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working paper

March 2008

ATP's New Pension Model:

Investment-Driven Liabilities in Practice[1]

In February 2008 the Danish parliament passed an amended ATP Act under which market value principles will be applied to the accrual of pension rights. New ATP contributions will be split into two parts: a 'guarantee contribution', which will accrue to provide a guaranteed, lifelong pension; and a 'bonus contribution' to ATP's bonus potential, which is ATP's investment buffer. The new model will thus directly bolster ATP's investment freedom, and is therefore a specific example of investment-driven liabilities.

Introduction

When contributions are paid into the ATP scheme, they are converted into a right to a lifelong annual pension from the age of 67 using a price list (tariff). The tariff used since 2002 is illustrated in Table 1. Further pension rights are earned for every year that new contributions are paid, and added to the existing entitlement.

The tariff from 2002 is based on a number of assumptions, which include, among others, life expectancy and an interest rate of 2 per cent.

The same assumptions also apply, in essence, to the accounting treatment of ATP's pension liabilities. However, on one point there is an important difference of method: this relates to the assumed interest rate. The accounting treatment of ATP's pension liabilities requires that these are reckoned at market value, i.e., that a market rate of interest[2] is applied, instead of the 2 per cent assumed in the tariff.

Michael Preisel, Head of Quantitative Research, ATP

Søren Fiig Jarner, Chief Analyst, ATP

Chresten Dengsøe, Chief Actuarial Officer, ATP

Table 1 The relation between age, annual pension right and the accounting provision to be made by ATP per DKK 100 contributed

Age	Contribution	Pension right per DKK 100 contributed		Difference between contribution and market value of guaranteed pension
		Guaranteed pension from age 67	Market value of guaranteed pension	
60	DKK 100	DKK 9 p.a.	DKK 75	DKK 25
50	DKK 100	DKK 11 p.a.	DKK 62	DKK 38
40	DKK 100	DKK 13 p.a.	DKK 51	DKK 49
30	DKK 100	DKK 16 p.a.	DKK 43	DKK 57
20	DKK 100	DKK 18 p.a.	DKK 35	DKK 65

Note: The Table uses the calculation basis of the accounts for Q1 2007 (excl. child and spouse benefits). The quoted annual pension rights therefore differ from the tariff published in the ATP Act from 2002.

The difference in interest rate assumptions results in a difference arising at the time the contribution is made between the contribution and the market value of the guaranteed pension that it corresponds to. As the market interest rate is higher than 2 per cent, the amount to be set aside by ATP is smaller than the amount of the contribution. The difference between the contribution and the market value of the guaranteed pension can be seen in Table 1.

It can also be seen from Table 1 that the difference between the contributions and the market value of the guaranteed pension is age-dependent. Younger members of the ATP scheme thus obtain pension rights that are, relatively, not as good as those obtained by older members, in terms of the market value of the pension. Furthermore, the difference depends on the actual level of market interest rates. The differences arising will thus vary from year to year, according to market rate fluctuations.

The new model

It is in this light that ATP has wanted to develop a new pension model that continually adjusts to the current level of interest rates. The rationale is that if the present market rate is 5 per cent, then ATP can guarantee 5 per cent in interest. If the market rate is 6 per cent next year, ATP will then be able to guarantee 6 per cent interest for new contributions.

Under the former scheme the pensions would in practice accrue at a higher rate than the one guaranteed. Indeed, the interest rate of 2 per cent figure was consciously chosen conservatively, in the expectation that in practice the investments would yield a higher return. The surplus thus arising is continually passed back to the members in the form of bonus (indexation).

ATP has wished to retain the possibility of bonus in the new pension model. This is due partly to the fact that the anticipated ATP pension increases when there is a certain freedom in the investment policy, and partly to make new contributions fit with the existing pension savings, which already have an expectation of bonus.

This aim will be achieved by dividing new contributions into two parts: a 'guarantee contribution' of 80 per cent and a 'bonus contribution' of 20 per cent. The guarantee contribution will be used for the 'purchase' of a pension right with a guaranteed rate of interest corresponding to the market rate. The bonus contribution will be added to the free reserves – the bonus potential – thereby serving as an investment buffer for ATP's investment policy. The bonus contribution thus becomes a direct payment for the bonus option to which existing rights already qualify.

It is important to emphasise that free reserves – including bonus contributions received – are passed back to members, over time, as future bonus attributions.

To summarise, the proposal on pension right accrual thus involves three components:

1. Age-pension rights to be earned in the new model on the basis of the level of current market interest rates.
2. The acquisition price of the age-pension rights (the tariff) to be set for one year at a time.
3. A fixed proportion of the contribution to be used to accumulate guaranteed age-pension rights (the guarantee contribution), while the remaining part enters the bonus potential (the bonus contribution).

The new pension model

As described in the Introduction, ATP's former and new pension models both contain a guaranteed component and a bonus component.

The guaranteed component is the annual pension that the recipient can be sure of receiving from retirement age until death. For historical reasons, ATP pension rights are based on a retirement age of 67, and therefore that will be taken as the retirement age in the following. For persons born before 1961, who under the Welfare Agreement still have an option of retiring before the age of 67, the ATP pension is recalculated on retirement, as it must last for a greater number of years.

Guaranteed pension

For example, a member who has accumulated pension rights amounting to DKK 20,000 and who is now 50 years old can look forward to receiving DKK 20,000 a year (divided into 12 monthly payments) from the month in which he or she reaches the age of 67, until his or her (unknown) date of death.

As the time of death for a given individual member is, in the nature of things, unknown, ATP's expenditure on future pension payments to that particular member are also obviously unknown.

However, that consideration only applies in relation to the individual. If instead one looks at all 50-year-old members of the ATP scheme (about 80,000), the majority will survive to the age of 67 and will therefore be due their DKK 20,000 pension. Fewer of them will reach 68, and still fewer 70, 80 or 100. ATP's expected pension payments to members who are now 50 years old therefore decrease the longer into the future one looks.

The expected payment *per member* is therefore also a decreasing figure. Precisely because ATP has such a large number of members, it is reasonable to consider only the average pension payment per member.

It is then relatively simple to calculate the market value of the ATP pension. For each member, the present value of the expected pension is calculated by discounting the expected cash flow, using the market interest rate.

There is, however, a 'but', because the calculated value is naturally very sensitive to the assumed life expectancies used to establish the expected cash flows. It is known that life expectancies are generally increasing, i.e., a 50-year-old in 2017 will have a higher life expectancy than a 50-year-old of today. The expected pension payments are therefore based on an annually updated prognosis for the future life expectancy development. In the accounts, the sum of the present values of all ATP pensions can be found under the item *Guaranteed benefits.*

Tariff

As the market value has been established, it is now easy to derive the tariff for the guaranteed part of the ATP pension in the new model by simply letting the guarantee contribution equal the market value of the guaranteed pension. This is illustrated in Table 2, in which the annual pension right per DKK 100 contributed is shown for various market interest rates. With an 80 per cent guarantee contribution (more on this below), pension is earned for 'only' DKK 80 of every DKK 100 contributed.

Apparently, the tariff will depend explicitly on the level of interest rates at the time the contribution is made. The annual pension of a 40-year-old who pays the full ATP contribution of DKK 3,240 will thus rise by DKK 648, if the level of market rates in the year the contribution is made is 4.5 per cent. The amount of DKK 648 is calculated as (3,240 · DKK 20)/100. However, if the general rate of interest had been 3.5 per cent, the annual ATP pension would have grown by DKK 486, while it would have increased by DKK 875 if the rate were 5.5 per cent.

Every autumn, ATP will therefore publish a tariff for the coming calendar year, so that the terms on which pension will be earned are known at the time the contributions are made.

Bonus

The guaranteed part guarantees only a minimum nominal pension – in other words, an annual amount in DKK. Accordingly, if the guaranteed part stood alone, pensioners would see the purchasing power of their ATP pension being eroded year by year as prices rose while the pension remained unchanged.

Table 2 Annual pension right per DKK 100 contributed at various market interest rates

Age	Market rate		
	3.5%	4.5%	5.5%
60	8	10	11
50	11	14	17
40	15	20	27
30	19	28	41
20	25	39	62

Note: Observe that in the example pension right is accrued only in respect of the guarantee contribution, i.e., 80 per cent of each DKK 100 contributed.

The second component of ATP's pension model is therefore bonus. To generate the excess return needed for being able to attribute bonus it is necessary to have a certain investment freedom allowing long-term investment in equities, for example. Historically, equities have given a higher return than, for example, bonds, but with much greater price fluctuations from year to year.

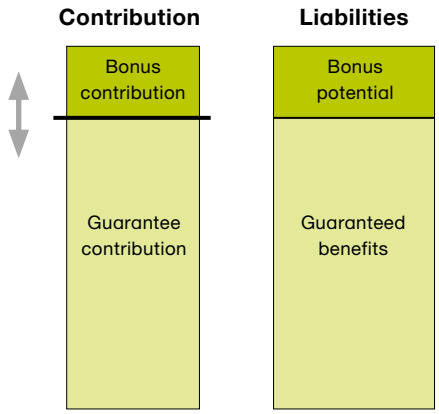
To withstand these greater price fluctuations it is necessary to have an investment buffer of a certain size, to absorb short term fluctuations in order to yield higher returns in the long run. This buffer appears in ATP's accounts under the item *Bonus potential.* The bonus potential represents funds that belong to ATP's members, but have not yet been distributed among them.

The former ATP scheme already has a considerable bonus potential as an investment buffer for existing pension rights. Therefore, if ATP were to begin to provide a guaranteed pension for the whole contribution, new contributions would be in a more favourably position than existing rights, being entitled to bonus from the bonus potential without having contributed to it.

This is illustrated in Figure 1, where existing members' claims on the assets, split into guarantee and bonus, can be directly observed from the relation between guaranteed benefits and the bonus potential. 'New' and 'old' money can be put on an even footing if the relation between the guarantee contribution and the bonus contribution is the same.

The purpose of the bonus contribution is thus to make the expectation of bonus associated with pension rights accruing under the new model the same as that for previously accrued rights. In this way equal status will be assured for all pension

Figure 1: Division of new contributions into guarantee contribution and bonus contribution compared with the division of already accrued rights into guaranteed benefits and bonus potential.



rights from inception, despite the fact that rights have accrued under different models.

Taken to its extreme, this principle would mean that the bonus contribution should also be set for one year at a time, since the relation between bonus potential and guaranteed benefits does vary from year to year. As ATP aims to attribute bonus if the bonus ratio (bonus potential divided by guaranteed benefits) exceeds 20 per cent, the average bonus ratio will stabilise at around 25 per cent in the long term.

The bonus contribution is therefore set at 20 per cent, corresponding to that long-term expectation, so that the relation between bonus contribution and guarantee contribution will be the same, 25 per cent, as is built into the bonus policy. The guarantee contribution is consequently set at 80 per cent.

Capital structure and business model

It is a key element in ATP's new pension model that the interest rate risk on new pension rights can be hedged. It thus fits seamlessly into the business model that ATP has developed over recent years. The model is described in Jepsen (2006), and we will merely sketch the general principles here.

The core of ATP's business model is the splitting of its investment activities into investment business and hedging business. The key to understanding this split is the so-called funding account, which consists of two opposing interest-bearing accounts, one in the investment portfolio and one in the hedging portfolio, with zero net value.

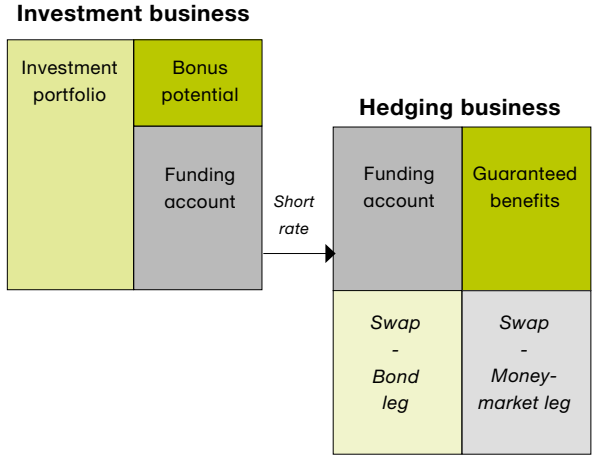
The principle is illustrated in Figure 2, where it can be seen how the funding account is used to create a balance sheet for ATP's investment business, with the assets – ATP's actual investment portfolio – being financed by the bonus potential and the funding account. ATP's hedging business has the funding account and the long leg of the swaps used for the hedging programme on the assets side, while the liabilities side comprises the pension liabilities (the guaranteed benefits) and the short leg of the swaps.

The principle is then to choose the composition of the swap portfolio in such a way that the interest-rate sensitivity of the swap agreements matches the interest-rate sensitivity of the guaranteed benefits. In an ideal world, it would be possible to put together a perfectly matching hedging portfolio, so that the market value of the fixed leg of the swaps was exactly equal to the guaranteed benefits.

In that case, the value of the money-market legs would also be equal to the guaranteed benefits, and so the value of the funding account too would have to match the guaranteed benefits to make the two sides of the hedging-business balance sheet equal. The interpretation of the funding account is, therefore, that it expresses the historic sum of the guaranteed benefits, as they are hedged.

However, the real world poses a number of challenges – taxation, for example, which mean that in practice the hedging business is more complicated than in the foregoing idealised outline. These issues are addressed in Preisel, Jarner & Eliasen (2006).

Figure 2: ATP's splitting into investment business and hedging business



New contributions
The new pension model has been created in the image of this business model.

For each DKK 100 in new contributions, DKK 80 is used for the 'purchase' of guaranteed pension. In the hedging business, the guaranteed benefits accordingly grow by DKK 80, because the guarantee contribution is equal to the market value of the guaranteed pension. The expected cash flow is now hedged with a swap, where the principal will be the same DKK 80 because it is precisely the swap rate which is used in the discount calculation to determine the guaranteed benefits. The fixed leg therefore now matches the new obligation, so the floating leg has to be matched by the funding account. The funding account therefore also increases by DKK 80. Accordingly, the hedging portfolio balance sheet totals show a net increase of DKK 160, but it remains a 'zero sum game'.

In the investment business, the assets side (investment portfolio) increases by DKK 100, which exactly corresponds to the increase in the funding account of DKK 80 plus an increase of DKK 20 in the bonus potential from the bonus contribution.

The point is that because it is precisely the market rate that ATP guarantees, it is possible to exactly hedge the new obligation (guarantee contribution = market value of guaranteed pension). The high interest-rate guarantee is therefore – from a financial point of view – risk free. It is of course not completely risk free, because ATP is accepting exposure to counterparty risk through the swaps. Tax changes may also have an unfavourable effect on ATP's balance sheet, because a tax-adjusted interest rate is used to calculate the guaranteed benefits.

Improved pension accrual
The most important motive for the change to the ATP scheme is that ATP believes the new pension model to be better. As described above, pensions accrued are brought in under the market value principle; but not only that, the expected pension itself will also be higher.

Such an assertion must necessarily be qualified.

In the following we use the former ATP model as a reference, and by 'higher expected pension' we mean a higher pension under the investment principles followed by ATP at present. Accordingly, in the calculations below it is only the *accrual principle* that is changed, while the investment and bonus policies (and risk tolerance) remain unchanged , cf. Jepsen (2006).

The central point is whether the generally higher guarantee in the new pension model reduces ATP's investment freedom: if ATP's freedom is reduced when the guarantee is increased, the bonus expectation will fall. The net result would therefore be zero, as a higher starting pension would subsequently be neutralised by lower bonus.

Investment freedom
That is not the case with the new pension model. The investment freedom is fundamentally unchanged under the new accrual principles, and the investment return engine is thus unchanged in relation to the former model.

Qualitatively, the explanation is to be seen in Figure 2. Here it can be seen that bonus can be distributed out of the excess of the return generated by the *investment* business over the funding interest paid to the hedging business.

The bonus contribution in the new pension model is exactly tuned to the bonus policy. The bonus potential will therefore *on average* be the same under the new as under the former pension model – and the investment freedom will therefore also be the same (on average). This is due to the fact that the bonus potential is both an investment buffer and a source of bonus distribution.

An unchanged investment engine does not in itself give rise to expectations of higher pensions. The anticipated return will indeed remain essentially unchanged, so the two pension models differ only in the time at which this return is passed back to the members as bonus.

Therefore, at this point we will conclude only that the investment freedom is not reduced in consequence of the higher guarantee.

The slope of the yield curve
There is, however, a particular component of the investment return that is of special interest. This is the so-called *term premium,* which popularly speaking means that long-term bonds typically have a higher average yield than short-term bonds. This can be explained by saying that investors demand a risk premium for choosing long bonds rather than short bonds.

However, it is not in the investment business that this is of interest, but in the hedging business.

As can be seen from Figure 2, the new pension model means ►

that ATP will be systematically issuing pension rights at long-term rates (the guaranteed benefits), while the net obligation will be at short-term rates (via the funding account).

ATP is thus continuously exposed to the slope of the yield curve, which – as mentioned – is essentially positive, and thereby to the term premium. In addition to the extra return (risk premium) that the investment business produces, ATP's business model thus entails that the hedging business will also ongoingly realise a risk premium, which will contribute to higher pensions.

It is in this light that the assertion regarding 'higher expected pension' in the new model has to be seen. As a greater proportion of the contribution will be guaranteed, the gain derived from term premium will also increase – thus increasing the expected pension.

Moreover, as the hedging business is a zero sum game, the improvement is achieved *structurally,* i.e., without increasing the investment risk in the ATP scheme. The new pension model is thus an example of *investment-driven liabilities,* where the overall pension result is improved exclusively by adapting the pension *product* to the investment realities.

Three scenarios

To illustrate these effects we have set up three scenarios. Each (static) scenario defines an equity return and a short- and long-term interest rate, which are used for hedging and calculation of the return on bonds. In each scenario, the ATP pension is projected for 150 years from 2005 to 2155 for both the former and the new pension model, with the assumption that the ATP contribution is ongoingly increased in line with wage inflation . The investment and bonus policies are the same in all the scenarios.

To demonstrate the effect of the accrual model alone, we follow a person born in 2005 who is assumed to pay the full ATP contribution from the age of 20 until pension age at 67. In this way, the transition effects of the change to the new model are largely eliminated .

The three scenarios are set out in Table 3. The first is a 'no difference' scenario, where allocation decisions are of no importance, since all investments yield a 5 per cent return. In the second scenario we introduce a 2 percentage-point yield-curve slope, and in the third scenario we further introduce a risk premium for equities.

Table 3 Three static financial scenarios

Scenario	Equity return	Short-term interest rate	Long-term interest rate	Price inflation
#1	5%	5%	5%	2.5%
#2	5%	3%	5%	2.5%
#3	8%	3%	5%	2.5%

Scenario #1

The pension profile according to the first scenario for a person born in 2005 and retiring in 2072 is shown in Figure 3. We have used the starting pension payment of the former model to establish the scale for the graph. The new model can be seen to pay out approximately 15 per cent more as starting pension than the former model, which subsequently catches up after about 12 years.

In scenario #1, the effects of investments and hedging are kept out of the picture, as all returns are set at 5 per cent. The result in Figure 3 is therefore that the higher guarantee results in a higher starting pension in the new model, but that the former model catches up over a period of approximately 12 years thanks to higher subsequent indexation. From then on, the former model gives a higher pension than the new model.

Figure 3: Expected pension payments in scenario #1 for a person born in 2005 under the former pension model and under the new model

Note: The pension profiles are standardised on the first pension payment under the former pension model.

Figure 4: Expected pension payments in scenario #2 for a person born in 2005 under the former pension model and under the new model

Note: The pension profiles are standardised on the first pension payment under the former pension model in scenario #1.

The steeper payment curve of the former pension model should be seen in the light of the fact that the expected pension in Figure 3 is dependent on *survival*. Thus, there are many more recipients of the starting pension, which is higher under the new model, and relatively fewer who survive to the age of 87, when the former model overall pays out more than the new model.

When the pension curves shown are weighted for the survival probabilities for persons born in 2005, the models pay out essentially the same amount of pension.

Scenario #2

In the second scenario we have introduced a 2 per cent yield-curve slope. In this way it is possible to study the net effect of guaranteeing the market interest rate and then hedging it. The result is shown in Figure 4. Here it can be seen that the starting pension is improved in both models in relation to the first scenario (Figure 3), but also that the new model gives a generally higher pension expectation than the former model.

The new model thus achieves far better realisation of the risk premium offered by the yield curve than does the former model. With weighting for survival, the value of the pension in the new model is considerably higher than in the former model.

Scenario #3

In scenario #3 we introduce an equity risk premium of 3 per cent in addition to the term premium of 2 per cent. The expected pension profiles are shown in Figure 5. On comparison with Figure 4 it can be seen that the starting pension in both pension models is further improved, as the 'investment engine' is now properly engaged. Investment freedom is thus not reduced by the higher guarantee in the new model.

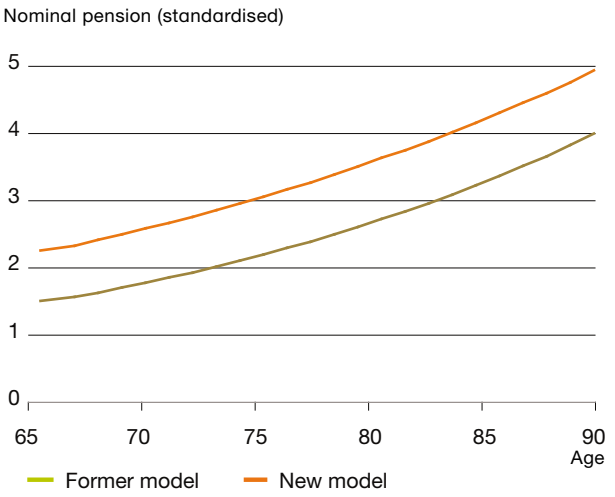
Conclusion

With the new model for pension accrual, ATP has taken a further step in the understanding of the interplay between assets and liabilities. The point of departure is the recognition that final pension depends on both the interest rate guarantee given when the contribution is made and on the bonus generated by ongoing investment activities.

ATP has been focusing on improving return on investments for a good number of years already. A significant early initiative in that connection was the establishment of the hedging business – see Figure 2 – that protects the guarantees already given. Internationally, such investment initiatives are often referred to as LDI: 'liability-driven investments'.

It was therefore natural to ask whether an accrual model could be found that, in interaction with the investment policy, would ►

Figure 5: Expected pension payments in scenario #3 for a person born in 2005 under the former pension model and under the new model



Note: The pension profiles are standardised on the first pension payment under the former pension model in scenario #1.

result in bigger pensions. The solution was to base pension accrual on the current market interest rate, because it can be *hedged.*

In other words, the liability is adapted to the investment reality, so that the (financial) risk can be transferred to the capital market. This eases the burden on the Company's risk capital, allowing it either to guarantee higher pensions or to increase risk investments. The expected pension increases in both cases.

In this light we introduce the concept of IDL – *investment-driven liabilities* – as a proactive strategy to improve future pensions. With this mindset, the design of pension products and investment strategies are discussed jointly in an endeavour to deliver the best possible pension.

Jepsen, H, 2006: Bør pensionskasser anlægge et nyt verdenssyn? [in Danish], *Finans/Invest,* 2, pp. 10-13.

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1 The paper is an English version of Preisel, Jarner & Dengsøe (2007).

2 ATP uses the Danish swap rate adjusted for 15 per cent tax on pension savings returns as the market yield curve. Allowance is also made for the fact that interest rate hedging for maturities longer than about ten years can in practice only be done on the euro swap market.

3 As the investment policy and the bonus policy are both dynamic, i.e., are adjusted to the bonus potential that ATP has at the time in question, the return on investments and attribution of bonus will usually be different in the two models, but ATP's total risk will be under control.

4 Price inflation plus 1 per cent.

5 However, the results still depend on the initial balance sheet, among other things.

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ATP, The Danish Labour Market
Supplementary Pension Fund
Kongens Vænge 8
DK-3400 Hillerød

Telephone +45 70 11 12 13
Telephone +45 48 20 41 92
mip@atp.dk
www.atp.dk