

Review of investment strategy setting in the AP-funds

15 April 2002

Prepared for

The Swedish Ministry of Finance

Prepared by

Hewitt Wassum Investment Partners

Contents

INTRODUCTION.....	1
MAIN FEATURES OF THE REVIEW PROCESS	3
ASSESSMENT CRITERIA FOR THE REVIEW	6
GENERAL FINDINGS	9
ASSESSMENT OF AP1	12
ASSESSMENT OF AP2	14
ASSESSMENT OF AP3	17
ASSESSMENT OF AP4	19
AP1 - REPORT	22
AP2 - REPORT	31
AP3 - REPORT	39
AP4 - REPORT	48

Introduction

According to the Swedish Pension Fund Regulation Act, the government will conduct an annual evaluation of the AP-funds portfolio management.

This year's report has a focus on the investment policies and the way in which they have been implemented, considering relevant regulations (see below) and objectives within the pension system. The pre-works of the Act clearly state that the investment policy for each AP-fund will be set on the basis of the liability structure. The natural way of approaching this is to conduct an ALM (Asset Liability Modelling/Management) study.

The Swedish Ministry of Finance has appointed Wassum Investment Consulting AB as an advisor, in order to support the ministry in the analysis of the processes of the four AP-funds in setting their investment policies.

Wassum Investment Consulting worked in close co-operation with its partner Bacon & Woodrow (merging with Hewitt Associates).

Overview of this report

In this report, we will initially give our general comments and views on the process of setting a fund's strategic investment policy.

In the following sections, we present our key findings and views, first on a general level, followed by fund-specific analysis. Each synopsis is supported with a report describing our study of each fund's methodology, organisation and approach in setting their investment policies.

As of January 1 2001, the rules governing investment by AP Funds were made more flexible. The objective is to maximize the return, but the overall risk shall be low for the total AP-fund system. Investment policies shall be based on the liability structure that applies for the funds. The new investment rules, which apply jointly to the First, Second, Third and Fourth AP Funds, were introduced to further enhance the requirement for a high return on investment. In brief, the new investment rules mean that:

- Investments may be made in all types of listed and negotiable instruments on the capital market.
- At least 30% of each fund's assets shall be invested in fixed income securities with low credit and liquidity risk.
- After a gradual increase, no more than 40% of a fund's assets shall be exposed to currency risk
- No more than ten percent of a fund's assets shall be exposed to one issuer or one group of issuers.
- Each fund's holding of shares in listed Swedish companies shall not exceed the equivalent of 2% of the total market value.
- Each fund may own no more than 10% of the votes in a single listed company.
- No more than 5% of the assets in each fund shall be invested in unlisted securities. Such investments shall only be made indirectly, via mutual funds or by similar means.
- External managers shall manage at least 10% of the assets of each fund.

These investment guidelines were interpreted in and elaborated upon in the pre-works of the Act.

Main features of the review process

Purpose of the review

The purpose of this review was defined by the Ministry of Finance:

- Assess whether the process followed by each Fund to set the investment policies and the strategic allocation is sensible from a financial and economic standpoint and takes into account the Funds' objectives as stated in the regulation
 - Review if the funds have undertaken relevant approaches in conducting ALM studies
 - Analyse the chosen benchmarks and reference portfolio
 - The Ministry of Finance wanted to examine whether the different boards were presented with material that adequately balances risk and return, considering the objectives of the funds. In particular, the ministry wanted to ensure that market assumptions, methodologies and conclusions were based on sound economic principles.
 - Assess whether the decision-making process allowed the boards to make an informed decision on the investment strategy setting.
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Process followed

We had at least two meetings with each Fund:

- The first one was essentially to receive a presentation by the Funds on the process followed to set the investment strategy
- The second meeting was a follow-up meeting to clarify certain issues after we had conducted a thorough review of all materials provided by the Funds

Besides these meetings, there has been extensive contact; meetings and information exchange with each Fund to further discuss specific matters. The different funds have provided us with documents, board minutes, policy documents and model descriptions to varying degrees. In order to avoid any misunderstandings on the interpretation of the information gathered, we shared with each Fund our summary of the process they followed (shown in appendix to this report) and took their comments into consideration.

We also had a meeting with the RFV to discuss the main features of the financial mechanism governing the new Social Security system. We also wanted to have a background on the factors they used in projecting the pension system into the future and on the information provided to the AP-funds.

What the review does not cover/ what we have not done

We have not done any calculations to "check" that the computing of the results was correct based on the methodology explained.

We have not reviewed the methodology used by the RFV to develop their projections, which are used by each AP fund to carry out their ALM study.

In order to set an investment strategy to manage a given amount of assets, it is widely accepted that it is best done by taking into consideration the features of liabilities – e.g. what amount of money is needed when – that the assets are meant to meet. This key principle is explicitly recognised in the legislation that applies to the AP funds.

In order to do so, a technique commonly used is Asset Liability Modelling (ALM). An ALM study considers the relationship between the assets and the liabilities and how the relationship changes over time. In doing so, it enables the "riskiness" of an investment strategy to be quantified. Each AP fund has carried out such a study in one form or another to help them set their investment strategy.

An ALM study assists in the task of formulating a long term "strategic" asset allocation or set of investment guidelines within which investment managers should operate and to which the asset allocation should periodically be rebalanced. It is not intended to affect the investment manager's "tactical" or short-term asset allocation timing decisions within the permitted ranges or decisions on the selection of individual stocks within each asset class.

An ALM study can help AP funds and other stakeholders gain a greater understanding of the factors influencing the financial position of the buffer funds and of the Social Security system, and the interaction between the assets and the liabilities. It must, however, be appreciated that an ALM study is not a prediction of future events - and furthermore it is not a guarantee of future events. The accuracy of any ALM study is always limited by the robustness of the econometric model used in the calculations and by the assumptions made.

A common technique to carry out an ALM study, which each AP fund used, is to project assets and liabilities in a stochastic way using the Monte-Carlo method. This means that a large number of projections, or simulations (typically a few thousands), of the assets and liabilities relating to the fund are carried out for a certain number of years into the future. Each such projection is based upon a random economic scenario reflecting an outcome that might happen in real life. The random variables projecting the key economic factors influencing the fund's finances (e.g. asset returns, price inflation, income index) are generated by our stochastic econometric model. It is usually assumed that demographic factors are non-stochastic, which is a reasonable assumption.

The range of outcomes for key measures for the AP funds, such as the balance figure, are then used to derive the statistical distribution of those measures as well the probability of certain events, e.g. probability that the buffer funds become insolvent over the next 40 years. The effect on the key measures of adjusting the AP funds' investment strategy can then be assessed, enabling us to analyse the relationship between risk and reward associated with investment in the various available asset classes.

In addition, it is possible to use an ALM study to analyse the effects of other factors such as changes in the legislative environment or the covered population's demography by varying these factors in the projections.

ALM process

The ALM process generally consists of a number of key elements:

- Objectives of the study
- Definition of asset classes
- Key financial variables modelled
- Process followed to select optimum portfolio
- Stochastic model
- Economic assumptions
- Demographic assumptions
- Sensitivity analysis

We describe these further in the next section. We reviewed how each AP fund considered each of those elements and used them as our assessment criteria of the process followed by the Funds to set their investment strategy. This is in addition to other key issues such as the organisation of strategic work and decision-making process.

Assessment criteria for the review

Organisation of strategic work

We wanted to understand and assess the formal and informal process followed in reaching the decisions and who was involved at the different stages:

- What tools was used?
 - How was the decision determined?
 - Who did what?
 - What resources, and what access to data and advice?
 - What are the experiences of the people involved?
 - How do they interact with the rest of the organisation?
 - How frequently is strategic work carried out?
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Objectives of ALM study

A successful ALM-study needs to start with the setting of its objectives, which can go beyond the legal requirements. It is the objectives of the study that creates the framework of the study and which impact on the results:

- What questions were the funds seeking to answer by conducting an ALM-study?
 - Who set the objectives and decided?
 - Involvement from the board and external parties?
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Asset classes

In order to be able to model and to conduct an ALM study, one needs to define the asset classes to be considered in the study and the rationale for including or excluding asset classes. It may be that certain asset classes are not reflected in the modelling process if it is believed that their modelling is difficult; they may, however, be added to the strategic portfolio based on a separate analysis. The asset classes considered may also be subdivided into sub-asset classes in a similar way. Relevant issues are as follows:

- To what extent do the asset classes considered cover available investment opportunities?
 - What is the rationale for considering those asset classes?
 - What is the rationale for ignoring certain asset classes, if applicable?
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Key financial variables modelled

Within the AP-fund system, there are several financial variables that have an important impact to the system.

- What are the financial variables modelled?
 - What is the rationale for choosing those variables?
 - Do they enable the funds to set the investment strategy in an informed way and in line with the AP funds' objectives as stated in the legislation?
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Process to select optimum portfolio

Using the asset liability model, a process is followed to determine the most appropriate portfolio:

- What was that process?
 - How robust is it?
 - Is that process in line with the AP funds' objectives?
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Stochastic model

Asset Liability Modelling is usually carried out using an econometric model that enables us to produce a number of economic scenarios under which both assets and liabilities are projected. The use of a sound model is quite important as it directly affects the quality of the results of the study.

What we looked at in particular was:

- What are the main features of the model?
 - How statistically robust and economically coherent is it?
 - To what extent does it allow for extreme events, e.g. market crashes and upside spikes?
 - Have the funds considered the model limitations and risks they exclude to analyse?
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Economic assumptions

The economic assumptions in an ALM study have an important impact on the results. We looked in particular at the following:

- What were the equity risk premia?
The equity risk premium is the expected excess return of equities over bonds and it directly affects the relative attractiveness of equities vs. bonds. How equity premia compare with each other for the different equity asset classes may have a substantial impact on the composition of the equity portfolio.
 - What was the expected excess return of bonds over inflation?
This, combined with the assumed equity premia, determines the added value generated by investments. How bond returns compare with each other for the different bond asset classes may have a substantial impact on the composition of the bond portfolio.
 - What was the expected increase in the income index?
This is an important driver of liability growth.
 - What volatilities were assumed for asset returns?
This makes an asset class more or less risky and attractive.
 - What was the rationale for setting the economic assumptions?
 - How robust was the process?
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Demographic assumptions

The demographic assumptions are used to project the population covered by the Swedish Social Security over the period used for the analysis. These are also important assumptions. We looked in particular at the following:

- What was the rationale for setting the demographic assumptions?
 - Do they make sense?
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Sensitivity analysis

Sensitivity analysis is the means by which to stress test and understand the marginal impact from various factors in the model. To really understand the ALM model and to be able to draw relevant and sensible conclusions, it is necessary to do an analysis of the sensitivity to the most important factors.

- What analysis of the results' sensitivity to the assumptions used, was carried out?
 - What analysis was done of the "model risk" and the approximations inherent in the model?
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Decision-making process

The analysis of the decision-making process aims to understand the decision-making process followed to arrive at the investment strategy:

- Where were the decisions taken?
- What was that process?
- What was communicated to the Board and when?
- Was the Board presented with all the relevant information to make an informed decision on sound financial and economic principles?

Our view

This summarises our view of the technical and decision-making processes followed by the Fund considered in order to set the investment strategy in the light of existing legislation.

General findings

A variety of approaches

Each fund is expected to define its risk factors (in line with the Act) and objectives, but on the basis of the same investment restrictions and liability structure. In doing so, they all chose a different methodology and approach to reach a conclusion on investment policy. All four funds conducted an ALM-study in co-operation with different external advisors and software providers.

They all used the liability projections produced by RFV (see below).

The variety of approaches offer an opportunity to analyse and discuss the different risk definitions, which is key for the future of the system.

Responsibilities of AP funds and the RFV in relation to liability projections

The message was very clear from the AP funds that it is not their role to do their own demographic and economic (e.g. expected labour participation) projections. This means that each AP fund relied on the projections RFV produces each year. It was also very clear from each AP funds' comments that the structure of the buffer funds within the Social Security system makes ALM studies peculiarly sensitive to the demographic and economic assumptions made in the RFV projections.

The RFV produces a number of liability projections as well as deterministic projections of the whole Social Security system for general use. Some important information for these projections comes from Statistics Sweden (SCB) and National Institute for Economic Research (KI). Some of the liability projections may vary from year to year and the emphasis is not put on ensuring consistency of projections from one year to the other. This makes it difficult for AP funds to do meaningful asset liability modelling and to make a fair assessment of the true liability and objectives for the AP-funds.

We believe that there is a need for the two parties (the AP funds and RFV) to work more closely together to arrive at assumptions for the liability modelling. This would enable long term planning, satisfying both parties. It is also necessary to allow for an open communication that allows each fund to be able to use and analyse the liabilities from their own starting point and approach. This may well mean the production of liability projections for the specific needs of the AP funds, e.g. emphasising the consistency of projections over time to the extent possible, besides the other projections carried out by RFV.

We believe that it should be the responsibility of the AP funds to ensure that they are fully confident and satisfied with the liability projections used.

Bias to Swedish equities

Investors universally tend to have a bias to their domestic market. This is justified by different reasons such as the greater familiarity to domestic stocks and managers. Each AP fund adopted a bias to the Swedish equity market.

We questioned whether this is reasonable, given the small size of the Swedish equity market. That market can also be subject to substantial changes due to mergers & acquisitions. The transition process from the old AP-system to the new one clearly showed the risks of a home bias in a small economy like Sweden.

Some of the reasons put forward to justify a bias to Swedish equities can certainly be questioned from an investment or risk-return standpoint, which is the only element the legislation refers to. Some funds believe that they can outperform the market in Sweden due to their experience and knowledge of the market. However, it is notoriously difficult to beat a developed market and one may wonder whether an investment strategy should be based on such an assumption. Similarly, the relative lack of experience of AP funds in foreign markets has little relevance as such expertise can be accessed through the outsourcing of asset management, if necessary. Greater complacency to a potential underperformance of the Swedish market, mentioned by some, also appears to be a questionable argument in light of the legislation. In most cases, the bias to Swedish equities is also justified by a higher expected return for the Swedish market. Although arguments are put forward to justify it, counter-arguments can equally be found to question it.

Objectives and liabilities

The Act states clearly that the investment policy for each AP-fund shall be set from the basis of the liability structure. In doing so, the objective shall be to maximise the long-term return with good risk diversification and a total risk level that is low. Risk shall be viewed in the perspective of future pension payments. This is in order to achieve maximum benefit for the total pension system.

It is our understanding that each of the four AP-funds shall define their own risk level, based on their own interpretation and assessment of the liabilities and determine how to best achieve the objectives expressed in the Act.

The benefit of such a system is that one gets different approaches and ideas on how to best deal with the complex issue of defining an optimal asset mix. For a new pension system like this, that can be the only way to be able to structure a sensible approach for the future.

The drawback of this is that no one has “ownership” and responsibility for meeting the total liability. Each fund will, in the end, focus on its own defined (asset) part of the system, without taking too much notice on the total impact of their decisions.

Each fund assumed in their analysis that the other funds had adopted the same approach as theirs.

That means that each fund has a broad range of alternative ways of defining the risk for the total system as well as for themselves. They also define the required return to maximise their benefit for the system as well as their own view on what the best benefit would be for the total system, without having any impact or insight on total level. Theoretically, that can lead to a situation where Funds offset each other’s strategic portfolio decisions.

The system has no source that will provide these definitions and there is no one who actively manages the asset structure for the entire pension system.

Model risk

In managing and defining their strategic investment policies, each fund used asset liability models, which we commented on separately. However, any modelling has limitations and built-in errors that one has to understand and deal with.

It is a very common belief that holding equities can only be a winning strategy in the long term. Although we believe it to be a reasonable statement that the higher the time horizon the more likely equities will outperform bonds, investments in equities might still lead to much poorer returns than bonds, even in the longer term, albeit with a small probability. The probability of equity underperformance decreases over time but the potential severity of that underperformance increases over time. This is corroborated by observations of option prices, which increase with the time horizon.

It may be that stochastic economic models used by AP funds (and indeed by most of the pension industry) underestimate the risk of equity underperformance as, for example, those models do not reflect equity market crashes (nor upside spikes). Extreme scenarios also tend to be overlooked on the basis of the small probability of their occurrence.

A related key question is the extent to which AP funds are expected to cope with extreme scenarios or conversely, the extent to which they can rely on the Swedish authorities to intervene, e.g. by increasing the Social Security contributions, if such scenarios were ever to materialise.

Another issue, which was raised in William M. Mercer's report last year, is that we do not believe that the models used capture all the interactions between assets and liabilities. Poor economic conditions resulting in low labour participation and contribution levels may likely be combined with poor equity returns. The only stochastic element considered for the liabilities is the income index and therefore, the above potential interactions are not reflected in the models. Some of the funds started addressing the issue, though. For example, AP3 aimed at capturing this through sensitivity analysis and also reported doing some further work on the matter. AP2 included addressing the issue in the objectives of their study. We believe it to be an important issue to be addressed in the analyses.

Diversification

The good thing about having four funds looking at the risks involved in the pension system, is that a diversification of ideas has its benefits, but also its limitations:

- The peer group risk is a very obvious one. Without a clear objective, there is high political risk as well as the risk of competitiveness forcing the alternative approaches to a consensus one (which is probably not in the best interest of the entire system).
 - All four AP-funds recognise that the main risk comes from economic factors and demographics, which is produced and delivered from the same source (i.e. there is no diversification of views on this matter). The main elements are given projections, produced for other purposes than modelling the risk of the AP-funds.
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Assessment of AP1

Organisation of strategic work

Two ALM studies were carried out independently, one by Morgan Stanley Dean Witter (MSDW) and one by Wilshire. In a sense, this avoids some of the model risk as the results are produced using different models. However, we find it unfortunate that the assumptions used are not the same, e.g. economic assumptions, which makes the comparison of results difficult; we would rather have compared apples with apples.

AP1 appears not to have access to the models used, as these studies were considered as one-off by the two organisations that performed them; this is because ALM work is seen as a service they offer aside their core management services. This prevents a continuous development and refinement of the models. Access to some key information, such as the features of the asset model used or some key assumptions, also seems difficult and this was not disclosed in the reports.

Objectives of ALM study

The objectives were clearly defined; in particular, it contains a definition of risk, which is consistent with legislation.

Asset classes

The asset classes considered cover well the universe of investment opportunities. The main asset classes not covered are real estate and alternative investments. The latter is to be considered by AP1, though.

Swedish index-linked bonds were not modelled (due to lack of data) but were included in a second stage of the study.

Output variables modelled

Variables considered are relevant and capture what we believe to be the key factors. In particular, we find the variable modelled by Morgan Stanley very useful: they modelled the average balance figure over the next 20 years, which is a good measure of the impact of investment strategy, over time, on outgoing pensions (the key risk).

We believe that it would be useful to include the next 20 years in the modelling as strong negative cash flows are expected then. However, we recognise that a prediction that far into the future is less reliable than for the first 20 years.

Process to select optimum portfolio

There is definite awareness from AP1 of the importance of a qualitative analysis, which we believe to be very important. In particular, we believe that AP1 has gained a good knowledge of the liability side; they also intend to explore further, what cause the liability projections to be so volatile (a key area).

However, there is some lack of rigour in the process followed. Firstly, the two ALM studies were based on different assumptions, which make the comparison of their results difficult. There is value in carrying out two studies in that it avoids some of the model risk (AP1 is the only Fund having taken such an approach). We believe though, that the exercise would have been even more useful if both studies had used the same assumptions (e.g. based on both firms' input). Secondly, the process followed to draw the conclusions, although based on common sense, appears to be rudimentary.

Another relative weakness of the approach is that both studies were done as one-off studies. AP1 only had limited access to the features of the models used, i.e. the results are an act of faith in the modeller's expertise. There is no possibility either for AP1 to have the model further developed or do sensitivity analysis.

Stochastic model	<p>MSDW used a stochastic economic model based on the Wilkie model; we did not have any information on the extent to which the MSDW model differed from the Wilkie model, though. The Wilkie model is a model commonly used, by UK pension funds in particular. It has been criticised for its modelling of mean reversion in some asset classes, notably equities: it makes a call as to whether equity markets are cheap or expensive (and hence, will outperform or underperform in the future) by assuming that dividend yields revert to their long term level. This runs contrary to the view of many commentators that markets are (broadly) efficient, which means that market prices reflect all available information and are therefore correctly priced.</p> <p>No information was available on the Wilshire model and we are therefore unable to comment on it. However, We believe that the economic model used should be disclosed.</p>
Economic assumptions	<p>The assumptions used by MSDW look broadly reasonable, with some reservation on the equity risk premia, which we find high.</p> <p>The assumptions used by Wilshire look broadly reasonable too. A key assumption, relating to the income index, was not disclosed and we are therefore unable to comment on this.</p>
Demographic assumptions	<p>Only one early scenario, produced in 1999 by RFV and not published, was used in the ALM studies.</p> <p>However, AP1 did some detailed qualitative analysis on subsequent scenarios released by the RFV in 2000 and in the second half of 2001; they concluded that no change in the strategic asset allocation was required. AP1 appears to be quite knowledgeable about the factors at work.</p>
Sensitivity analysis	<p>No proper sensitivity analysis was carried out as part of the ALM studies (except MSDW testing different inflation levels). AP1 did some separate analysis of the more recent demographic scenarios, though.</p>
Decision-making process	<p>The Board has not had any direct input during the ALM process. Although they have made comments on minor aspects of the proposed strategic asset allocation, it does not seem that they have been an integral part to the process.</p>
Our views	<p>Altogether, we found that AP1 had put a lot of emphasis on qualitative analysis and focused on the main mechanisms at work, particularly on the liability side. A good understanding of these is crucial.</p> <p>In a sense, they are the only ones who diversified the model risk by carrying out two independent studies. However, we believe that the process as a whole had some weaknesses.</p>

Assessment of AP2

Organisation of strategic work

When assessing the strategic implementation of the investment policies and strategic portfolio, it is fair to acknowledge the extreme time constraints that AP2 had to work with, as they had a very small organisation and limited resources until the end of 2001. A few individuals dealt with the work, with the CEO as the only one with executive abilities. It is obvious that AP2 had to focus on several key activities in parallel in building a new investment organisation and ALM-work was given a fair and relevant part of that focus. The basic ALM-model was supplemented with several qualitative and judgmental analyses, which lead to a number of common sense recommendations from the management to the board.

It is our understanding that AP2 have taken a pragmatic approach and tried to find a solution that fitted their time constrain and their focus on other organisational issues.

Objectives of ALM study

The objectives decided by the board are all relevant, and relate to the objectives described in the Act. Given the tight time constraints under which AP2 operated, it is probably fair to assume that the search for an asset mix was the leading objective, and only limited time and effort was spent by the board looking at effects and understanding of extreme event risk etc.

The board was presented with two different risk definitions, which they had to decide upon. That decision then became an important guide for setting the portfolio strategy. It is good to have a clearly defined objective as the driver for setting investment policies. This approach of taking a clear view on a specific risk to focus on at this stage is specific to AP2.

Asset classes

Due to the simple approach taken given the time constraints specific to AP2, a limited number of asset classes were considered. We believe it is good to reduce the number of asset classes in an ALM model to a minimum and we think that AP2 have used the main asset classes to be considered in that context. Any other asset classes, which they want to consider, could easily be added in an asset only study, aiming to optimise the asset allocation. This has not been done yet, though.

AP2 is aware of the shortcomings of its exposure to asset universe, e.g. global bonds, and plans to address this.

Output variables modelled

We believe that the variables modelled cover the relevant issues.

AP2 focused their study on the next 20 years, arguing that projections over longer periods become meaningless. AP2 produced results for a much longer period though, and realises that the Social Security system will come under most strain in 20-40 years from now. Given this, we believe that taking the latter period into some consideration would make sense even if we agree that emphasis should be put on shorter periods due to better predictability.

Process to select optimum portfolio	<p>The process followed to conclude that only portfolios showing an exposure higher than 50% should be further analysed appears rudimentary and we believe a more thorough analysis should have been carried out.</p> <p>AP2 then developed portfolios with an exposure between 50 and 70% to equities to test different hedging levels and the exposure to Swedish equities. The conclusion was that a low exposure to Swedish equities provides less risk in case of the adverse economic scenario provided by RFV; this was attributed to the Swedish economy being less correlated to global equities than Swedish equities. However, we have doubts as to whether this can be illustrated with the model used (e.g. labour participation, a key factor of economic health is not stochastic) and in our opinion, the results observed are the result, at least partly, of the risk-return assumptions made.</p> <p>This is not to say that the key belief of AP2 about global equities providing a better protection than Swedish equities is not founded. However, we would find it useful to see this more substantiated. This statement may not be obvious given the high exposure of Swedish companies to foreign economic conditions. We do, however, acknowledge that the concentration of the Swedish equity market in a relatively small number of companies means that stock specific factors become very important, which limits the use of index series in the modelling process.</p>
Stochastic model	<p>US software provider Winklevoss Technologies, Inc developed the stochastic economic model used. This simple model does not appear to model nominal bonds in a sensible way. Nominal bonds tend to underperform in times of high inflation, whereas this model would suggest that they would outperform.</p>
Economic assumptions	<p>Economic assumptions were based on a consensus approach, averaging the forecasts from ten management houses for the next ten years with some judgement. It is unclear how much judgmental adjustments AP2 added to set the assumptions.</p> <p>Altogether, the assumptions look reasonable to us.</p>
Demographic assumptions	<p>Two different demographic scenarios from RFV's 2000 scenarios were used (the central and the worse scenarios).</p>
Sensitivity analysis	<p>Two different demographic scenarios were used in the ALM process. No analysis of sensitivity to economic assumptions was done, except a few judgmental tests.</p>
Decision-making process	<p>It is our understanding that the board has been actively involved in all aspects of the setting of investment policies. There is always a risk when implementing a totally new structure like AP2, that in-depth knowledge and information is concentrated in a few individuals' hands and that documentation is limited to the absolute minimum. As for all new organisations, AP2 will need to document and broaden the internal awareness of the investment policies, a process we understand is already happening.</p>

Our views

The analysis carried out by AP2 captured the main aspects of the Social Security system but has some shortcomings; we believe that AP2 is aware of most of them; these probably resulted from the tight timeframe within which AP2 operated. They have plans to address this; in particular; they are to redo an ALM study this year.

Assessment of AP3

Organisation of strategic work

Two different ALM studies have been carried. The first analysis was made to larger extent of Watson Wyatt and the second was carried out mostly by AP3. Both rely on different asset models by Watson Wyatt. The model risk is partly reduced since the first sets of the economic assumptions were used also in the second analysis. There have been stress tests made to economic assumptions and three sets of RFV demographic assumptions have been used.

ALM work is a part of the investment process and includes a small team of three. AP3 have major impact on assumptions made and analysis carried out since they have the Watson Wyatt model for in-house use and analysis.

Objectives of ALM study

The objectives were well defined and cover the relevant issues.

The robustness of the results to demographic assumptions is an explicit part of the objectives, which shows AP3's awareness of the importance of a proper sensitivity analysis.

Asset classes

The asset classes considered cover well the universe of investment opportunities. The only main missing area for investments is alternative investments.

However, an exposure to hedge funds is currently being considered and analysed.

Output variables modelled

Extensive work appears to have been done as 39 variables were modelled. We believe this to be far too many but view this as part of the ongoing research activity. AP3 only focused on a handful of them for a more detailed analysis for submission to the Board; these are all relevant variables and are indeed the main ones we believe should be considered.

Process to select optimum portfolio

The process followed is without question the most thorough and detailed of the four AP funds and we believe that any variable of importance has been analysed in great detail.

The downside of this is that it is difficult to have a full understanding of the exact process followed to determine the best portfolios as well as of its rationale; there were a vast amount of results produced (the summary presented to us consisted of 90 slides).

The process is by far the most advanced in terms of testing robustness of results to different sets of assumptions, which is an important step of an ALM study.

However, we believe that there may be too strong a reliance on quantitative models. For example, in the final part of the process, the number of portfolios considered is narrowed down to six, based on the analysis of balance figures in 2030. Each of these portfolios is very similar in that the exposure to each asset class typically only differs by 1% of total assets or less. We believe that there is no way that such modelling can distinguish between those portfolios. Thirty years ahead is a very long period to hope to do reliable projections; moreover, demographic developments in the coming years (which are not known yet at this time) may provide a very different picture of what is expected to happen in 2030.

Stochastic model	<p>The Watson Wyatt Global Asset model was used. We have no particular reservation based on the broad features of the model we were provided with.</p>
Economic assumptions	<p>A thorough process was followed to set the assumptions, using three different sources. Assumptions put forward look broadly reasonable to us and reflect different opinions.</p>
Demographic assumptions	<p>These were based on RFV projections produced in 2000 and 2001. AP3 recognised the sensitivity of results to these assumptions, and consequently, made comprehensive use of the different scenarios provided by the RFV, testing the robustness of the results as an integral part of their ALM process.</p> <p>AP3 is the only fund that also explicitly used the 2001 sets of RFV projections, in order to use most up-to-date information.</p>
Sensitivity analysis	<p>Again, a thorough analysis was carried out, testing the sensitivity to both economic and demographic assumptions.</p> <p>For economic assumptions, three sources were used to obtain assumptions and results were produced on those three sets as well as on a number of additional stress-testing sets. For demographic assumptions, a number of scenarios, covering both expected and pessimistic scenarios in particular, were used.</p>
Decision-making process	<p>It seems to us that the board has been duly informed during the ALM process. There was even one member from the board included as a non-working member in the ALM process. Valid information has been put forward to the board, sometimes perhaps more detailed than necessary.</p>
Our views	<p>AP3 is the fund that by far developed the most sophisticated ALM approach, making it an ongoing process and there is no doubt that the fund has a lot of in-house expertise in that respect.</p> <p>The analysis presented to us and to the Board is essentially quantitative driven and we believe that there may be an over-reliance on those techniques. In our opinion, the process to determine the optimum portfolio also appears overly complicated and may hamper communication with non initiated board members, who may be left to trust the specialists.</p>

Assessment of AP4

Organisation of strategic work

The first thing that comes to mind concerning the organisation of the strategic work is that it is rather vulnerable. There were primarily two people involved in the process, and one of them is ending his employment during 2002, which leaves only one person on this matter.

Secondly, there is a question mark surrounding the formal purpose and impact of the review of SSE (Stockholm School of Economics). They commented on the recommendation but there was no means of including their input in the recommendation.

AP4 is an equity organisation that puts a lot of trust in its ability to produce good returns within Swedish equities, and it seems this has influenced the organisation of the process.

Objectives of ALM study

The objectives were not explicitly detailed at the initial stage, beyond providing clear guidance to the Board to set up the investment strategy.

Asset classes

The asset classes considered cover well the universe of investment opportunities. The main missing areas for investments are alternative investments and emerging markets. AP4 also identified exposure to small companies (beyond the MSCI World coverage).

However, AP4 reported that they plan to carry out a study to examine potential exposure to those missing areas.

Output variables modelled

A thorough qualitative analysis of risk factors was carried out. The main risk identified was that the actual portfolio return be lower than the income index in the long term; consequently, the probability of this happening over the next ten years was modelled. The other variable modelled, considered as being of secondary importance, was the Fund's strength in 2040 (i.e. after the period of expected strong negative cash flows).

The first variable is clearly a key variable, which makes intuitive sense. However, it does not enable quantifying the potential impact on pension levels brought by the balancing mechanism. We believe this to be necessary to assess the extent to which the system treats equally the different generations as well as to measure the risk to outgoing pensions in the legislation.

Like AP4, we realise that results of a more thorough ALM study (e.g. modelling additional variables) would be more sensitive to the demographic and economic factors than the investment policy followed by the buffer funds (at least in the short-term). On the other hand, this may change over time depending on actual demographic and economic development in particular.

Process to select optimum portfolio

A clear process was followed based on sound principles.

However, we believe that more detailed work on the modelling of the liability side would be appropriate. The study carried out is essentially an asset only study where a liability proxy is taken to be the income index. Liabilities were only taken into account in a deterministic way (to identify the minimum return required to secure the buffer funds' existence) and to model a variable of secondary importance (Fund's strength).

The analysis carried out is also very sensitive to the economic assumptions used (e.g. selection of portfolios meeting the minimum return criterion).

However, we agree that more detailed asset liability projections would be most useful if more stable demographic and economic forecasts could be used.

We have some reservation on the argument used to justify a greater exposure to Swedish equities than suggested by the ALM study; it is based on the expectation of a higher active management performance by AP4 for Swedish equities than for global equities. This links strategic work to implementation issues, possibly with the implicit assumption of internal management of assets.

Stochastic model

A multivariate lognormal model was used, which we believe to be broadly sensible. A potential weakness is that it models nominal returns instead of real returns (returns over and above inflation). The former are more stable and predictable over time than the latter and an approach which models absolute returns may fail to capture this adequately.

Economic assumptions

A reasonable process was followed to set up those assumptions; these were the result of a discussion between the consultant (Watson Wyatt) and AP4, and a third party (Stockholm Economics school) 's second opinion was requested.

The assumptions put forward look broadly reasonable to us, although there are things to be said about including forecasts on the ability of AP4 to produce excess returns within Swedish equities.

Demographic assumptions

The demographic assumptions corresponded to the single set of projections produced by the RFV in 1999 (not published). When the official projections were published in early 2001, AP4 carried out a comparison of the central scenario and the scenario they used and came to the conclusion that the latter was more pessimistic and hence, on the safe side. AP4 realises that the results of ALM studies are very sensitive to the demographic and macro-economic (e.g. labour participation) assumptions and they have some question marks on the validity of the projections, which probably justifies the simple approach taken.

No analysis was carried out of the new set of RFV projections published in 2001, due to lack of time.

Sensitivity analysis

Although some sensitivity analysis was carried out by the Stockholm school of economics on the first part of the study (construction of efficient portfolios), we believe that it was not fully integrated in the strategic work process. The methodology used to determine the strategic portfolio is very sensitive to the economic assumptions, i.e. the identification of those portfolios expected to achieve a minimum return and the efficient frontier analysis. This also implicitly eliminated real estate; there may be reasons to eliminate real estate but we would rather view this backed by some qualitative analysis.

No analysis of sensitivity to demographic assumptions was carried out, probably due to the view taken that it would add little value (see above).

Decision-making process

It seems to us that the board has been duly informed during the ALM process, discussing crucial aspects of the modelling work (i.e. assumptions). This means that the board has made its decisions in an informed way.

Our views

A sound qualitative analysis of risk was carried out and a clean and simple methodology was retained.

We believe that it should be further refined to properly analyse the impact of the different portfolios considered on outgoing pensions, focus more on the modelling of the liability side as well as proper sensitivity analysis. However, we realise that added value may be limited if too volatile demographic and economic (e.g. labour participation) forecasts are to be used from year to year; this gives some credit to the approach taken so far.

AP1 - report

History

The current AP1 was founded in April 2000 as a merger of the former AP1-3. These funds have been part of the AP-system since the beginning of the early 1960s. The focus of all these funds has been investments in fixed income securities only. This changed after 2000 due to new investment policy guidelines being valid from January 1 2001.

Organisation of strategic work

There has been, in total, four separate parties involved in the ALM process. The Asset Allocation Committee (internal), Wilshire Associates, Morgan Stanley Dean Witter and Wassum Investment Consulting. In September 1999, Wassum was primarily involved when the funds made a statement on the matter concerning the AP-funds in the reformed pension system, submitted to the funds for consideration. The Wilshire report (Feb. 2000) can be described as a traditional ALM study and the Morgan Stanley report (Feb. 2000) is an economic/financial model. The latter one also considers an upside part of the balancing mechanism at the 1.1 level (in contrast to the other two that only considers the downside part of the balancing mechanism).

The internal organisation concerned with the strategic asset allocation decision is the Asset Allocation Committee consisting of 4 permanent members (CEO is the fifth member). The committee has acted as an overlay to the external parties, using the findings from the three studies as an input to the SAA decision coupled with their own considerations and findings.

The strength of this organisation is that critical qualitative considerations (that are not easily modelled) are allowed to play a significant role in the decision process, whereas the weakness can be found in the inability to perform updates and sensitivity analysis due to changes in circumstances surrounding the model.

AP1 intends to carry out ALM studies every 3-5 years or whenever dictated by any major event affecting strategy. The first review has been done earlier due to a better understanding of the system during the first few years.

Objectives of ALM study

The objectives were summarised as follows:

- determine a long-term investment strategy minimising the risk taken; the risk was defined as being the application of the balancing mechanism, including its magnitude
 - learn about the liability side
-

Asset classes

The asset classes considered by MSDW are as follows:

- Swedish equities
- European equities (hedged/unhedged)
- World ex Europe equities (hedged/unhedged)
- Emerging Market equities (unhedged but expressed in DEM)
- Swedish nominal bonds
- Euro nominal bonds (hedged/unhedged)
- Global nominal bonds (hedged/unhedged)

The asset classes considered by Wilshire are as follows:

- Swedish equities
- European equities (hedged)
- US equities (hedged)
- Pacific equities (hedged)
- Emerging Market equities (unhedged)
- Swedish nominal bonds
- Euro nominal bonds (hedged)
- US nominal bonds (hedged)
- Currency basket
- Cash

Emerging Market equities were considered to be unhedged by Wilshire because their hedging was deemed to be difficult in practice.

Swedish equities were considered as a separate asset class in both cases for the following reasons: (1) the risk of diverging from the other AP funds as well as other Swedish institutional investors; (2) media coverage and the difficulties of explaining losses on foreign securities compared with Swedish securities (or differently put, the Swedish people may have an implicit wish of investing a relatively large part of the portfolio in Swedish securities).

Bond exposure both relate to government and non-government investment grade bonds. Inflation-linked bonds were not modelled due to data insufficiency.

No real estate was considered in either case. The reasons for this are that there is a lack of data for modelling it properly and past experience has not always been conclusive, which means that there is no plan to increase the current exposure of about 3% of total assets. The current property holdings are through a joint investment with the other AP funds and it is not straightforward to realise those if AP1 wished to do so.

The same asset classes as the ones defined in the Wilshire study were used by AP1, with the exception that Euro and US nominal bonds were merged into a Global bond asset class due to the fact that the proposed allocations did not differ materially from their weights within the benchmark.

Output variables modelled

The balance figure ((buffer funds' assets+ contribution capital)/ pension debt) was identified as the main risk factor.

MSDW modelled the average balance figure over the next 20 years. Wilshire modelled the balance figure as well as the real returns of portfolios considered and buffer funds' assets.

Morgan Stanley used 20 years as the time horizon for its study. Wilshire used 50 years, although the results presented relate to a 20 year period.

API recognises the fact that buffer funds only correspond to 10% of pension debt and that volatility in buffer fund returns will only marginally affect the balance figure in the short-term. Demographic factors have a much bigger impact on the balance figure.

Process to select optimum portfolio

MSDW carried out its analysis under two hedging scenarios: one without any hedging constraints and the other one with a 50% hedging constraint for each asset class. They also produced a full set of results under the scenario that Europe and not Sweden is the domestic investment zone for AP1; we understand that these results were not used.

MSDW developed 100 portfolios using an efficient frontier analysis. The optimisation was done against a 100% domestic bond portfolio. Besides the regulatory constraints, they also set some constraint on the maximum exposure to emerging markets.

They then calculated, for each portfolio, the 95th percentile of average balance figure for the period up to 2019 vs. its 5th percentile and determined an efficient frontier. In particular, their calculations showed those portfolios with an equity exposure lower than 36% - 54% (depending on the scenario considered; see below) were inefficient; in other words, portfolios with a higher equity content provided a lower or equal risk but with a greater upside potential.

Three portfolios were considered: the minimum risk portfolio (i.e. that portfolio with the highest 5th percentile), the portfolio offering an average balance figure of more than 110%-115% (depending on the scenarios; see below) with a 5% probability and another one corresponding to a 10% probability. These portfolios are as follows:

Asset class (%)	Min. risk	5%	10%
EM equities (unh.)	2	2	3
World ex Eur equities (h.)	11	13	17
World ex Eur equities (unh.)	11	13	17
European equities (h.)	15	17	22
European bonds (unh.)	61	55	41

It is to be noted that MSDW assumed a six-year transition period from the current to the modelled portfolios in their simulations; AP1 believes this to be far too long and attributes this to a misunderstanding.

Wilshire started with an efficient frontier type of analysis. Besides the regulatory constraints, they used the following constraints: Swedish equities to be minimum 20% of equity portfolio, emerging market equities to be maximum 10% of equity portfolio and Swedish bonds to be minimum 1/3 of the bond portfolio. They observed that these additional constraints only marginally affected the risk/return ratio of efficient portfolios.

They limited their choice to six portfolios providing volatility between 7% and 12%, corresponding to an equity exposure of 39% to 70%. They considered these portfolios as being realistic choices by AP1. No clear rationale for this is given in the report. This may have been influenced by their analysis of market practice (mainly among US public pension funds) in terms of asset allocation. This may also be due to the perceived necessity of achieving a high enough expected return (see below; all portfolios tested have a real expected return of more than 5.2%). AP1 found the portfolios acceptable in particular as the MSDW study showed that portfolios with an exposure of less than 40% in equities are of no particular interest.

They looked at distributions (5th, 25th, 50th, 75th and 95th percentiles) of real returns (returns above inflation) for one year and ten year periods. They then looked at the distribution of the buffer funds' assets and balance figure for years 2005, 2010 and 2020.

They noted that the greatest harm to the system would be to adopt a too conservative portfolio approach which would not enable buffer funds to grow and

would make it more likely to trigger the balancing mechanism (in the longer term at least!). They estimated that the real long-term returns must be at least 4.5% to enable such a growth.

The shortest time horizon considered was 5 years; the more aggressive portfolios did not show any increased risk in the 95th percentile of the balance figure (but showed upside potential).

Based on all this, they concluded that the two most aggressive portfolios among the six considered were most appropriate. These portfolios are as follows:

Asset class (%)	D	E
Swedish equities	14	14
European equities (h.)	20	11
US equities (h.)	20	27
Pacific equities (h.)	9	11
EM equities (unh.)	5	7
Swedish bonds (nom.)	11	30
Euro bonds (h.)	6	0
US bonds (h.)	15	0
Currency (Euro)	0	23

They noted that as the buffer funds are a relatively small part of the pension debt, this enables to take a reasonable amount of (short-term) risk to ensure a healthy long-term future. There is, however, a "reasonable possibility" that the downside part of the balancing mechanism will be applied in the first five years; this probability decreases further into the future.

Some adjustments were made by the API to above portfolios to derive the final portfolio, which is as follows:

Asset class	%
Real estate	3
Swedish equities	12
Global equities (h.)	40
EM equities (unh.)	5
Cash	2
Swedish bonds (nom.)	10
Swedish bonds (index-linked)	8
Global bonds (h.)	20
Currency (G4)	10

The Asset Allocation Committee recommended this portfolio to the Board, after discussing the findings of the different studies. The Board approved the recommendation; we explain below the rationale for the recommendation.

In a first stage, there was a discussion on the proposed equity exposure. The recommendation was 60%, which is broadly in the middle of the two portfolios resulting from the two ALM study (and not too close to the maximum level authorised). Secondly, the decision was taken to have a bias to Swedish equities (20% of the equity portfolio; should be large enough without being excessive), one of the reasons being that this is perceived as being more "politically correct" (it is more acceptable to make a loss on Swedish equities than on global equities). It is to be noted that, in the MSDW study, there was no exposure to Swedish equities in

the efficient portfolios considered (Wilshire assumed a fixed 20% of equities in Swedish equities as a constraint in their study). An exposure of 5% of total assets to emerging markets was also assumed. The balance was allocated to other regional equities (after allocating 3% to real estate, corresponding to the current holdings), in line with market capitalisation.

In the bond portfolio, a bias to Swedish bonds was also assumed; this is in particular due to API's knowledge of the market, which helps them assess credit ratings. 20% of total assets were allocated to Swedish bonds, of which 2% in cash and 8% index-linked bonds (good inflation matching properties but illiquid). The balance of assets, 20% was allocated to foreign bonds (in proportion to market capitalisation). No reruns of the studies were done following the release of new data by RFV in 2000 and in the autumn 2001. A qualitative analysis was carried out which led to the conclusion that no change in the investment strategy was required. These new data showed API that the liability side is also very uncertain due to economic and demographic factors.

A separate study was carried out to set the currency hedging strategy. The conclusion was that some exposure to currency was desirable, although the risk reduction from including it was almost unnoticeable. The rationale for including it anyway was that currency ought to reduce risk since returns are not perfectly correlated.

Some important conclusions by API were as follows:

- They realised that ALM is no exact science; in particular, the liability side, which is out of the control of the AP funds, is also very volatile. The study turned out to be more qualitative than expected.
- They viewed their mission as being to prevent application of the balancing mechanism and not to achieve a certain fund size or asset return.
- They also noted that asset volatility does not necessarily trigger the downside part of the balancing mechanism (such as today; the current balance figure is higher than when the studies were carried out) and that the fund has a long-term investment horizon. They did not focus on short-term but on long-term in order to set the strategy.
- Liquidity is no problem for the coming 10 years as positive (or small negative) cash flows are expected.
- It is not necessary to have a too large exposure to assets correlated with Swedish economic growth (eg Swedish equities) as long as the old ATP system represents a significant part of the liabilities (currently, more than 20%). This is because the liabilities under that system are not linked to the Swedish economic growth (but to inflation).

API stresses the importance of a qualitative approach, in addition to a quantitative approach, due to the uncertainties of both liabilities and assets, and the sensitivity of ALM results; they believe it is more important to understand the mechanisms at work rather than using heavy mathematics.

Stochastic model MSDW uses a time series model that is based on the Wilkie model. It is an economic model built to reflect economic relations between variables. It takes historical data into account and uses regressions. No information was available on the Wilshire model.

Economic assumptions

The economic assumptions used by MSDW are as follows (all in nominal terms):

Variable	Return (%)	Risk, st.dev. (%)
Inflation	2	1,5
Wage inflation	3	2
Interest rate	5	1,2
Swedish equities	9,4	31
Europe equities	9,4	18,5
World ex Europe equities	9,9	19,5
EM equities	12,5	29,8
Swedish bonds (nom.)	5	9,1
EU bonds	5	4,7

The correlations used by MSDW are as follows.

Variable	2	3	4	5	6
1 Swedish equities	0,60	0,48	0,32	0,27	0,14
2 Europe equities		0,81	0,53	0,46	0,23
3 World ex Eur equities			0,65	0,41	0,21
4 EM equities				0,27	0,14
5 EU bonds (nom.)					0,51
6 Swedish bonds (nom.)					

The economic assumptions used by Wilshire are as follows (all in nominal terms):

Variable	Return (%)	Risk, st.dev. (above inflation) (%)
Inflation	1,5	-
Swedish cash	3,5	2
Swedish equities	9,0	23,5
Europe equities (h.)	8,75	15,2
US equities (h.)	8,75	16,6
Pacific equities (h.)	8,75	20,6
EM equities (unh.)	10	27,5
Swedish bonds (nom.)	5,5	6
Euro bonds (h.)	5,25	5,1
US bonds (h.)	5,25	5,7

Inflation at 1,5% is a little less than most predictors. Wilshire argues that it is justified considering the implicit inflation in inflation-linked bonds.

The correlations used by Wilshire are as follows (all in nominal terms):

Variable	2	3	4	5	6	7	8	9	10
1 Swedish equities	0,73	0,50	0,53	0,54	0,39	0,08	-0,02	0,25	0,02
2 Europe equities (h.)		0,68	0,55	0,65	0,42	0,31	0,15	0,15	-0,05
3 US equities (h.)			0,43	0,43	0,33	0,22	0,40	-0,06	-0,05
4 Pacific equities (h.)				0,43	0,25	0,10	0,11	-0,12	-0,05
5 EM equities (unh.)					0,20	0,11	-0,12	0,44	0,09
6 Swedish bonds (nom.)						0,57	0,39	0,07	0,35
7 Euro bonds (h.)							0,53	0,17	0,14
8 US bonds (h.)								-0,10	0,03
9 Currency basket									0,07
10 Cash									

Demographic assumptions

The ALM process has used the 1999 RFV base scenario (base case from 1999).

AP1 realises that these assumptions are crucial but their only option is to use whatever RFV projections are available, as AP1 does not have the expertise to deal with this.

Sensitivity analysis

In a preliminary phase of its study, MSDW produced their results based on three economic scenarios (only the inflation level varied between those scenarios).

No other sensitivity analysis to economic or demographic assumptions was performed. Sensitivity analysis of the impact of return levels and the level of initial contribution to the treasury has been carried out. These have been done by AP1 and have not been part of the ALM studies carried out by the consultants.

The AAC also performed sensitivity analyses on a number of critical issues (i.e. the size and timing of net outflows, demographics, size of labour force, retirement age and inflation) based on RFV projections released in 2000. AP1 also did a qualitative analysis relating to the 2001 RFV projections. These analyses are general and not part of an integral model.

Decision-making process

The Asset Allocation Committee (AAC) was created in late 1999. During this period, Wilshire and MSDW were hired to independently perform ALM studies. Their findings were presented to management on the 11 February 2000. The BoD was not an integral part of this process, though they were informed on the type of activities that was going on.

During the next couple of months, the AAC put together the main document supporting the recommended strategic asset allocation. The document contains the findings of the external parties as well as extensive internal analysis, qualitative in particular. The full document together with executive summary was presented to, and discussed with, the BoD in May 2000. This initial discussion was not found to be sufficient and there was a second meeting scheduled during June 2000. These two meetings lasted approximately four hours each. Certain areas of discussion were the risk premia and the risk levels of different equity investments.

An analysis of additional demographic scenarios was carried out during summer 2000 (see above). The findings were presented in September 2000 and final decision on the strategic asset allocation was taken in a December 2000 meeting, based on the AAC recommendations.

Findings of similar research on most recent RFV projections were also discussed with the Board; the conclusion was that no change to the strategic benchmark was required.

Future developments

Volatility of short-term and long-term forecasts of the balance figure (for example, why is the actual balance figure based on other data than the forecasts?)

Analysis of short-term forecasts produced by the RFV:

- How are they impacted by the economic factors (eg labour participation)
 - How reliable are they?
 - How volatile are actual figures?
 - Alternative investments
-

AP2 - report

History

The fund is the only fund that did not exist in any form in the old AP fund system. The board was selected by the government spring 2000. Their first mission was to recruit a CEO for the operation.

Before AP2 got the assets, AP 1 managed it until the 1st of January 2001. AP2 got their assets in the first days of 2001.

Organisation of strategic work

During year 2000, the board's focus, besides organisational issues and recruiting a CEO, was to be able to manage assets from the 1 January 2001. They had the option of leaving the assets with AP 1 fund for a while, but felt that it was in everyone's interest to take on the responsibility managing assets from day one.

One of the first and most important issues to solve was the management of assets. Since they did not have an organisation yet to carry out an ALM-study nor were they staffed to act as an active asset manager, they decided to go for an interim strategy and select external managers for each asset class. The manager structure decided upon that basis was overall mainly passive. The ongoing strategy will be to team up the organisation and increase the internal asset management in areas they define as core competence and where there are possibilities to add value.

In parallel with the manager selection process, the administration and risk control functions, with IT-system and custodian selections, were about to be established.

Next step was to recruit key management staff and to establish internal documentation for operational issues and other policies.

By the end of December 2000, AP2 decided to go for a basic ALM study with a restricted number of asset classes and factors modelled. The strategic work started beginning of January 2001, with an external consultant, Deloitte & Touche. They used external managers' and investment banks input for identifying economic assumptions. The board decided the first strategy in early May.

In June 2001, they hired a head of asset allocation. They are in the process of doing a new ALM study.

A lot of efforts were spent undertaking to solve practicalities to deal with the incoming initial portfolio.

Objectives of ALM study

There were some general objectives of the ALM study put forward to the board:

- Find an asset mix that maximises expected return in relation to the risks taken (as stated in the legislation).
- Find an appropriate asset mix given the nature of the liabilities of the Swedish National Pension System.
- Understand the effect of various asset mixes on financial strength of the buffer fund.
- Provide decision support to the Board in defining the strategic portfolio.

The risk for the fund was defined by the board .It was presented with two clear alternative definitions:

- The Fund will maximise expected return when the buffer funds will be most needed (i.e. low GDP growth, low nativity and employment participation rate), while taking the lowest risk possible, or
- The Fund will maximise the expected return, regardless of the Swedish economy, while taking the lowest risk possible.
 - The more Swedish assets held, the higher the probability to perform in line with the financial Swedish situation;

The overall objectives approved by the board were as follows:

- Maximise the return so the balance mechanism will not be utilised
- Avoid a weak return when the Swedish economy is weak.

Asset classes

The asset classes considered are as follows:

- Swedish fixed income
- Swedish Equities
- Non-Swedish Equities – unhedged
- Non-Swedish Equities – hedged

When defining asset classes, AP2 wanted an as straightforward and simplistic approach as possible due to the time constraints.

Equities were subdivided into Swedish and Global ex Sweden equities due mainly to the following reasons:

- Swedish equities are believed to be more correlated with the Swedish economy than global equities and this correlation is viewed as a key issue. Swedish equities were defined as stocks included in a typical Swedish equity index.
- The initial portfolio has a strong Swedish equity bias, which meant that AP2 had to consider the asset class separately.
- The better knowledge of the Swedish market should enable AP2 to achieve a better performance in that market.

Global equities only refer to developed markets; emerging markets may be considered at a later stage.

Only Swedish fixed income was considered at this stage, as AP2 did not have the resources to manage non-Swedish fixed income during 2001; they also believed that global hedged bonds would not add much to the portfolio and could be ignored initially. There was no further breakdown of the fixed income portfolio between nominal and index-linked bonds for ALM purposes. The extra

added value did not seem worth it in the first ALM study, but would be considered in the next step.

Real estate and alternative investments will be invested in from time to time, but have a zero weight in the strategic benchmark. It would be a tactical decision to invest in these asset classes. Considering these asset classes was again viewed as fine-tuning, which can be addressed at a later stage. For the time being, real estate (AP2 inherited some) would fall under the fixed income asset class for benchmarking purposes.

Output variables modelled

AP2 modelled the following key variables:

- Fund strength (Buffer Funds' assets/ pension payments)
- Balance figure (Contribution capital + buffer fund)/pension debt)
- Probability that the buffer fund becomes insolvent
- Probability that the brake will be utilised
- Contributions vs. pension payments
- Net inflows as a percentage of Fund assets

Although AP2 had projections produced on 20 year and 90year time horizons, all the analysis was carried out based on the 20year period. Although it realises that the social security system is expected to come under most strain during the coming 20-40 years, AP2 finds it a too long time horizon to carry out meaningful modelling.

Process to select optimum portfolio

Besides the above asset classes and output variables, inflation and real average wage growth were identified as the key variables to be modelled.

In a first step, portfolios with equity exposure of 0% up to 70% were analysed based on the RFV projections. AP2's findings were that there was at least a ten year time horizon with net inflows to the buffer funds; this means that the system can cope with the short-term risk implied by a relatively high equity exposure. They also conclude that some minimum exposure to equities is needed to avoid a too high risk of a too low long-term return on assets.

Portfolios including 50%, 60% and 70% were selected since they were shown as exhibiting superior risk and return characteristics, based on the above analysis, compared to the other portfolios and the rest of the analysis focuses on such portfolios.

On that basis, 12 portfolios were considered for further analysis. For each of the three overall equity allocations of 50%, 60% and 70%, four equity sub-allocations were reflected in the portfolios: high weight to Swedish or non-Swedish equities (25%/ 75% or vice-versa) and high weight to hedged or unhedged non-Swedish equities (85%/ 15% or vice-versa).

By plotting the 12 portfolios on a risk-return graph, only the three portfolios corresponding to a low Swedish equity and a high hedged non-Swedish equity exposure are shown to be efficient compared to the other nine. On that basis three portfolios with high hedged non-Swedish equities was compared with the three portfolios with low non hedged Swedish equities in the further analysis.

Two different RFV projections were used: the expected demographic scenario and "the worst" demographic scenario (low mortality, low birth rates and low wage growth). For the latter, two options were considered in the projections: either the brake applies as foreseen in the legislation or no brake mechanism is assumed to examine whether the system balances itself out or not after all in the end or not.

One of the objectives is to maximise the return on assets. Even the analysis of the 5th percentile shows that after a long enough period (towards the very end of the 20 year period), a high equity exposure will ensure this. The analysis of the 5th percentile results for the balance figure and the Fund strength also shows that more risk is taken with a high exposure to Swedish equities. This is somewhat even more the case in the worst demographic scenario. AP2 attributes these findings to the higher correlation of Swedish equities to the Swedish economy. One of the objectives of the strategic asset allocation is to avoid a weak return when the Swedish economy is weak; therefore, those portfolios showing a low exposure to Swedish equities should be favoured.

In the base demographic scenario, there is little chance that the buffer fund will become insolvent for any of the portfolios considered. However, in the worst demographic scenario, the probability of the buffer funds becoming insolvent is the lowest for an exposure of 70% in equities. The probability of the balance mechanism being used is less than 30% for all portfolios in the model used.

The strategic allocation retained is as follows:

- Swedish Equities, 20%
- Global equities (hedged), 30%
- Global Equities (non-hedged), 10%
- Fixed Income, 40%

Some amendments were made to the most appropriate portfolio tested to arrive at the above allocation:

- Judgmental input made the fund to choose 60% of equities, rather than 70%. It was also an effect of allowing for some tactical asset allocation decision.
- Increase exposure to Swedish equities (1/3 of equity portfolio instead of 25%), as AP2 believes that it can achieve a higher performance in Swedish than global equities due to its greater knowledge of the former.
- The hedge ratio was set to be 75% for the global equity portfolio (instead of 85%).

An allowed tactical allocation range for Swedish index-linked bonds, alternative investments and real estate was decided upon based on the argument that these asset classes would be used primarily as tactical asset classes to improve the risk-adjusted characteristics of the Fund versus the strategic benchmark of the Fund.

As a next step to the ALM study, Swedish fixed income will be subdivided between nominal and index-linked bonds using fixed weights based on current holdings and upcoming maturations. No further subdivision was considered for the equity portfolio.

Stochastic model

The model used was ProVal Help developed by software provider Winklevoss Technologies, Inc through Deloitte & Touche

The model is a classic mean-variance simulation model.

The unique retirement design in Sweden made Deloitte & Touche determine that the standardised ALM tools could not be applied. They developed a customised Excel based solution that incorporated the relevant unique aspects of the Swedish demographics relating to the Andra AP Fonden (e.g., projected inflow of contributions, projected outflow of pensions, etc.).

The model incorporated the correlation between investment returns, inflation, and wage growth.

In relation to the long-term risk of equities, AP2 believes that any bad performance of equities must catch up over time. No catastrophic events were allowed for, which it believes is more relevant for short-term periods (5-10 years).

Economic assumptions

Consensus capital market expectations for a 10 years time horizon, collected from 10 surveyed investment managers, were used. This covered expected returns, volatilities and correlations for the asset classes considered and inflation. The different manager assumptions have been averaged with some judgment; the forecasts that looked odd were not included. These assumptions were:

Variable	Return	Volatility
Swedish fixed income	4,85	4,20
Swedish Equities	8,7	25,8
Non-Swedish Equities - unhedged	8,1	17,1
Non-Swedish Equities - hedged	7,9	14,0
Inflation	2,1	1.30
Real Wage Growth	1,25	0.38
Nominal Wage Growth	3,35	(1.60)

Correlations used: In the board meetings there were

	2	3	4	5	6
1 Inflation	-0,06	0,03	-0,05	-0,04	0,34
2 Swedish Equity		0,27	0,67	0,65	-0,36
3 Swedish Fixed Income			0,30	0,32	-0,16
4 Non-Swedish Equities – unhedged				0,84	-0,14
5 Non-Swedish Equities – hedged					-0,09
6 Nominal Wage Growth					

The expected growth in real average wage is 1.25% per annum; this was taken as the average between the low (0.5%) and high (2.0%) growth figures in RFV projections. The volatility of 0.383% was taken such that the actual growth in real wage remains between the two RFV figures with a 95% probability in any given year (assuming a normal distribution).

In most of the managers' forecasts, global unhedged equities and Swedish equities had the same expected returns. However, the Swedish managers tended to have higher expected returns on Swedish equities compared to global equities.

The Swedish GDP was used as a proxy for Swedish average wage growth when calculating historical correlations. The historical correlation was reported to be 83%.

The correlation between Swedish inflation and Swedish average wage growth was determined from historical time series. Correlations between inflation and asset classes were derived from the consensus forecasts of managers.

Demographic assumptions

Two different demographic scenarios from the 2000 RFV scenarios were used for the simulations, with some adjustments made by Deloitte & Touche:

- Expected demographics: expected mortality, birth rate and wage growth;
 - Worst demographics: low mortality, low birth rate and low wage growth.
-

Sensitivity analysis

Two different demographic scenarios were used as part of the analysis (see above). No sensitivity analysis was carried out for economic assumptions but this will be part of future studies.

Decision-making process

During the board meeting in December 2000, the focus was on selection of external asset managers. The Management started the process of selecting advisors for the ALM study and hired Deloitte & Touche New York.

During January and February the fund worked closely with the advisor in defining objectives, approach, overall asset classes to be able to analyse the effect and risk of the buffer fund system.

Beginning of February the RFV projections was sent to the board members after discussing the funds liability side at the 1 February 2001 board meeting. Both the management and the board agreed that the board should have insight in the demographics and the pension system as well as projections of the balance figure.

There were mainly two board meetings discussing strategic allocation, the 28th of February and the 29th of February. Before each meeting a document were sent out. At the first meeting, the overall project plan was proposed as well as asset classes assumptions and methodology. A set of portfolios with equity exposure between 0% and 70% were shown. An approach focusing on three main asset mixes of 50%, 60% and 70% of equities, which was approved by the board.

After the board meeting on the 28th of February, a range of board decisions was made. Net in and outflows were shown for a 20 year time horizon, since they argued that 95 years is too long a period. They came to the conclusion that there will be outflows from year 2010 (for both 50th and 5th percentiles). They summarise the result by saying that it does not matter if the equity exposure is high, since it does not affect the short term risk. Low return will also have bad influence in about 15 years, which is a long-term risk they do not want. Clear risk definition will be made before finding the right mix in the equity portfolio.

At the board meeting of 29 March, emphasis was put on risk definitions, e.g. is it more risky to have a relatively low return in a weak economy, than in a normal growth economy. Risk is defined as weak return in a pessimistic scenario for the Swedish pension system (or economic environment in Sweden). The board decided that the risk should be defined as weak return in a weak Swedish economy. The proposed return was to maximise the return so the break will not be utilised.

After the meeting a new summary was made of conclusions so far (April 2001). A proposed Normal portfolio, Benchmarks and allowable limits were given.

Future developments

Future developments considered are:

- Subdivide the global equity portfolio into regions
 - Break down bond portfolio into nominal, indexed-linked and global bonds; consideration of Corporate bonds
 - Further analyse credit risks
 - Further analyse results below the 5th percentile
 - Carry out some sensitivity analysis
 - Consider alternative investments (next year)
 - Analyse alternative benchmarks for Swedish equities, they believe the current benchmarks are too large cap biased
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AP3 - report

History

The fund has its origin from one of the former “equity funds”, AP5 fund. The Fund has had the same CEO since 1998.

Together with the deputy CEO/CIO he started the process of building the organisational structure, with the expected change in regulation and new mandates in sight, beginning 1999.

Organisation of strategic work

The funds current structure was put in place during 1999-2000 through a combination of assistance from an external consultant and internally made benchmarking with similar international organisations. ALM is seen as an organic part of the investment process.

Different groups of people with specialist competence are put together for each defined project within the fund. So far, there have been mainly three people from the fund working together with an external consultant. During 2001, the team also involved a non-working member of the AP3 board.

For the first ALM-study that was carried out during year 2000 in close co-operation with Watson-Wyatt. Watson-Wyatt set up the overall structure of the model, while a large part of the calculations were done at AP3. The asset side was modelled using the Wilkie model. The study resulted in the strategic portfolio for year 2001.

The ALM analysis was deepened during autumn 2001. AP3 did almost all the calculations and modelling in house, but Watson-Wyatt helped to set up the model and read in data from RFV. Watson-Wyatt also participated in the analysis of hedge funds. Several aspects of the modelling framework were amended: all assumptions and parameters in the model were updated. A completely new demographic scenario was added (RFV 2001) while 2 of the older ones were updated. External sources were used for stress testing internal and Watson Wyatt asset assumptions. The Wilkie model was completed by a new asset model, GAM, Watson-Wyatt Global Asset Model, which was understood to be a better tool for simulations of different currencies. The updated ALM-study resulted in a new strategic portfolio for 2002 with an increase of 5,5% in equities and a corresponding decrease in global bonds.

AP3 intend to put extensive resources to focus on ALM-analysis. ALM is viewed as an ongoing process. Practically, a proper study will be done every year, and some specific research projects are developed throughout the year as appropriate.

Objectives of ALM study

The objectives of the latest ALM study was as follows:

- Find an asset mix that maximises expected return in relation to the risks taken (as stated in the legislation). Both return and risks are interpreted in terms of outgoing pensions.
- Understand the interaction of the buffer funds with the overall pension system:
 - Identify those aspects of the pension system AP3 can affect with its investment policy
 - Use this understanding to choose the optimum portfolio

The leitmotiv of the study was summarised as follows:

- Find an allocation that minimises the effect of the brake
 - Across different demographic scenarios
 - Along time
- but which gives a good upside potential
- while keeping in mind other risk dimensions

Asset classes

The asset classes considered in the ALM study are as follows:

- Equities – Swedish
- Equities – Europe ex-Sweden
- Europe – Global ex-Europe
- Fixed Income – Swedish
- Fixed Income – Europe ex-Sweden
- Fixed Income – Global ex-Europe
- Fixed Income – Swedish index-linked bonds
- Real Estate
- Cash

Swedish equities were considered as a separate asset class as AP3 has particular experience in that market. Also, it wanted to examine the possibility of hedging foreign investments. Global equities exclude emerging markets.

The split between Europe ex-Sweden and Global ex-Europe is essentially to mirror the split done for equities but there is no compelling case to do so.

The above nine classes were identified in 1999 based on qualitative analysis.

Real Estate is meant to correspond to either Swedish or internationally diversified real estate. Currently, AP3 only have exposure to Swedish property (3% of assets; 7% taking account of the gearing) but it is likely to be internationally diversified at some stage.

Both unhedged and hedged asset were modelled so different hedging levels could be tested as a part of the study. However, it turned out the ALM model could not differentiate between the different hedge ratios with a satisfactory precision, so the choice of hedge ratios was done using asset-only arguments.

Nominal bonds relate to both government and investment grade bonds.

Output variables modelled

Altogether, AP3 modelled 39 variables. Some of the ones considered to be the most meaningful ones are as follows:

System state

- Contribution capital (CC), pension debt (PD), buffer fund (BF) value
- System surplus, defined as $(CC+BF)-PD$
- Balance figure, defined as $(CC+BF)/PD$

Fund size measures

- Relative fund size, defined as $BF/(CC+BF)$
- Net cash flows
- Fund strength ($BF/$ pension payments)

Income Index (II) and Balance Index (BI)

- Ratio BI/II
- Expected (average) loss of benefits up to a given time T. This is defined as the average of expected $1-BI(t)/II(t)$ for the period up to T.

Expected annual excess return on buffer funds over Income Index.

Process to select optimum portfolio

Besides the above asset classes and output variables, inflation and wage growth were modelled. The latter two are the key variables directly influencing the liabilities and were modelled stochastically.

A combination of asset-only optimisation analysis and asset liability modelling was used interactively to define the most appropriate portfolios. Altogether, 80 portfolios were tested, corresponding to several sets of investment constraints and several return assumptions (sensitivity analyses); several additional interesting portfolios were considered. In particular, other AP funds' portfolios were analysed. The asset-only optimisation was a traditional mean-variance analysis; in that analysis, risk was defined in absolute terms (and not relative to any "liability matching" portfolio).

The first part of the study (as well as the previous study) showed that the "best portfolios" have 45% - 65% in equities. This analysis looked at the expected value, upside and downside of key variables for different demographic scenarios. Not too much emphasis was put on extreme upside, as the utility structure was not clearly defined in that case (accelerator mechanism not defined).

The following was examined in detail:

- Balance figure in 2030: analysis of expected value vs. 5th and 1st percentiles
- Distribution of fund strength for the next 40 years
- Expected ratio Income Index/ Balance Index for the next 40 years
- 5th and 1st percentiles of Income Index/ Balance Index ratio in 2042 (this is when most strain is expected to be put on system)
- Expected loss of benefits in 2025 and 2040
- Distribution of average loss of benefits in 2025 and 2040

It was stressed that the development of all the above variables was also monitored over the whole period of 40 years, although the presentation occasionally focused on particular years. That period was chosen to cover times when the system is expected to come under strain due to large negative cash flows (in 25 to 40 years). The previous study only covered 25 years.

It was felt that the most interesting results were mid- to long-term, i.e. when the system goes through that negative cash-flow period. AP3 also believes that the stochastic model used is not best designed to cope with short-term modelling, e.g. next five years, and plans to look into that issue (e.g. by adding a 'structural' level to the modelling)

The second stage of the analysis aims at understanding the behaviour of the portfolios in the range 45% - 65% equities; in addition to variables mentioned earlier, the following was examined for these portfolios:

- Distribution of Fund strength in 2026
- Impact of marginal allocation change (2% exposure increase to individual asset classes) on expected vs. 5th percentile surplus in 2026.
- Balance figure in 2030: analysis of expected value vs. 5th percentile

A couple of optimum portfolios are identified, corresponding to (or very close to) the following and final allocations for year 2001 and 2002.

Asset class (%)	2001	2002
Swedish equities	16.3	16
European equities	16.3	17.5
Global equities	16.3	21
Swedish bonds (nom.)	15	13.5
Swedish bonds (IL)	7	8
European bonds	12	8.5
Global bonds	10	8
Real estate	7	7.5

Note that the fixed income benchmarks use fixed weights between government and investment grade bonds and when applicable, between regions. Equity benchmarks for each equity asset class is market capitalisation based.

The desirable level of currency hedging was tested in A/L model, but it transpired that the model could not distinguish between reasonable hedge ratios (in the 50 – 80%) range with sufficient precision. Therefore, it was decided to base the currency hedging decision on asset only analysis on optimal hedge ratios as well as disequilibrium considerations (undervaluation of Swedish Krona). The decision was made to fully hedge bonds and hedge 80% of the exposure to foreign equities; this was based both on the results on the quantitative study and a judgment on the relative current undervaluation of the Swedish Krona.

The largest changes implied by the above portfolio compared with the current portfolio is an increase in global ex Europe equity by 4.7% and a decrease in European ex-Sweden fixed income by 3.5%.

Stochastic model

For the asset side The Watson Wyatt proprietary asset model was used. The model (Global Asset Model) can be seen a modification of the Wilkie model. As in Wilkie framework, the model is driven by inflation (with both local and global) components. Inflation affects, but does not fully determine asset returns. The main differences to the Wilkie model are the following:

- The total return of equities is modelled directly, not via dividend yield and dividend growth as in Wilkie
- The equity returns have a slightly smaller tendency to mean reversion than in Wilkie
- The model is better suited for the modelling of multicurrency portfolios: most asset return series are affected by both local and global components which make it easier to capture the desired correlation structure.

The stochastic asset return series were used to randomise the A/L model. In the randomisation, 5000 Monte-Carlo simulations were used instead of 1000 in the previous study. This gave a more accurate picture of "extreme" events, e.g. 1st percentile.

As concerns the potential underestimation of long term risk of equities, AP3 agrees that it is an area, which should be looked into; at present, this was handled through the various sensitivity analyses carried out and using 1st percentiles. They also note, however, that if there were to be a long-term severe downturn in markets ("catastrophic" scenario), the legislator would be expected to step in to amend the system.

Economic assumptions

The fund received asset return and inflation assumption from several distinct sources: the fund's chief economist, Watson-Wyatt and several external investment managers (the fund sent out a request of data to four major investment managers). In the model parameterisation, three sets of assumptions were used, each based on input of a different party: AP3 (forecasts based on review of academic literature and current market conditions), Watson Wyatt and Goldman Sachs. As the assumptions from the four managers turned out to be very similar, there was no need to take the four sets into account.

The economic assumptions used by the three sets of assumptions from managers (4 of them) identified by M, Watson Wyatt (WW) and Goldman Sachs (GS) are as follows (all in nominal terms):

Variable	M	WW	GS
Swedish cash	4,5	4,05	4,25
Swedish equities (ex SWE)	8,9	9,75	9,45
Europe equities (ex SWE)	8,6	8,4	8,55
Global equities (ex Europe)	9,10	8,60	8,55
Swedish bonds (nom.)	5,50	5,75	5,30
Swedish bonds (IL)	5,50	5,00	5,25
European bonds (ex SWE)	5,50	5,30	5,30
Global bonds (ex Europe)	5,80	5,50	5,30
Real estate	7,8	6,60	7,3
Sweden (wages)	3,90	3,55	3,80
Sweden (goods)	2,00	2,00	2,30
Europe	1,90	2,00	2,00
Global	2,50	1,50	1,70

In all three sets, Swedish equities are expected to have the highest return. This was justified by the higher volatility of Swedish market compared with European and global equity markets.

Equity risk premium of European and global equities vs. European and global bonds, respectively, vary from 3.1% to 3.3%.

Nominal bond returns were set somewhat higher for global bonds than for European bonds based on the longer duration of the former.

Inflation figures were based on monetary policy targets for Sweden and Europe and historical inflation record for global inflation.

The correlation matrices are not an explicit input in the model but knowledge of historic correlation patterns as well as judgemental analysis was used when choosing the parameters of the GAM (and Wilkie) model. One matrix for each of the 40 year was modelled, although they differed only slightly.

Demographic assumptions

The fund is not doing own demographic modelling, but relies on the (deterministic) scenarios produced by RFV, which are then randomised. The three new demographic scenarios produced by RFV were used: RFV2001, based on SCB's newest demographic assumptions; RFV2000, based on the same assumptions as last year's central scenario and RFV2000L, which is one of the previous year's stress scenarios assuming a longer life expectancy.

In the previous study, 15 scenarios were considered: the main scenario with 4 alternative demographic scenarios and three labour market assumptions.

The comparison between the main scenarios from the 2000 and 2001 studies shows that, the demographic expectations can change from year to year (in this case, mainly due to a change in immigration assumptions) in a rather significant way. Therefore, the fund stressed the importance of using both old and new demographic assumptions. Furthermore, the analysis showed that demographic developments could have a larger impact on the state of the pension system than the fund's asset choice.

Sensitivity analysis

The robustness of results, i.e. their validity under various sets of assumptions, was reported to be part of the ALM process itself, i.e. it was one of the criteria to select the "best portfolio". A number of alternative assumptions were used for the economic assumptions (the three sets described above plus a number of other stress tests, e.g. lower equity premium) and the demographic assumptions (all RFV scenarios were tested). The results were also produced with the asset model used for the previous study (the Wilkie model); we understand that this did not alter the conclusions of the study.

Decision-making process

Methodology has been refined over time. The first discussions of the strategic portfolio were made during 1999 and involved a rigid, although more qualitative approach, resulting in definition of nine asset classes.

The board had been involved in the qualitative assessments during 1999 and also had presentations of the pensions system during 2000. The first actual ALM-study was carried out during 2000.

The process in 2000

The board discussed ALM during two occasions, in August and October. The first meeting focused on explaining the nature of ALM work as well as presenting the main features of the pension system. The ALM study was carried out between June and October, and the conclusions were presented to the board in the meeting on October 2nd, 2000.

The October agenda focused on how the analysis had been made, including assumptions and key variables. A short summary of findings and proposed allocations were presented together with a final suggested strategic portfolio. The presentation included RFV's demographic scenarios as well as asset assumptions from five different sources.

A two step process involving a pre-selection of well-behaved portfolios in an asset only approach and an in-depth analysis of all the pre-selected portfolios in relation to the liability side, were described. Some key variables were identified; system state, fund size measures and the ratio; Income index (I.I.) and balance index (B.I). There were pointed out that the outcomes had to be monitored in two dimensions, time and severity.

All different analysis shows that portfolios with higher equity proportion are the best performing portfolios. There is one portfolio identified as the most balanced, which is suggested to the board. The board approved the suggested portfolio on the board meeting on the 2nd of October 2000.

The process in 2001

The ALM-work was continued during autumn 2001, mainly by AP3 but with some assistance from Watson & Wyatt. This lead to some refinements in methodology changes in some model aspects as well as to new insights of system variables. The objectives and conclusions presented to the board on the 11th of December 2001 were to be more focused on the "break" both along time and in different demographic aspects.

Much emphasis was put in the understanding of the downside. This was motivated by the fact the pensioners would feel the effect of the brake by certainty, while the objective function on the upside was not as clearly defined. To summarise the effect of the brake the fund introduced a new risk measure (ELB, the expected loss of benefits), which captures the expected cut-off of pensions up to a certain year. The measure was illustrated for 2025 and 2040. An increased equity exposure by 5,5% was suggested since the analysis shows better risk/reward ratio measured as system surplus or balance figure. It is also shown to provide a better downside protection in poor demographic scenarios. The board approved the strategic portfolio and also a hedge ratio of 80% of global equities and 100% for bonds.

Future developments

Future developments considered are as follows:

- Introduce hedge fund as an asset class and analyse the behaviour of different types of hedge funds in order to determine an optimal hedge fund mix
 - Use time and scenario dependent asset returns
 - Subdivide economic assumptions into two categories: short-term assumptions (next five years) and assumptions for the period thereafter.
 - Make distinction between short and long-term allocation (optimal mix of the fund might be time dependent)
 - Portfolio insurance (required fund return)
 - Study alternative asset models in addition to Wilkie and GAM
 - Analysis of alternatives ways to divide the asset universe into entities that can be modelled.
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AP4 - report

History

The current AP4 was founded in the beginning of the 1970s. Originally, the fund only managed Swedish equities, and for a number of years it has been the single largest individual investor on the Swedish stock market. As such, it has been deeply involved in corporate governance issues. This has changed dramatically after 2000 due to new investment policy guidelines being valid from January 1 2001.

Organisation of strategic work

There have been three separate parties involved in the ALM process internal management (Erik Sjöberg, Björn Lind and Thomas Halvorsen), Watson Wyatt Partners (WWP) and Stockholm School of Economics (SSE).

WWP performed the main ALM study during spring and summer 2000. A first draft was presented to management in April, and the board of directors was presented with a preliminary report in June (in English). The final report was submitted late August 2000.

The internal organisation dealing with the strategic asset allocation decision has acted as an integral part of WWP's ALM study, among other things finalising assumptions. Executive summaries (in Swedish) were submitted to the board of directors in early September 2000.

The SSE was used to provide a second opinion on the study. The SSE work consisted of a sensitivity analysis, a discussion on return assumptions and how they relate to theoretical models, a discussion on inflation, asset returns (which inspired further investigation in 2001), correlation and finally a discussion on currency hedging, which was also investigated further in 2001. The analysis of SSE was not forwarded to the board.

The board of directors decided on the strategic asset allocation in October 2000.

AP4 states that the relative size of buffer funds vs. liabilities means they are not convinced that traditional ALM enough to capture the full complexity of the system. For now, they are not aware of any alternative and they feel that further work on the demographic factors is needed, and that it might be a good idea to carry out this kind of work at the central level rather than within each fund.

They intend to carry out ALM studies every three years and a review each year (or whenever needed in the interim period due to changes likely to have an impact on the investment strategy).

Objectives of ALM study

The objective of the ALM study was to provide clear guidance to the Board to set investment strategy.

Asset classes

The asset classes considered are as follows:

- Swedish equities
- Global equities (unhedged)
- Global bonds (hedged)
- Swedish index-linked bonds
- Real estate
- Cash

Swedish equities were identified as a separate asset class as AP4 management believes that their particular knowledge of the Swedish equity market and their contacts can help them deliver superior performance. In particular, the Board wished that management carried on their Corporate governance activities that they believe would deliver enhanced shareholder value. AP4 used to own 3-4% of the Swedish equity market, with a current stake still around 1%. They also expect that Swedish equities will deliver a higher return than global equities due to their tilt to more cyclical (that is higher beta) sectors, such as industrials and IT companies.

It is to be noted that global equities will initially relate to developed markets only and therefore exclude emerging markets.

They felt there was no need to have a separate Swedish bond portfolio as this asset category is highly correlated to hedged global bonds and shows very similar risk return features. Hedging bonds substantially reduces risk based on historical analysis, as currency risk is a relatively high proportion of total risk for that asset class, unlike for equities, which were taken unhedged.

Bonds both include government as well as investment grade non-government bonds.

Swedish index-linked bonds are considered due to their inflation-hedging properties.

Real estate was considered in a 'generic way', without specifically defining a corresponding geographic area, eg Swedish or European property.

Cash is assumed to be in SEK.

Output variables modelled

The main output variables modelled are:

- Probability for portfolio return to be lower than income index in next ten years
- Expected Fund's strength ("fondstyrka") in 2040

The time horizon of 40 years was chosen as deterministic projections show that important negative cash flows are expected during this period.

A time horizon of 10 years was also chosen on the grounds that it was more realistic from a management standpoint.

The main risk factor is seen as the portfolio not achieving a high enough excess return compared with the income index. The Fund's strength is only viewed as a secondary risk factor as the legislation does not provide for any minimum size for the buffer funds. Another reason why the analysis is done in such relative terms is that the impact of demographic factors (which they do not model themselves – they use RFV projections) dwarfs economic factors anyway, making meaningful modelling difficult.

There was no modelling of the balance figure (= (contribution capital + assets of buffer funds)/pension debt), which is not seen as a key risk factor. This was based on the fact that buffer funds only correspond to 10% of pension debt and that volatility in buffer fund returns will therefore only marginally impact the balance figure; demographic factors, which were taken as provided by RFV, have a much bigger impact on the balance figure than the evolution of the buffer funds. Focusing on the balance figure can also result in the fund taking a too short-term perspective with negative long-term effect.

Data were also not available in the spring 2000 when the study was carried out (they only became available in the autumn 2000). However, it is not decided whether AP4 should model the balance figure in the future.

The average duration of cash flows in the next 40 years was calculated to be 25 years, which confirmed the long-term nature of the liabilities.

There is also a belief that the extreme scenarios will not materialise, as they would result in intervention by the government to change the general parameters of the system such as the contribution rate.

Process to select optimum portfolio

Besides the above asset classes and output variables, inflation and income index were modelled. The latter is the key variable directly influencing the liabilities.

Liabilities grow in line with the income index and therefore the main idea behind AP4's modelling is to adopt an investment strategy of which return exceeds the growth of that index.

In a first stage, 20 portfolios to be tested were constructed using efficient frontier analysis. The optimisation of risk-return was done relative to the minimum risk portfolio, i.e. the portfolio best matching the liabilities. This was considered to be the portfolio showing the smallest tracking error relative to the income index. A simple optimisation showed that that portfolio is composed of 78% cash and 22% Swedish index-linked bonds (based on economic assumptions used).

No constraints were used in the optimisation process. The efficient portfolios considered happened to comply with currency restrictions, which meant no explicit constraints in that respect was needed in the analysis.

Deterministic simulations suggest an excess return over the income index of at least 3% is necessary to keep the buffer fund size broadly stable. Based on economic assumptions chosen, this means an exposure of at least 50% to equities. Given the current investment constraints, that exposure may not exceed 70%.

The optimum portfolio is then identified as the one maximising the marginal gain in expected excess return vs. marginal increase in risk, measured by the probability that actual excess return be negative over the next 10 years. The expected Fund's strength in 2040 is also calculated for the different portfolios.

The optimum portfolio resulting from the above ALM process and the one finally adopted are as follows:

Asset class	ALM study	Adopted strategy
Global equities	60	40
Swedish equities	10	22,5
Nominal bonds	30	32,5
Index-linked bonds	0	5

Some adjustments made to the left hand side portfolio above to derive the final portfolio (on the right hand side):

- Reduce total exposure to equities to 62.5% to allow tactical asset allocation;
- Increase exposure to Swedish equities, as they believe that they can achieve a higher performance in Swedish than global equities due to the Fund's greater competence with the former. Other reasons were that global equities require substantial hedging in the first years to comply with regulatory investment constraints that generate extra costs; and there is scope for gaining greater to riskier Swedish equities as decreasing the total exposure to equities reduced portfolio risk in the first place.
- After analysis, AP4 concluded that they would not take any exposure to index-linked bonds as initially thought.

Amendments made above only affect marginally the risk–return of the portfolio, based on economic assumptions considered.

Within the global equity asset class, market capitalisation was used. For bonds, a separate analysis was carried out which lead to the use of fixed weights for the different currency blocs and (non-) government bonds.

A separate analysis was carried out to define the currency hedging policy. The outcome of the study was that the strategic allocation to currencies was to be 30%. The rationale behind this is that this proportion corresponds to the import proportion of total consumption, and the allocation between foreign currencies was recommended on the same basis.

Stochastic model

A multivariate lognormal model was used, with autocorrelation for inflation, cash and income index.

In relation to the long-term risk of equities, AP4 comments that it has not really discussed this. They agree that looking at the distribution of annualised returns (one of the graphs used shows the 5th, 25th, 50th, 75th and 95th percentiles for different time horizons) may be misleading as this may suggest that equity risk becomes negligible as the period considered is long enough; this is not the case when looking at the distribution of final wealth (such as the Fund's strength in 2040).

They also pointed out that the model used allows the use of serial correlations, introducing some kind of momentum, although they chose not to use that feature.

Another comment was that they believed that there is a mean reversion in stock returns, which is not reflected in the model; this should more or less compensate for not reflecting fat tails, when looking at bad economic scenarios over time.

Economic assumptions

	Expected Nominal Ann. Ret. %	St. Dev. %
Swedish Equities	8,00	24,0
Global Equities	7,75	18,0
Global Bonds (Medium-Dated)	5,75	5,0
Index Linked Bonds	5,50	5,0
Property (direct)	6,25	15,0
Cash	3,00	2,0
Income Index	4,00	2,0
Inflation	2,00	1,5

Correlation:

Variable	2	3	4	5	6	7	8
1 Swedish equities	0,70	0,50	0,30	0,25	0,00	0,10	0,10
2 Global equities		0,50	0,30	0,10	0,00	0,10	0,10
3 Global Bonds (Medium-Dated)			0,50	0,20	0,15	-0,05	-0,10
4 Index Linked Bonds				0,35	0,20	0,50	0,70
5 Property (direct)					0,00	0,15	0,20
6 Cash						0,35	0,50
7 Income Index							0,70
8 Inflation							

Swedish equities are assumed to outperform global equities by 0.25% pa. This is justified by the Swedish economy having a growth bias and a historical beta of the order of 1.2. AP4 considers this assumed outperformance to be conservative; this is certainly the case in historical terms.

Assumptions correspond to market average (index) returns. When implementing the strategy, the managers' performance objectives are to be set such that their performance net of fees at least match market returns.

These assumptions were the ones AP4 felt comfortable with and were partly based on Watson Wyatt input; the SSE also commented on them, raising question marks on the higher risk premium assumed for Swedish equities but AP4 decided not to make any changes.

Demographic assumptions

AP4 used the preliminary version of RFV projections, provided to them in February 2000; these projections were not published. When RFV scenarios were subsequently made available in the fall 2000 and published in early 2001, AP4 analysed them and came to the conclusion that the middle scenario (as opposed to more optimistic or pessimistic scenarios) was slightly more favourable than the preliminary scenario used (which was thus more on the "safe side"); hence, no changes in the conclusions of the original study was required. None of these new scenarios were actually used in the ALM study.

There were also some question marks on the rationale and validity behind some of the underlying assumptions of those new projections.

AP4 realises that these assumptions are crucial but consider that they do not have the expertise to deal with this themselves. They believe it is much more appropriate that these assumptions be made centrally by RFV as it is currently the case and would welcome an even more thorough research (e.g. some statistical data used in the RFV projections are believed not to be most up-to-date).

Sensitivity analysis

No sensitivity analysis was performed for the economic assumptions, with the exception of the sensitivity analysis done by the Stockholm school of Economics for the efficient frontier analysis part of the study, as part of their second opinion mandate. Verbal comments were made to the Board on the sensitivity of results to assumptions.

No analysis of the sensitivity to demographic assumptions was carried out as such. However, note the analysis of an extra demographic scenario referred to in the previous section.

Decision-making process

WWP started out their study early 2000. A first draft was submitted to management in April, and the board of directors received a preliminary report in June (in English). WWP's final report was submitted late August 2000.

The committee submitted executive summaries (in Swedish) to the board of directors in early September 2000. Management discussed the model and the economic assumptions with the board during a couple of seminars in September 2000.

The board's main comments were about the Swedish Equity exposure rather than the other aspects of the modelling, e.g. assumptions used. In this respect, the board also pointed out the importance of AP4 continuing to be active in corporate governance of the Swedish holdings. Also, the board discussed the underlying demographic assumptions.

AP4 states that the results of the ALM process are their own and that models and data from WWP support them. This seems plausible since a number of qualitative considerations are taken into account within the documents produced internally. For instance, due to the long history within the Swedish Equity markets the AP4 chooses a much higher share within this asset class than indicated by WWP's study.

Future developments

Future work will include study of further diversification of the portfolio into emerging markets, small companies, alternative assets and possibly other areas (e.g. high yield bonds).
