

The following letter was submitted to the Ministry of Finance on 10 April 1997

FUTURE MANAGEMENT OF THE GOVERNMENT PETROLEUM FUND

The Government Petroleum Fund was established by the Storting (Norwegian parliament) in 1990. Section 1 of the Act states that "The Act shall regulate the allocation and investment methods for a Fund which shall promote the long-term considerations pertaining to the use of petroleum revenues". Pursuant to the Act relating to the Government Petroleum Fund, the Ministry of Finance shall manage the Fund's capital. When the Fund was established, the Standing Committee on Finance and Economic Affairs emphasised that most of the Fund's capital should be invested in financial assets abroad.

Norges Bank is responsible for the operational management of the Government Petroleum Fund, see Revised National Budget 1995. The Ministry of Finance issues the regulation for the management of the Fund based on proposals from Norges Bank. The regulation was issued on 10 May 1996 in connection with the presentation of the Revised National Budget 1996, with a minor revision on 29 November 1996. In view of the changes in important underlying assumptions for the management of the Petroleum Fund since Norges Bank last submitted a statement concerning the guidelines, the Bank would now recommend that some changes be considered, particularly as regards the distribution of assets (asset classes), currencies and markets in which the Fund's capital shall be invested. The implementation of a new management strategy and the development of the necessary control and evaluation routines are also discussed.

Changes in underlying assumptions for the management of the Petroleum Fund

When the regulation on the Fund was issued in the spring of 1996, the allocation to the Government Petroleum Fund in 1996 was estimated at a little less than NOK 25 billion. Furthermore, it was assumed that allocations in 1997 and 1998 would be slightly lower than in 1996. The regulation for the management of the Petroleum Fund was therefore formulated with a greater emphasis, at least compared with what would have been the case today, on liquidity considerations and the limited likelihood of wide variations in returns in the various

markets in which the Fund's capital was invested, as well as the need for security (minimal credit risk). Estimates of future allocations to the Government Petroleum Fund have been revised upwards by a considerable margin since May 1996. In the Government's Long-Term Programme for 1998-2001, presented in March 1997, the accumulated capital in the Fund was estimated at a little more than NOK 300 billion in the year 2000 and NOK 400 billion at the end of 2001. The Long-Term Programme's estimate for the size of the Petroleum Fund in the year 2000 represents a doubling of the estimate in the Revised National Budget 1996. The projections in the Long-Term Programme indicate that we will not begin to draw on the Fund's resources until the year 2020.

Based on current projections for the central government budget balance, it will not be necessary to transfer capital from the Petroleum Fund to the central government budget in the long-term programme period or in the first years following this period. This conclusion is fairly robust even in the event of considerable variations in oil prices. Therefore, the Petroleum Fund's investments must now be evaluated over a considerably longer time horizon than was assumed in 1996. The extended time horizon entails that we can now place a different emphasis on returns and risk than previously. As a result, some adjustments in the guidelines for the management of the Fund would be desirable.

Main principles for the management of the Petroleum Fund

Total central government wealth encompasses considerably more than just the Petroleum Fund. It might be argued that, in principle, a management strategy should be devised for total central government wealth. In addition to the Petroleum Fund, this wealth includes other financial assets such as Norges Bank's foreign exchange reserves and the National Insurance Fund, ownership interests in commercial activities, real capital as well as natural resource capital such as oil and gas wealth in the North Sea. In practice, an overall management strategy of this nature is not feasible. However, there is a particularly close relationship between petroleum wealth and the Government Petroleum Fund inasmuch as the depletion of petroleum wealth is being accompanied by a parallel accumulation of capital in the Petroleum Fund. It may thus be appropriate to take petroleum wealth into account when defining the

long-term investment strategy for the Petroleum Fund. This implies that the management of the Fund should be based on a relatively long investment horizon, and that emphasis is placed on investments which, through negative covariance with the oil price, reduce the total risk.

The capital in the Petroleum Fund must be invested on the basis of a clear mandate for the investments and with a division of roles between the Ministry of Finance and the manager which permits the Fund's management to be evaluated.

In order to allow the Ministry of Finance and the public at large to measure and evaluate performance, there must be clearly defined measures for the management of the Fund, including in particular clarity concerning the concept of return. This can be done in a meaningful way as long as only purely financial instruments are involved. Any investments for which performance is measured on the basis of criteria other than the direct financial return, taking risk into account, should therefore be separated from the Petroleum Fund.

This investment strategy entails that a number of types of risk will arise for the management of the Petroleum Fund:

- Since the wealth shall be invested in currencies other than NOK, the accounts for the Fund's investments will show varying results from one year to the next as a result of exchange rate movements between NOK and the currencies included in the Fund's investments. However, with the objective of stabilising the Fund's international purchasing power, it is not relevant to consider movements in the NOK exchange rate as an exchange rate risk. Any deviations in the currency distribution between the Fund's investments and a currency basket which best reflects the objective of stabilising international purchasing power will, however, involve an exchange rate risk.
- In relation to purchasing power in Norway, however, any appreciation of the krone from the time of investment until the time of use will have an influence. Drawing on the resources of the Fund may be based on the desire to increase:

- purchases of goods and services abroad,
- domestic demand.

In the latter case the central government faces an appreciation risk.

- In connection with interest-bearing instruments and equity instruments, there is a risk of price changes (capital loss or gain) as a result of changes in interest rates or other events which result in changes in the market's assessment of the price of each instrument.
- In connection with the purchase of interest-bearing securities other than those that are not government guaranteed, there is a risk that the issuer will default on its obligations when the coupon or principal falls due, ie a credit risk.
- In connection with equity instruments, there is a company risk.
- There is an administrative risk associated with the settlement of transactions.

With the exception of the last two points, this can be summarised as the risk that the market value of the investments fluctuates over time. The main emphasis has been placed on this type of risk when discussing the balance between expected return and risk later in this submission.

In the management of foreign exchange reserves, Norges Bank has so far limited price risk and credit risk by selecting government and government-guaranteed interest-bearing securities or deposits in highly rated banks as investment vehicles. Liquidity risk is also maintained at a low level by selecting markets and instruments that have satisfactory depth and breadth so that the securities can be traded in large volumes without resulting in a substantial change in price.

It is important to formulate more precisely in the guidelines exactly what types of risk should

be emphasised for the investments of the Petroleum Fund. In the case of the Petroleum Fund it is particularly important to be aware of the difference between the uncertainty surrounding the return in the short and long term. An investment for which there is considerable short-term uncertainty may be less risky if a long-term evaluation horizon is applied. Even with the current investment strategy it is accepted that the return can vary more in the short term (one year) if the investments increase the expected return or reduce the uncertainty in the long term. In this connection reference is made to the Revised National Budget 1996, which states:

“Due to interest and exchange rate changes, the return in the account for the Government Petroleum Fund may be negative in some years. This can occur, for example, if the Norwegian krone appreciates substantially or if interest rates rise to the extent that the market value of long-term investments declines. As noted earlier, however, the objective is to maintain the Fund’s purchasing power on a long-term basis, and it is then of lesser importance if the Fund’s value in NOK fluctuates somewhat from year to year.”

The extension of the time horizon for investments, as described above, further indicates that less importance should be attached to short-term variations in return and instead focus more on the expected return.

Finally, it is necessary to underline the importance of coherent supervision of the Fund’s management. Irrespective of who has the operational responsibility for the management of the Petroleum Fund, the responsibility for continuous monitoring of the portfolio’s total investments must be centralised. This control will ensure that the investments always comply with the regulations for the management of the Petroleum Fund.

Expanding investments to include a new asset class (equities)

A sound management strategy will be characterised by minimising the uncertainty linked to the total risk of the investments, given a required rate of return or, alternatively, maximising the rate of return, given an upper limit for acceptable risk. In this connection risk is defined as the uncertainty associated with the variation in the total return from one period to the next. In

an efficient portfolio the risk will be spread among several types of assets (asset classes) - in different markets and securities. Risk diversification reduces risk without reducing the expected return. In an efficient portfolio risks are only undertaken when they are paid for in the form of a higher expected return. Investments in a mixed portfolio of securities will have a lower risk than investments in an individual security. The greater the negative covariance between price changes for various securities is, the greater the potential for eliminating the risk without costs. An investment strategy based on standard portfolio theory will imply:

- investing in several different asset classes
- investing in a number of markets
- spreading the investments in each market segment in various securities.

As a rule, Norwegian and international funds with a long-term investment horizon distribute most of their financial investments among equities, bonds and property. Large pension funds, life insurance companies or state investment enterprises which can be compared to the Petroleum Fund all have a substantial proportion of their total assets in equities. Data on returns for international capital markets indicate that the return on investments in even a well-diversified equity portfolio shows greater variation from one year to the next than investments in a bond portfolio. The likelihood of a very poor return in a randomly selected year increases when the equity portion in a securities portfolio is increased. Capital managers with a long-term investment horizon invest a large proportion of their portfolios in equities because experience shows that equities provide a higher average return than bonds. Surveys of a number of international capital markets show that equities have provided a higher return than bonds over longer periods. In a study carried out by the G-10 countries in 1995, the excess return on equities in an historical context was estimated at 4 per cent. An average excess return on equities of 4 per cent cannot be guaranteed in the future, but there are many indications that equities will continue to provide a long-term excess return compared with bonds.

An increase in the time horizon increases the likelihood that equities on average provide a higher return and less variation in the return. In the US market, for example, the return on

equities has been higher than the return on bonds in 60 per cent of the years between 1871 and 1992. If we look at subperiods of five years in this same period, equities have provided an excess return in more than 70 per cent of the five-year periods. With a ten-year time horizon, the figure rises further to more than 80 per cent.¹

A portfolio which consists of both equities and bonds will provide diversification gains between these two asset classes. These diversification gains arise because the market value of equities and bonds seldom moves completely in tandem. A very weak trend in one market might be partly offset by a more favourable trend in the other. If longer time horizons are applied, it is also possible, by combining equities and bonds, to achieve less variable returns than by just investing in bonds.² It must be emphasised, however, that the risk-minimising equity portion not only depends on the time horizon, but also on the distribution of returns over time. It is therefore not given that the standard deviation of the return will decline when equities are included, even when evaluated over a longer time horizon.

Oil and gas are an important part of Norway's total national wealth. Sizeable changes in oil prices will thus have considerable consequences both for central government revenues and for the value of the central government's total wealth. The Petroleum Fund can be looked upon as wealth that has been converted from oil and gas to foreign financial assets. Historical data show that whereas equities have had negative covariance with the oil price in the long term, there has been some positive covariance between bonds and the oil price. This indicates that greater stability in the value of total national wealth can be achieved by including a substantial proportion of equities in the Petroleum Fund. These arguments would imply that the Petroleum Fund should have a considerable equity portion. Professional managers would

¹ Source: Jeremy Siegel: "Stocks in the long run", IRWIN (1994).

² Historical returns in the US and UK for equity and bond markets (data for the period 1926-1995 were obtained from "Stocks, Bonds, Bills and Inflation 1996 Yearbook" (Ibbotson Associates) and "BZW Equity-Gilt Study 1996", respectively) illustrate the substantial diversification gains to be found in spreading the risk between equity and bond investments. Even though the return on equities has shown wider variations than bonds in both markets in this period, equity portions of 30-50 per cent have nevertheless minimised the variability of the return on the combined portfolio if a five-year time horizon is applied. With a one-year time horizon the same risk-minimising portion would still be positive, but low.

not have any strong objections to an equity portion of at least 30 per cent. Other management institutions that are responsible for large portfolios with a long-term investment horizon often have a higher proportion than this. This will increase the Fund's expected return. Even though it will make the Fund's return more variable in the short-term and, in isolation, result in a greater likelihood of a negative return in a randomly selected year, this is not true to the same extent in the long term. In international markets for which there are long time series for returns on both equities and bonds, portfolios consisting of both equities and bonds have provided a higher return without entailing that the return has been more variable than portfolios where only one of the asset classes has been represented. This applies when time horizons of several years have been used, but is not necessarily representative for the future. However, a decision to invest large parts of the Fund's capital in equity instruments will definitely increase the likelihood of a substantial decline in the Fund's market value during one calendar year.

With regard to investments in international equity markets, it is further recommended that:

- investments are distributed among a large number of individual equities in the various markets. This spreads the risk and results in smaller variations, and also helps to avoid equity stakes of a magnitude which forces the investor into an active role as owner. An upper limit should be established for the Fund's total equity stake in a company's share capital which guarantees this;
- derivatives such as futures or share index swaps can to some extent be used in addition to direct equity investments. This can provide the same desired exposure in the stock market as direct investments, but direct purchases of individual equities are then unnecessary. It is not recommended, however, that only derivatives are used to achieve the desired exposure. In the long term, the transaction costs for the use of derivatives will probably be higher than the costs of owning the underlying equities. Some of the derivative markets are also so small that it may prove difficult to achieve the desired exposure without influencing prices. It is further assumed that the use of derivatives is based on

rules for monitoring the portfolio's expected variation in return and that derivatives are not used to increase the exposure in individual markets beyond the level stipulated in the rules;

- the acceptable limit for the difference between the expected return on the equity portfolio and the return on a recognised market index (tracking error) should be relatively low, at least in the start-up phase. This will contribute to better risk control and also be in keeping with the recommendation concerning a broad diversification of instruments in and between the various markets. In practice, this means that indexing strategies should primarily be used. An emphasis on management strategies with relatively low risk tolerance is also consistent with trends in international capital management. Within an overall strategy based on this principle, however, there is still scope for more active management of small portions of the portfolio.

Based on this strategy, even a Petroleum Fund which is considerably larger than today will only own small stakes in the various companies. This strategy will make it possible to set certain types of restrictions concerning those companies in which the Fund shall not invest due to political considerations. Any restrictions must be set by the political authorities and be taken into account when establishing benchmark portfolios for the purpose of comparison. Such restrictions will in principle have a cost in the form of higher administrative expenses. The costs, and the practical problems relating to implementation, may increase if restrictions that are unclear or unusual in the market are imposed. Experience shows that it has been extremely difficult to establish clear-cut criteria which safeguard all considerations. This will hamper decision-making processes.

Change in currency and market distribution

Since May 1996 the currency distribution in the Petroleum Fund has been based on Norwegian import weights with a view to stabilising the Fund's international purchasing power. The Fund has therefore had a currency distribution with about 75 per cent invested in

European currencies. About one fourth is invested in SEK and DKK.

The decision to use import weights was based on an earlier estimate of the size of the Fund, and was thereby based on a shorter evaluation horizon than now being applied. The question of currency weighting is in principle different with a longer time horizon. It applies to a portfolio with only bonds. The inclusion of equities in the portfolio also raises other questions concerning currency weighting and market distribution, see below.

The Fund's currency distribution has also been the basis for the distribution of investments between bond markets in various countries (market distribution). In principle, these are independent decisions, but so far it has not been deemed necessary to distinguish between these two decisions in the existing guidelines. For investments in bond markets the choice of currency distribution will probably have greater consequences for the total return than the market distribution. The choice of market distribution for equities may have a potentially greater impact on the result. On the other hand, there are considerable problems linked to defining the concept "market distributoin" for international equity portfolios. This will be discussed further later in this submission.

Even if, as previously, a short time horizon were to be applied, the question may be raised as to whether import weights produce a risk-minimising currency distribution. First, the official import weights only reflect about 85 per cent of Norwegian imports. A number of countries, particularly in Southeast Asia, are not represented in the import weights. Second, it may be pointed out that the import weights are not adjusted for third-country effects, ie that factor inputs for a finished good may be produced in several other countries. An adjustment for this would probably result in a currency distribution closer to global gross domestic product weights (or global export weights).

The risk of deviating from an index which is defined as the basis for the management of the Fund (in our case the import index) is often quantified on the basis of historical relationships because it is difficult to find a better alternative. This is an acceptable method for quantifying risk a few years ahead, but is highly unsatisfactory for estimating risk for a very long future

period. A longer evaluation horizon thus implies that the currency and market distribution should be reassessed.

With a long time horizon for the Petroleum Fund, it will be important to take account of the possibility that various events may occur (such as wars, major technological breakthroughs, natural disasters, etc.). This would point to the need for a broader global spread of the Fund than that implied by the existing guidelines.

There are two reasons for this. The first is linked to fluctuations in the return on investments by the Fund, and the second to the covariance between trends in the Norwegian economy and the return on investments by the Fund. In order to minimise variations in the return on investments by the Fund, the portfolio should be spread over regions where unique events are not likely to occur simultaneously. In order to reduce the covariance between trends in the Norwegian economy and the return on investments by the Fund, capital in the Fund should be invested in countries which generally differ from Norway. In isolation, this indicates that we should limit investments in countries which are geographically close to Norway and which have a similar economic structure. The current currency and market distribution of the Petroleum Fund exposes investments to a considerable risk if events in Europe occur which have a negative influence on the return on foreign exchange and capital markets in this region, compared with the US and Asia. A more balanced distribution between the three major regions, the US, Asia and Europe, would reduce this risk.

If equities are included in the portfolio, the situation remains the same: a currency and market distribution must be achieved which stabilises the international purchasing power of the Petroleum Fund. As regards bonds, there is a clear relationship between the currency weighting and the choice of country and market in which we invest. If we want a special distribution of currencies in the portfolio, we have to purchase bonds in the different countries on the basis of a corresponding weighting. The relationship is less clear in the case of equities. Return differentials between markets may be considerable and be less correlated with movements in exchange rates.

The actual definition of 'market' is also more unclear for equities. In many investment strategies it is common to define individual markets based on geographical differences, eg by establishing how much of the portfolio is to be invested in the respective countries. But equities represent ownership interests in enterprises that often operate in many countries. For example, the fact that an enterprise's head office is located in one country does not prevent the company from recording most of its earnings on sales and activities in other countries. In some cases it may be more appropriate to base the division of global sectors on distribution by market rather than by country.

It is also important to be aware that the export weights and import weights in the Norwegian economy are relatively similar. If export markets (which are generally in Europe) are affected by a recession, this would affect those segments of the Norwegian business sector that are dependent on these markets. A petroleum fund which is invested on the basis of import weights may also record a poor return on investments in stock markets in the same countries. This covariance between the Norwegian economy and the return in foreign markets may thus give rise to more substantial fluctuations in the total domestic supply of goods in a situation where capital is being drawn from the fund.

For equity investments with a long time horizon, there are many indications that it would be better to apply global market weights rather than Norwegian import weights to stabilise international purchasing power. Liquidity considerations in the various countries' foreign exchange and capital markets would seem to indicate the same. Based on current forecasts for the accumulation of capital in the Petroleum Fund and the assumption that parts of this will be invested in equities, with the current market distribution, the Fund will be a significant participant in the Scandinavian stock markets. In practice, it will be impossible for the Fund to invest such considerable capital in these markets without influencing individual equities in the Fund's disfavour. This, in itself, would point to the need for reducing portions in the smallest markets in favour of investments in the largest capital markets, primarily the US and Japan.

With a longer evaluation horizon, which entails that a substantial proportion of the Petroleum

Fund is invested in equities, there are many indications that the currency and market distribution of the Petroleum Fund should be adjusted so that a higher share of the Fund is invested outside Europe, and that more markets, especially in Asia, are included than at present.

As mentioned, the currency and market distribution may, in principle, be seen as two independent decisions. By using the forward exchange market, it is theoretically possible to have a currency distribution that is essentially different from the market distribution in the portfolio. All the same, Norges Bank would recommend that the guidelines for the Fund do not define a permanent division between the Fund's currency and market distribution. A strategic division between these two elements would result in additional transaction costs, and an extra credit risk without an increase in the expected return. Furthermore, it is difficult to hedge currency positions effectively for the length of time discussed here. Hedging foreign currency investments in the forward market is the most appropriate technique for investments with a limited time horizon, limited amounts and when a nominal return in the country's own currency is emphasised. None of these criteria are satisfied in the case of the Petroleum Fund.

Organisation of managment

The most important task linked to the management of the Petroleum Fund is to ensure that the different risk limits, which are defined in the guidelines, are observed at all times. This will include continuous monitoring of the distribution of asset classes, of currency distribution and market distribution. In addition, adjusting investments to changing market conditions within the guidelines stipulated by the Ministry of Finance must be given priority. Norges Bank is currently responsible for the operational management of the Petroleum Fund. The evaluations below will, however, to a large extent be relevant regardless of which institution has this responsibility. It must be emphasised that the Petroleum Fund is a government fund and, as the responsible owner, the central government must devise a system for the administrative management of the accumulated wealth which safeguards the owner's need to monitor continuously that the guidelines for Petroleum Fund management are observed.

In order to fulfill the requirements which must be set for adequate risk control of Petroleum Fund investments, Norges Bank intends to select a global custodian institution to manage that part of the portfolio which is invested in equities. The custodian institution will be responsible for custodial services in connection with securities and the settlement of all transactions in equities, all practical matters in connection with dividends and other cash flows in the portfolios, and organising account-keeping for the equity component of the Petroleum Fund. The global custodian institution will also play a key role as regards the control of risk in the equity portfolio, both at a transaction and aggregated level. Key activities will also include return measurement and explanations for differences in the return in the benchmark portfolio and on actual investments. Close cooperation with a recognised global custodian institution will be crucial for ensuring good routines for controlling different types of risk. This is particularly important for investments in equity markets as Norges Bank does not have the same systems and administrative skills in this area as it does for investments in interest-bearing instruments. In the case of Petroleum Fund investments in interest-bearing instruments, Norges Bank uses the services of several custodian institutions but is responsible for consolidating the information from the different institutions. However, a global custodian institution has been selected for those parts of the foreign exchange reserves which are managed externally.

Norges Bank will continuously assess how large a share of the active management of the Petroleum Fund shall be assigned to external managers. In assessing internal versus external management, the main emphasis will be on commercial criteria. If there is reason to expect that institutions other than Norges Bank are in a position to undertake the management at a lower cost and/or with a higher return, responsibility for the management itself should be outsourced. This will, however, be based on overall risk management in Norges Bank, in accordance with the guidelines set by the Ministry of Finance.

Norges Bank has considerable experience as regards investments in interest-bearing instruments with high security (government bonds) and has established the necessary systems for transaction settlement and accounting. In this area it is thus reasonable to expect that Norges Bank is equally effective and professional as other managers. It is therefore assumed

that these investments will continue to be managed internally. As the Ministry is aware, Norges Bank has appointed two external portfolio managers - one for USD investments in the US and one for investments in European currencies. Norges Bank has also appointed a consultant to construct a benchmark portfolio which the Bank can use as a reference for its own assessment and control of management. The question of increasing external management of parts of the bond portfolio will, however, be further assessed, based on the experience gained in connection with the agreements concluded with the above-mentioned external managers for the management of parts of the foreign exchange reserves. Norges Bank has focused more on strategic issues related to reserves management in the past year. Seven permanent positions linked to reserves management have been established, and management expertise in the area of capital management has also been acquired. Norges Bank is of the view that the current size of the foreign exchange reserves and the portfolio strategy for the reserves and the Petroleum Fund in themselves justify an increased use of resources in this area. Depending on the investment strategy chosen, however, it may be appropriate to develop further expertise, and Norges Bank will evaluate the situation following the deliberations on the Revised National Budget 1997.

Norges Bank has considerable experience in the bond market and in overall risk management, but not in equity investment. Nor has the Bank developed expertise in evaluating individual equities. Should it be decided that Petroleum Fund investments in equities are permitted, such investments will therefore have to be undertaken by external managers, at least initially. In the event, Norges Bank would, as the responsible management institution and in line with overall risk management, draw up management mandates and appoint and follow up managers. If necessary, external consultants will assist in the selection process. Moreover, the Bank will aim to develop further expertise in line with the requirements for executing these functions effectively. Indexing strategies, or strategies with a low risk tolerance compared with a recognised market index, will largely be used, primarily due to the requirement for effective risk control. Once more experience has been gained in evaluating the management of such portfolios, the Bank will further evaluate whether it may be more cost effective to carry out parts of the active management internally. Investment strategies that permit certain managers to incur considerable risk compared with a recognised market index will not be

applied in the start-up phase. Nor is it likely that Norges Bank would want to assume operational responsibility for such strategies in the longer term.

However, it may be appropriate for Norges Bank to assume responsibility for investments in derivative markets for equity investments (index-futures/swaps) from the start. Derivatives will be a useful tool for managing the portfolio's total risk, and the use of derivatives does not involve the same administrative risk as purchases of individual equities.

Norges Bank is currently evaluating various alternatives for the future organisation of reserves management in the Bank. When evaluating these different alternatives, emphasis will be placed on creating an organisation that provides the best possible basis for high-quality management and risk control, that ensures a clear distribution of responsibilities and that promotes an efficient use of resources. Regardless of the form the organisation takes, emphasis will be placed on linking the management function more closely to the Bank's senior management.

Recommendations

Norges Bank would make the following recommendations regarding the future management strategy for the Government Petroleum Fund:

1. The management of the Fund must be based on a clear division of roles between the Ministry of Finance and the operational manager. The Ministry of Finance must define a clear mandate for the management, which outlines the responsibilities of the Ministry and the responsibilities of the manager. If both the Ministry of Finance and the public at large are to be able to evaluate the management performance, it is a prerequisite that the measurement of management is only linked to the financial return. Furthermore, the relevant time horizon as regards the likelihood of variations in the financial return and the types of risk that shall be controlled must be clearly specified.
2. Investments by the Fund should be extended to include investments in international

equity markets. Based on an evaluation of which time horizon is deemed appropriate for Fund investments, this portion should be considerable. Professional managers would not have any strong objections to an equity portion of at least 30%, although other management institutions that are responsible for large portfolios with a long investment horizon often have a higher proportion than this.

3. Equity investments should be spread among many different markets, and over a vast number of individual equities in each market. Based on this strategy, even a Petroleum Fund which is considerably larger than today would only own small stakes in each enterprise's equity.
4. A relatively low tolerance level should be set for expected variations in the return on equity investments in each market and a recognised and well-diversified market index.
5. In relation to the existing regulation for the Petroleum Fund, the share invested in European currencies and markets should be reduced in favour of investments in the US and Asia. It should be evaluated whether more markets in Asia should be included than is currently the case.
6. Responsibility for overall control should be centralised in one institution in order to ensure that the different limits for low risk in the total portfolio (distribution of asset classes, currency and market distribution, etc.) set out in the Ministry of Finance's guidelines are observed at all times. This institution should, however, be authorised to use other managers for parts of the portfolio. On the whole, it must be appropriate to assign the operational responsibility for any equity investments to those managers that can execute this in the most cost-effective manner.

Yours sincerely

Kjell Storvik

Governor

Helge Eide

Enclosure**A simple, empirical analysis of the relationship between risk and the return on equity and bond investments**

In this enclosure we will present the results of a simple, empirical analysis of the relationship between the return and risk when equities are included in the investment portfolio. We will first present the results of a standard expectations-variance analysis in which the expectations of future return and risk are solely based on historical estimates. We will then modify this analysis to incorporate various subjective estimates for future risk premia and the nominal return. In both the historical and the modified analyses the probability of losses in any one year will be calculated to illustrate the relationship between returns and risk. Finally, we will present a simple dynamic analysis where we look at the portfolio strategy that has historically provided the smallest annual losses over a given period.

1. A standard expectations-variance analysis based on historical data

Table 1. Annual return, standard deviation and probability of negative return for different equity shares in the ex-post optimal portfolio. Optimisation is based on historical monthly returns in the period 1980-1996

Equity portion	Return	Standard deviation	P ($r < 0$)
0%	9.3%	4.7%	2.4%
10%	10.0%	5.2%	2.7%
20%	10.8%	6.1%	3.8%
30%	11.5%	7.2%	5.5%
40%	12.2%	8.5%	7.6%
50%	12.9%	9.9%	9.6%
100%	15.5%	16.0%	16.6%

Table 1 shows the annual historical return and standard deviation on portfolios with the lowest variance for a given equity portion in the portfolio. These optimal portfolios are calculated with the help of an optimisation routine developed in Norges Bank. The data series used consists of monthly returns for equity indices and bonds with different maturities¹ for each of the main currencies: DEM, JPY, GBP and USD. In order to isolate the relationship between the equity share, the return and the standard deviation from fluctuations in the krone exchange rate, all return figures are measured in local currency. The data series covers the period January 1980-September 1996.

In all the optimisations, market shares are held constant at 40% in DEM, 15% in JPY, 15% in GBP and 30% in USD. The distribution of equities in the different portfolios mirrors the market distribution. For example, the portfolio with 50% equities has 20% in German equities, 7.5% in Japanese equities, etc. The duration in each market and overall has been held constant at 5 years. We have placed these constraints on the optimisation to arrive at a more realistic estimate of the expected relationship between the return and risk.

The end column to the right shows the estimated probability of losses in each budget year $P(a < 0)$ ², where a equals the return on the portfolio. For example, the probability of losses is 10% if an optimal portfolio with 50% equities and 50% bonds is chosen.

¹ Maturities used are 3 years, 5 years, 7 years and 10 years.

² Under the assumption that a is normally distributed $P(a < 0) = P\left(\frac{M[a] - 0}{SD[a]} < 0\right) = 1 - F_{m(x)}\left(\frac{M[a] - 0}{SD[a]}\right)$ where $M[a]$ equals the estimate for the average return, $SD[a]$ equals the estimated standard deviation and $F_{m(x)}$ equals the area under the t-curve to the left of x with $m = n - 1 = 188$ degrees of freedom.

2. Modified analysis which incorporates subjective estimates for the risk premium and the nominal return

For illustrative purposes, it may be of interest to analyse how sensitive the probability of losses is to changes in the risk premium and the nominal return. Table 2 shows the estimated probability of losses $P(a < 0)$ ³ for risk premia in the range 1-4% for an unchanged variance-covariance structure. The risk premium $r = a_a - a_o$ where a_a equals the return on the equity portfolio and a_o equals the return on the bond portfolio.

Table 2. The risk premium r and the probability of a negative return when the nominal return on the bond portfolio remains unchanged

Equity portion	$r = 1\%$	$r = 2\%$	$r = 3\%$	$r = 4\%$
10%	3.4%	3.2%	3.1%	2.9%
20%	5.4%	5.1%	4.7%	4.4%
30%	8.1%	7.5%	6.9%	6.3%
40%	11.2%	10.2%	9.3%	8.5%
50%	13.8%	12.5%	11.5%	10.6%

As shown in the table, if the risk premium equals the G-10 estimate of 4%, a 45% equity portion will result in a 10% probability of losses. If the G-10 estimate is halved to 2%, the equity portion which results in a 10% probability of losses is 40%.

³ Under the assumption that a is normally distributed $P(a < 0) = P(\{MA[a]/SD[a]\}/0) = 1 - F_{m(x)}(MA[a]/SD[a])$ where $MA[a]$ equals the estimate for the expected return, $SD[a]$ equals the estimated standard deviation and $F_{m(x)}$ equals the area under the t-curve to the left of x with $m = n - 1 = 188$ degrees of freedom. $MA[a] = b * \{M[a_0] - 2\% + r\} + (1 - b) * \{M[a_0] - 2\%\}$, where b equals the equity share, $M[a_0]$ equals the estimated average return on the bond portfolio and $r = [1\%, 2\%, 3\%, 4\%]$. $M[a_0]$ and $SD[a]$ for different equity portions in the portfolio are obtained from the underlying optimisations in Table 1.

Table 3 shows the estimated probability of losses in one budget year $P(a < 0)^4$ when the return on the bond portfolio a_b is 2% lower than the historical estimate $M[a_b]$ and the risk premium r varies in the range 1-4% with an unchanged variance-covariance structure. The table shows that a 30% equity portion results in a 10% probability of losses if the return on bonds is 2% lower than the historical estimate used in Table 1. Consequently, the likelihood of losses is more sensitive as regards changes in the absolute level of return than changes in the risk premium.

Table 3. The risk premium r and the likelihood of a negative return when the nominal return on the bond portfolio is 2% lower than the historical estimate

Equity portion	$r = 1\%$	$r = 2\%$	$r = 3\%$	$r = 4\%$
10%	7.4%	7.1%	6.8%	6.7%
20%	10.0%	9.5%	8.9%	8.4%
30%	13.1%	12.3%	11.3%	10.6%
40%	16.1%	14.9%	14.0%	12.9%
50%	18.7%	17.4%	16.1%	14.9%

3. Simple dynamic analysis

The analyses of the likelihood of losses above were carried out within the framework of a static model where we look at expectations and variance in a given period. The validity of the estimated probability is contingent on the assumption concerning normally distributed returns holding true. It may be useful to supplement this analysis with a more informal dynamic analysis where we look at how the return varies over time for a given composition in the portfolio. More specifically, we will look at a worst case scenario and determine which portfolio historically has resulted in the smallest losses.

Table 4 shows the annual average return and the lowest return in one year for portfolios with varying equity portions. The data series used consists of annual figures for returns on equity and bond indices. The market distribution is the same as in the optimisation analysis above. The data series covers the period 1 January 1984-31 December 1996. The lowest return in one year is calculated as $\text{Min}_{t(a(t))}$ where a equals the return on the portfolio and t equals [1984....1996].

The table shows that the portfolio which has resulted in the smallest absolute minimum losses in one year during the analysis period is a portfolio with 40% equities and 60% bonds.

Table 4. Annual return and annual minimum return for different equity shares in the portfolio. Historical monthly returns for the period 1984-1996

Equity portion	Return	Minimum return
0%	11.0%	-10.5%
10%	11.5%	-9.9%
20%	12.0%	-9.3%
30%	12.5%	-8.7%
40%	12.9%	-8.2%
50%	13.4%	-9.1%
60%	13.8%	-10.8%
80%	14.5%	-14.1%
100%	15.2%	-17.4%