting common interests.

different methods. Remember that their joint demand will always be constrained by the current total supply of goods and services. Whatever method used, the actual value of the claim (on future output) of the elderly (or of any other age group) can never be completely guaranteed.

Risks remain. Guarantees given are in some way or other always virtual. In a pay-as-you-go scheme they are based on the strength of an implicit social contract between generations; under funding they are based on the ability of the economy always to yield an adequate return on financial assets.

When, in a funded scheme, total monetary purchasing power or the demand for goods and services (largely) exceeds the value and amount of current output at prevailing prices, a general price inflation will bring them back into line. First, prices of consumer goods will rise, thereby bringing about a cut in the real income of the retired. Secondly, the elderly will see the prices of the securities they wish to sell to the younger age groups, decreasing and thereby their claims on real goods and services. This means a further cut in their real purchasing power. On the other hand, under a pay-as-you-go scheme contributions will be lowered when a readjustment seems to be inevitable and consequently the real income of the pensioners will decrease proportionately. Under both pension finance systems as a result a new equilibrium will develop at a lower level of income and consumption of the retired. Both pension finance systems then appear not to be immune against aging.

One may wonder which type of redressing is preferable, the price adjustment mechanism (led by an invisible hand) under funding or the (democratic?) decision making process in respect of tax and contribution levels when a pay-as-you-go system is at work.

Under circumstances only the (well-organized) state – up to a certain pension income level - can offer a reasonably complete guarantee against inflation, e.g. by issuing indexed bonds or from general tax revenues, although this solution is artificial and has its own disadvantages. When this gloomy world is reality, the preferential policy will be to let people work longer, often in part-time and at a lower wage rate. Pre-pension payments as an income supplement – if society can afford them - can be desirable or necessary until the (higher) statutory retirement age.

Apart from the ultimate risks – of which inflation is the most dangerous - it may be concluded that financial claims in the case of funded schemes generally can be considered as undeniably stronger than claims in the case of unfunded schemes, particularly if the Aaron-rule holds. Full funding of pensions therefore seems to be the more attractive and secure option in an aging society – a result that replicates the discussion of life cycle savings versus altruistic gifts. Thus, funding can be considered as the best way of strengthening security.

Not having children (2.3.3)

For demographers in particular it is interesting to note that it can be argued that the present baby-boom generation has caused the old age pension problem by not having children, thus by not having invested in human capital. In order for a pay-as-you-go system to function properly and to survive, each generation had to perform two tasks. It has to pay the old-age pensions of the elderly and it has to pay for raising-up its children[13,14]. Since they have chosen not to raise as many children as previous generations did – a moral

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13) The present working population and the future leading edge working population presumably as well have chosen not to raise as many

hazard effect of the introduction of any pension system –, they should now be asked to use the expenditures saved by not raising children for financing investment in material capital goods rather than increasing their consumption. Thus, by capital deepening up to certain extent the production of a sufficiently large future national income can be secured. Moreover, those generations by paying extra contributions are not worse off than they otherwise would have been with an unchanged population (under a pay-as-you-go system). Or, in other words, no pension for you or paying extra contributions if you default on financing the raising up and education of the young.

children as previous generations did. They can be asked therefore, it is argued, to use the expenditures saved by not raising children for financing the transitional costs of the shift from pay-as-you-go to funding rather than increasing their consumption. They are not worse off than they otherwise with an unchanged development of the population (under a pay-as-you-go system) would have been. After the transition future generations under funding pay pension contributions that, ceteris paribus, mainly depend on the real rate of return on capital and not on the number of children they have. Though less future labour supply will increase the wage rate and lower capital returns.

14) Note however that under a funded pension system a sufficiently large well-equipped future labour force is of equal relevance. Generations which renounce their duties to raising-up children will be confronted with low pension asset prices when old.