RAPP
Övr.20.735

Public Pension Systems and the Cyclical Sensitivity of Public Finances in the Nordic Countries

Economics/Finance

t' Amsterdam by
JOANNE Svan KEULEN

TemaNord

Public Pension Systems and the Cyclical Sensitivity of Public Finances in the Nordic Countries

Henrik Braconier*

Adress of Correspondance: Henrik Braconier, IUI, Box 5501, SE-114 85 Stockholm, Sweden

E-mail: Henrik@iui.e

Public Pension Systems and the Cyclical Sensitivity of Public Finances in the Nordic Countries

The Nordic Co-operation on Economy and Finance
Nordic co-operation in the area of economy and finance includes consultations on stabilisation policies, studies and discussion of strategies for structural policies, evaluation of adjustment policies for the European economic integration process as well as support to the economic transformation process in Eastern- and Central Europe. The work in this area is governed by the Ministers of Finance and Economy and they are assisted by a Nordic Committee of Senior Government Officials.

The Nordic Council of Ministers
was established in 1971. It submits proposals on cooperation between the governments of the five Nordic countries to the Nordic Council, implements the Council's recommendations and reports on results, while directing the work carried out in the targeted areas. The Prime Ministers of the five Nordic countries assume overall responsibility for the cooperation measures, which are co-ordinated by the ministers for cooperation and the Nordic Cooperation committee. The composition of the Council of Ministers varies, depending on the nature of the issue to be treated.

The Nordic Council
was formed in 1952 to promote cooperation between the parliaments and governments of Denmark, Iceland, Norway and Sweden. Finland joined in 1955. At the sessions held by the Council, representatives from the Faroe Islands and Greenland form part of the Danish delegation, while Åland is represented on the Finnish delegation. The Council consists of 87 elected members - all of whom are members of parliament. The Nordic Council takes initiatives, acts in a consultative capacity and monitors cooperation measures. The Council operates via its institutions: the Plenary Assembly, the Presidium and standing committees.

Table of Contents

Summary

During the coming 40 years, the increasing share of pensioners in the Nordic populations is likely to lead to a large increase in public pension spending as a share of GDP. This increase will tend to make the public finances in the Nordic countries even more sensitive to cyclical changes than they are at present. This study points to two important factors when considering the effects of public pension systems on the cyclical sensitivity of public finances. Firstly, high public spending on pensions will lead to higher cyclical sensitivity of public finances. Secondly, a fully-funded pension scheme will affect the cyclical sensitivity of public finances less than a pay-as-you-go system.

Altogether, the results indicate that the cyclical sensitivity of public finances will be significantly affected by the aging in the Nordic populations. In our baseline specification, the cyclical sensitivity increases between 5 and 15 percent, compared to the cyclical sensitivity in the late 1990s, between 2000 and 2040.

Sammanfattning

Under de förestående 40 åren kommer den allt större andelen av pensionärer i samhället sannolikt leda till en avsevärd ökning av den offentliga sektorns pensionsutgifter som andel av BNP. Denna ökning tenderar att ytterligare öka konjunkturkänsligheten i de offentliga finanserna i de nordiska länderna. Två viktiga faktorer framhävs i rapporten när det gäller offentliga pensionssystems påverkan på de offentliga finansernas konjunkturkänslighet: (i) Höga offentliga pensionsutgifter leder till en ökad konjunkturkänslighet i de offentliga finanserna. (ii) Ett fonderat pensionssystem har en mindre påverkan på de offentliga finansernas konjunkturkänslighet än ett så kallat "pay-as-you-go" system.

Sammanfattningsvis indikerar studiens resultat att de offentliga finansernas konjunkturkänslighet kommer att påverkas påtagligt av den åldrande populationen i de nordiska länderna. I studiens grundspecifikation ökar de offentliga finansernas konjunkturkänslighet i de nordiska länderna fram till år 2040 med mellan 5 och 15 procent, jämfört med konjunkturkänsligheten under det sena 1990-talet.

Tiivistelmä

Seuraavien neljänkymmenen vuoden aikana eläkeläisten osuus pohjoismaitten asukkaista todennäköisesti johtaa suureen julkisten eläkemenojen BKT-osuuden kasvuun. Tämä kasvu aiheuttanee sen, että pohjoismaissa julkisen talouden rahoitusasema on nykyistä herkempi talouskehityksen vaihteluiden suhteen. Tämä tutkimus osoittaa kaksi tärkeätä tekijää ajateltaessa julkisten eläkejärjestelmien vaikutusta julkisen talouden suhdanneherkkyyteen. Ensiksi, korkeat julkiset eläkemenot johtavat julkisen talouden korkeampaan suhdanneherkkyyteen. Toiseksi, kokonaan rahastoitu (fully funded) eläkejärjestelmä vaikuttaa vähemmän julkisen talouden suhdanneherkkyyteen kuin jakojärjestelmä (pay-as-you-go).

Kaiken kaikkiaan tulokset osoittavat, että pohjoismaitten väestön ikääntyminen vaikuttaa merkittävästi julkisen talouden suhdanneherkkyyteen. Lähtötasoomme verrattuna suhdanneherkkyys kasvaa 5–15 prosenttia vuosina 2000–2040.

1 Introduction

Public spending on pensions is an important part of total government spending in the Nordic countries. Similarly, contributions to the social security system in general, and pensions in particular, is one of the most important sources of revenues for the government sector. Furthermore, pensions are not only important for public finances but are increasingly becoming even more so, as demographic changes will lead to a significant shift towards older populations in all Nordic countries. These changes will have long-ranging effect both on public finances and on the economies in general.

It has long been recognizes that the choice of pension system will have a profound effect on savings, growth, public finances and macroeconomic stability in the long run. While these effect are certainly important, the analysis in this paper will focus on a less discussed side effect of the pension system, that is the consequences for the cyclical sensitivity of public finances. The analysis in this paper shows how different aspects of pension systems in the Nordic countries will affect the cyclical sensitivity of public finances. The results indicate that the cyclical sensitivity of public finances is likely to increase in the Nordic countries over the coming forty years, as well-developed government administered pension schemes and graying populations will increase benefits and contributions in relation to GDP. Another important result is that the difference between government-administered pay-as-you-go schemes and fully funded schemes in terms of cyclical sensitivity of public finances appears on the benefit side. In fact, the level of contributions in either system is unlikely to have a large impact on the cyclical sensitivity of public finances. In the base scenario, which is a pay-as-you-go system where individual levels of benefits are tied to the wage rate, we find that the cyclical sensitivity of public finances will increase due to higher expenditures for pensions in relation to GDP. The estimated increase in the cyclical sensitivity of public finances for the Nordic countries between 1998 and 2040 is between 5 and 15 percent compared to the figures presented by Braconier & Holden (1999) for the late 1990s. If individual benefits where to be kept constant in real terms in a pay-as-you-go scheme, the cyclical sensitivity of public finances would hardly be affected by the aging of the Nordic populations. Compared to the pay-as-you-go schemes, a fully funded scheme with similar levels of benefits would yield a lower cyclical sensitivity.

2 Long-run properties of pension systems

In principle, there are three central dimensions of pension schemes: Private contra public administration, fully funded contra pay-as-you go and defined benefits contra defined contribution schemes. For public finances, the most fundamental dimension is private contra public administration, where a wholly privatized system would have no direct impact on public finances.

Regarding pay-as-you-go contra fully funded schemes, Samuelson (1975) showed that one crucial difference between a fully-funded and a pay-as-you go system is that the rate of return. In the former system the rate of return is the real interest rate (r), while the rate of return in the pay-as-you-go system is equal to the real growth in the wage sum, which in the long run grows in line with GDP. As the interest rate tends to be higher than the growth rate in most advanced market economies, a funded system is usually assumed to give a higher return to "investment" in pensions than a pay-as-you-go system. Specifically, unfavorable demographic trends where the labor forces share of the total population shrinks will lead to low returns – or drastic increases in contributions - in a pay-as-you-go system.

Another well-known effect of a pay-as-you-go system - compared to the fully funded system - is that levels of savings, capital stocks and output are lower as individuals substitute future transfers through the pay-as-you-go system for savings.[1] Feldstein (1995) presents evidence that the "pension capital" earned within a pay-as-you-go system affects savings negatively. Thus, the choice of pension system can affect public finances through the GDP as well. In this study, we will however not analyze how these secondary effects can affect the cyclical sensitivity of public finances for two reasons. Firstly, as our base assumption is that benefits are tied to the GDP level then the benefit-to-GDP ratio will be independent of the actual level of GDP. Secondly, higher savings may not transform into a higher GDP and a lower rate of return in an open economy, as domestic savings may be used to fund investment abroad.[2] Our analysis could thus be rationalized in an open-economy context.

In order to highlight how different aspects of pension systems affects the economy and public finances, we set up a simple model to analyze the questions at hand. Individuals live for two periods, where they earn wage income, consume and pay contributions to the pension system in the first period and live of pensions in the second period. In each point of time, the population is divided into young (working) and old (pensioners).

In a fully funded system, each generation's benefits are proportional to the contributions they made in the previous period. Thus if there are N_O pensioners in the current period and each of them have contributed a share c_{FO} of their wage (w_O), total contributions in the previous period is

$$C_{FO} = c_{FO} w_O N_O, \tag{1}$$

---

[1] See e.g. Blanchard & Fischer (1989). Casarico (1998) shows how a pay-as-you-go system may actually increase investment if the capital market for borrowing for education is imperfect. As government provision of education and guaranteed loans is prevalent in the Nordic countries this restriction seems less relevant in the Nordic context.

[2] Empirically, there do however seem to be a close correlation between domestic savings and domestic investment, as shown in the so-called Feldstein-Horioka paradox.

and total benefits paid in the current period is

$$B_{FO} = (1+r)C_{FO}. \tag{2}$$

From (2) it follows that real benefits received in the current period depends on the contributions made in the previous period and the real interest rate. Although a fully financed pension system has a natural adjustment mechanism to cope with e.g. demographic changes, a government-administered system implies that public finances will be affected by changes in productivity and demographic changes. Basically, the contribution-to-benefit ratio will increase in productivity growth and decrease in old age dependency ratios.[3]

In a defined benefit pay-as-you-go system, we assume that individual benefits are fixed as a share of the average income, i.e. individual benefits are assumed to increase with the average wage rate

$$B_{PO} = b_{PO} w_Y N_O, \tag{3}$$

where b_{PO} is the level of benefits for the old generation as a share of the wage rate in the current period. Contributions are proportional to wages

$$C_{PY} = c_{PY} w_Y N_Y. \tag{4}$$

Assuming that contributions and benefits equals over each generation, i.e. the pension system is fully financed, total contributions equals total benefits

$$C_{PY} = B_{PO} \tag{5}$$

and we can solve for the contribution rate as

$$c_{PY} = b_{PO} \frac{N_O}{N_Y}.^4 \tag{6}$$

Equation (6) shows that the contribution rate is increasing in benefit levels and the ratio of pensioners to workers.[5]

---

[3] To see this, note that contributions made in the current period equals $c_{FY} w_Y N_Y$ while the government earns interest rC_{FO} on the old generations savings within the system. Combining with (2) it follows that the contribution to benefit ratio (i.e. the effect on public finances) is equal to $(c_{FY} w_Y N_Y)/(c_{FO} w_O N_O)$.

[4] In a defined contribution scheme, the benefit ratio would be equal to $b_{PO} = c_{PY} N_Y/N_O$.

[5] Although we explicitly only analyze a fully-funded system and a pay-as-you-go system, the reader should notice that usually these are supplemented with a tax-financed government pension scheme. Analytically, this system will behave in a similar manner as a pay-as-you-go system.

3 Effects on the cyclical sensitivity of public finances from the pension system

Following Braconier & Holden (1999), we analyze the cyclical sensitivity of public finances by decomposing total changes in revenues and expenditures into induced (economy dependent) and discretionary (policy dependent) changes. Due to lack of data, we focus the analysis on old age pensions. An important aspect of this decomposition is that it enables us to see how changes in the economy affect revenues and expenditures when policy is held constant. Compared to the long-run analysis above, no considerations regarding sustainability in the long run for a set of policies are taken in this short-run analysis. This also means that we loosen up the long-run budget constraints, as stated in equation (2) and (6) and allow for short-run deviations between contributions and benefits.[6] Thus, both benefits and contributions are policy variables in the short run. It should be noted that the method of analyzing the cyclical sensitivity of public finances with respect to public pensions described below only gives a rough approximation of actual effects. Specifically, lack of data hinders us from studying how early retirement and disability benefits co-vary with the business cycle. Consequently, our computations treat all benefits as if they were old-age pensions.[7]

When we focus on the cyclical sensitivity of public finances that can be attributed to the pension system, the discretionary component relates to changes in policies *vis-a-vi* pensions while the induced component measures how contributions and benefits vary with the economy, given a constant pension policy. Regarding pension contributions and benefits we define constant fiscal policies to entail:

- Contributions in both a fully funded and a pay-as-you-go system are proportional to the wage bill.
- Benefits for each age group in a fully funded system are proportional to final-year assets, which are a function of the rate of return and previous contributions.
- Individual benefits in a pay-as-you-go system are proportional to the trend wage bill or, equivalently, to the price level.

For contributions, constant policy implies that contributions grow in line with their tax base, which is the wage bill. Thus, a change in contribution rates corresponds to changes in policies. For benefits in a pay-as-you-go system, constant policy means that individual benefits grow in line with the trend growth rate in wages. Benefits in the fully funded system depend on the rate of return.

3.1 Revenues

For the purpose of analyzing pensions and the cyclical sensitivity of public finances, we define government sector primary revenues as

---

[6] A real-world argument for this approach is that most public pension schemes seems to have some type of shock absorbers, such as buffer funds or smoothing mechanisms.

[7] It is however worth noticing that increases in e.g. early retirements during economic downturns most likely should be interpreted as a discretionary change in policy. See Braconier & Holden (1999) for a general discussion.

$$T = T_T + C_F + C_P,\qquad(5)$$

where T_T denotes other revenues. To analyze how pension systems affect the cyclical sensitivity of public finances, we substitute (1) and (4) into (5) and differentiate

$$dT = dT_T + \left(dc_F(wN) + d(wN)c_F\right) +$$
$$+ \left(dc_P(wN) + d(wN)c_P\right) \qquad (6)$$

From (6) it follows that changes in contributions can be attributed to changes in the contribution rate, changes in the average wage rate, and changes in the work force. We decompose changes in total contributions into induced and discretionary changes

$$dC^I = d(wN)\left(c_F + c_P\right) \qquad (7)$$

$$dC^D = dC - dC^I = \left(dc_F + dc_P\right)wN . \qquad (8)$$

From (7) and (8), it follows that constant fiscal policies regarding pension contributions implies that the share of each individuals income that goes to contributions is constant, while contributions grow at the same rate as total income. To analyze the effects on the cyclical sensitivity of public finances, when holding policy constant, we derive the induced change in total revenues as

$$dT^I = dT_T^I + d(wN)\left(c_F + c_P\right). \qquad (9)$$

3.2 Expenditures

Define primary government expenditures as

$$G = G_T + B + B , \qquad (10)$$

where G_T denotes other government expenditures. Differentiation of (10) yields

$$dG = dG_T + dB_F[r, C_{FO}] + \left(db_P(\overline{w}N_O) + d(\overline{w}N_O)b_P\right), \qquad (11)$$

where r is the rate of return, C_{FO} is contributions made by the old into the fully funded part of the pension system when they worked, $\overline{w}$ is the trend wage, and N_O is the number of individuals in the old generation. When analyzing the cyclical sensitivity of government expenditures, it is reasonable to assume that previous contributions, the trend in wages and the size of the old generation is unaffected by cyclical changes and thus

$$dG^I = dG_T^I + dB_F[r, C_{FO}] \qquad (12)$$

$$dG^D = dG_T^D + db_P(\overline{w}N_o).\text{[8]} \tag{13}$$

3.3 Cyclical sensitivity and the primary balance

In order to analyze how pensions affects the cyclical sensitivity of the government's primary balance, we write the primary balance as a share of GDP as

$$\frac{S}{Y} = \frac{(T_T - G_T)}{Y} + \frac{(c_F + c_P)wN}{Y} - \frac{(B_F + b_P\overline{w}N_O)}{Y}. \tag{14}$$

From (14) we can derive the (induced) change in the primary balance as a share of GDP – keeping pension policies constant – as

$$d\left(\frac{S}{Y}\right) = d\frac{(T_T - G_T)}{Y} + d\left(\frac{wN}{Y}\right)(c_F + c_P) - d\frac{(B_F + b_P\overline{w}N_O)}{Y}. \tag{15}$$

Based on (15) we can derive how a change in GDP affects the primary balance as a share of GDP given a constant policy regarding pensions. We compute the semi-elasticity of the primary balance as a share of GDP with respect to GDP as

$$\varepsilon = \frac{d\left(\dfrac{S}{Y}\right)}{dy} = \frac{d\dfrac{(T - G)}{Y}}{dy} + \frac{d\left(\dfrac{wN}{Y}\right)(c + c)}{dy} - \frac{d\dfrac{(B + b\,\overline{w}N_O)}{Y}}{dy}, \tag{16}$$

where dy is the deviation in real GDP from the baseline. Equation (16) implies that the sensitivity of the primary balance with respect to (cyclical) changes in GDP depends on:

- The sensitivity of other revenues and expenditures with respect to changes in GDP.
- The sensitivity of the wage bill to GDP ratio and rates of contributions with respect to changes in GDP.
- The sensitivity of benefit-to-GDP ratios with respect to changes in GDP.

Equation (16) points to an important result regarding the cyclical sensitivity of the primary balance and the choice of pension system. As contributions in both types of systems are tied to the cyclical development of the economy (i.e. the wage rate), contributions in both types of systems have a similar impact on the cyclical sensitivity of the primary balance. The impact from benefits will, however, differ between the two systems. Equation (16) also highlights why long-run growth effects attributable to the pension system will not affect the cyclical sensitivity of public finances. The cyclical sensitivity with respect to pensions relates to contributions and benefits as a share of GDP. An increase in trend GDP would, however, lead to an induced increase in benefits

---

[8] From (11) it follows that we assume that there is no potential for discretionary changes in benefits in a fully- funded system.

and contributions of an equal magnitude and therefore the cyclical sensitivity would remain unchanged.[9]

3.4 Cyclical sensitivity and the total budget balance

So far, the analysis has focused on effects of pension schemes on the cyclical sensitivity of the primary balance. For our purpose, the difference between the total budget balance and the primary balance is net interest payments (iD). Therefore we can write the semi-elasticity of the total balance as a share of GDP with respect to GDP as

$$\varepsilon_T = \frac{d\left(\dfrac{S}{Y}\right)}{dy} - \frac{d\left(\dfrac{iD}{Y}\right)}{dy}. \tag{17}$$

Consequently, the difference between the cyclical sensitivity of the primary and the total balance is how the net interest payments in relation to GDP are affected by a change in real GDP. This difference can be summarized into three effects:

- For a given level interest rate and a fixed stock of net debt, the cyclical sensitivity of the total balance will be larger the larger the net debt payments are in relation to GDP.
- If net debt increases in downturns, the cyclical sensitivity increases.
- If interest rates increases (decreases) in downturns and net debt is positive (negative) then the cyclical sensitivity increases.

Even though the relationship between cyclical sensitivity and net debt payments is clear, the relationship between the pension system and the debt payments is much more difficult to substantiate. Evidently, debt financing of pensions will lead to higher net debt, higher debt payments and, hence, probably a higher cyclical sensitivity of public finances. As Braconier & Holden (1999) shows, the cyclical sensitivity of the total budget balance seems to be higher than the sensitivity of the primary balance in the Nordic countries that have relatively high levels of net debt.[10] Consequently, it could be argued that debt financing will increase the cyclical sensitivity of public finances, but it is hard to evaluate to what extent debt financing could be used. Furthermore, debt financing is most likely not a viable long-term solution for funding pension schemes.

---

[9] There are two caveats to this line of reasoning. Firstly, the higher savings in a fully funded system would put a downward pressure on the rate of return in the country, unless capital markets were completely integrated with the rest of the world. Secondly, the induced changes in non-pension related revenues and expenditures would not necessarily be of the same magnitude (See Braconier & Holden (1999)).

[10] These countries are Sweden, Denmark and Finland.

4 Trends in the Nordic economies

It is a truism to say that the aging populations will put greater strain on economic growth and public finances in the Nordic countries. Well-functioning pension systems may mitigate the effects of lower labor participation rates and higher costs for health care even though these effects will still affect the economy adversely.

Even though the Nordic countries - with the exception of Iceland - have relatively old populations compared to other OECD-countries, they do not seem to face the same increase in old-age citizens as countries such as Italy, Japan and Spain (OECD, 2000). This also means that *changes* in the cyclical sensitivity of public finances, for a given pension system, will not be as dramatic as in other countries. Still, the high levels of government spending in general and on pensions in particular means that the *level of* sensitivity of public finances in the Nordic countries will continue to be high by international standards.

Table 1. Share of Total Population above 65 Years Old and Old Dependency Ratio (UN medium variant)

		1980	1990	2000	2010	2020	2040
Denmark	(65+)	0.14	0.16	0.15	0.17	0.21	0.25
	Old age DR	0.25	0.26	0.25	0.29	0.35	0.48
Finland	(65+)	0.12	0.13	0.15	0.17	0.20	0.26
	Old age DR	0.20	0.22	0.25	0.28	0.35	0.48
Iceland	(65+)	0.09	0.11	0.12*	0.12	0.15	0.19**
	Old age DR	0.23	0.22	0.23*	0.24	0.29	0.38**
Norway	(65+)	0.15	0.16	0.15	0.16	0.20	0.25
	Old age DR	0.27	0.29	0.26	0.27	0.34	0.49
Sweden	(65+)	0.16	0.18	0.17	0.20	0.23	0.27
	Old age DR	0.28	0.31	0.30	0.33	0.41	0.52

Sources: OECD (2000) except for Iceland where the data comes from the National Economic Institute. * Refers to 1999. ** Refers to 2030. Dependency ratios for Iceland have been computed as the age group 65+ in relation to the age group 25 to 64. Although these ratios are not directly comparable to the actual dependency ratios for Iceland, the changes in those ratios are likely to follow changes in actual ratios.

Table 1 shows UN forecasts of how the old-age share of the Nordic populations will evolve from 1980 to 2040. For the Nordic countries, old dependency ratios will increase 50 to 100 percent between 2000 and 2040. This demographic change will, under certain conditions, affect public finances in general and the cyclical sensitivity of these finances in particular. In *Table 2*, we present OECD forecasts for employment, productivity and output for the Nordic countries that will be used in later calculations.

Table 2. Predictions on Employment, Productivity and GDP (1995=100)

	TOTAL EMPLOYMENT				Labor Productivity				GDP			
	1980	2000	2020	2040	1980	2000	2020	2040	1980	2000	2020	2040
Denmark	95.7	104.0	94.9	84.8	74.2	105.1	147.7	198.9	71.0	109.3	140.2	168.7
Finland	104.6	107.6	97.0	89.8	68.4	113.3	183.4	247.1	71.6	122.0	177.8	221.8
Iceland	-	103.2	126.7	127.4	-	108.2	167.3	204.0	-	111.7	212.1	260.0
Norway	90.0	104.9	107.5	101.9	71.8	108.0	148.3	199.8	64.6	113.3	159.5	203.6
Sweden	94.0	105.0	101.6	91.8	74.8	108.6	148.5	200.0	70.3	114.1	150.9	183.6

Sources: OECD (2000) except for Iceland where the data comes from the National Economic Institute.
For Iceland, we have assumed a yearly growth rate in labor productivity of 0.02. Figures for Iceland for
2000 refers to 1999 and for 2040 refers to 2030.

5 Stylized shocks and the cyclical sensitivity of public finances

As a prerequisite for the analysis of the current pension schemes in the Nordic countries and their effects on public finances in the future, we analyze how three stylized schemes affects the cyclical sensitivity of public finances with respect to shocks.

5.1 Pay-as-you-go and constant benefit ratios

In order to analyze the effects of pensions and demographic changes on the cyclical sensitivity of public finances we follow Braconier & Holden (1999) and construct stylized macroeconomic shocks and evaluate their effects on the primary balance. Assume a shock where real GDP falls by one percent while prices remain stable, i.e.

$$dy = -0.01. \tag{17}$$

As shown in Braconier & Holden (1999), the elasticity of the wage bill with respect to GDP varies between 0.88 and 1.16 for the Nordic countries for the period 1981 to 1997. Furthermore, it is difficult to argue for a diverging trend between nominal GDP and the wage bill in the long run and, hence, we assume that a one- percent change in GDP is accompanied by a similar change in the wage bill. Given this assumption, it follows from (16) that $d(wN/Y)$ equals zero and therefore contributions decrease in line with GDP. In the baseline scenario, we assume that all public expenditures for pensions are of a pay-as-you-go type. In the pay-as-you-go scheme defined in section 3, benefits do not change due to a cyclical downturn and we can then approximate (16) as

$$\frac{d\left(\frac{S}{Y}\right)}{dy} \approx \frac{d(T_T - G_T)}{dy} + \frac{B}{Y}. \tag{18}$$

Disregarding other revenues and expenditures, we find that the semi-elasticity of the primary balance with respect to cyclical changes in GDP is proportional to the benefits-to-GDP ratio. Thus the basic result from the analysis is that the cyclical sensitivity of public finances with respect to GDP will increase as rates of benefits increase and the share of the population that is pensioners increase.

In order to estimate how a pay-as-you-go system with unchanged benefit ratios will affect the cyclical sensitivity of public finances, we start by computing implied benefit-to-wage ratios (b_p) and implied benefit-to-output ratios (b_p^y) for 1998.[11] The benefit-to-wage ratio measures the average government pension spending per pensioner in relation to the average wage (including social security contributions) for the workforce. The benefit-to-output ratio instead relates average spending per pensioner to

---

[11] The implied benefit-to-wage ratio is computed as $b_p = \dfrac{B}{Y} \dfrac{Y}{W} \dfrac{N}{N}$, where the ratios denote pensions-to-GDP ratio, the GDP-to-wage bill ratio and the inverse of the old dependency ratio, which measures the workforce in relation to old-age pensioners. The benefit-to-output ratio is defined as $b_p^y = \dfrac{B_p}{Y} \dfrac{N_Y}{N_O}$.

the average output (GDP) per worker. As shown in the last column of *Table 3*, Sweden has the most generous government benefit levels, while Iceland have the least generous system. Sweden's rank as the top spender in relation to GDP can, to a large extent, is explained by its high old age dependency ratio, while Iceland combines low per capita spending with a relatively young population.

Table 3. Pensions and Implied Benefit Ratios in the Nordic Countries (1998).

	Public pension spending / GDP	Inverse of old dependency ratio (2000)	GDP to wage bill ratio	b_P	b_P^y
Denmark	0.088	4.07	1.76	0.630	0.358
Finland	0.057	4.07	1.47	0.341	0.232
Iceland	0.033	4.31	1.86	0.265	0.142
Norway	0.078	3.82	1.68	0.501	0.298
Sweden	0.107	3.38	1.70	0.615	0.361

Sources: Herbertsson *et al* (2000), OECD (2000), Braconier & Holden (1999) and author's own computations. Public pension spending are defined as Social Security spending on old age pensions, early retirement benefits and disability benefits.

The implied benefit-to-output ratio computed in *Table 3* may be used to evaluate how changes in dependency ratios may affect the cyclical sensitivity of public finances, given benefit ratios and holding other revenues and expenditures constant. This baseline scenario corresponds to a complete pay-as-you-go system, where benefit ratios are constant over time (i.e. there are no discretionary changes in benefits) and where the wage bill and GDP grow at the same rate. *Table 4* shows the results for the period 1990 to 2040 for the Nordic countries.

Table 4. Cyclical Sensitivity of the Primary Balance due to Pension Benefits in the Nordic Countries 1990 to 2040 (Constant Benefit Ratios).

Country	Cyclical sensitivity due to pension benefits (deviation from 1998)				
	1990	1998	2010	2020	2040
Denmark	0.10 (0.01)	0.09	0.10 (0.01)	0.13 (0.04)	0.17 (0.08)
Finland	-	0.06	0.06 (0.00)	0.08 (0.02)	0.11 (0.05)
Iceland	0.05 (0.02)	0.03	0.03 (0.00)	0.04 (0.01)	0.05 (0.02)*
Norway	0.10 (0.02)	0.08	0.08 (0.00)	0.10 (0.02)	0.15 (0.07)
Sweden	0.11 (0.00)	0.11	0.12 (0.01)	0.15 (0.04)	0.19 (0.08)

Source: Figures for 1990 and 1998 are actual figures from Herbertsson *et al* (2000), while other figures are the author's own computations based on benefits in 1998. Figures in parentheses are deviations from 1998 levels. * Refers to 2030.

As the results in *Table 4* shows, the primary balance in all the Nordic countries seem to become increasingly more sensitive to cyclical changes, when constant benefit ratios and increasing old age dependency ratios increases pension outlays as a share of GDP. Put differently, if individual benefits are constant in relation to average wages, the increase in old dependency ratios will lead to higher benefit-to-GDP ratios and a higher cyclical sensitivity of public finances. Holding other primary revenues and expenditures constant, the increase in the cyclical sensitivity in the primary balance due to changes in GDP ranges from 0.02 for Iceland to 0.08 for Denmark and Sweden. To put these figures in perspective, we note that Braconier & Holden (1999) finds that the total sensitivity in the primary balance with respect to GDP in the Nordic countries ranges

from 0.35 for Iceland to 0.65 for Sweden in the late 1990s.[12] It should however be stressed that these predictions are based on constant benefit-to-output ratios and that (discretionary) policy changes will affect the cyclical sensitivity of public finances.

5.2 Pay-as-you-go and constant real benefits

Whereas the previous section analyzed how a pay-as-you-go scheme affects the cyclical sensitivity of public finances under constant benefit ratios, i.e. when individual benefits are tied to the general economic development, we now analyze fixed real benefits. Such a scheme could be seen as a transition to a privatized system, where the government scheme only ensures a minimum level of benefits. In order to analyze the cyclical sensitivity we set real benefits per pensioner to the 1998 level.[13] From these constant benefits per pensioner we then compute total benefits as a share of GDP. The computed benefit to GDP ratios are presented in *Table 5*.

Table 5. Cyclical Sensitivity of the Primary Balance due to Pension Benefits in the Nordic Countries 1998 to 2040 (Constant Benefit Levels).

| Country | Cyclical sensitivity due to pension benefits | | | |
	1998	2010	2020	2040
Denmark	0.09	0.08	0.09	0.09
Finland	0.06	0.05	0.04	0.05
Iceland	0.03	0.03	0.03	0.03*
Norway	0.08	0.07	0.07	0.08
Sweden	0.11	0.10	0.11	0.10

Source: Author's own computations. * Refers to 2030.

A striking feature of the results in *Table 5* is that even if individual benefits were to be held constant in real terms, government spending on pensions as a share of GDP would more or less stay constant. Thus, the decrease that takes place due to shrinking individual benefits in relation to the wage rate is of a similar magnitude as the increase due to increases in the old age dependency ratio. The results in *Table 5* also give a picture of how a defined contribution system would cope with the demographic changes in the Nordic countries. Assume that defined contributions are equal to a constant share of the wage bill or GDP. Then the results in *Table 5* suggests that if the contribution rate is held constant over time, the increase in total contributions roughly suffices to ensure a constant real benefit level for the retired. Altogether, we find that if the Nordic pension systems were of a fixed real benefit pay-as-you-go type, the effects of demographic changes on the cyclical sensitivity of public finances would be small.

5.3 A fully funded system

Contributions and the rate of return determine benefits in a fully financed pension system. To analyze the effects on benefits in a fully financed system, we assume that

---

[12] These estimates are based on stylized shocks that are similar to the ones used in this paper. Braconier & Holden (1999) also present estimates of the cyclical sensitivity of public finances based on regression analysis and macroeconomic simulation models.

[13] Total benefits as a share of GDP is calculated as $\dfrac{B_P}{Y} = b_{p,98}^{y} \dfrac{y_{98}}{y} \dfrac{N_O}{N_Y}$.

when an individual retires, the government pays an annuity based on the accumulated assets and the expected life-time.[14] In each period the government pays annuities to all pensioners. Specifically, we define total benefits paid as

$$B_F = (n-1)\overline{B}_F + B_F^R ,$$ (19)

where $\overline{B}_F$ is the average total benefits (across age groups of pensioners) and $n-1$ is the number of (equal sized) age groups of pensioners, excluding the group that is retiring. The retiring group earns benefits equal to B_F^R which is the annuity they receive when they become pensioners. Assume now a shock to GDP equal to dy, which is accompanied by a change in the value of assets equal to dx. This means that the value of the assets decreases and hence post-shock yearly benefits are equal to $B_F^R(1+dx)$, which yields overall benefits equal to $(n-1)\overline{B}_F + (1+dx)B_F^R$. Based on (16) we can now approximate the shock's effect on the primary balance as

$$\frac{d\left(\dfrac{S}{Y}\right)}{dy} = \frac{d(T-G)}{dy} + \frac{B_F}{Y} - \frac{\dfrac{dB_F}{Y}}{dy} .$$ (20)

To simplify the analysis, we assume that benefits across groups are constant such that $B_F^R = \dfrac{B_F}{n}$, which enables us to rewrite (20) as

$$\frac{d\left(\dfrac{S}{Y}\right)}{dy} = \frac{d(T_T-G_T)}{dy} + \frac{B_F}{Y} - \frac{dx}{dy}\frac{B_F}{nY} .$$ (21)

From (21) we see that the cyclical sensitivity of the primary balance tends to be smaller for a fully financed system as compared to the pay-as-you-go system, where the difference between the two schemes is captured by the third term on the right-hand side. As GDP falls, asset prices go down and therefore the annuity that the retiring age group receives goes down, which leads to a decrease in government expenditures compared to the reference case.

While it seems clear that expenditures on pension benefits falls as a result of the shock, the magnitude of this fall is difficult to estimate. Firstly, the effect of the shock on different asset-prices is hard to assess. Secondly, the composition of the portfolio of assets that the retiring age groups hold is crucial. If the retiring age group only held risk-free assets, the effect on benefit levels would disappear and the fully funded system would behave just like a pay-as-you-go system during the shock. Thirdly, the simplicity of the model above disregard effects on soon-to-be retired age groups, whose benefits also will be affected by the shock. In order to compute these effects, we would however also need information on the frequency and magnitude of different shocks. Finally,

---

[14] Actual government-administered fully funded systems tend to be much more complicated than the system described above. See e.g. Herbertsson et al (2000).

government-administered fully funded pension schemes tend to build in certain shock absorbers, which also will affect the results.

In order to establish an upper limit on how a shock to GDP can affect benefit levels, we construct a crude example. Assume that a decrease in GDP with one percent leads to a fall in asset prices equal to 2.5 percent.[15] Furthermore we assume that three age groups are affected, that the life expectancy after retiring is 15 years and that benefits amount to 10 percent of GDP. Based on these assumptions we can compute the sensitivity the effect from pension benefits as $0.1 - \frac{0.025}{0.01}\left(\frac{0.1}{15}\right)3 = 0.05$. Consequently, the cyclical sensitivity due to pensions under the fully funded scheme would be 0.05 rather than 0.1 that the pay-as-you-go scheme would give.

---

[15] One motivation for this assumption could be that a lowering of GDP with one percent seems to lead to a decrease in profits of 2.5 percent in the Nordic countries (See Giorno *et al*, 1995). We assume that this decrease is considered to be permanent and therefore asset prices fall to the same extent. Furthermore we assume that all assets are held in shares and that the government do not intervene to smooth benefits across age groups.

6 Current systems in the Nordic countries: Future effects

The analysis in section 5 focused on comparing how current benefit ratios from public funds and future demographic changes affect the cyclical sensitivity of public finances. While these computations highlight the effects in the different countries if the pension systems were similar, they do not take account of the heterogeneity of the public pension systems in the Nordic countries. Furthermore, while the analysis in section 5 showed the main differences between a defined benefit pay-as-you-go system and a fully funded system regarding the cyclical sensitivity of public finances, real world pension schemes involve other components than these two. In this section, we will make a brief qualitative analysis of the cyclical sensitivity of public finances in the Nordic countries based on the current systems, as described in Herbertsson *et al* (2000).

6.1 Denmark

The public pension system in Denmark consists of three basic components: a flat-rate benefit, a flat-fee funded and a funded supplementary pension. The dominant part is the flat-rate benefit, whereas contributions in each of the other two are around one percent of the wage bill. The flat rate benefit is a pay-as-you-go scheme funded out of tax revenues. Consequently, contributions vary with tax revenues. In terms of benefits, the flat-rate scheme is indexed to lagged changes in wages. Altogether, the flat-rate scheme, and therefore the public pension system in general, corresponds quite well to a defined benefit pay-as-you-go scheme, as was analyzed in section 5.1. A further source of public spending on pensions is public sector pensions, but this is also a defined benefit pay-as-you-go scheme. Altogether, we conclude that the public part of the Danish pension system corresponds quite well to a defined benefit pay-as-you-go system. The effects on the cyclical sensitivity of public finances of such a scheme was analyzed in section 5.1.

6.2 Finland

The National Pension Scheme in Finland is a flat-rate benefit pay-as-you-go scheme. Contributions in the scheme partly come from payroll taxes, but central and local government also contributes from general tax revenues. Benefits are indexed to the cost of living and, thus, the National Pension Scheme correspond closely to the defined benefit scheme pay-as-you-go system with constant real individual benefits analyzed in section 5.2. Apart from the National Pension Scheme, the statutory pension scheme also consists of an earning-related pension. This system is mainly of the pay-as-you-go type, but some prefunding takes place. Benefits are adjusted in line with wage and price increases and contributions are paid on wages. Altogether the public pension system in Finland can be seen as a defined-benefits pay-as-you-go scheme with some elements of prefunding.

6.3 Iceland

Compared to the other Nordic countries, the Icelandic pension system has a larger private component and is also more reliant on pre-funding. The public funded part of the Icelandic pension system consists of a social insurance system and public sector pensions. The social insurance system is a pay-as-you-go system where contributions are a part of the general tax system. The benefits mainly consist of a flat-rate pension that provides relatively modest benefits. There are two public sector pension schemes which both have elements of pre-funding.

6.4 Norway

The public part of the Norwegian pension system consists of the National Insurance System (NIS) and the public sector pensions, which are integrated with the NIS. The NIS is basically a defined benefit pay-as-you-go scheme, although the funds accumulated in the State Petroleum Fund may be used to fund social security benefits. The NIS is partly financed by contributions tied to pensionable income and partly by general government revenues. Benefits within the NIS are tied to the basic amount, which is adjusted annually in line with changes in average earnings. Consequently, the system seems to correspond quite well to a pay-as-you-go system, as analyzed in section 5.1. Public sector pensions are partly pre-funded and partly pay-as-you-go.

6.5 Sweden

The public part of the Swedish pension system consists of a flat-rate pension combined with a supplementary earning-related component. Both components are basically pay-as-you-go defined benefit schemes, where benefits are tied to the lagged consumer price index. The two components are now being phased out in favor of a new, partly funded, defined contribution scheme. Contributions in the new system are tied to earnings. Benefits are tied to the rate of real income growth, unless unfavorable economic conditions (e.g. demography) imply that the present value of future contributions and funds are smaller than the present value of future benefits. If this is the case, the indexation of benefits will be reduced until balance is resumed. The system can be characterized as a defined contribution system. The national pension system is accompanied by a public sector pension scheme that is a defined benefit scheme where future tax revenues are the sources of funding. Altogether, the cyclical sensitivity of the public Swedish pension system during the coming 40 years is a combination of defined benefits and defined contributions with some prefunding. The cyclical sensitivity of public finances with respect to pensions is therefore likely to lie between the estimates in section 5.1 and section 5.2.

7 Conclusions

As populations are graying in the Nordic countries, public spending on pensions is likely to increase, which also means that contributions to the public pension systems would have to increase. Increased benefits as a share of GDP will, however, make the public finances in the Nordic countries even more sensitive to cyclical changes than they are at present. Our computations suggests that if public pension systems remain unchanged, while benefit ratios follow the wage rate in the economy, public spending on pensions as a share of GDP may roughly double over the coming 40 years. Such an increase would mean that the cyclical sensitivity of public finances would increase between 5 and 15 percent, compared to the cyclical sensitivity in the late 1990s. The analysis also shows that a fully funded public pension scheme leads to less cyclical sensitivity than a pay-as-you-go system. Thus, one way of diminishing the cyclical sensitivity of public finances could be increase prefunding. The other way would, of course, be to lower public spending on pension schemes either through keeping benefit levels constant in real terms combined with a stronger reliance on private pre-funded schemes.

References

Blanchard, O. and S. Fischer (1989). Lectures in Macroeconomics. MIT Press.

Braconier, H. and S. Holden (1999). The Public Budget Balance, Fiscal Indicators and Cyclical Sensitivity in the Nordic Countries. TemaNord 1999:575.

Casarico, A. (1998). Pension Reform and Economic Performance under Imperfect Capital Markets. Economic Journal 108:344-362.

Giorno, C., P. Richardson, D. Roseveare och P. van den Noord (1995). Potential output, output gaps and structural budget balances. OECD Economic Studies 24:167-209.

Herbertsson, T., Orszag M. and P. Orszag (2000). Retirement in the Nordic Countries: Prospects and Proposals for Reform. TemaNord 2000:548.

OECD (2000). Ad Hoc Working Party No 1 Experts Group on the Public Finance Implications of Ageing, ECO/CPE/WP1.

OECD (1998). Economic Outlook.

Samuelson, P. (1975). Optimum Social Security in a Life-cycle Growth Model. International Economic Review 16:539-544.

Public Pension Systems and the Cyclical Sensitivity of Public Finances in the Nordic Countries

At the meeting of the Nordic Council of Ministers (Ministers of Finance and Economic Affairs) in November 1998 it was decided that a study concerning the status and future prospects of financing the pension systems in the Nordic countries should be undertaken. The report Retirement in the Nordic Countries (TemaNord 2000:548, Herbertsson/Orszag/Orszag) reveals the main findings of the study.

The present study was commissioned to relate pension financing to the cyclical sensitivity of public finances and to follow up on the report Public Budget Balance, Fiscal Indicators and Cyclical Sensitivity in the Nordic Countries (TemaNord 1999:575, Braconier/Holden).

The report points to two important factors when considering the effects of public pension systems on the cyclical sensitivity of public finances. Firstly, high public spending on pensions will lead to higher cyclical sensitivity of public finances. Secondly, a fully funded pension scheme will affect the cyclical sensitivity of public finances less than a pay-as-you-go system.

Altogether, the results indicate that the cyclical sensitivity of public finances will be significantly affected by the aging of the Nordic population: the cyclical sensitivity is expected to increase up to 5 to 15 percent between 2000 and 2040.

The views and opinions expressed in the report do not necessarily correspond to the views of the Nordic Council of Ministers or the Nordic governments.