Financial and Inter-generational Balance?

An introduction to how the new Swedish pension system manages conflicting ambitions

by Ole Settergren

> *"The most serious weakness in the scheme is that the return on the accounts reflects the return in average wages, whereas the underlying return from PAYG is the growth in the wage bill."*
>
> The Economist February 16:th-22nd 2002, commenting the new Swedish pension plan

The new Swedish pay-as-you-go pension system has been designed to be financially stable, i.e. regardless of demographic or economic development it will be able to finance its obligations with a fixed contribution rate and fixed rules for calculating benefits. This type of financial stability inevitably entails a risk that the value of pensions will vary over time. To minimise this variability, while at the same time securing the financial stability of the system, it has indexing rules that work asymmetrically.

The aim of a stable pension level is attempted by basing the indexing of the systems liability on the growth in average income. As the growth in average income normally will deviate from the systems internal rate of return this index implies that assets may grow faster than liabilities, or vice versa. If and when liabilities should exceed assets, the basis for indexation is automatically switched to an approximation of the system's internal rate of return, thus automatically adjusting pension levels as well. The pension level is automatically re-established, as is growth in average income as the basis of indexation, as soon as this is possible without undermining the financial balance of the system. Only historic transactions are used to calculate the liability and the assets.

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1 Introduction

Faced by largely the same demographic challenges as other OECD countries, Sweden opted in 1992/94 for a radical reform of its national old-age pension system.[1] Most of the legislation on the new system was passed in 1998. Parliament adopted the final legislation, providing for *the automatic balance mechanism*, in May 2001.

Financially, three key principles have guided the decade of research and decision-making on the reform:

- For every krona paid in contribution to the system by or for an individual, that individual should receive the exact same amount of pension credit – i.e., no pension credit without a corresponding contribution.
- The financing of pension payments should be *guaranteed* by a fixed contribution rate.
- The average pension in relation to average income (here referred to as the pension level) in the new system should equal the corresponding ratio in the old system if it would have been retained in the following scenario: an average working life time of 40 years, a growth in average income of 2 percent and life expectancy is the one measured 1994. The pension level in the old system is about 50 percent, while the replacement rate is about 60 percent.

This paper presents a non-technical explanation of the rules that are intended to ensure the financial stability of the system while also optimising its social-welfare effects. Section 2 briefly describes the reform. Section 3 serves as a general background to the financial and inter-generational problems that the automatic balance mechanism is designed to manage. Financial aspects of the new system are discussed in Sections 4–6. Specifically the paper aims to refute the assertion made by the Economist. The claim that the underlying return from pay-as-you-go pension schemes is the growth in the wage bill, is a widely spread misconception among economists. From an academic point of view I believe that one of the important results of the Swedish pension reform is that it has identified the (true) internal rate of return in this type of pension plans. This has made it possible to design the system so that it is automatically financially stable. Further, and perhaps more important, it has made it possible to disclose the pension scheme by means of a more or less conventional financial statement and balance sheet, calculated entirely without projections.

2 Pension generics

Traditionally old-age pension systems are categorised into four generic types according to degree of funding, and the distribution of risks between insurer and insured. The risks can be summarized to be the risk that the growth of system resources will be insufficient to meet expected benefits (economic risk) and the risk that mortality will be less than expected (mortality or actuarial risk). In theory the losses (gains) from economic and mortality development will either rest with the insurer or the insured. In the case of national pension systems the economic and actuarial risks are of such magnitude that there is no possibility of insuring against them. In these systems actuarial and economic risks are uninsurable. Their distribution will be within the insured collective, and concern when during the life cycle an insured will be exposed; when contributing to or benefiting from the system. The four generic types that follow from the criteria of funding and risk distribution are illustrated in Figure 1. The figure also indicates the directions of the Swedish reform.

Degree of Funding

Systems with funded assets equal to or greater than the pension liability can be considered fully funded. Fully funded systems are repre-

sented by quadrants II and IV in Figure 1. Pay-as-you-go systems have zero or very limited funded assets in relation to pension liability; in Figure 1 these are represented by quadrants I and III. The fund of a pay-as-you-go system can, if it is of any importance, be regarded as demographic and economic *buffer fund*. The Swedish pay-as-you-go system, both the old and the new, have a buffer fund.[2]

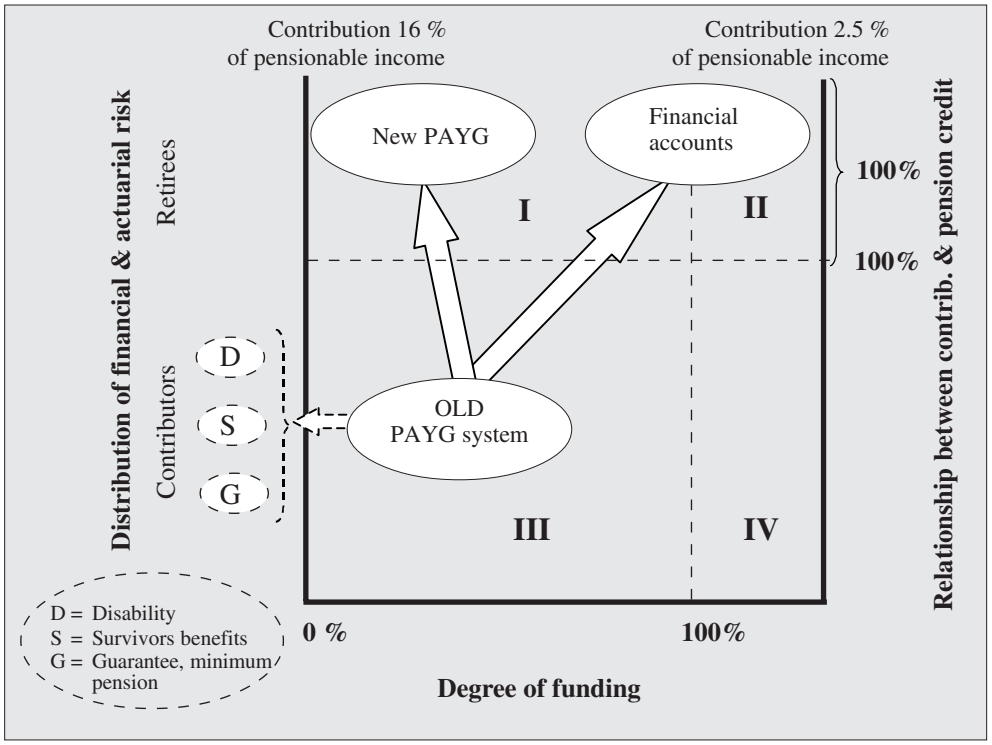
Distribution of Risks Between Insurer and Insured, Between Contributors and Retirees

In a *defined-contribution* pension plan the economic and actuarial risk is, in principle, carried by the insured, rather than the insurer. In the context of a national pension system this translates to a risk of lower than expected benefits for retirees. Note that, depending on the design of the system, this may imply also lower than expected benefits for those contributing to the system. Defined-contribution systems have traditionally been associated with fully funded schemes. In Figure 1 defined-contribution schemes are represented by quadrants I and II. It may be argued that quadrant I does not represent a genuine defined-contribution system, largely on the ground that the pension liability is not (fully) backed by funded assets and hence the return on contributions will normally differ from the market return on capital. To distinguish between defined-contribution systems that are fully funded and those that are financed on a pay-as-you-go basis, the latter are often called *Notional Defined Contribution (NDC)* systems.

In defined-benefit plans the financial and actuarial risk should, in principle, be carried by the insurer. In the case of public pension systems that means that the contributors, or taxpayers carries those risks. Typically such systems define the benefit in terms of a percentage of final or late-career salary. Defined-benefit schemes may be either pay-as-you-go (III) or fully funded (IV). In a defined-benefit scheme, the relationship between contributions and pension credit can be zero, as in a flat-rate pension system, or 100 percent as in a so-called career average scheme. National pension schemes have generally been defined-benefit and financed more or less entirely on a pay-as-you-go basis. Schemes designed in this manner are found in quadrant III of Figure 1. In principle a defined-benefit system assume uninsurable risks by altering the contribution rate. In practice, however, public defined-benefit systems have been known to manage the effects from uninsurable risks also by adjusting the value of accrued pension credits and pensions. Since financially warranted adjustments in government run defined-benefit schemes *can* be made either by changing the contribution rate or by changing the value of pensions, it is more flexible than a defined-contribution scheme.

The additional, right hand, axis in Figure 1 illustrates the meaning that the defined-contribution label has had in the Swedish pension reform debate. Defined contribution has simply meant that the for every krona paid in contribution to the system by or on behalf of an individual, that individual should receive the exact same amount of pension credit, in kronor, and no pension credit without a corresponding contribution. However such a system is not as innocent as it may sound. It must, to be logically consistent, assume uninsurable risk by adjusting the pension level, i.e. it must also comply with the stricter economic definition on the left hand axis. As the accumulation of pension credits in a defined-contribution plan is a function of contributions, varying the contribution rate is not a viable response to the financial effects from, for example, increases in life expectancy or a low return on assets. If the contribution rate were to be increased in response to such developments, and if the cause of the deficit in the first place continues, the deficit will become even larger than at the outset. [3]

Figure 1. Four Generic Types of Pension Systems and the Direction of the Swedish Reform



3 The Direction of Swedish Pension Reform

"Critics of the Swedish system say that the reform is as virtual as the accounts are notional. After all, the contributions that are supposed to go into the accounts are in practice paying for the benefits of today's pensioners."

The Economist, February 16:th-22nd 2002

As is clear from Figure 1, Sweden has moved from a defined-benefit system to two types of defined-contribution systems, a fully funded and a pay-as-you-go (NDC) complemented by a guarantee (minimum) pension benefit. The guarantee pension replaces the flat rate component of the old system and it is financed by general tax revenue. Also the disability and survivors benefits that were an integrated part of the old system have been separated from the pension system and are now financed by general taxes. These benefits will not be addressed to any extent in this paper.

In the new income related system, 14 percent of contributions (2.5/18.5) will go into individual financial accounts (fully funded), while the remaining 86 percent (16/18.5) will be channelled into the new NDC pay-as-you-go system. This paper will only discuss financial aspects of the pay-as-you-go system.

An amount corresponding to the 16 percent of annual pensionable income[4] is paid by or on behalf of the individual to the systems buffer fund. Consequently 16 percent of each individuals annual pensionable income, will be credited yearly his or hers notional account. The default "interest" credited the notional account, is the increase in average income as measured by an income index. This

indexation will be interrupted if the automatic balance mechanism is triggered. In that case the interest credited the notional account will be an approximation of the systems internal rate of return, as explained in Section 5. Also pensions receive "an interest". The default indexation of pensions is by the growth in the income index minus 1.6 percent. Pensions will thus grow by the nominal increase (or decrease) in nominal average wage minus 1.6 percent.[5] If the balance mechanism is triggered pensions will be indexed by the approximation of the systems internal rate of return minus 1.6 percent.

The reduction by 1.6 percent is explained by the fact that when the notional capital is converted to an annuity an interest rate of 1.6 percent is used. The motive for the interest rate is to achieve a more even distribution of the purchasing power of the benefit during retirement. The imputed interest rate and its subsequent reduction of the yearly indexation implies that if the nominal average income grows by exactly 1.6 percent *more* than the inflation pensions will increase in line with inflation. If nominal average income grows by more than 1.6 percent more than inflation, real pensions will grow by the margin of real income growth and 1.6 percent. If the nominal average income grows by less than 1.6 percent more than inflation real pensions will decrease by the shortfall of real income growth and 1.6 percent.

There is no formal retirement age in the new system.[6] Pension credits will always be earned and added to the notional (as well as financial) accounts if the individual has pensionable income regardless of his or her age and irrespective of weather pension has begun to be drawn. Pension can be drawn from age 61 and upward, without upper age limit. Pension benefits are paid by withdrawals from the buffer fund.

Pension from the pay-as-you-go system is calculated at the duration of retirement by dividing the notional-account balance by a so-called annuity divisor. The annuity divisor reflects remaining unisex life expectancy at retirement and the stated interests rate of 1.6 percent. A specific annuity divisor is thus determined for each annual cohort. If life expectancy increases the same notional capital will produce a successively lower yearly pension for younger cohorts, if conversion to an annuity (pension) is made at the same age. To maintain a fixed pension level when life expectancy increases, the withdrawal of pensions must on average every year be made at a slightly higher age. In table 1 the projected (2003) effects on either pension levels or pension age is presented.

Both the fully funded and the pay-as-you-go parts of the national Swedish income related pension plan follow the risk distribution that is characteristic of a defined-contribution plan. How is further explained in sections 3-6.

Guarantee pension

Persons with no or a low income related pension are entitled to a so-called guarantee pension. The guarantee level in the system is expressed in real, inflation adjusted, terms. This implies that if the economic or mortality risks force the value of the income related pension to decrease the share of guarantee pension for retirees with relatively low income related pension will increase. The design of the guarantee is such that a reduction of the real value of the income related pension by 1 percent will increase the guarantee by 1 percent for those with the lowest income related pensions and by 48 percent by those in an intermediary segment. The top segment will have their income related pension reduced by 1 percent. Thus the design of the guarantee pension shifts the distribution of risks "back" to the taxpayers and gives the low income segment a defined benefit type of old-age pension insurance. The interaction between the income related pension scheme, which

Table 1. Effect of projected increase in life expectancy on pension levels or pension age

Birth cohort born	*reaches 65 year*	*Annuitization Divisor at age 65, projection*	*Effect of changed life expectancy on pension*	*Retirement age needed to neutralize effect on pension from increase in life expectancy*	*Remaining life expectancy at age 65*
1940	2005	15.7	0 percent	(age 65)	18 years and 6 m.
1945	2010	16.1	-2 percent	+ 4 months	+ 6 months
1950	2015	16.4	-4 percent	+ 7 months	+ 11 months
1955	2020	16.7	-6 percent	+ 10 months	+ 16 months
1960	2025	17.0	-7 percent	+ 13 months	+ 20 months
1965	2030	17.2	-9 percent	+ 16 months	+ 24 months
1970	2035	17.4	-10 percent	+ 18 months	+ 28 months
1975	2040	17.7	-11 percent	+ 21 months	+ 32 months
1980	2045	17.9	-12 percent	+ 23 months	+ 35 months
1985	2050	18.0	-13 percent	+ 25 months	+ 38 months
1990	2055	18.2	-13 percent	+ 26 months	+ 41 months

Source: Riksförsäkringsverket, The Swedish Pension System, Annual Report 2002.

places all risks on the benefit, and the guaranteed pension, which places all risks on the taxpayers, implies that the more scarce the resources of the society are, relatively more will be directed towards those retirees with low income. The interaction also implies that the tax content in the contribution may increase if growth is slow or if life expectancy increases. However since the guarantee pension is price indexed its importance is expected to decline as real incomes are expected to grow.

4 Inter-generational balance – an attempted definition

Financial balance or stability can be defined as the systems ability to finance its obligation with a fixed contribution rate and with assets in the buffer fund. Inter-generational balance, or fairness is related to the ability of the system to finance its obligations with a fixed contribution rate but adds the aspect of the pension level.

One aim of an income related old-age pension insurance is to compensate individuals (or households) economically for the loss of income generating capacity due to high age. With this aim the growth in average income is the relevant discount factor when comparing how well the system performs in this task for different generations. Inter-generational balance or fairness can then be defined as having a constant ratio of present value of pension benefits over present value of contributions for all birth cohorts, using the growth in average income as discount factor. Inter-generational fairness can be expressed as the expected or ex post standard deviation in the "cohort benefit/contribution ratio". Maximum inter-generational fairness is when the benefit/contribution ratio is constant for all a birth cohorts, i.e. a zero standard deviation.

A (notional) defined contribution system, which index notional pension capital and pensions with the growth in average income, produces a very stable cohort benefit/contribution ratio, i.e. a high degree of inter-generational fairness. It will also have the potential to produce a rather stable ratio of average pension over average income; this ratio is referred to below as *the pension level*.[7] Mainly for these two reasons Swedish reformers

have decided that the default indexation of notional pension capital should be the growth in average income. The default indexation of pensions is the same measure minus the interest rate 1.6 percent used when converting the notional capital to an annuity. The reduction of 1.6 percent implies that the pensions of each cohort will grow 1.6 percent slower than average income. However, since younger cohorts will enter the group of retirees each year, the average pension for all pensioners as a collective will grow at about the same rate as average income when the growth in average income is used as the basis for indexation.

Uninsurable risks, i.e. economic[8] and actuarial risks, imply that pension systems risk to yield significant and unwarranted inter-generational transfers of income. The downside of uninsurable risks is that the contribution rate may be increased while the same pension benefit is maintained, or that the value of pensions may be reduced while the contribution rate is left unchanged. In either case the pension system risk to cause significant and unwarranted standard deviation in the cohort benefit/contribution ratio, cause inter-generational transfers of income. The down side of the main uninsurable risk in a fully funded scheme is the risk of a return on capital lower than required to keep the average pension in percent of the average income of those working fixed. In pay-as-you-go pension systems the down side of the main uninsurable risk is a development of the contribution base of the system that is slower than the growth in average income. The contribution base may grow slower than average income if the population in working ages declines or if labour force participation declines. Changes in life expectancy may also cause standard deviation in the cohort benefit contribution ratio.

The existence of uninsurable risks thus *may* make it impossible to achieve the dual goal – financial and inter-generational balance – of the Swedish pay-as-you-go system; indexing the pension liability by the growth in average income and maintaining a fixed contribution rate. In other words it may be impossible to achieve a zero standard deviation in the cohort benefit/contribution ratio.

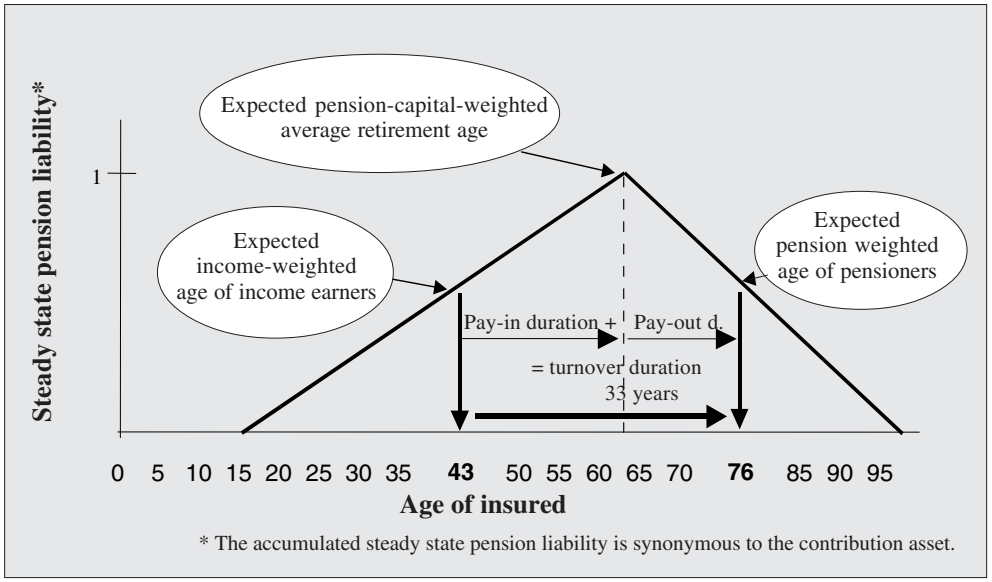
Uninsurable risks are present whether a pensioninsurance scheme is organised as a private or public system and whether it is funded or not and weather it is defined-contribution or defined-benefit. Only the sources, character, magnitude and distribution of these risks depend on the rules of the insurance and on whether it is private or public, funded or unfunded. Arguably a public pension system should be designed to reduce to a minimum the potential impact of uninsurable risks. With this perspective it should be designed to minimize unwarranted inter-generational transfers of income. This is the aim of the combined design: fixed contribution rate, buffer fund, default indexation by growth in average wage automatically interrupted by the balance mechanism if necessary to secure financial stability.

5 Assets and Liabilities

As Swedish pension reformers had set out to create a (notional) defined-contribution scheme it was necessary to make sure that the system was financially stable. Otherwise it would have been logically inconsistent.[9] The obvious way to secure the financial stability of any economic system is to make sure that its liabilities cannot exceed its assets. This is the way in which fully funded pension systems normally are designed. The main problem with applying this principle to a pay-as-you-go pension system has been the lack of an objective method of valuing its most important asset: that is, its assumed perpetual flow of contributions.

The automatic-balance mechanism incorporates a method for valuing contributions to a pay-as-you-go system. It makes it possible

Figure 2. Illustration of the Turnover Duration Concept



to compare assets and liabilities of such systems. Both the assets and the liabilities are calculated without projections. Both the calculation of the contribution asset and the pension liability follows from the Law Sec 1, Art. 5 a-c on an Earnings-related Old Age pension and the regulation (2002:780) on calculation of the balance ratio.The determinants of assets and liabilities are briefly explained below.

The Contribution Asset[10]

The value of contributions to a pay-as-you-go pension system depends on the degree to which the contributions can finance, i.e. amortise, the pension liability. The capacity of a given amount of contribution to amortize the pension liability depends in turn on the age-related income and mortality patterns of those covered by the system.[11]

Figure 2 illustrates the age-related distribution of the pension liability in the Swedish system that would accrue with the present income and mortality patterns, assuming zero population growth. The expected pension-weighted average age at which pensions are disbursed is 76. The expected income-weighted average age at which contribution is paid is 43. What can be called the *expected turnover duration* of the system is then approximately 33 years (76–43). The expected turnover duration is the sum of the *expected pay-in duration* and the *expected pay-out duration*.[12] In this particular case the turnover duration implies that contributions, in a steady state defined by the income and mortality patterns the year of measurement, would perfectly match pension payments while the pension liability is exactly 33 times contributions.

Contributions multiplied by expected turnover duration indicate how large a pension liability can be pay-as-you-go financed given the income and mortality patterns prevailing in the period measured. Accordingly, the expected turnover duration can be used in determining the value of the contribution flow to a pay-as-you-go system, or the *contribution asset*.

Contribution asset = contributions x expected turnover duration (1)

The contribution asset can also be seen as the present value of a perpetual contribution flow discounted by the inverse of the expected turnover duration (referred to below as turnover duration). The turnover duration is a somewhat complex concept, but calculating it is simple. The method involved resembles that used in determining life expectancy.[13] To my knowledge there has been no previous reference in actuarial or economic literature of either the existence or the importance of expected turnover duration in analysing the financing of pay-as-you-go systems. This paper attempts no thorough explanation of the expected turnover duration measure. [14]

It follows from Eq. 1 that the asset of the pay-as-you-go system will grow with the growth of the contribution base, assuming that the contribution rate is fixed. It also follows from Eq. 1 that growth in the contribution base is not the only factor affecting the return on contributions, contrary to common assumption.[15] Asset growth is also dependent on changes in the age-related income and mortality patterns that determine the capacity of contributions to amortise the pension liability, i.e. turnover duration. Further, the rate of return on the buffer fund, if there is one, should be taken into account in determining the growth in assets of a pay-as-you-go system. The capital market provides a valuation of the buffer fund on a daily basis. Thus, the assets of the pension system are defined and computable.

Total assets = contribution asset + buffer fund (2)

The Pension Liability

The calculation of the pension liability is as simple as the calculation of the assets. The pension liability (*PL*) can be thought to consist of two parts, the liability to those who have not yet started to draw their pensions (PL_w) and the liability to those who are already receiving pensions (PL_r), thus the nominal pension liability

$$PL = PL_w + PL_r \quad (3)$$

where,

$$PL_w = \sum NPC_i, \text{ for all individuals } i \quad (4)$$

$$PL_r = \sum P_a \times 12 \times G_a, \text{ for all age groups } a \quad (5)$$

NPC_i = notional pension capital of individual *i*, (closing balance at year end)

P_a = pension payments (in December) to age group *a*

G_a = life expectancy (in years) for individuals that have reached age *a,* measured yearly[16]

Eq. 4 simply defines the pension liability to "workers" as the sum of the balance of each individual's notional account. Eq. 5 defines the pension liability to retirees as the sum of the products of the pensions payable to each age group times the life expectancy of that age group.

The valuation of the liabilities is an extreme simplification – in essence summing nominal values in the registers of RFV – relative to the normal present value calculation performed in both private and public insurance to measure pension liability. The calculation gives a correct *ex post* valuation of the liability only if the rate at which the liability is indexed coincides with the systems internal rate of return. If this condition could be assumed to prevail at every moment, the automatic balance mechanism would be superfluous.

The rational behind abstaining from making any assumption on how the future indexing of the pension liability relates to the systems internal rate of return is based on two circumstances. The first is that the automatic balance mechanism secures the financial stability of the system without making any bet on how the average income index will relate to

the systems internal rate of return. This since the automatic balance mechanism will, if necessary, switch the indexation of the pension liability to a good approximation of the internal rate of return of the pay-as-you-go system. Thus the simple valuation entails no risks that it will under estimate the size of the pension liability relative to the size of assets.

The second reason is that there are a number of good practical arguments for refraining from trying to project how the average income will relate to the internal rate of return. The accuracy of economic and demographic forecasts are in general poor. Further with projections there is the possibility that political considerations may have an impact on the forecasts. Even if we thought that we could make good long-term forecasts, it might still be rational not to use them. There is a trade-off between a higher degree of sophistication in disclosing the financial position of the system and the real or perceived increased risks of manipulation that follow from projections.[17] In the lack of forecasts and low degree of sophistication the method used for valuing the pension liability and assets resembles traditional accounting, and it has similar strengths and weaknesses.

The need for projections in estimating the present value of the pension liability is eliminated if the system is defined-contribution and if it is assumed that the indexing of the nominal liability is equal to the internal rate of return of the system. Before that assumption is discussed, the components of the internal rate of return will be summarised and commented.

The Components of the Internal Rate of Return

The internal rate of return is the rate at which the pension liability must be indexed to assure that liabilities grow at the same rate as assets. Allowing for some simplifications, the internal rate of return of the pension system is a function of the following four factors: [18]

(a)	+	growth of the contribution base
(b)	+	change in income and/or mortality patterns as measured by the turnover duration
(c)	+	return on the buffer fund
⟶		*rate of return on assets*
(d)	–	impact of changes in life expect ancy on pension liability
⟶		*internal rate of return*

(a) growth of the contribution base

The growth of the contribution base is the major determinant of the internal rate of return. This relationship is obvious, since disbursements in a pay-as-you-go system are entirely or largely financed directly by contribution revenue. If the labour force is reduced because of a decrease in the working-age population or a drop in labour-force participation, contributions will grow more slowly than average income. There will then be a danger that the indexation of the pension liability by the growth in average income will exceed the internal rate of return of the system. If so, pension disbursements will sooner or later exceed the revenues of the system and the buffer fund will risk to be depleted.

(b) change in income and mortality patterns

Changes in income and mortality patterns affect the liquidity of the system. Income pattern is in this context defined by the average income of each age over the average income of all ages, the mortality pattern is simply the life table. If, for example, income patterns change so that a larger share of incomes is earned by older workers this will have the effect of increasing pension payments when those older workers are retired. This increase in pension expenditure is, ceteris paribus, not countered by any increase in contributions. Thus the capacity of a given contribution flow to finance the pension lia-

bility has decreased by the change in income pattern. The relevant age-related income and mortality patterns are measured by the turnover duration. In the example of a larger share of total incomes earned by older workers the turnover duration is shortened. If turnover duration decreases, so does liquidity, and *vice versa*.

(c) return on the buffer fund

The return on the buffer fund naturally affects the rate of return on assets as well as the internal rate of return.[19] The higher the return on the buffer fund, the greater the growth in the assets of the system – and vice versa. In defined-benefit systems the return on buffer-fund assets may have implications for the contribution rate, but normally not for pension levels. In a defined-contribution pay-as-you-go system, the return on buffer fund assets may of course have an impact on the size of pensions, but normally not on the contribution rate. A low rate of return, in relation to the growth of the average wage, implies that the system may not be able to pay pensions that increase in step with the growth in average earnings. A high rate of return entails less such risk and may even provide coverage for "deficits" due to other uninsurable risks.

(d) impact of changes in life expectancy on pension liability

Changes in life expectancy changes the size of the pension liability. This implies that changes in life expectancy will make the internal rate of return differ from the rate of return on assets. In almost all existing public pension schemes, the persistent strong increase in life expectancy is claiming a large share of the return on assets. In defined-benefit schemes this has normally implied higher contribution rates. In a defined-contribution scheme the effect from an increase in life expectancy must in principle force a lower pension level – or a postponement of the retirement age.

The cohort-specific annuity divisors, described in Section 2, absorb about two-thirds[20] of the risk that changes in life expectancy entail for the financial stability of the system. This effect is obtained by a successively higher divisor for every age, i.e. lower pensions if retirement age is not increased. Thus, one-third of the pension liability will still be affected by changes in life expectancy. The financial exposure to changes in life expectancy results from the fact that pensions already granted are not (directly) influenced by changes in life expectancy after an individual has reached 65.

6 The Automatic Balance Mechanism

By default the pensions and the notional pension capital of the Swedish pay-as-you-go pension system is not indexed by its internal rate of return. In response to this potential source of financial instability, the so-called automatic balance mechanism has been developed. The use of the balance mechanism implies that the assets and liabilities of the pay-as-you-go system are to be calculated and disclosed annually, thus providing the pay-as-you-go system with a *balance sheet*. The formula for calculating the assets and liabilities of the system is prescribed by legislation. Aside from the buffer fund, which is valued on the basis of capital-market transactions, the calculation is based exclusively on transactions that are recorded in the pension system. There is no element of forecasting in the calculation. The relationship between assets and liabilities is to be reported annually as a *balance ratio*[21]:

$$\textit{Balance ratio} = \frac{\textit{Contribution asset} + \textit{Buffer fund}}{\textit{Pension liability}} \qquad (6)$$

The balance ratio summarises the effect of all uninsurable risk factors (a)–(d).[22] When the

balance ratio exceeds 1, the system has a surplus in the sense that it is expected to meet its obligation with a margin to spare. In that case the pension liability is less than the assets of the system, the net present value of the system is positive. If the balance ratio is less than 1, the system is in a state of financial imbalance; the pension liability exceeds the assets which are to finance it, the system has a negative net present value. If this imbalance were allowed to persist, the buffer fund would be depleted.

If the balance ratio falls below 1 the automatic balance mechanism is activated. It switches the indexation of pensions and notional pension capital to a new index series, called a *balance index*. The balance index is established by multiplying the income index by the balance ratio. The balance index henceforth increases with the growth in the income index times the balance ratio. When the balance ratio is below unity, pensions and notional pension capital will grow slower than average income.[23] If the balance ratio exceeds 1 *in a period when the balance mechanism is activated,* the indexing of pensions and notional accounts will continue at the rate of growth in average income times the balance ratio. Then the pension liability will be indexed at a rate higher than the growth in average income. No further calculation of the balance index will be made after it re-attains the same level as the income index. The pension liability will then be indexed once again at a rate equal to the change in the income index (average income).

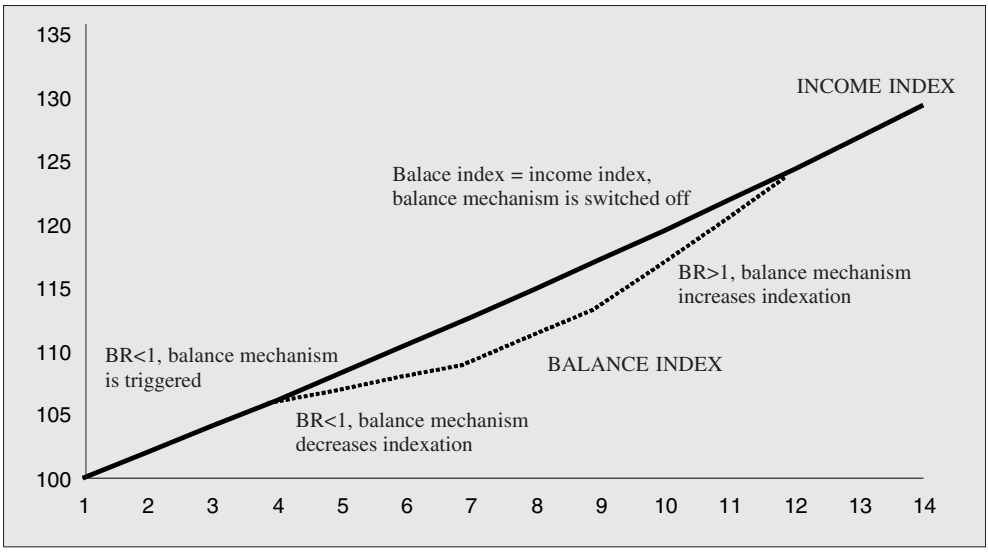
When the balance mechanism is activated and the system starts to index its liability by the balance index, the liability will be "compounded" at an approximation of the internal rate of return of the system. The rate is only approximate, since turnover duration is calculated on the assumption of zero population growth. As long as indexing is done by the balance index, the buffer fund will tend towards zero.[24] To prevent the liability from becoming more than insignificantly larger than assets, i.e. to secure a net present value of ap. zero, the system objective of keeping pensions increases in line with growth in average income is disregarded until the balance ratio permits it to be reinstated. This will cause inter-generational unfairness in the sense defined in section 3, however increased taxes would do the same but place the burden on the active rather than the retirees. As mentioned the guarantee pension system may imply that the burden, partially, is placed with the active generations, partially protecting the pension levels of the poorest retirees. Figure 3 illustrates how balancing works in a scenario where it is first activated and later discontinued.

7 Risk Aversion and Asymmetric Financial Stability

The new Swedish pension system introduces both new principles and methods in the area of public pay-as-you-go pension system. Common to most of these novelties are that they derive from the ambition to create a truly defined contribution, pay-as-you-go pension plan. This is in itself a new animal in the social insurance biotope.

The pension reform promoters have recognized the conflicting ambitions of the system: to achieve both financial and inter-generational balance. While managing its conflicting ambitions the system does not allow for uninsurable risks to be indiscriminately reflected in the indexation or calculation of pensions. These risks can only affect pension levels through their impact on the balance sheet of the system. As the system will accumulate assets in some circumstances, it will be able to sustain indexation exceeding the internal rate of return for some time without endangering the financial stability of the system. Deviations from the objective of the system –

Figure 3. Income index and the balance index



a stable pension level – are thereby reduced while it can hold on to a fixed contribution rate.[25]

The rules of the pension system allow for surpluses to accumulate, but exclude (substantial) deficits.[26] Thus the system allows for a positive net present value but excludes a negative net present value. In this sense the design is asymmetric. A symmetrically designed pension system, one that always ensures a zero net present value and a balance ratio of unity, is irrational if the insured have any degree of risk aversion as regards their pension level. The insured are risk avert if they assign a higher negative value to a decrease in their average pension, than they would assign a positive value to a corresponding increase in their pension. If the insured are risk avert, their economic well-being is enhanced by the asymmetric design that has been chosen. Considering that a large share of individuals' total assets is invested in the national pay-as-you-go pension system, the value of the risk reduction produced by the combination of average-income indexing and automatic balancing may be considerable.

The risk reduction achieved by the asymmetric design of the pay-as-you-go system has been made possible by determining the time preference of the system in regard to contributions, as measured by the *expected turnover duration*. It has thereby been possible to value contributions and to generate balance statements for the system. The balance mechanism provides for what might be called actuarial accounting, a form of double entry bookkeeping for a pay as-you-go pension system. This accounting makes the system transparent, probably more so than is the case for any other existing pay-as-you-go pension system. Please check the validity of this claim by yourself. The annual report of the Swedish pensions system is available at www.rfv.se selcect "Publications" then subtitle "In English" and in Swedish at www.rfv.se/english/index.htm

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Notes

[1] The principal features of the new system were published in 1992. The Riksdag decided in 1994 that legislation should be drafted in accordance with the principles proposed in 1992. In 1998 the greater part of the legislation was adopted. The legislative proposals have consistently been supported by some 85 percent of the members of the Riksdag.

[2] As per 31December 2002 the Swedish buffer fund holds assets of SEK 488 billion. This represents some 20 percent of GDP, or 3.2 years of pension payments, see The Swedish Pension Annual Report 2002.

[3] Some analysts have considered the NDC "formula" to be a redressing of a career average defined benefit formula, see for example Cichon (1999) and Disney (1999). This view fails to recognise that uninsurable risks in a defined contribution plan should be, and in the Swedish NDC system is, assumed by the pension level, rather than by the contribution rate.

[4] Pensionable income are incomes (including social insurance payments other than pensions) up to 8.07 income-related base amounts, 330 063 SEK (2003). The total contribution base to the pension system consists to about 83 percent of wages and salaries; some 17 percent is pensionable incomes from social insurance, for example unemployment or sickness insurance and non-income contribution base such as pension credits to parents of small children. Government annually finances, by general revenue, the pension credits that derive from the non-wage contribution base.

[5] "minus" is not entirely correct, pensions year *t* are indexed by: [income index(t)/income index(t-1)]/ 1.016

[6] However, guarantee pension benefit is only paid from age 65.

[7] In a NDC indexed by the growth in average wage variations in the ratio of average pension over average income are mainly attributable to variations in life expectancy. Such variations do not cause inter-generational transfers of income as defined above. Further policy makers in Sweden have considered that a higher life expectancy imply also a longer time with income generating capacity. Thus an increase in life expectancy should, in principle, lead to a longer work life and thereby keeping both the cohort benefit/contribution ratio and the "pension level" fixed.

[8] Often the value of assets is subject both to market and political risks, i.e., risks of changes in legislation that have retroactive effects, see Diamond (1997). Another risk, which in some contexts can be substantial, is that of fraud.

[9] A lively debate has been in progress at least since 1994 on the merits of so-called notional defined-contribution systems (NDC). A major criticism of NDC's has been that they would not be financially stable (Valdés-Prieto 2000, Disney 1999), contrary to the more or less explicit claims of their advocates (Palmer 2000, Fox and Palmer 1999). This criticism of NDC's is unjustified, at least in the special case of the Swedish system. The general outline of the balance mechanism was described in *The legislative history of the Automatic Balance Mechanism* (1997).

[10] The explanation here is kept very short; unfortunately there is yet no detailed explanation in English of the expected turnover duration.

[11] This capacity is also influenced by the population growth rate (labour force growth rate). In the automatic balance mechanism, turnover duration is calculated on the implicit assumption of zero population growth rate. This assumption simplifies the calculation and reduces the volatility of turnover duration and contribution assets. It implies, however, that the turnover duration and thus the contribution asset will be (slightly) overestimated if population growth is negative, and vice versa.

[12] I am indebted to Eric Steedman, an actuary at Watson Wyatt in Stockholm, for the English translation of the expressions used in the Swedish legislation.

[13] See *The legislative history of the Automatic Balance Mechanism* (2001) for the formula for calculating the turnover duration. Possible effects of the rules are described and analysed in that publication (in Swedish).

[14] The concept of turnover duration was presented in Settergren (1999), further developed in Settergren (2000), both in Swedish. Valdés-Prieto (2000) derives most of the "risk" factors of a NDC, all of which either are captured by the turnover duration or the other components of the balance ratio defined by Eq. 6 in Section 5. The article by Valdés-Prieto offers a good background to the problems managed by the automatic balance mechanism.

[15] The standard reference in this context is Paul Samuelson (1958). In the pioneering work of

Samuelson and those following him, for example Aaron (1966) and Buchanan (1968), a static demography and economy are assumed. Economists do not seem to have developed the framework needed to deal with divergence from a steady state in pay-as-you-go or partially funded systems.

[16] It is the "life expectancy" of an average pension amount that is relevant, not the life expectancy of individuals; this is acknowledged in the legislation on the automatic balance mechanism. The pension liability is measured yearly with a three-year moving average of economic "life expectancy".

[17] The disclosure and governing of a public pay-as-you-go system suffers from what economists commonly refer to as an agency problem.

[18] The description disregards the effect that the population growth rate has on turnover duration, and it also ignores inheritance gains and administrative costs.

[19] In a pay-as-you-go system, the return on the buffer fund normally has only a limited effect on the return on total assets, since the buffer fund will normally represent only a small share of total assets. In Sweden, the assets of the buffer fund are presently equivalent to somewhat more than 10 percent of the value of the contribution asset.

[20] About two-thirds of the pension liability in a mature system, in an "OECD-economy and demography" relates to persons who have not yet retired, one-third relate to pensioners.

[21] For purposes of illustration, the figures from The Swedish Pension System Annual report 2002 can be used. Contributions were SEK 163,738 billion and turnover duration was 32.325 years. The resulting contribution asset is SEK 5 293 billion (163,378 x 32.325). The buffer fund is SEK 488 billion. The pension liability is SEK 5,729 billion. This results in a balance ratio rounded of to 1.01 [(5 293 + 488)/5,728]. Thus a "surplus" of assets over liabilities of roughly 1 percent, or SEK 52 billion. The GDP of Sweden year 2002 was approximately SEK 2 300 billion.

[22] Note that fund will be increased (or decreased) by contributions net of pension payments, in a defined-contribution system which indexes with its internal rate of return this increase/decrease will be equal in amount to the increase/decrease in the pension liability from new pension credit net of amortised pension liability.

[23] The interest rate of 1.6 percent used in converting the notional capital to a pension is subtracted when indexing pensions. This implies that the pensions of each cohort will grow 1.6 percent slower than average income even when indexing is performed with the income index. However, since new cohorts will enter the group of retirees each year, the average pension for all pensioners as a collective will grow at about the same rate as average income.

[24] However, if there are long-term strains on the system, such as a long-term population decrease, long-term deficits in the buffer fund can arise. For simulations of effects on the buffer fund when the balance mechanism is activated, see *The legislative history of the Automatic Balance Mechanism* (2000).

[25] There is however an important inefficiency in the system. Pension credits that are earned after the balance mechanism is triggered and thereby entirely or partially unaffected by a slower indexation receive the same faster indexation as all other notional capital and pensions when the balance mechanism strives towards the level of the income index. Technically this inefficiency could have been avoided, at the possible cost of increased complexity of the design.

[26] The government bill 2000/01:70 suggests the possibility of imposing a ceiling on the balance ratio. A committee is at present working on a proposal that will present rules for how a surplus should be established and distributed. Since this kind of positive balancing would still allow a balance ratio above unity, it would not change the general asymmetric design of indexing in the system.