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The Automatic Balance Mechanism of the Swedish Pension System

Ole Settergren

RIKSFÖRSÄKRINGS VERKET
The National Social Insurance Board

The Automatic Balance Mechanism of the Swedish Pension System[1]

– a non-technical introduction

Ole Settergren*
Riksförsäkringsverket
(The National Social Insurance Board)

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Abstract

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 are asymmetrically designed.

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 verca. 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. The valuation of assets is performed by a new concept, *expected turnover duration.*

* Ole Settergren is a researcher at the Swedish National Social Insurance Board (NSIB). He has been responsible for developing the automatic-balance mechanism of the new Swedish old-age pension system.

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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.[2] 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.[3]

Financially, two 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.

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 provides an introduction to the basic forms of financing and calculating pensions. It also briefly describes the reform. Section 3 serves as a general background to the financial problems that the automatic balance mechanism manages. The main financial aspects of the new system are discussed in Sections 4–6.

From Defined Benefit to Defined Contribution

Traditionally pension systems are categorised into four generic types according to degree of funding and rules for accrual of pension credit. The four types are illustrated in Figure 1.

Degree of Funding

Systems with funded assets equal to or greater than the pension liability can be considered fully funded. Fully funded systems are represented by quadrants II and IV in Figure 1. Systems with zero or relatively limited funded assets in relation to pension liability are called *pay-as-you-go* systems; in Figure 1 these are represented by quadrants I and III.

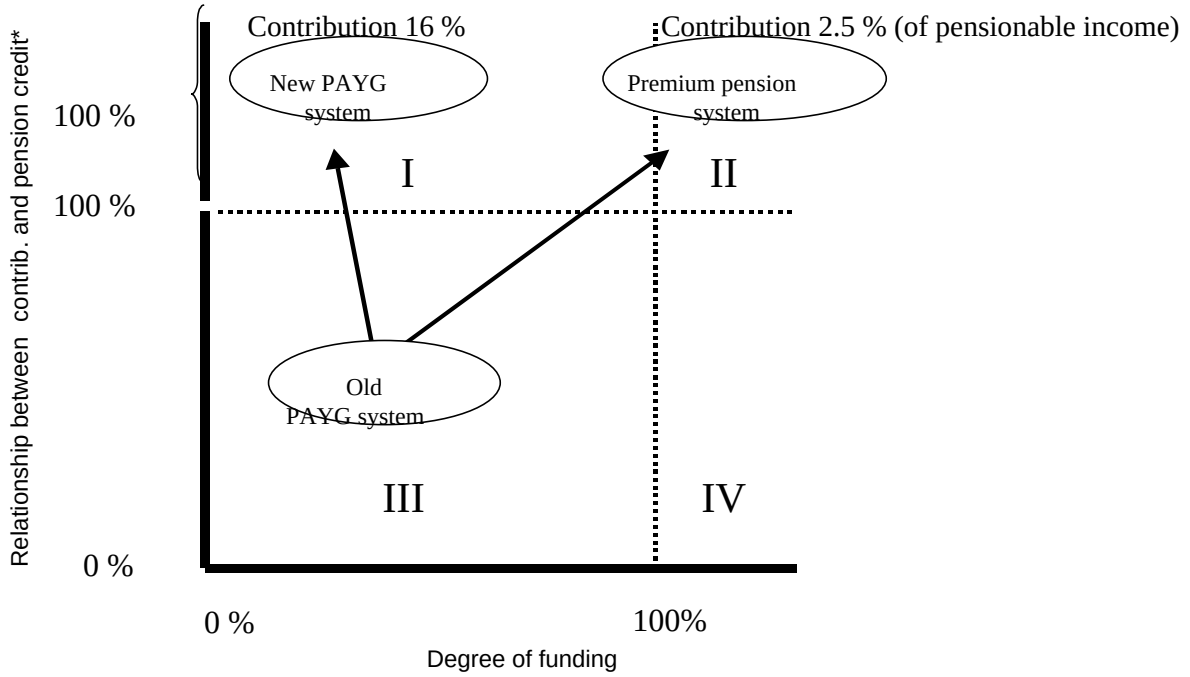
Several pension systems are treated as pay-as-you-go systems even though they possess a substantial fund. Such funds can be regarded as demographic and economic *buffer funds.* An example is the federal pension system in the United States – possibly the largest single economic transfer system in the world – which includes a substantial buffer fund. The Swedish pay-as-you-go systems, both the old and the new, also have a buffer fund.[4]

[2] The principal features of the new system were published in 1992. Parliament decided in 1994 that legislation should be drafted in accordance with the principles proposed in 1992. At about the same time, the Amato (1992) and Dini (1995) reforms of Italy were presented. The Italian reform is similar to the Swedish one.

[3] The process of pension reform has been consistently supported by some 85 % of the members of Parliament.

[4] Presently the Swedish buffer fund holds assets of roughly SEK 550 billion. This represents some 25 % of GDP, or four years of pension payments.

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



* Even if pension credit exactly equals contributions for every individual, contributions will only equal expected pension benefits (as distinct from pension credit), for individuals whose "time-preference rate" in substituting income for pension equals the rate of indexing (compounding) of his/her pension claim (capital).

Relationship Between Contribution and Pension Credit

Pension systems in which every contribution gives rise to corresponding pension credit are called *defined-contribution* systems.[5] Private life insurance is normally of this type. Defined-contribution systems have traditionally been associated with fully funded schemes. In Figure 1 the defined-contribution schemes are represented by quadrants I and II. It may be argued that quadrant I does not really 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.[6]

[5] The International Accounting Standards Committee, IAS 19 (revised 1998), states that under a defined contribution plan:

(a) the enterprise's legal or constructive obligation is limited to the amount that it agrees to contribute to the fund. Thus the amount of the post-employment benefits received by the employee is determined by the amount of contributions paid by an enterprise (and perhaps also the employee) to a post employment benefit plan or to an insurance company, together with investment returns arising from the contributions; and

(b) in consequence, actuarial risk (that benefits will be less than expected) and the investment risk (that assets invested will be insufficient to meet expected benefits) fall on the employee.

Recognising that governments normally can not be legally constrained in fulfilling "promises" made under a pay-as-you-go pension plan, the new largely unfunded Swedish pension system complies with the IAS definition, substituting *investment returns arising from the contributions* with "indexation of the contributions" (and *employer/enterprise* with "government/taxpayers", *employee* with "insured")

[6] Since there is nothing n*otional* about either the contribution or the pension credit resulting from it, the term "notional defined-contribution (NDC) system" is somewhat unfortunate.

Pension systems that allow discrepancies between the contribution paid by an individual and the pension credit that accrues in relation to that contribution are called *defined-benefit* systems.[7] 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 %. National pension schemes have universally 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.

Differences in the Dynamics of Defined Benefit and Defined Contribution Systems

The demographic and economic developments that force changes in contribution rate or the value of pensions is here called *uninsurable risks*, it is more precisely defined in Section 3. A defined-contribution system (weather funded or *pay-as-you-go*) must assume uninsurable risk by adjusting the pension level. Increasing the contribution rate is not a viable response to a deficit.[8] A government run defined-benefit system can be designed to assume uninsurable risks by altering the contribution rate *or* by adjusting the value of pensions *or* by a combined adjustment of contribution rate and pension level.[9]

Since financially warranted adjustments in a government run defined-benefit scheme *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. There are both positive and negative aspects to this flexibility. In practise government run defined-benefit schemes have not specified in the rules of these schemes how it will accommodate for uninsurable risks.

The Direction of Swedish Pension Reform

As is clear from Figure 1, Sweden has moved from a defined-benefit system to two types of defined-contribution systems. In the new system, 14 % of contributions (2.5/18.5) will go into individual financial accounts (fully funded), while the remaining 86 % (16/18.5) will be channelled into the new pay-as-you-go system. This paper will only discuss financial aspects of the pay-as-you-go system. For a description of the old and new systems, including the fully funded portion of the new system, see Palmer (2000).

The equivalent of 16 % of each individuals annual pensionable income,[10] will be credited yearly his or hers notional account. The corresponding amount is transferred to the systems buffer fund, which finances pension payments. The "interest" earned on the notional account is either

[7] The IAS states that under a defined contribution plan:
(a) the enterprise's obligation is to provide the agreed benefits to current and former employees; and
(b) actuarial risk (that benefits will cost more than expected) and the investment risk fall, in substance, on the enterprise. If actuarial or investment experience are worse than expected, the enterprise's obligation may be increased.

[8] In an NDC system, a temporary deficit can be remedied by increasing the contribution rate, but it is risky to do so. If the cause of the deficit in the first place continues, the deficit may become even larger than at the outset. In both a fully funded DC system and a NDC system the long-term pension level can be increased or withheld by increasing contribution rates, but not the pension level in the short term.

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

[10] The pensionable income consists to about 80 % of wages and salaries; some 20 % is pensionable incomes from social insurance, for example unemployment or sickness insurance. Government annually finances pension credits on such non-wage pensionable income.

the increase in average income as measured by an income index or an approximation of the internal rate of return in the system, as measured by the balance index explained in Section 5.

There is no formal retirement age in the new system. 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 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 the average life expectancy at retirement, which is calculated in the year the individual reaches the age of 65. A specific annuity divisor is determined for each annual cohort. If life expectancy increases, this implies that 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. Further the annuity from the notional account is calculated at an interest rate of 1.6 %. The pension is subsequently indexed with the growth in average income or with the internal rate of return minus 1.6 %.

One important reason for changing to defined contribution systems was to establish a closer link between contributions and expected benefits. Thereby the negative effects of marginal tax rates would be lessened, work incentives would improve, and hopefully the legitimacy and credibility of the public pension system would be enhanced.

Uninsurable Risks and Financial Stability

Pension systems are instituted to distribute risk. Basically the risk is that of prolonged old age: i.e., of living longer than an average number of years with little or no income-generating capacity. However ingeniously pension insurance may be designed to accomplish its task of risk distribution, it will carry uninsurable risks at the aggregate level of all insured persons as a collective. The primary uninsurable risk arises from the fact that the payment of obligations incurred now and in the past will be made in the future; tomorrow's income from today's assets is always uncertain. [11] A second uninsurable risk of a pension system derives from its promise to pay a pension as long as the insured is alive. When the pension annuity is calculated, it is uncertain for how long it will have to be paid.

The downside of these 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. The existence of uninsurable risks may lead to significant and unwarranted inter-generational transfers of income.

A NDC system which index notional pension capital and pensions with the growth in average income produces a very stable ratio of average pension over average income. The average pension as a percentage of the average income of those working is referred to below as *the pension level*. Pensions will increase (decrease) at the same rate as average earnings.[12] Replacements rates will be rather stable over time.

[11] 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 situations can be substantial, is that of fraud.
[12] In the new Swedish system, however, a "guarantee pension level" will protect pensioners with the lowest pensions from the loss of purchasing power that other pensioners will suffer if average income growth is less than 1.6 %. The

Mainly for this reason, Swedish reformers have decided, as a general rule, to index notional pension capital and pensions[13] by the growth in average income, as measured by an income index.

Certain courses of demographic and economic development *may* make it impossible to achieve the dual goal of indexing the pension liability by the growth in average income *and* maintaining a fixed contribution rate. The social and political objective of a stable relationship between the average pension and average income is the principal source of the financial-instability problem. In the Swedish discussion on pensions, "uninsurable risk" has thus come to mean the risk of being unable to index notional pension capital and pensions by the growth in average income while also maintaining a fixed contribution rate.

Uninsurable risks are present whether a pension-insurance scheme is organised as a private or public system and whether it is funded or not.[14] By definition, an uninsurable risk cannot be avoided. However, a public pension system can and arguably should be designed to minimise the potential impact of uninsurable risks on the contribution rate and/or the value of pensions. A financially stable pension system is a comprehensive contract. Its rules extend to the manner in which it will deal with uninsurable risks. These rules may define under what circumstances, when, and by how much either the contribution (tax) rate or pension level must be changed. The new Swedish pay-as-you-go pension system is financially stable in the sense that legislation specifies the circumstances under which pension levels must be decreased and the way in which this is to be accomplished.[15] The legislation also provides for automatic re-establishment of the pension level after it has been decreased.[16]

Assets and Liabilities

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 problem with applying this simple principle to a pay-as-you-go pension system is the lack of an objective method of valuing its principal asset: that is, its assumed perpetual flow of contributions.

The valuation of the pension liability in pay-as-you-go systems entails the same general difficulty in choosing the "right" discount factor as in the case of funded insurance. Since there has been no method of valuing assets for comparison with a pension liability which is also of uncertain value, generally this liability in pay-as-you-go systems has been of limited interest.

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guaranteed pension is indexed by the change in the consumer-price index and is financed by general tax revenue, not by the contributions to the income-related system. The potential cost of this safeguard is thus borne by the taxpayers.

[13] The interest rate of 1.6 % 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 % slower than average income. 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.

[14] The source, character and magnitud of these risks dependent on the rules of the insurance and on how the scheme is organised, whether it is private or public, funded or unfunded.

[15] 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 Settergren (1997, in Swedish).

[16] Possible effects of the rules have been described in Settergren (2000). Available at www.rfv.se/publi/alder.

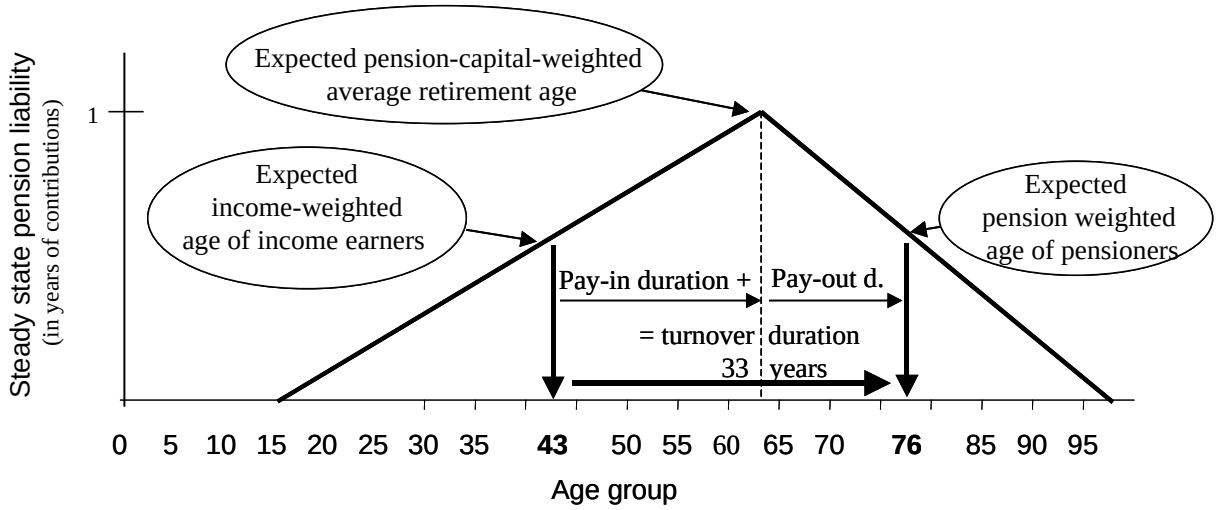
The automatic-balance mechanism is essentially a method of valuing contributions to a pay-as-you-go system. It makes it possible to compare assets and liabilities of such systems. The determinants of assets and liabilities are briefly explained below.

The Contribution Asset

The value of contributions to a pay-as-you-go pension system depends on the degree to which the contributions can finance, or 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.[17] The age-related income and mortality pattern is referred to here as the *expected turnover duration* of the system.

Figure 2 illustrates the age-related distribution of the pension liability in the Swedish system that would accrue with the income and mortality patterns of 1998, assuming zero population growth. The expected income-weighted average age at which pension credit is received is 43. The expected pension-weighted average age at which pensions are disbursed is 76. Turnover duration is then approximately 33 years (76 - 43). Turnover duration is thus the sum of the *expected pay-in duration* and the *expected pay-out duration*.[18] 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.

Figure 2. Illustration of the Turnover Duration Concept (Sweden 1998)



* The accumulated steady state pension liability is synonymous to the contribution asset.

Contributions multiplied by expected turnover duration indicate how large a pension liability can be financed by contributions 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 contributions to a pay-as-you-go system, or *contribution asset*.

[17] This capacity is also influenced by the population growth rate (labour force growth rate). In the automatic balance mechanism, turnover duration will be 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 assets will be (slightly) overestimated if population growth is negative, and vice versa. The interest rate of 1.6 % that is deducted when indexing pensions shortens the turnover duration.

[18] 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.

Contribution asset = contributions x *expected turnover duration* (1)

The contribution asset can be defined as the present value of a perpetual annual fixed contribution 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.[19] To my knowledge there has been no previous mention 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.[20]

It follows from Eq. 1 that the asset of the pay-as-you-go system will grow with the growth of the contribution base (the contribution rate is assumed to be 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.[21] 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.

Assets = contribution asset + buffer fund (2)

The Pension Liability

The present value of the pension liability is the discounted flow of expected future pension payments represented by the pension liability at the time of measurement. If the notional pension capital and pensions are indexed at the internal rate of return of the system, the present value of the liability will equal the nominal pension liability. In a defined-contribution pension system, the nominal pension liability is easy to calculate. 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) and the liability to those who are already receiving pensions (PL_r), thus

$$PL = PL_w + PL_r \tag{3}$$

where,

$$PL_w = \sum NPC_i, \text{ for all individuals } i \tag{4}$$

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

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

[19] The formula for calculating turnover duration in the Swedish system is found in Settergren (2000) pp. 93–96 (www.rfv.se/publi/alder) and in the Swedish Government proposal Regeringens proposition 2000/01:70, pp. 73–75.

[20] The concept of turnover duration was presented in Settergren (1999). Valdés-Prieto (2000) lists 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.

[21] The standard reference in this context is Paul Samuelson (1958) "An Exact Consumption Loan Model of Interest, With or Without the Social Contrivance of Money". 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 have not developed the framework needed to deal with divergence from a steady state in pay-as-you-go or partially funded systems.

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[22]

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 need for projections in estimating the present value of the pension liability is eliminated 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: [23]

(a) +	growth of the contribution base
(b) +	change in age-related income and mortality patterns
(c) +	return on the buffer fund
⟶	*return on assets*
(d) -	impact of changes in life expectancy 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 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 in time be depleted.

(b) change in age-related income and mortality patterns

Changes in age-related income and mortality patterns affect the liquidity of the system. The relevant age-related income and mortality patterns are measured by the turnover duration. If turnover duration increases, so does liquidity, and *vice versa*. The isolated present value effect on liquidity from a turnover-duration-change is equal to the change multiplied by contributions.

(c) return on the buffer fund

The return on the buffer fund naturally affects the internal rate of return.[24] The higher the return on the buffer fund, the greater the growth in the assets of the system – and vice versa. In

[22] 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".

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

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, mainly in relation to the growth in the contribution base, 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

With changes in life expectancy, the internal rate of return will differ from the return on assets. An increase in life expectancy increases the pension liability. 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.[25] 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[26] 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.

The Automatic Balance Mechanism

As a rule, the pension liability 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 which are recorded in the pension system. There is thus no element of forecasting in the calculation. The relationship between assets and liabilities is to be reported annually as a *balance ratio*:

$$\textit{Balance ratio}^{27} = \frac{\textit{Contribution asset} + \textit{Buffer fund}}{\textit{Pension liability}} \quad (6)$$

[24] 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 % of the value of the contribution asset.

[25] This feature of a public old-age pension system is highly irrational if some share of the years added to life expectancy is healthy and potentially productive ones.

[26] About two-thirds of the pension liability in a mature system in a OECD country relates to persons who have not yet retired, one-third relate to pensioners.

[27] For purposes of illustration, the following figures can be used. Contributions are approximately SEK 145 billion; turnover duration is roughly 33 years (of which 22 are pay-in duration and 11 are pay-our duration). The resulting contribution asset is SEK 4,785 billion (145 x 33). The buffer fund is assumed to be SEK 550 billion. The pension liability is approximately SEK 5,300 billion. The balance ratio is then (4,785 + 550)/5,300 = 1.0066. (The GDP of Sweden in the year 2000 was approximately SEK 2 100 billion).

The balance ratio summarises the effect of all risk factors (*a*)–(*d*). Note that fund will be increased (or decreased) by contributions net of pension payments, in a defined-contribution system 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.

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. 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. If this imbalance were allowed to persist, the buffer fund would be depleted.

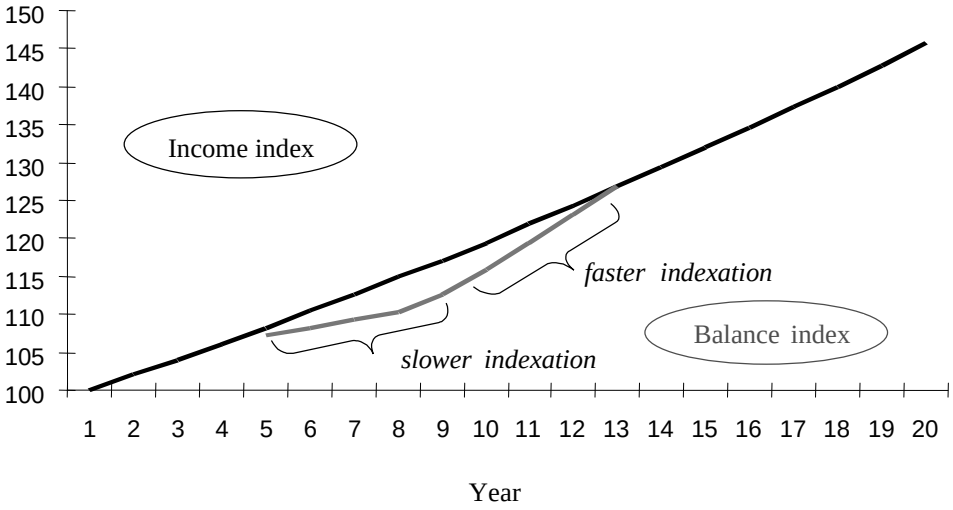
If the balance ratio falls below 1 the automatic balance mechanism is activated. It switches the indexation of pensions and notional pension capital to a new index series, called a *balance index*. The balance index is established by multiplying the income index by the balance ratio. The balance index 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. 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 (and pensions as well) 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.[28] To prevent the liability from becoming more than insignificantly larger than assets, 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.

Figure 3 illustrates how balancing works in a scenario where it is first activated and later discontinued.

[28] 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 Settergren (2000).

Figure 3. Income index and the balance index



The Assumption Behind the Valuation of the Pension Liability

In Section 4 it was explained that the nominal pension liability is used as an estimate of the present value of the pension liability. This gives a correct *ex post* valuation of the liability only if the rate at which the liability is indexed, including the effect of changes in life expectancy, coincides with the systems internal rate of return. If this condition could be assumed to prevail, the automatic balance mechanism would be superfluous. The nominal valuation of the pension liability is not made on an assumption that the growth in average income, including the effect of changes in life expectancy, will equal the internal rate of return. Rather, the nominal valuation is based on the view that the relationship of the long-term growth in average income to the long-term internal rate of return cannot be sufficiently known to permit a rational wager on this outcome.

There are a number of good arguments for refraining from such a bet: a generally poor record of economic and demographic forecasts; the specific demographic situation of Sweden, with zero or slightly negative population growth; 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 it.[29] 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. Note also that the valuation of the pension liability will only have a direct effect on the value of pensions when the balance mechanism is activated.

Risk Aversion and Asymmetric Financial Stability

The design of the Swedish 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

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

some time without endangering the financial stability of the system. Deviations from the objective of the system – a stable pension level – are thereby reduced.[30]

The rules of the pension system allow for surpluses to accumulate, but exclude (substantial) deficits.[31] 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 the ratio of their average pension to the average income, than they would assign a positive value to a corresponding increase in this ratio. Risk aversion implies that the cost of maintaining a buffer fund potentially larger than the fund required for a balance ratio of unity could be justified if the larger fund reduces the risk of variations in the ratio of average pension to average income. If the insured are assumed to be risk avert in this sense, 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. Balance statements are at least as crucial for judging the solvency and credibility of pay-as-you-go pension systems as they are for determining the financial position of a business or any other organisation. 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.

[30] 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 receives 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.

[31] The government bill 2000/01:70 suggests the possibility of imposing a ceiling on the balance ratio. An appropriate level of the balance ratio for initiating positive balancing has not yet been proposed, nor has the necessary analysis been performed. 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.

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