

Can Norway afford the National Insurance Scheme?

The challenge to Norway's social security policy in a European context¹

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The article presents calculations that show that the pension burden may rise considerably faster in Norway than in the EU over the next fifty years. This must be viewed in light of the fact that relatively favourable demographic developments in Norway are more than counteracted by an estimated sharp increase in pension per beneficiary in real terms. At present, however, Norway enjoys a considerably more propitious financial situation than the EU countries. The Norwegian government has sizeable net assets and substantial petroleum wealth, which can be regarded as an implicit partial funding of future pension obligations. However, preserving today's pension system requires considerable government saving in the years to come. Continual use of petroleum revenues corresponding approximately to the expected real return on the Government Petroleum Fund implies that in the future Norway must either implement cutbacks in the pension system or accept that other expenditure categories will increase more slowly than direct and indirect taxes from mainland Norway.

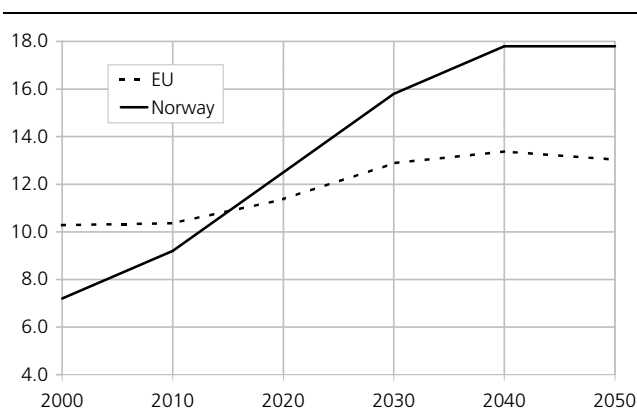
Introduction

During the last fifteen years the question of the long-term viability of public pension schemes has been high on the political agenda. In Norway and in a number of other industrial countries, these schemes involve "pay-as-you-go" financing to a considerable degree. This means that current disbursements are financed by taxes on current value added. Increased longevity and an increasing number of disability pensioners and early retirees, however, have placed strains on established schemes. For a number of industrial countries, continuing to raise pension levels in line with earlier intentions would involve an increase in expenses that would be considerably more rapid than the rise in value added as measured by GDP. This is illustrated for the seven major industrial nations as well as for Sweden by Chand and Jaeger (1996), among others, and for 20 OECD countries by Roseweare et al. (1996). Recently the Ecofin (2000) (EU's council of ministers of finance) also presented estimates for 13 EU countries. For Norway, such calculations have been made on a number of occasions; see, for example, Frederiksen (1998a) and the Ministry of Finance (2001a). If such pension growth takes place without prior accumulation of sufficient financial reserves, the tax burden must either rise over

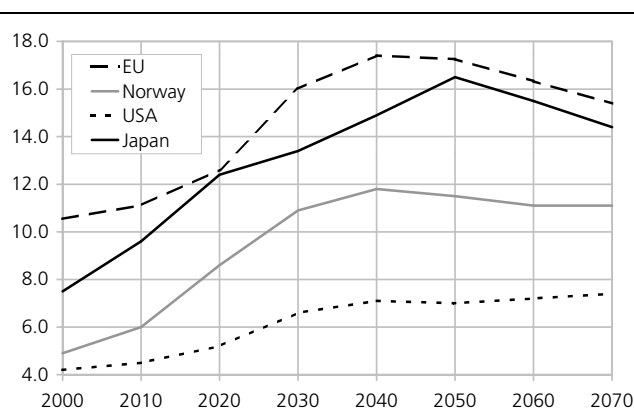
time and/or other public expenditure must be reduced. Such adjustments can have undesired consequences both for income distribution, broadly speaking, and for the economy's efficient use of resources. This article examines the expected growth of Norway's pension burden in a European context. Calculations in the Long-Term Programme 2002-2005 and updated estimates from Statistics Norway's microsimulation model, MOSART, show that relatively favourable demographic developments in Norway are more than counteracted by an assumed sharp real increase in pension per beneficiary. Accordingly we shall examine some possible adjustments to this challenge to pension policy, including funding as an alternative to pay-as-you-go. We shall argue that Norway, over the last 25 years, has implicitly followed a strategy of partial funding. Furthermore, considering current expectations about future petroleum revenues, it looks as if a continuation of the fiscal policy pursued over the last 2-3 years would gradually lead to a situation in which the present value of all future pension payments would have a counterpart in government assets or remaining petroleum wealth. This picture can be altered if, from now on, we phase petroleum revenues into the Norwegian economy in pace with the expected return on the Government Petroleum Fund.

¹ This article is an updated version of a speech given at the conference "Challenges to the Nordic Welfare State," Copenhagen, October 13-15, 2000. We have incorporated new figures for pension obligations in Norway and the EU from, respectively, the Ministry of Finance (2001a) and Ecofin (2000). We thank Axel West Pedersen for his comments on the speech, and Ådne Cappelen, Arne Magnus Christensen and Erling Holmøy for constructive comments on an earlier draft.

* This article was prepared while Knut Moum was Head of Research and Ingvild Strømsheim Wold was economist at Statistics Norway. Both now work in the Ministry of Finance. The article was translated from Norwegian by Helle Snellingen.

Figure 1. Pension burden: Old age and disability pension as share of GDP. Per cent

Sources: Ecofin (2000), Ministry of Finance (2001a).

Figure 2. Pension burden: Old age pension as share of GDP. OECD estimates. Per cent

Source: Roseweare et al. (1996).

Future developments in the pension burden

In a pay-as-you-go system, pension payments are financed by taxes on current value added. In order to quantify the burden under such a system, it is usual, when making international comparisons, to look at payments in relation to Gross Domestic Product (GDP).² Table 1 shows that old-age and disability pensions in Norway accounted for roughly 7 per cent of GDP in 2000. This is a markedly lower portion than for most of the EU countries. According to the calculations by Ecofin (2000), the GDP share for most of these countries was between 9 and 14.5 per cent, with an estimated GDP-weighted average of 10.3 per cent. Of the EU countries, only the UK and Ireland

had a lower share than Norway in 2000, with GDP shares of around 5 per cent.

The table also presents Ecofin's projections for the EU countries for the year 2050, and estimates for Norway from the Long-Term Programme 2002-2005 (see Ministry of Finance 2001a). Both Ecofin and the Ministry of Finance estimate that the pension burden will rise in the future. This is evident both from the table and from figure 1, which show the estimated growth in the pension burdens for Norway and the EU over the next fifty years. According to these estimates, the pension burden in Norway in 2050 may exceed the average for the EU countries by 5 per centage

Table 1. Pension burden, dependency ratio, demographic features, employment ratio, and change in compensation ratio in Norway and 13 EU countries

	Pension burden		Dependency ratio		Fertility rate		Average life expectancy		Employment ratio		Percentage change in compensation ratio 2000-2050
	2000	2050	2000	2050	2000	2050	2000	2050	2000	2050	
Germany	10.3	14.6	26.0	53.3	1.4	1.5	77.8	82.5	65.3	67.8	-28.3
France ¹	12.1	15.8	27.2	50.8	1.7	1.8	78.8	83.5	62.1	65.6	-26.2
Italy	14.2	13.9	28.8	66.8	1.2	1.5	78.8	83.5	53.8	65.0	-49.1
Great Britain	5.1	3.9	26.4	46.1	1.7	1.8	77.6	82.5	71.5	72.3	-55.7
Austria	14.5	15.1	25.1	55.0	1.3	1.5	78.1	83.5	74.4	88.3	-43.6
Belgium	9.3	12.6	28.1	49.7	1.5	1.8	78.4	83.0	59.1	62.7	-18.7
Denmark	10.2	13.2	24.1	41.9	1.8	1.8	76.6	81.0	76.8	77.0	-25.3
Finland	11.3	16.0	24.5	48.1	1.7	1.8	77.5	82.5	68.3	68.4	-27.8
Ireland	4.6	9.0	19.4	44.2	1.9	1.8	76.7	81.5	67.4	75.9	-3.3
The Netherlands	7.9	13.6	21.9	44.9	1.7	1.8	78.2	82.5	65.3	66.6	-14.4
Portugal	9.8	14.2	25.1	48.7	1.5	1.7	75.6	81.0	68.5	71.7	-21.8
Spain	9.4	17.7	27.1	65.7	1.2	1.5	78.5	82.0	55.9	68.0	-5.6
Sweden	9.0	10.0	29.6	46.1	1.5	1.8	79.7	84.0	73.1	77.3	-24.6
EU-13	10.3	13.0	26.7	53.4	1.5	1.6	78.2	82.8	61.4	66.3	-31.6
Norway	7.2	17.8	25.9	41.4	1.8	1.8	78.4	82.5	78.3	78.2	24.9

¹ The figure for dependency ratio is for the year 2040.

Sources: Ecofin (2000), Ministry of Finance (2001a), Statistics Norway and our own calculations.

2 This approach is used by Ecofin (2000) and the Ministry of Finance (2001a). One can argue, however, that national income and not GDP should be used in such comparisons. National income also includes, among other things, the return on the country's net foreign assets. With such assets accumulating very rapidly, GDP is a less reliable measure of national income for Norway than for most other industrialized countries. Since the accumulation of assets, in part, has its corollary in the reduction of petroleum wealth, it should also ideally be adjusted for this. This could be done by calculating GDP excluding the excess return deriving from petroleum activity (petroleum rent) by calculating national income and then adding the estimated return on petroleum wealth. The concepts of petroleum rent and petroleum wealth are explained in an appendix.

points. Of the EU countries, only Spain is expected to be faced with approximately the same pension burden as Norway in 2050, and none of the EU countries will experience anything close to the same estimated growth in the pension burden during the period as will Norway.

The calculations referred to above deviate slightly from earlier estimates of the growth in *old-age* pensions in Norway and in a selection of OECD countries that were presented in Roseweare et al. (1996). As shown in figure 2, the earlier calculations assumed that Norway's old-age pension burden would also be relatively low in 2050, even though these calculations also showed a sharp increase in the pension burden for Norway over the next 50 years. Several EU countries have implemented changes in their pension systems in the wake of the estimates by Roseweare et al. This may imply that their figures for these countries are systematically overestimated. One merit of the calculations, however, is that the figures for the individual countries have been arrived at by means of a uniform method of calculation. This is not necessarily the case when we compare the estimates for Norway in the Long-Term Programme with Ecofin's estimates for the EU countries. Below we will take a closer look at the significance of different assumptions for the scenarios associated with these two projections.

Why is the growth in Norway's pension burden expected to be so high?

In order to understand the background of the pension developments outlined above, it is appropriate to decompose the pension burden by contributions from the following key variables:

$$(1) \quad \frac{P}{X} = \frac{W}{X} * \frac{p}{w} * \frac{N^B}{N^Y} * \frac{1}{N^E/N^Y}$$

Here P is pension expenditure, X is Gross Domestic Product (GDP), W is aggregate wage expenditure, and N is number of persons. p is pension per beneficiary, and w is wage cost per employee. B , Y , and E stand for, respectively, the beneficiaries, those of working age, and the employed.

According to the decomposition in (1) the pension burden (P/X) can be considered as the product of wage share (W/X), compensation ratio (p/w),

dependency ratio ((N^B/N^Y)) and the inverse of the employment share ((N^E/N^Y)).

Historically, the wage share has been reasonably stable. If we disregard that this may change in the future,³ the growth in the pension burden will depend on developments in the following three key ratios:

- Dependency ratio
- Employment ratio
- Compensation ratio

The dependency ratio is given by the sum of the number of old-age and disability pensioners relative to the working age population,⁴ while the corresponding compensation ratio denotes the ratio of average benefits for old-age and disability pensioners to average wage cost.⁵ Unfortunately, unlike the Long-Term Programme 2002-2005, the report from the Ecofin contains no estimates for these two ratios. It does, however, give the expected growth in number of persons over 64 relative to the number of persons in the working population, defined as the population between 20 and 64. In the following, the discussion will be confined to this last ratio as an indicator of the growth in the dependency ratio, and we will refer to it as the demographic dependency ratio. We can residually calculate an associated estimate for the compensation ratio. This estimate is the product of two variables: the actual compensation ratio and the number of old-age and disability pensioners relative to the number of persons over 64. Over time the latter ratio is influenced primarily by two factors: changes in the average retirement age and changes in the number of disability pensioners relative to the number of old-age pensioners. This must be taken into account in interpreting changes in the three key ratios for Norway and the EU.

Developments in the dependency ratio

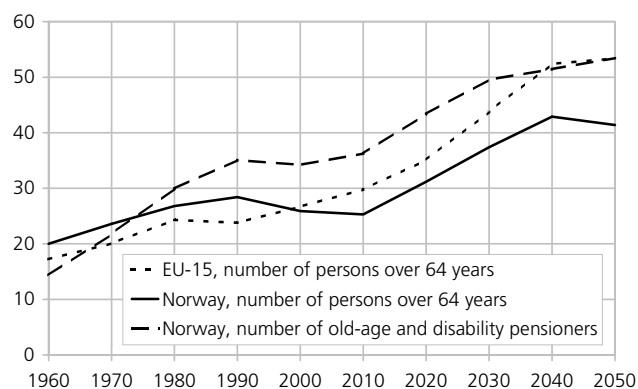
Figure 3 shows developments in the demographic dependency ratio for the EU countries and Norway through the second half of the last century, and projections for the first half of the current century. While the figure only includes this variable for the EU, for Norway the figure also shows the change in the relationship between old-age and disability pensioners and the working population, i.e. the actual dependency ratio. What emerges from the figure is that the actual dependency

3 Both the ageing of the population and the adjustment to this (for example in the form of increased saving) can in principle influence the wage ratio. In Norway's case the expected decline in oil activity is likely to have the greatest significance, since value added per employee is significantly higher in this sector than in the rest of the economy.

4 In the decomposition, we are interested in the dependency ratio that is associated with the retired population. Children and young people are also dependants. The total dependency ratio is the sum of these two variables. The change in the dependency ratio associated with children and young people has significance for the economy's ability to sustain the burden of the dependency ratio associated with the elderly. If the last figure rises as a result of higher life expectancy or lower retirement age, however, there is limited comfort to be found in a decrease in the number of children. This will also gradually have the effect of reducing the working population.

5 In this decomposition, changes in average working hours that are not offset by a corresponding change in wage per hour influence the wage cost per employee and thus the compensation ratio. In the calculations for Norway, more or less unchanged working hours are assumed over the projection period. The same is presumably the case for the EU calculations, since these take account only of approved changes in economic policies.

Figure 3. Number of persons over 64 years of age / number of old-age and disability pensioners relative to the number of persons aged 20-64. Per cent

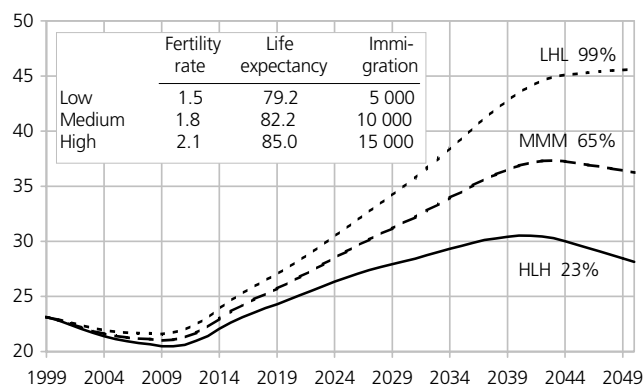


Sources: UN (1998), Ecofin (2000), Statistics Norway's population statistics and our own calculations.

ratio, according to the estimates in the Long-Term Programme, will roughly keep pace with the demographic dependency ratio over the next 50 years.⁶ If we look back in time, however, the number of old-age and disability pensioners has risen much faster than the number of persons over 64 years of age. The figure also shows that, as measured by the first indicator, Norway has thus far had a dependency ratio higher than the EU average. This picture, however, is changing. In the years to come, many of the EU countries stand to experience a considerably higher dependency ratio than Norway. This development is also illustrated in table 1. According to the table, the EU will double the demographic dependency ratio between 2000 and 2050, while the figures for Norway suggest a rise of 60 per cent.

Table 1 also shows that the large continental European countries face a considerably greater demographic challenge than the UK and most of the smaller European countries. Italy and Spain are in a class of their own, while Germany and France are close to the EU average. It would thus appear that the problems generally become greater the farther south one goes in Europe. The table suggests that the particularly unfavourable demographic change in the southern European countries is related to a low fertility rate, since the estimated increase in life expectancy is not particularly pronounced. It is nonetheless worth noting that Ecofin has assumed that the fertility rate will rise in all the EU countries except Ireland and

Figure 4. Dependency ratio 1999-2050, three alternative estimates. Per cent



Sources: Statistics Norway and our own calculations.

Denmark, while the fertility rate is postulated to remain stable in Norway. The increase in the fertility rate in Italy and Spain is quite substantial. With a continuation of today's low birth rates the rise in the dependency ratio in these countries, as well as in Germany, may become even more pronounced than suggested in the table. This underscores the significance of the fact that future birth rates, life expectancy, and other key demographic factors are not known variables, and that considerable uncertainty is associated with the long-term population projections.

The significance of the uncertainty surrounding future demographic variables is further illustrated in figure 4. The figure shows three alternative paths for the dependency ratio in Norway based on different estimates of the fertility rate, life expectancy, and immigration. The dependency ratio is here defined as the number of persons 67 or older, as a proportion of the population between 20 and 66. The figure is thus not fully comparable with the previous figure. This has no significance, however, as far as the main point is concerned: namely, that reasonable variations in assumptions as to the overall fertility rate, anticipated life expectancy, and estimated immigration levels can have considerable impact on the dependency ratio over a 50-year horizon. It is worth noting that the variations in assumptions lie within, or in the vicinity of, what we have historically observed in Norway or other industrial countries.⁷

6 There is reason to believe that this roughly applies also to the EU estimates, and that the use of the demographic dependency ratio as a substitute for the real dependency ratio therefore has little impact on the decomposition of the pension burden. According to Ecofin (2000), pages 4 and 12-18, there are only minor changes in the different age limits qualifying for pensions after 2004. The report does not address changes in disability, which may indicate an assumed constant rate of disability over time.

7 During the post-war period, until the beginning of the 1970s, the fertility rate in Norway was higher than in the high scenario. Even though the fertility rate in the low scenario has not been observed in Norway during the last fifty years, as much as eight EU countries did, during the mid 1990s, have a comparably low aggregate fertility rate (Belgium, Sweden, and the Netherlands) or an even lower rate (Germany, Austria, Spain, Portugal, and Italy). As far as life expectancy is concerned, we note that the low scenario is less than a year over the average life expectancy at birth in 1998, while the high scenario is closer to seven years above this level. Such an increase in average life expectancy at birth may seem very sizable, but is nevertheless only a year greater than the increase between 1950 and 1998. For immigration, the middle scenario is on the higher side of the observed average for the 1990s, while the low scenario is close to the average for the previous twenty-year period.

Even though the figures are uncertain, the figure illustrates that the future dependency ratio will, in all likelihood, show a considerable increase. Even given a stabilization of life expectancy at today's level, a rise in birth rates to reproduction levels, and the highest of the alternative projected immigration rates, the dependency ratio will, as shown in the figure, rise from 23 per cent in 2000 to 28 per cent in 2050, i.e. by over 20 per cent. The dependency ratio, however, will be *twice* today's level in 50 years' time, if life expectancy continues to rise at the same rate as during the second half of the last century, if the fertility rate falls to the average for the EU countries, and if net immigration drops to the levels reported in the 1970s and 1980s. The middle scenario would lead to developments roughly halfway between these two extreme variants, with growth in the dependency ratio of about 60 per cent.

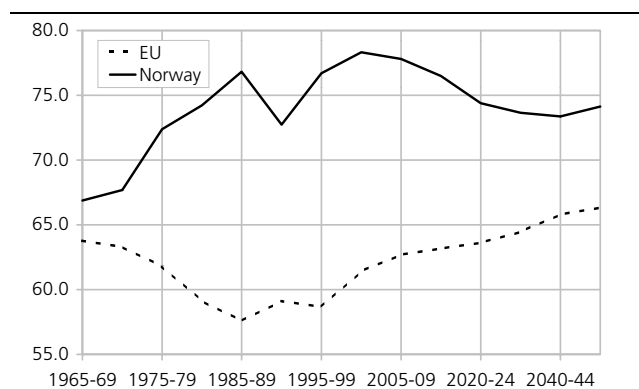
Employment ratio

Far from all persons of working age are employed in income-generating work.⁸ This may be due to, among other things, unemployment, education, work at home, illness, disability, or early retirement. Thus it is not clear that the employment ratio will be stable over time. As illustrated in figure 5, neither the EU countries nor Norway has had a stable employment ratio over the last 40 years.

While the employment ratio generally exhibited a rising trend in Norway during this period, the reverse was the case for many of the EU countries. In the latter half of the 1990s, more than 75 per cent of the Norwegian population between 16 and 64 were engaged in income-producing work. At the same time the average for the EU was under 60 per cent. Over the next 50 years, the Long-Term Programme expects relatively stable age- and gender-specific employment and no significant changes in unemployment. This also implies that the employment share will remain fairly stable. Given the high Norwegian employment level, it is unlikely that it will rise in Norway in the years to come. The labour force participation rate for women is still lower than that of men, and some increase among some age groups is conceivable. If this does not occur, i.e. if age- and gender-specific labour force participation rates remain unchanged, changes in the age composition of the population will give a slight decrease in the average labour force participation rate later in this century.

The high employment share partly explains Norway's low pension burden relative to that of many other countries, but it is not unlikely that this difference will narrow in the future. Ecofin thus assumes that in the future the labour force participation rate will rise somewhat in the EU countries, while unemployment is assumed to fall. Both factors suggest an increase in the employment

Figure 5. Employment in per cent of the population between 16-64. Five-year averages 1965-2050. Break in the series in 2000¹



¹ The numbers are arrived at by extending the historic series of employment ratios for the 16-64 age group from the OECD. For the EU, the series is extended using growth rates taken from Ecofin's projections for the 20-64 age group. For Norway, the series is extended using the growth rate for the 16-74 age group based on a projection with constant age-specific employment ratio and steady unemployment rate. This projection is close to the estimates in the Long-Term Programme 2002-2005.

Sources: OECD, Ecofin (2000), and our own calculations.

share. With a time horizon as long as 50 years, however, one must also take into account the fact that a higher participation rate will be accompanied by higher pension payments, because those who have been employed generally receive higher pensions than those who have not. It is not clear from the source to what extent this factor has been taken into account in Ecofin's calculations.

Compensation ratio

Compared with many EU countries, Norway stands to experience relatively favourable demographic changes. Nonetheless figure 1 and the figures in table 1 indicate that the pressure on state finances may prove to be particularly strong in Norway. This is due primarily to different assumptions as to future changes in the compensation ratio.

In most countries changes in the compensation ratio are subject to a relatively complicated set of regulations. In Norway the pension from the national insurance scheme consists of three components: basic pension, supplementary pension, and special supplement. The basic pension is owed to all, and is tied to the current value of the national insurance scheme's basic pension unit. The supplementary pension is linked, but not rigidly, to the individual's previous labour income. Because of the entitlement rules, this linkage will not be fully implemented until the cohorts born around 1950 retire. In order to ensure a reasonable income level for persons without supplementary pension, or with low supplementary pension, the national insurance scheme also provides for a special supplement that is now equivalent to approximately 80 per cent of the basic pension unit. The minimum pension consists of the basic pension plus this special supplement.

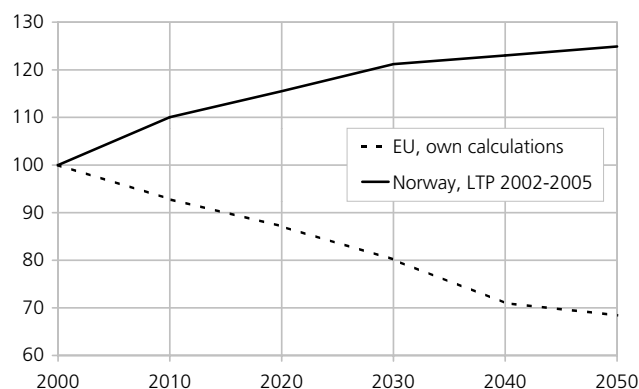
⁸ A small fraction of the population over 65 is also employed, but this has no substantial implications for the following reasoning.

For a given set of rules, the rise in the compensation ratio is determined in the Norwegian system partly by indexation of the basic pension unit and partly by the prior employment of the pensioners. There have been clear political signals that the adjustment of the basic pension unit will enable pensioners with a national insurance pension to receive increases in income that are approximately in line with the increases enjoyed by the employed. Ever since the national insurance scheme was introduced, however, the basic pension unit has risen more slowly than average wages. This also applies to the last 15-20 years and the annual difference has been approximately percentage point in disfavour of the basic pension unit during this period. That the minimum pension has nonetheless clearly risen faster than average wages can be explained by an upward adjustment of the special supplement. An effect of this practice, however, is a reduction in the future growth of the supplementary pension. This is because there is a ceiling on the income that qualifies for earning supplementary pension entitlements, and this ceiling is dependent on the size of the basic pension unit.

Fredriksen (1998b) looks at possible future developments in the compensation ratio based on two different assumptions as to the indexation of the basic pension unit. By wage-indexing the basic pension unit over the next 50 years, he estimates a rise in the compensation ratio of about 17 per cent for men and 37 per cent for women between 2000 and 2050. In an updating of the type of MOSART-calculations that are presented in Fredriksen (1998a), the average compensation ratio for old-age, disability, and early-retirement pensioners is estimated in line with this to rise by a good 23 per cent between 2000 and 2050. With a continued slower growth of the basic pension unit of 3/4 per cent per year over the next 50 years, the compensation ratio, according to Fredriksen (1998b), will fall by around 14 per cent for men. However, the rise in the participation rate from about 1970 and into the future will in this case also contribute to a rise in the average compensation ratio for women, but only by a couple of per cent. If the difference between the rise in the basic pension unit and average wages is smaller than 3/4 per cent per year, then, there is a likelihood of a marked increase in future compensation ratios, partly as a consequence of the phasing in of supplementary pension and partly as a result of an increased labour force participation rate among women over the last 30 years. Basing its calculations on estimates from the National Insurance Administration, the Long-Term Programme 2002-2005 assumes an increase in the average compensation ratio of around 25 per cent (appendix table 2.3). This development is illustrated in figure 6.

Ecofin (2000) provides an overview of current rules for the indexing of pensions in the EU countries. It is evident from this overview that some countries index pensions to wages and some to consumer prices,

Figure 6. Average compensation ratio. Index 2000=100



Sources: Ecofin (2000), Ministry of Finance (2001a) and our own calculations.

while others have chosen a combination of the two. The report from Ecofin, however, contains no figures for expected changes in the compensation ratio, neither for individual countries nor for the EU on average. We can, however, use the relationship given in equation (1) to calculate the *change* in the compensation ratio implied by the estimates for the pension burden, the dependency ratio, and the employment share, if we assume a stable wage share over time. The result is shown in table 1 and in figure 6.⁹

Figure 6 illustrates a very important difference between the projections for the EU and Norway. Given a continuation of current rules and an assumption of wage indexing, the compensation ratio in Norway is expected to rise by around 25 per cent. Ecofin's figures, meanwhile, imply that the compensation ratio will decline markedly in the EU, by a little more than 30 per cent over the next 50 years. The sharpest declines are estimated for Italy, the UK, and Austria, with an approximate halving in the compensation ratio. This must be considered dramatic. In contrast to Norway, then, Ecofin's figures seem to indicate that the EU countries, to a greater or lesser degree, are preparing to meet the pension challenge by providing pensioners with a substantially lower degree of income growth than that achieved by the economically active.

Some possible responses to the pension policy challenge

Regardless of the pension schemes, it is always the case that the source of current pensions must be current income. Basically, there is a limited number of options as to *how* we, as pensioners, will acquire our share of this income. We can raise our families and hope that future generations will be willing to support us, or we can set aside funds (in the form of durable consumer goods, durable production equipment, or "durable" claims on others). Pay-as-you-go social security systems are based on the first model, fund-based pension schemes on

⁹ The estimate must be regarded as tentative, since the residually calculated change in the compensation ratio, as mentioned, also captures the assumed changes in pension ages and in the number of disability pensioners. As mentioned in footnote 6, however, there is reason to believe that these changes is assumed to be small, at least after 2004.

the other. Below we will first briefly examine some possible responses to the pension policy challenge associated with pay-as-you-go systems. We shall then consider funding as an alternative approach.

Pay-as-you-go

As illustrated above, demographic changes – and, in the case of Norway, rising compensation ratios – suggest that pensions will account for a rising share of GDP later in this century. If compensation rules remain unchanged, societies with pay-as-you-go systems must respond to such developments by raising taxes or by reducing public benefits other than pensions. *Reduction of public benefits* can be problematic from a welfare perspective, in terms of both efficiency and distribution considerations, depending on the benefits selected. *Increased taxation* of the broad tax bases earned income and consumption can, for its part, also reduce the incentive to work, by further shifting the private financial trade-off between consumption and leisure in favour of leisure. Such a shift can result in social losses if it in fact results in people working less than what is optimal from an economic viewpoint.¹⁰

Over time, one result of a rising tax level will be that future employees will keep a smaller portion of their income than present-day taxpayers. With sufficient growth in productivity, however, they can in real terms be left with more after taxes than today's employees. A simple calculation illustrates this possibility: according to estimates in the Long-Term Programme, the pension burden in Norway will rise from 7.2 per cent of GDP in 2000 to 17.8 per cent in 2050. An average GDP growth of about 1/3 per cent per year would suffice for GDP (less the pension burden) to be as large as it is today, viewed in relation to the population (excluding pensioners). A higher growth rate makes it possible for everyone to achieve real income growth after taxes. The material welfare of the working population, however, will rise considerably more slowly than productivity. It is therefore likely that future working generations may at some point refuse to meet their predecessors' expectations, even though, in principle, they will be making similar demands on later generations.

Another possible approach to addressing the future pension challenge is *to reduce or reverse growth in the compensation ratio*. This can be done by underindexing pensions in relation to wage growth. As argued above, it looks as if underindexing is in the process of becoming an important part of the EU countries' strategy for "solving" the pension problem. A striking consequence of such an approach is the reduction of pensioners' level of welfare growth. If a considerable underindexing of public pension schemes is not combined with one or another form of individual saving, society may again gradually face a large *relative poverty* problem. Such problems were, in their time, among the reasons why public welfare schemes were introduced.

A third approach can be to raise the retirement age. In the 30-odd years that have passed since the national insurance scheme was introduced in Norway in 1967, life expectancy at birth has risen by about 4.5 years for both men and women. With a constant formal pension age, such a rise in life expectancy will almost entirely translate into an increase in the number of years as a pensioner. The drop in the real pension age in Norway has contributed to the fact that a larger proportion of people's lives is spent living on a pension. A possible answer to the pension policy challenge can thus be to raise the actual retirement age instead of lowering it.

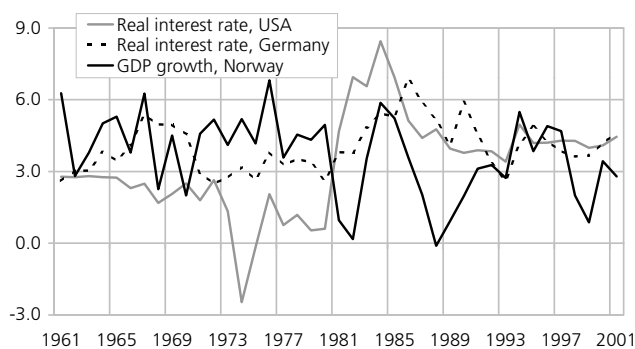
Funding as an alternative to pay-as-you-go

When comparing pay-as-you-go financing and funding of public pension plans, it can be appropriate to distinguish between a situation in which one or another system is fully implemented and the transition from one to the other. In a fully funded system, people save for their own pensions, and the earnings on the saving correspond to the real rate of return. For participants in a pay-as-you-go system, the world looks a little different. They pay for their predecessors' lives as pensioners, and assume that their descendants will pay for them in the same way. Seen in this way, the financing of predecessors' pensions can be regarded as a contribution, where the return is determined by the size of the pension payments they themselves will receive later in life. As shown by Aaron (1962), this return is roughly equal to GDP growth.¹¹ A pay-as-you-go pension system thus makes for a higher pension for a given contribution than

10 A person who reduces his or her work effort by one hour per week will have one hour more in leisure. The personal cost of this is a reduction in purchasing power approximately equivalent to the value of the hourly wage after direct and indirect taxes. Value added, however, shows a considerably larger decline, approximately equal to the value of the hourly wage, including employers' contribution tax.

11 In order to understand the logic of this result, it is appropriate to make some stylized assumptions. First, assume that the compensation ratio is not changed, i.e. that pensions make up a fixed portion of the real wages of the economically active (for example, 2/3). Second, assume that both life expectancy and the pension age remain constant, and that the pensioner period is equal to a fixed per cent of the economically active period (say, 1/3). Finally, assume that the population is stable over time. Under these assumptions, the individual pay-as-you-go participant will work during three periods and be pensioned during one. In each of the economically active periods, she has relinquished 1/3 of 2/3 of her real wage. In return, she receives, as a pensioner, 2/3 of the prevailing real wage from subsequent generations. The return per period is given by real wage growth. This is easily seen if we think of the pension as divided into three equally large sums. The first third of the 2/3 of the prevailing real wage can be regarded as a return on the third of the 2/3 of the then-prevailing real wage that was used to finance pensions three periods earlier. Obviously this "contribution" has in three periods had an annual growth equal to real wage growth. Likewise, the second 1/3 may be viewed as the return on the third of the 2/3 of the then-prevailing real wage that was used to finance pensions two periods earlier, and so forth. Assume now that the population is not stable, but grows over time. This means that every new generation of workers is larger than the preceding one, and therefore does not need to contribute an entire 1/3 of 2/3 of prevailing real wage to the financing of social security in a single period. The rate of return thus becomes higher than the growth rate of real wages, or, to put it more specifically, is roughly equal to the sum of the periodic growth in real wages and in population, which normally is roughly equal to GDP growth rate.

Figure 7. Real interest rate and GDP growth 1961-2000. Per cent



Sources: OECD and Statistics Norway.

does a fully funded system, if the GDP growth rate is higher than the real rate of return on financial investment and vice versa.

The above result can also be expressed in the following way: if GDP growth is lower than the real rate of return on investment, all generations cannot profit from a transition from funding to a pay-as-you-go system. The first generation, however, will always profit from the transition, because it does not need to contribute to the system. Accordingly, there is profit to be reaped for the birth cohorts that manage to raise its own compensation ratio or the length of the pension period (which comes with lower pension age or longer life expectancy) in relation to its predecessors. The increased burden is passed on to the subsequent generation, and so on, until the system is dismantled or breaks down. These kinds of changes to a pension system can be likened to an intergenerational ponzi game. The first generation receives something without making a corresponding contribution, whereas later generations must pay for their pensions by contributing to their parents' support. If the system breaks down, the last paying generation is left holding the bag, since they have paid something in without getting anything out.

As the above discussion illustrates, the relationship between GDP growth and the real return on investment is crucial in evaluating the logic of a pay-as-you-go system. Figure 7 sheds some light on this. First of all, the figure shows real growth in Norway's GDP over

the last 40 years. In the first half of the period the growth rate averaged 4.5 per cent annually; in the second half it was 2.8 per cent. For the period as a whole growth was around 3.6 per cent. We can further observe developments in real yields on government bonds in the US and Germany, which provide an indication of the long-term level of return on fairly sound investments. In the first half of the period the interest rate averaged 1.7 per cent in the US and 3.6 per cent in Germany, whereas in the second half it stood at 4.5 per cent in both countries. Thus the interest rate was first substantially lower than, and afterwards considerably higher than, the GDP growth rate for Norway. For the period as a whole the real rate of return on investments in government bonds was 4.1 per cent in Germany and 3.2 per cent in the US. Fixed investment and equity investments have systematically generated a considerably higher return than investment in government bonds, but have probably also involved greater risk.

The fact that the real rate of return on many investments has been systematically higher (sometimes considerably higher) than the GDP growth rate has induced some economists to argue in favour of a shift from pay-as-you-go pension systems to funded systems; see, for example, Feldstein (1997). The point is that individuals will fare better in the long term if they can invest their pension contributions with a real rate of return that is clearly above the GDP growth rate. A transition, however, will involve a double burden on the generation or generations that must both save for their own pension and finance their predecessors' pay-as-you-go-based benefits, a burden that corresponds to the one-time gain reaped when the system was introduced (or the pension period extended). An important question thus becomes whether a transition to funding allows for a profit that is large enough to compensate the transition cohorts for the double burden.

As pointed out by Breyer and Straub (1993), the answer is generally no, if there are no efficiency losses associated with the tax funding of the pay-as-you-go system.¹² If the additional taxation that is necessitated by a pay-as-you-go system leads people to work less than they would have in a funded system with a lower tax level, however, it is possible to come out better. In such circumstances there is a real economic

12 To illustrate the principal point we make a few simplifying assumptions. Assume, first, that all agents enjoy the same real rate of return, and that this rate is higher than the GDP growth rate. Further assume that an arbitrary individual in the first cohort who will not be financed by a pay-as-you-go system saves an amount equal to that which she otherwise would have paid to finance her predecessors' pensions. This amount gives a return per krone that is equal to the interest rate, while in the pay-as-you-go system it would have given a return per krone equal to the GDP growth rate. In order to finance the social security disbursements that are now not covered by payments into the pay-as-you-go system, the state borrows. If no principal is paid, this debt will increase from period to period at a rate equal to the rate of interest. Since the rate of interest is assumed to be higher than the GDP growth rate, the debt will rise relative to GDP. In order to keep the debt constant as a share of GDP, annual downpayments must be approximately equal to the difference between the real rate of interest and the GDP growth rate. If every individual in the first generation without a pay-as-you-go pension finances this repayment in addition to his or her own fund accumulation, the profit from funding will be canceled out by the increased tax payment which purpose is to keep the state's debt stable in relation to GDP. The increased tax per krone of the shortfall in pension contributions is approximately equal to the difference between the real interest rate and the GDP growth rate, which is precisely equal to the gain per krone invested in the new pension funds.

cost tied to social security funding, which can be reduced or eliminated by shifting towards funding. Such a possible gain can be shared between the generations by using public borrowing as a part of the financing of social-security payments while moving towards a funded system. These kinds of gains, however, can also be realized, at least in part, in a pay-as-you-go system. This requires a closer linkage between contributions and benefits so that the social-security tax (at the margin) is considered to be not a tax but a contribution to one's own pension. One disadvantage of such a linkage (and of funding) is that it may impair a pension system's redistributive role.

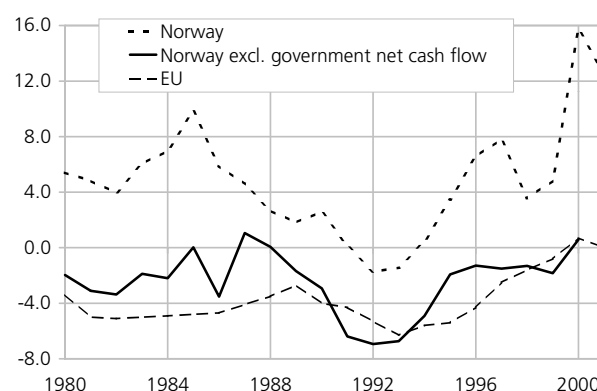
Pension expenditure and petroleum wealth – a Norwegian perspective

Excluding the efficiency losses associated with tax funding of pensions, there is not much to be gained by switching from a pay-as-you-go system to funding for an *existing* pension scheme. It will be a different matter if the question is one of expanding such schemes. In such cases one can also argue *from a distributional perspective* that generations that intend to live longer on pensions than their predecessors, and/or want to have fewer children and higher pensions relative to the incomes of the economically active, should not, in addition, raise the implied debt in the pension system, but should instead save more money.

The Norwegian social security system today involves no explicit saving.¹³ The Norwegian government does accumulate financial savings, however, unlike most of the EU countries. This is illustrated in figure 8, which shows developments in general government net lending in Norway and the EU over the past 20 years. While the EU countries have generally increased general government net debt during this period, the Norwegian government has accumulated both net assets and real capital. In part, this increased demand has its corollary in the decline of government petroleum wealth, while some is genuine saving. One may ask how large actual saving has been in relation to the accumulation of "debt" in the form of an increase in expected future pension outlays, how sizeable this "net wealth" is today, and how it may be expected to evolve in the future.

In an appendix, the relationship between general government wealth and net cash flow is explained in greater detail. It is illustrated that the overriding requirement of long-term balance in public finances means that the present value of all future expenditure must not exceed the sum of today's wealth and the present value of all future revenues. There is an array of possible paths for the future general government revenues and expenditure that are consistent with this

Figure 8. General government net lending 1980-2000. Per cent of GDP



Sources: OECD, Statistics Norway, Ministry of Finance and our own calculations.

requirement, but also many paths that are not. A policy that ensures stable general-government net assets over time, i.e. net lending that at all times equals zero, is clearly viable. Since not all revenues and expenditures grow at the same rate, however, such a path can involve considerable changes in tax and/or expenditure levels over time. This is hardly a desirable scenario.

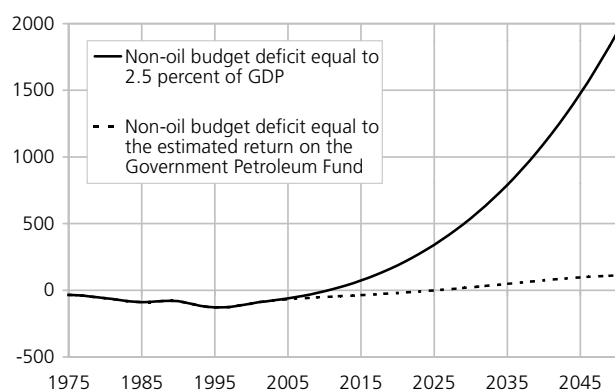
We have seen that pension disbursements by the National Insurance Fund may follow a different course in the future than the tax base as measured by GDP. The same is true of the net cash flow from petroleum activities. It may thus be appropriate to consider these as *wealth items* by calculating the present value of future revenue and expenditure flows. This leads to a broader definition of government "net wealth" as equal to net assets (including the Petroleum Fund) + the present value of government net cash flow from petroleum activities (petroleum wealth, including the government's share of the capital in the sector) – the estimated present value of future government old-age and disability pension disbursements under the national insurance/early-retirement scheme ("pension debt").¹⁴

At the end of 1999 government net assets, excluding the capital in the Government Petroleum Fund, came to around NOK 340bn. This item now changes little over time because the entire central government budget surplus is transferred to the Government Petroleum Fund. At the end of 2000 the capital in this fund amounted to just under NOK 390bn. In the Long-Term Programme 2002-2005 the present value of the government's future net cash flow from petroleum activities is estimated at a good NOK 2300bn at the beginning of 2001. The total value of the aforementioned assets thus comes to a good NOK 3000bn.

13 Originally such saving was intended to be part of the National Insurance Fund. After 1979, however, the Fund has not received any capital other than the return on its own investments.

14 Note that we include pension "rights" that are still not earned in the debt concept.

Figure 9. Change in government "net assets" under two alternative assumptions about fiscal policy and constant basic pension units in real terms. Constant prices. Index = 100 in 2000

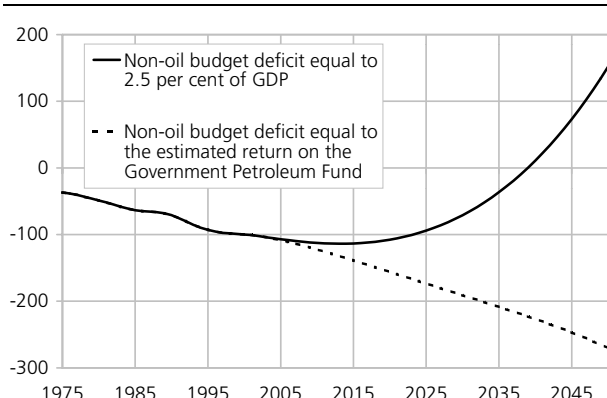


Sources: Statistics Norway, Ministry of Finance and our own calculations.

The Long-Term Programme also contains an estimate of the present value of the government's *accrued obligations* under the national insurance scheme. The size of the accrued obligations is relevant to a discussion of funding of earned pension rights, but constitutes only a part of the present value of the *expected future pension disbursements* under the national insurance plan. It is this last variable that is relevant to a discussion of the government's total finances, and it may be estimated on the basis of the updated calculations in Statistics Norway's microsimulation model MOSART.¹⁵

The MOSART calculations give estimates for changes in pension outlays measured in constant basic amounts, and can be converted into amounts in constant prices by applying an assumption about indexing. We have focused on the sum of old age and disability pensions, together with early retirement pensions. The rise in the average compensation ratio between now and 2050 in these calculations differs little from the corresponding estimates in the Long-Term Programme. The same applies to the estimates for the number of beneficiaries. In the period to 2050, therefore, there cannot be a very large difference between the estimates of future disbursements in the updated MOSART calculations and the estimates in the Long-Term Programme, even though the figures are not identical. The MOSART calculations, however, are carried through to 2200, and we have therefore made use of these as the starting point for calculating the present value of the government's expected future pension payments. In the calculations of present value we have assumed that the basic pension unit is wage-indexed.¹⁶ With a discount rate (real rate) of 4 per

Figure 10. Change in government "net assets" under two alternative assumptions about fiscal policy and a future real growth in the national insurance scheme's basic pension units of 1 per cent per year. Constant prices. Index = 100 in 2000



Sources: Statistics Norway, Ministry of Finance and our own calculations.

cent, this gives a present value for *future social security disbursements* of NOK 6900bn.¹⁷

This estimate of present value is very sensitive to altered assumptions as to changes in the basic pension unit. We have thus looked at two alternative paths: no real growth in the basic amount, and a real growth of 1 per cent per year. In the first of these cases the present value of future pension disbursements is reduced to somewhat below NOK 3800bn (2001 prices); in the other case the present value is estimated at around NOK 5450bn (2001 prices).

All three alternative estimates of the size of pension debt exceed the estimate of the total value of the three asset items mentioned above. In the case of fully wage-indexed future social-security disbursements, the difference is considerable. This implies that the present value of future tax revenues from the mainland economy must be correspondingly larger than future expenditure, excluding pension disbursements, if the balance in government finances is to be maintained. A sufficiently large surplus in the near future implies that the surplus can be smaller at a later stage, and vice versa. It can therefore be of interest to examine whether we find ourselves on a path where the government's *total "net wealth"* increases or declines over time, because this provides information as to the need for future adjustments in fiscal policy (or in the social security system).

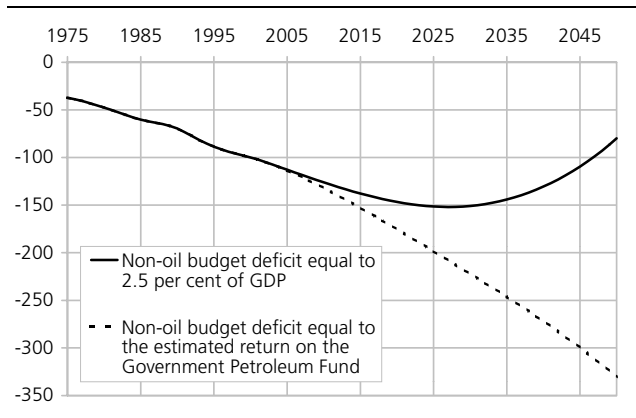
We have tentatively estimated the change in this "net wealth" under two alternative assumptions as to future fiscal policy: non-oil budget deficit equal to 2.5

15 The model is further discussed in Fredriksen (1998a).

16 For the first 50 years, we have, in the first scenario, used the estimates for average real wage growth in the Long-Term Programme, 1.5 per cent per year for the period 2000-2010, 1.8 per cent per year for the next 20 years, and 1.4 per cent per year from 2030-2050. Real wage growth of 1.4 per cent per year is also applied for the next 150 years.

17 In comparison, the Long-Term Programme estimates the present value of government accrued obligations under the national insurance scheme at the beginning of 2001 at about NOK 2800bn.

Figure 11. Change in government "net assets" under two alternative assumptions about fiscal policy and full indexation of the national insurance scheme's basic pension unit per year. Constant prices. Index = 100 in 2000



Sources: Statistics Norway, Ministry of Finance and our own calculations.

per cent of GDP (which is approximately equal to the historical average) and non-oil budget deficit equal to the estimated return on the Government Petroleum Fund. The second fiscal policy rule was proposed by the Petroleum Depletion Commission— see Ministry of Finance (1983) – and recently reintroduced by Cap-pelen (2000) and the Ministry of Finance (2001b). While fiscal policy under the first rule can be characterized as cyclically neutral, the other involves an expansionary fiscal stance many years ahead.

Government petroleum wealth is estimated using the figures for government net cash flow from petroleum activities in the Ministry of Finance (2001a and c), extended to 2070 with a path that implies that most of the estimated remaining petroleum resources will be depleted by that time. Changes in the Government Petroleum Fund are given by the difference between government net cash flow and the return on the Fund, on the one hand, and the non-oil deficit on the other. The change in government “*pension debt*” under the national insurance scheme from one year to the next is estimated as the difference between the “interest costs” of the debt (i.e. the costs that arise as future pension liabilities become increasingly imminent) and “the repayment of debt” in the form of estimated annual pension disbursements. The estimates are based on the MOSART calculations mentioned above.

The result of the calculations is shown in figures 9-11, one for each of the three alternative indexations of future social-security payments. Because we are now primarily concerned with the path over time and not the difference in the level of net assets, this is indexed to -100 in 2000 in all three figures. The figures indicate at least two interesting features:

- First, we observe that, independent of indexing, “net wealth” has fallen over the last 25 years, i.e. that the accumulation of assets and government petroleum wealth has systematically been slower than the rise in pension “debt”.
- Second, we observe that a continuation of a cyclically neutral fiscal policy would lead to very fast growth in government assets. According to our figures, this fiscal policy would result in growth in government “net wealth” as from 1997 with a constant basic amount, from 2015 with real growth in the basic amount of 1 per cent per year, and from about 2030 if the future basic amount follows the wage path in the Long-Term Programme. With such a fiscal policy, the present value of future pension disbursements would gradually have such a large counterpart in the form of net assets and remaining government petroleum wealth that the policy could later be shifted in a more expansionary direction. If on the other hand the non-oil deficit follows the estimated real return on the Petroleum Fund in the future, it is only in the case of a constant basic pension unit that government assets increase faster than pension debt. Hence, this guideline is only sustainable combined with considerable under-indexation or other future changes in the pension system, or with an arrangement where expenditure, excluding pension expenditure, gradually increases more slowly than direct and indirect taxes from mainland Norway.

Closing remarks

Even though future population changes are expected to be relatively favourable, a comparison of calculations suggests that the pension burden may increase considerably faster in Norway than in the EU over the next 50 years, and to a higher level. We have argued that this is primarily due to the assumed growth in the compensation ratio. The considerable potential for higher employment in the EU countries, as a result of today's low labour force participation and high unemployment, also plays a part. On the other hand, Norway at present enjoys a much more favourable financial situation than the EU countries. The Norwegian government has high net assets and considerable petroleum wealth that can be regarded as an implicit partial funding of expected future pension disbursements. With a fiscal stance in line with that announced in the Long-Term Programme, however, one must either implement cuts in the pension system or accept that other types of expenditure will increase more slowly than direct and indirect taxes from mainland Norway.

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Appendix

General government budget over a long-term horizon

If we simplify matters by excluding valuation changes (for example in the form of price gains and losses on securities), the change in general government net assets over time can be expressed by

$$(1) F_{t+1} = (1+r)F_t + S_t.$$

Here F_t is the value of net assets at the beginning of period t , r (the constant) interest rate, and S_t the primary budget surplus during the period, i.e. the difference between revenues excluding wealth income and expenditure excluding wealth expenditure. F and S are measured in constant prices, so that r is the real interest rate. To simplify, we disregard general government net assets aside from the Government Petroleum Fund.¹⁸ If we introduce the discount factor $k=(1+r)^{-1}$, (1) can be rewritten as

$$(2) k^t F_{t+T} = F_t + \sum_{s=t}^{T-1} k^{(s+1-t)} S_s$$

which indicates that the present value of financial wealth T periods into the future must be equal to the sum of the following two items: the value of the assets today and the present value of all budget surpluses up to and including the period $T-1$. It seems reasonable to assume that general government in the long run neither wishes to allow net assets to explode nor is permitted to allow net debt to do the same, so that the present value of net assets in the distant future can be set at zero (i.e. $\lim_{t \rightarrow \infty} k^T \cdot F_{t+T} = 0$). With this additional requirement, the long-term budget constraint is written as

$$(3) F_t = -\sum_{s=t+1}^{\infty} k^{s+1-t} S_s$$

The budget constraint (3) implies that the present value of all future budget deficits must be equal to today's net assets. There is an infinite number of possible paths for the future budget balance that do not fulfil (3), and an infinite number that do. For example, a path where the primary budget deficit is equal to general government net interest income will be clearly viable, because such a path according to (1) will give constant net assets over time. Since not all components in S_t will trend together, however, this is not a formula for a stable use of fiscal policy instruments.¹⁹

¹⁸ With today's budgeting practice, it is reasonable, in any case as an approximation, to include the return on these net assets in the primary budget deficit S .

¹⁹ An interesting example of steady growth over time is that both revenues and expenditure follow GDP growth. Assume that GDP grows at a constant rate g . Then we have $S_s = S_0 (1+g)^s$ so that (3) can be written as $F_t = -\sum_{s=t+1}^{\infty} k_g^{s+1-t} S_s$ where $k_g = (1+g)/(1+r) \approx (1+(r-g))^{-1}$. It follows that $\Delta F_t \approx (r-g) F_t + S_0$, so that a constant primary deficit $-S_0$ approximately equal to $(r-g)F_t$ will result in constant net assets forever.

In Norway, petroleum revenues and pension expenditure, in particular, will change considerably in the future (in a more detailed analysis, however, we should also have taken into consideration other demography related expenditure). Let us therefore distinguish among the following four key items in the budget: government net cash flow from petroleum activities (NCF); direct and indirect tax revenues from mainland Norway (T); current pension disbursements (U); and all other expenditure items (G). This gives us the following definition of the primary balance in period t .

$$(4) \quad S_t = \text{NCF}_t + T_t - U_t - G_t$$

The following two equations are assumed to express the relationship between government net cash flow from petroleum activities, compensation for normal costs of government capital in petroleum activities $((r+\delta)K)$, general government revenues in excess of compensation for normal capital costs (petroleum rent, PR) and government gross investment in petroleum activities (J):

$$\begin{aligned} \text{NCF}_t &= (r+\delta)K_t + \text{PR}_t - J_t \\ K_{t+1} &= (1-\delta)K_t + J_t \end{aligned}$$

where δK_t stipulates the loss in capital value (depreciation) during the period t as proportional to K_t . Substituting for J_t gives the following relationship between net cash flow, petroleum rent, and government capital in the sector:

$$(5) \quad \text{NCF}_t = \text{PR}_t + rK_t - \Delta K_t = \text{PR}_t + (1+r)K_t - K_{t+1}$$

Further insertion of (5) in (4) and of (4) in (3) gives the following equation for total government wealth (W):

$$(6) \quad W_t = F_t + F_t^p + K_t - L_t = - \sum_{s=t}^{\infty} k^{s+1-t} (T_s - G_s)$$

Here $F_t^p = \sum_{s=t}^{\infty} k^{s+1-t} \text{PR}_s$ is the value of the

government share of petroleum wealth, defined as the present value of all future government petroleum rent.

$L_t = \sum_{s=t}^{\infty} k^{s+1-t} U_s$ is the general government's pension

debt, equal to the present value of all future pension disbursements.

$\sum_{s=t}^{\infty} k^{s+1-t} (T_s - G_s)$ is the present value of all future

non-oil and pension-adjusted primary budget surpluses. We have also utilized that

$\sum_{s=t}^{\infty} k^{s+1-t} [(1+r)K_s - K_{s+1}] = K_t$. The following

relationships apply:

$$(7) \quad \Delta F_t^p = rF_t^p - \text{PR}_t, \quad \Delta L_t = rL_t - U_t$$

The first equation in (7) implies that the change in petroleum wealth from one period to the next is given by the difference between the gain from the "reaping" of future petroleum rent coming closer in time and the loss arising because the future rent is reduced by the "harvesting" over the period. The first expression on the right hand side of the equation also defines the permanent revenues from petroleum wealth at the outset of period t , i.e. the maximum consumption that these asset items can support without eroding the wealth itself. Similarly, the other equation in (7) expresses that the change in pension debt over a period is equal to the difference between the costs that arise as future pension liabilities become increasingly imminent and the repayment of debt through pension disbursements over the course of the period.

In the same way that (1) implies that the change in net assets is equal to the sum of interest income and the primary budget surplus $(\Delta F_t = rF_t + S_t)$, it follows from (6) that the change in total wealth is equal to the sum of the return on the wealth and the non-oil and pension-adjusted primary budget surplus.

$$(8) \quad \Delta W_t = r(F_t + F_t^p + K_t - L_t) + (T_t - G_t)$$

From (8) and the definition of W_t , we also see that .

$$\begin{aligned} \Delta W_t &= \Delta(F_t + F_t^p + K_t) - \Delta L_t \\ &= r(F_t + F_t^p + K_t) - rL_t + (T_t - G_t) \end{aligned}$$

Combined with (7), this implies that .

$$(9) \quad \Delta(F_t + F_t^p + K_t) = r(F_t + F_t^p + K_t) + (T_t - G_t - U_t)$$

(9) says that the change in "broad" petroleum wealth, i.e. including the capital in the sector and the Government Petroleum Fund, is equal to the sum of the return on this wealth and the non-oil budget deficit.

Using the concepts presented above, it is now relatively simple to illustrate the change in public wealth over time as a result of a number of alternative budget rules.

Rule A: *The non-oil, pension-adjusted budget deficit is equal to the return on wealth.*

This rule implies that $r(F_t + F_t^p + K_t - L_t) = -(T_t - G_t)$. From (8) we see immediately that general government wealth, as we have defined it, will be constant over time if and only if this rule is followed. If the deficit is lower than this, wealth increases over time; if it is greater, wealth is reduced.

Rule B: General government net lending equals zero.

In the national accounts, general government net lending is defined as the sum of the primary budget deficit, net wealth income, and government net direct investment in state enterprises. To simplify, we only include direct investment in state enterprises. With our terminology, the requirement that net lending be equal to zero can thus be expressed as follows:

$$NFI_t = rF_t + S_t + \Delta K_t = 0 \Rightarrow \Delta F_t + \Delta K_t = 0,$$

i.e. that the sum of financial wealth and cumulated direct investment in petroleum activities shall be constant over time. It follows directly from (1), which implies that $\Delta F_t = rF_t + S_t$. As expressed in (6), this further implies that the change in general government wealth will equal the difference between the change in petroleum wealth and the change in pension debt. As long as the remaining petroleum wealth falls and pension debt increases, total wealth will thus inevitably decline over time. The sum of financial wealth and the remaining petroleum wealth, including the government's cumulative direct investment, will also decrease over time.

Rule C: Non-oil budget deficit equals permanent petroleum revenues.

In our setting, the non-oil budget surplus is defined as general government net lending less direct investment in petroleum activities, government net cash flow and the return on the Government Petroleum Fund. If we simplify matters by disregarding that general government net assets do not consist only of investments in the Petroleum Fund,²⁰ the non-oil budget surplus can be written as $NFI_t - \Delta K_t - NCF_t - rF_t = T_t - G_t - U_t$, cf. (4) and the definition of NFI_t . Rule C thus implies that

$$(T_t - G_t - U_t) + r(F_t + F_t^P + K_t) = 0$$

Since $U_t = rL_t - \Delta L_t$, it follows from this rule that $r(F_t + F_t^P + K_t - L_t) + (T_t - G_t) + \Delta L_t = 0$. According to (8), this means that $\Delta W_t = -\Delta L_t$, i.e. that the change in general government net wealth is equal to the change in pension debt. This increases or decreases over time depending on whether "interest loss" rL_t is greater or smaller than "repayment" given by U_t . From the wealth definition (6) it further follows that the sum of the Petroleum Fund and petroleum wealth (including the capital in the sector) under this rule is constant over time.

Rule D: Non-oil budget deficit equals return on the Petroleum Fund.

This rule was first proposed by the Petroleum Depletion Commission (see Ministry of Finance 1983) and recently reintroduced by Cappelen (2000) and the Ministry of Finance (2001a and b). Assuming that general government net assets consist only of investments in the Petroleum Fund, this budget rule can be written as

$$(T_t - G_t - U_t) + rF_t = 0$$

If we combine this with (9), it follows that

$$\Delta W_t = \Delta(F_t + F_t^P + K_t) - \Delta L_t = r(F_t^P + K_t) - \Delta L_t.$$

This means that the change in total general government wealth is given by the difference between the return on petroleum wealth (including the capital in the sector) and the change in pension debt. The rule implies that we gradually phase in all of the permanent income from petroleum activities, including the return on the Petroleum Fund. The time profile for this phasing-in, however, is decided by the time profile of net cash flow and not by some deeper analyses of optimal saving (or the time path for consumption).

²⁰ Alternatively, we could assume that the return on other net assets, which, under today's budgetary practices do not change much over time, are included in the tax amount T .