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Abstract

Generational Accounts (GAs) measure the fiscal sustainability of the public sector. We ask whether the contributions from the Government Pension Fund and remaining oil and gas wealth in the ground, together with the pension reform taking effect in 2011, are sufficiently large to secure generational balance in Norway. Our results show that the pension reform has a substantial effect, and contributes as much to generational balance as the total petroleum wealth. Neither increased economic growth per se nor increased fertility contribute to improve the GAs. The structural characteristics of higher employment and lower transfer payments typical for cyclical upturns, improve the GAs substantially. Optimistic assumptions regarding these structural characteristics do not remove the need for further reforms to obtain fiscal sustainability of the Norwegian public sector.

Generational Accounting, Norway, Fiscal Policy, Intergenerational redistribution
JEL Classification: H50, J10

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1. Introduction

In an almost twenty year old study, Auerbach et al. (1993) asked the question: “Norway: Is the nation over-consuming its petroleum wealth?” They analyzed this question with the method of Generational Accounting and their answer was: yes, Norway did over-consume. This result was partly confirmed in a later study by Steigum (1996). In this paper we first examine whether the Auerbach-conclusion still holds. There are indications that it does. Foremost, Norway has experienced a significant rise in life expectancy at birth from 77.3 to 80.7 years. In addition, the share of the younger part of the population that are not working has increased. However, net migration has increased over the period. Many of the immigrants are relatively young and well educated, alleviating long-term fiscal challenges. Furthermore, since 2000 oil prices have risen sharply, and the petroleum wealth has increased accordingly.

Instead of consuming the petroleum wealth right away, the Norwegian Parliament has chosen a fiscal rule to inject the Petroleum wealth into the economy along a moderate path. It has been a stated policy objective to pursue moderation in the sense that the petroleum wealth should be perpetuated to benefit all future generations. The newly enacted pension reform is a major political effort to bolster such a policy of intergenerational distribution of the petroleum wealth. The second purpose of this paper is to inquire whether this reform secures such an aim.

The pension reform is to take effect from 2011. It seeks to neutralize the expenditure effect due to population ageing in general, and to the recent increased growth in life expectancy. The reform strengthens ties between former earnings, retirement decisions, and pension benefits, thus providing work incentives particularly for elderly workers.

As in the Auerbach et al. (1993) paper, our evaluation tool is Generational Accounting. This method was introduced during the early nineties to estimate both explicit and implicit public debt in the long run. In Section 2 we describe the method of Generational Accounting and the calculation of the sustainability indicators used. The sources of data used for these calculations are reported in Section 3. Generational Accounting needs three kinds of data; a population projection, age- and sex-specific profiles and a general government budget of a certain base-year. Furthermore, we discuss in Section 3 our choice for global parameters (growth and discount rates) and the influence of the public oil-revenues on the general budget. In Section 4 we provide the results of the

Generational Accounting analyses using different kinds of sustainability indicators. Furthermore, we illustrate the findings of the sensitivity analyses, wherein we analyze the effects of different population scenarios and the choice of several parameters. In Section 5 the current Pension Reform is analyzed, and Section 6 concludes.

2. The Methodology of Generational Accounting

To measure the sustainability of a country's public sector we use the method of *Generational Accounting* developed by Auerbach, Gokhale and Kotlikoff (1991, 1992 and 1994). In contrast to traditional budget indicators which are based on annual cash flow budgets, *Generational Accounting* is founded on the intertemporal budget constraint and therefore the long-term implications of a current policy can be computed.[1] The intertemporal budget constraint of the public sector, expressed in present value terms of a base-year b is:

$$B_b = \sum_{k=b}^{b-D} N_{b,k} + \sum_{k=b+1}^{\infty} N_{b,k} \,. \tag{1}$$

D denotes agents' maximum age and $N_{b,k}$ the present value of year *b*'s net tax payments, i.e., taxes paid net of transfers received, made by all members of a generation born in year k over the remaining lifecycle. Then, the first right-hand term of equation (1) represents the aggregate net taxes of all generations alive in the base-year b. The second term aggregates the net tax payments made by future generations born in year $b+1$ or later. Together this is equal to the left-hand side of equation (1), B_b, which stands for the net debt in year b. That means if the sum of all living generations' net taxes, $\sum_{k=b}^{b-D} N_{b,k}$, is negative (i.e. if they receive a net transfer) and the net debt, B_b, positive, the sum of future generations' net taxes has to be positive to balance the government's intertemporal budget i.e. in a long-term perspective net transfers received by living generations plus the net debt of the base-year have to be financed by net taxes paid by future generations.

[1] The further description of the methodology of *Generational Accounting* is mainly based on Raffelhüschen (1999) and Bonin (2001). For an analytical derivation of the intertemporal budget constraint see Benz and Fetzer (2006) or Fetzer (2006). Hagist (2008) gives an overview about the empirical studies with generational accounting along with a discussion concerning critical points in theoretical as well as empirical terms.

To calculate generations' aggregated lifecycle net tax payments, the net payment terms in equation (1) are decomposed into:

(2) $$N_{b,k} = \sum_{s=\max\{b,k\}}^{k+D} T_{s,k} \; P_{s,k} \; (1+r)^{b-s} \quad .$$

In equation (2), $T_{s,k}$ denotes the average net tax paid in year s by a representative member of the generation born in year k, whereas $P_{s,k}$ stands for the number of members of a generation born in year k who survives until year s. To compute the remaining lifetime net payments of living generations, the future demographic structure is specified conducting long-term population forecasts.

Typically, *Generational Accountants* disaggregate equation (2) even further. To incorporate gender-specific differences in average tax payments and transfer receipts by age, separate aggregation of the average net taxes paid by male and female cohort members is required. The products aggregated in equation (2) represent the net taxes paid by all members of generation k in year s. For generations born prior to the base-year the summation starts from year *b*, while for future born cohorts, the summation starts in year $k > b$. Irrespective of the year of birth, all payments are discounted back to the base-year b by application of a real interest rate r.

The age-specific net tax payment in year s of agents born in year k can be decomposed as

(3) $$T_{s,k} = \sum_i h_{s,k,i} \quad .$$

$h_{s,k,i}$ stands for the average tax or transfer of type i paid or received in year s by agents born in year k, thus of age $s-k$.[2] In equation (3), $h > 0$ indicates a tax payment, whereas $h < 0$ defines a transfer.

Applying the method of *Generational Accounting* it is conventionally assumed that initial fiscal policy and economic behavior are constant over time. Under this condition it is possible to project future average tax payments and transfer receipts per capita from the base-year age profile of payments according to

[2] In case of an isolated analysis of public subsystems like health care or public pension as conducted in the following chapters, *i* is just chosen so that all relevant payment streams are included in the analysis.

(4) $$h_{s,k,i} = h_{b,b-(s-k),i} \left(1+g\right)^{s-b}.$$

where *g* represents the annual rate of productivity growth. Equation (4) assigns to each agent of age *s-k* in year *s* the tax and transfer payment observed for agents of the same age in base-year *b*, uprated for gains in productivity. The base-year cross section of age-specific tax and transfer payments per capita is generally determined in two steps. First, the relative position of age cohorts between themselves in the tax and transfer system is estimated from micro-data profiles. In a second step the relative age profiles are re-evaluated proportionally to fit the expenditure and tax revenues of the base-year.

For living and future generations, division of the aggregate remaining lifetime net tax payments by the number of cohort members alive in year *s* defines the cohort's *Generational Account* in year *s*:

(5) $$GA_{s,k} = \frac{N_{s,k}}{P_{s,k}}.$$

Generational Accounts are constructed in a purely forward-looking manner, only the taxes paid and the transfers received in or after the base-year are considered. As a consequence, *Generational Accounts* cannot be compared across living generations because they incorporate effects of differential lifetime. One may compare, however, the *Generational Accounts* of base-year and future born agents, who are observed over their entire lifecycle.

To illustrate the fiscal burden of current fiscal policy we use seven sustainability indicators:[3] The starting point for the first indicators are the *intertemporal public liabilities* which can be computed by the assumption that the intertemporal budget constraint of the public sector (1) is violated:

(6) $$IPL_b = B_b - \sum_{k=b-D}^{\infty} N_{b,k}.$$

The amount of *intertemporal public liabilities* measures aggregate unfunded claims on future budgets, assuming that the present policy will hold for the future. The first sustainability indicator, the *fiscal gap* (FG_b), can be derived if the *intertemporal public*

[3] For a discussion of measuring fiscal sustainability and the development of sustainability indicators, see Raffelhüschen (1999) and Benz and Fetzer (2006).

liabilities are set in relation to base-year's GDP (GDP_b). This indicator is akin to the debt quota well known since the Maastricht treaty but it addresses the total debt, i.e. the debt which will occur in the future added to the debt inherited from the past:

(7) $$FG_b = \frac{IPL_b}{GDP_b}.$$

How the policy adjustment required to redeem *intertemporal public liabilities* will affect generations' fiscal burdens is uncertain. For illustrative purposes, *Generational Accounting* typically assigns the entire adjustment to future generations which is equivalent to $k > b$. All tax payments made by members of future born cohorts are adjusted proportionally with the help of a uniform scaling factor θ. The factor θ is set to ensure balance of the intertemporal public budget defined in equation (1):

(8) $$h_{s,k,i} = \theta \times h_{b,b-(s-k),i} \left(1+g\right)^{s-b}$$

for and instead of equation (4). Computing the average age-specific net taxes paid by representative future born agents, the burden for future generations can be illustrated as an absolute difference between the *Generational Account* of the base-year agent and the *Generational Account* of the one year after base-year born agent. This is our second sustainability indicator, the *future generations' burden*:

(9) $$FGB = GA_{b,b} - GA^{\theta}_{b,b+1}$$

The third indicator that illustrates the burden of current fiscal policy is the *revenue gap*. In this case the scaling factor $\theta = \theta_{rev}$ reflects the enhancement of age-specific revenues in per cent for all generations which is necessary to close the intertemporal public budget constraint. It can also be interpreted as the ratio of the *intertemporal public liabilities* to the present value of all age-specific revenues of the fiscal system :

(10) $$\theta_{rev} = \frac{IPL_b}{\sum_{s=b}^{\infty} \mathrm{Re}\, v_s \cdot \frac{1}{(1+r)^{(s-b)}}}$$

with $\mathrm{Re}\, v_s$ referring to the sum of revenues in year s by all living generations in year s. Analogous to the *revenue gap*, we compute also the so-called *transfer gap.* In this case

the scaling factor $\theta = \theta_{trf}$ reflects the necessary decrement of age-specific public transfers (*Trf*) like health benefits in per cent for all generations that is necessary to close the intertemporal public budget constraint. Constructing the *revenue* and *transfer gap*, we implicitly assume that the government is able to enforce an immediate adjustment of all taxes and contributions or transfers respectively.

All used indicators are defined using an infinite time horizon. In the practical calculation all relevant variables like population or cohorts' tax payments are projected for 300 years from the base-year on. Afterwards a geometrical serial is used to determine the remaining net tax payments. The choice of 300 periods is nearly completely arbitrary and just reflects a good approximation point for our analysis.

3. Data and Assumptions

To compute Generational Accounts and to calculate the described indicators, a population projection is needed. Furthermore the calculations require the expenditures and revenues of the Norwegian public sector in 2009, age-sex-profiles for the different expenditure and revenue types and a growth rate of the productivity as well as a discount rate. The population projection in the following is calculated with a demographic program developed by Bonin (2001).

3.1 Population Projection

Generational Accounting requires detailed population projections, which distinguish between three possible scenarios titled *medium variant*, *high variant* and *low variant*. Based on different assumptions about the three parameters life expectancy, fertility and migration it is possible to derive a population projection for each of the demographic scenarios. Own calculations are necessary for the reason of *Generational Accounting's* assumed infinite time horizon: The official projections end in 2060 while we need a 300 years projection period. In these calculations we use for the parameters of the year 2009 the given data of Statistics Norway. The projected parameters until year 2060 in the different scenarios originate from the assumptions made by Statistics Norway (2010a). Table 1 shows those central assumptions of the three scenarios.

Table 1: Central Assumptions of Norwegian Population Projections

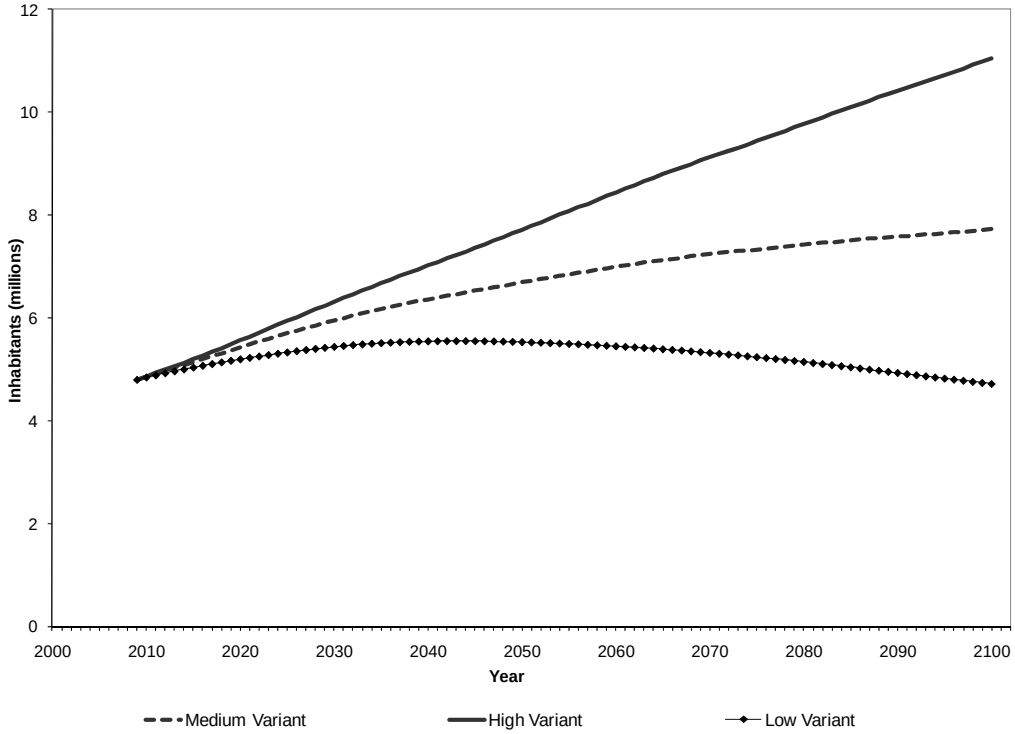
Parameter	Year	Scenario		
		Medium Variant	High Variant	Low Variant
Total Fertility Rate	**2009**	1.98	1.98	1.98
	2060	1.95	2.1	1.7
Life Expectancy at birth for females/males in years	**2009**	83.1/78.6	83.1/78.6	83.1/78.6
	2060	90.3/87.1	93.4/90.2	87.1/84.0
Net migration	**2009**	38,637	38,637	38,637
	2060	22,000	31,000	14,000

Source: Statistics Norway (2010a)

In the following the future size and structure of the Norwegian population can be anticipated for all three different demographic scenarios. The outcomes of these projections are shown in Figure 1. Compared to the official calculations of Statistics Norway (2010a), we (nearly) exactly hit the Norwegian population in 2050 within our medium projection.

From Figure 1 we see that in the *medium variant* of the Norwegian population projection the population grows over the projection horizon. After this scenario the population increases from 4.7 million in 2007 to 7.7 million in 2100. The *high variant* causes a constant increase in terms of population. The population rises to 6.7 million in 2050 and 9.5 million in 2100. Only the *low variant* contains a decrease of the population. Until it reaches the year 2036, the population grows also in this scenario due to the increasing life expectancy of both men and women, afterwards a shrinkage process begins which causes a population of 5 million in 2050 and 3.9 million in 2100. For the following analysis we take the *medium variant* as our standard scenario if not stated differently. Outcomes for the two other scenarios can be found in Section 4.3 of this paper.

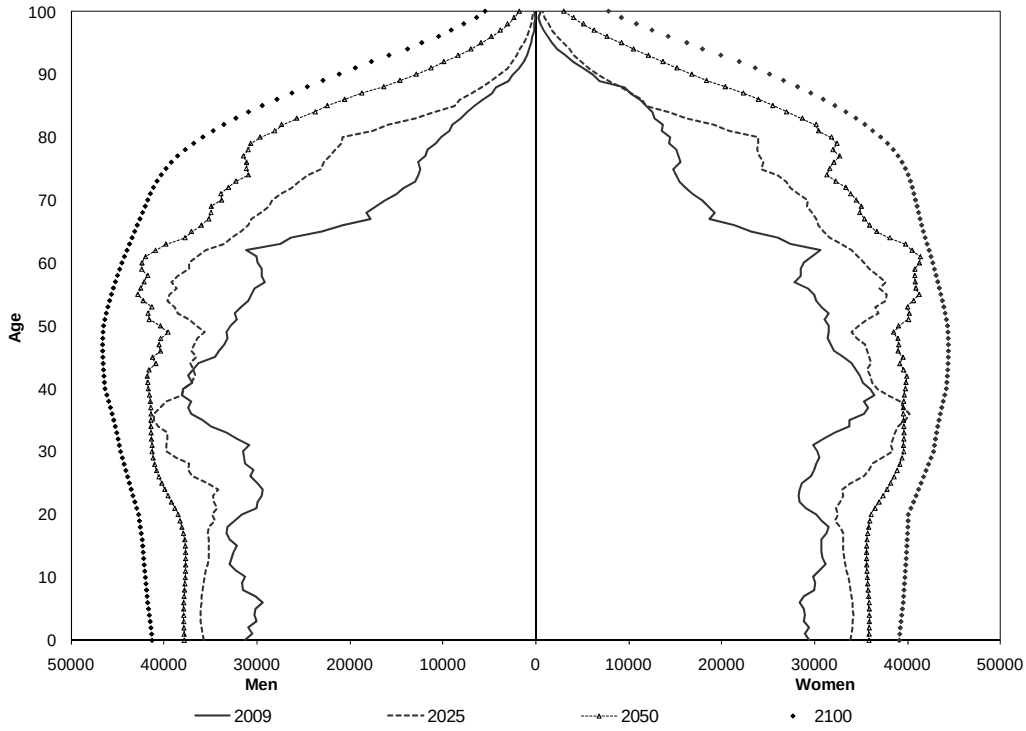
Figure 1: Different developments of the Norwegian population until 2100



Source: Own calculations

Figure 2 presents the population projection based on the *medium variant* in the years 2009, 2025, 2050 and 2100 divided by age and sex. In the base-year the Norwegian population shows a few remarkable patterns. The first anomaly in the development of the Norwegian population occurred for the cohorts of the 86-year-olds until the 72-year-olds in 2009. This is caused by the Second World War. However, the impact of the war for the population structure in Norway is much lower than in most other middle-European nations. The “baby-boom” gave birth-rates of almost three children per woman. At the end of the 1960s the so-called “pill kink” finished this boom with sharply lower fertility rates. Due to increasing fertility rates after 1985 there is growth in the cohorts of 24-year-olds and younger. The reasons for this increase are difficult to pin down, because it did not happen in most other middle-European countries. However, the generous family benefits together with a sound economic development may be one cause (Rønsen (2004)).

Figure 2: Norwegian population in 2009, 2025, 2050 and 2100

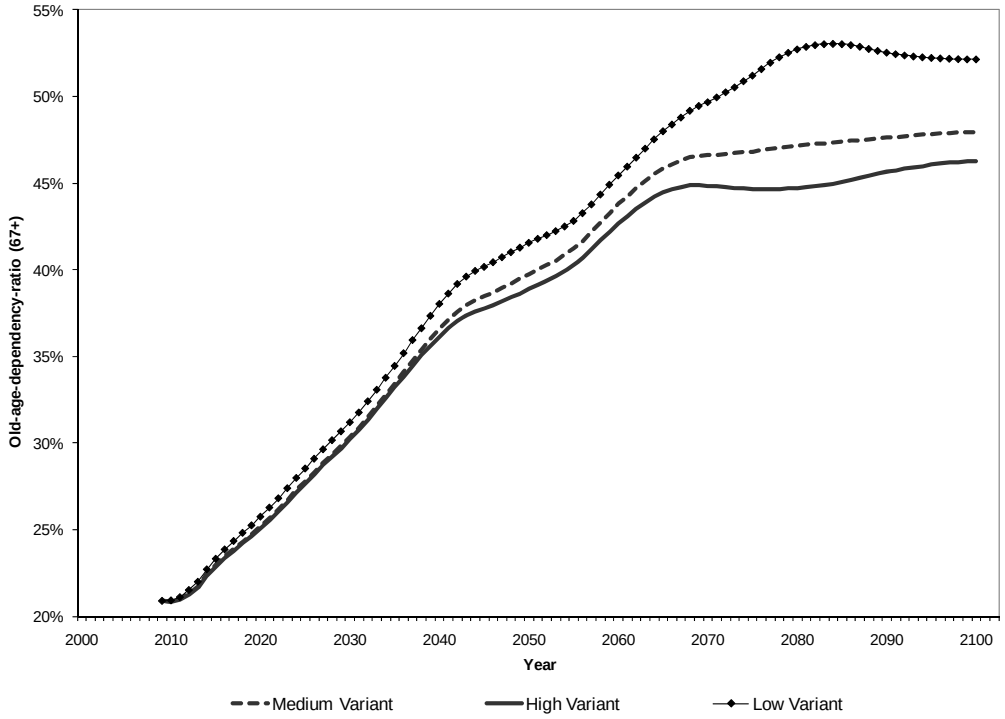


Source: Own calculations

Figure 2 shows an increase in the absolute size of the Norwegian population in the future. Especially the cohorts above the age of 60 years are expected to grow constantly, while the size of the younger cohorts will be more stable. This is mainly caused by the augmentation of the life expectancy in Norway combined with fertility rates near reproduction levels.

Figure 3 shows the development of the *old-age-dependency-ratio (67+)*, defined as the ratio between members of cohorts older than 66 years to the sum of all generations between 20 and 66 years. This ratio measures how future changes in the population structure affects the relative size of cohorts, i.e. this ratio shows the proportion between the old part of the society and the younger working part. The development of the old-age-dependency-ratio gives a first hint of potential social security imbalances in the future.

Figure 3: Development of the old-age-dependency-ratio until 2100 in Norway



Source: Own calculations

3.2 Public Sector Finances and Petroleum Revenues

The budget of the Norwegian general government, which is shown in Table 2 based on Statistics Norway (2010b) is characterized by a few remarkable patterns. The aggregates for revenues and expenditures which are discussed in the following are taken from Statistics Norway (2010b). Revenues include taxes on labor and capital incomes, value added tax, property tax and social insurance contributions. The largest part on the revenue-side of the Norwegian budget is given by the earnings out of the oil resources of the country. The public expenditures contain expenses for general public services, defense, public order and safety, economic affairs, and environmental protection, housing and cultural activities which are aggregated in the budget item “Governmental Consumption”. The aggregate *health expenditures* on the one hand is divided into four different subcategories according to Statistics Norway (2010c). The entry *disability and sickness* (in the original budget of Statistics Norway (2010b)) on the other hand is divided into again four subcategories after Ministry of Finance (2008) such as disability pensions, sickness benefits, vocational training and the early retirement scheme AFP.

Table 2: Public expenditures and revenues of the Norwegian General Government in 2009

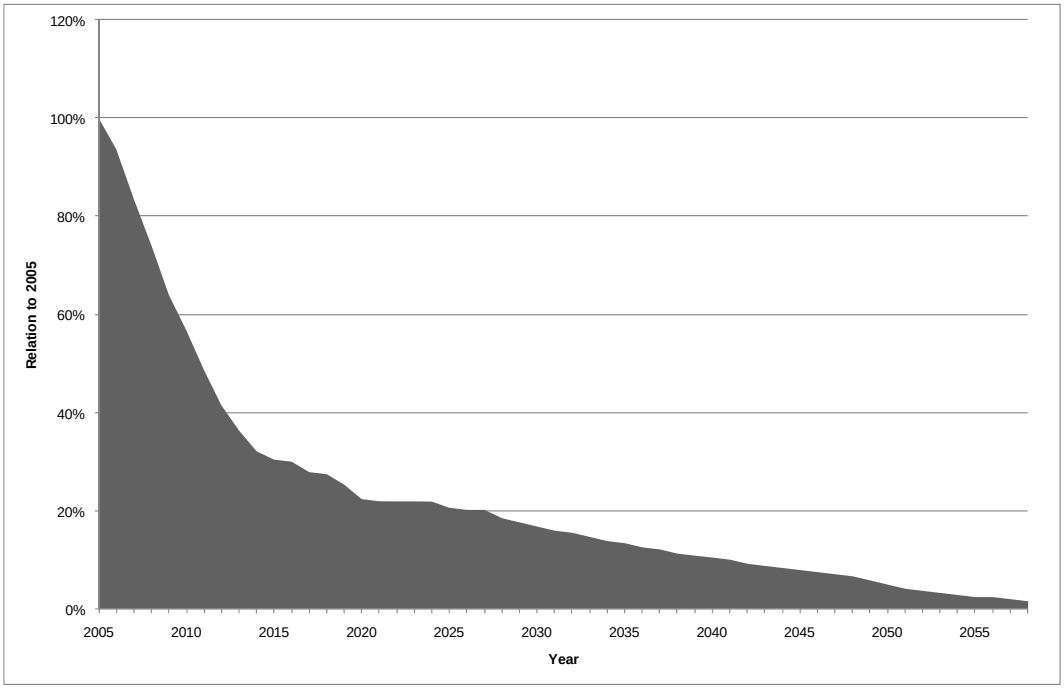
Public Expenditure (Billion NOK)		Public Revenues (Billion NOK)	
Government Consumption	297.7	Non-Oil Property Income	101.7
Oil related expenditures	16.2	Dividend GPF	74.9
Interest Payments	34.0	Property Income from Oil	98.3
Outpatient Medical Care	40.7	VAT	187.0
Inpatient Medical Care	64.4	Customs duties	2.4
Pharmaceuticals	22.6	Indirect Taxes on Oil	3.7
Health Administration	5.3	Alcohol Tax	11.3
Long-Term-Care	49.4	Tobacco Tax	8.1
Primary Education	59.7	Gas and Pollution Tax	53.9
Secondary Education	29.6	Real estate tax	6.5
Tertiary Education	36.3	Other indirect taxes	12.3
General Education Expenditures	16.7	Social Security Contributions	234.6
Old Age Pension	131.6	Income Tax without petrol	305.3
Survivor Benefits	6.1	Income Tax on petrol activities	149.0
Early Retirement Scheme (AFP)	12.7	Motorvehicle Tax	6.9
Disability Benefits	92.3	Other income	75.7
Sickness Benefits	23.97		
Vocational Training	30.2		
Family Benefits	84.9		
Unemployment Benefits	10.8		
Housing	2.7		
Social Welfare	31.1		
Total Expenditures	1098.6		
Surplus	*232.9*		
SUM	1331.5	SUM	1331.5

Source: Own calculations based on Statistics Norway (2010b,c)

Public coffers in Norway are remarkable compared to other OECD countries. In 2009 Norway was blessed with a primary surplus of 232.9 billion NOK, nearly a fourth of what the public sector spends. Four budget items should be highlighted concerning this number. Norway pays 34.0 billion NOK on interest for its public debt of 59.2% of GDP in 2009 while receiving 74.9 billion NOK in interest and dividends from the Government Pension Fund (GPF). These figures show that the Norwegian governmental sector has a booking net wealth. Furthermore, oil revenues either from taxes or dividends contributed a total of 251.0 billion NOK. However, petroleum revenues will not be sustainable in the future. According to official prognoses of the OECD (2007) revenues will shrink to 0.4% of their 2005 level until 2060, taking into account price as well as output effects. Figure 4

shows the assumed development of oil revenues in relation to GDP 2005 which will be used in the forthcoming calculations.

Figure 4: Development of Norway's petroleum revenues



Source: Own calculations based on OECD (2007)

3.3 Micro profiles

Beyond the population projection and the base-year budget of the public sector, age- and sex-specific micro-profiles are necessary to define the intertemporal budget constraint of the public sector. These profiles are needed to distribute the different aggregates of public revenues and expenditures on the cohorts which live in the base-year and hence to determine the future public revenues and expenditures. Clearly, these are dependent on the demographic development. Entries like government consumption which are not paid or consumed in an age-specific way are distributed with a flat per capita profile. The used age-and sex-specific profiles stem primarily from Statistics Norway.[4] Health expenditures profiles for in-and outpatient treatments, pharmaceuticals and long-term care are taken from Fetzer et al. (2005). All profiles together with an overview about how the different budget items are distributed are presented in the appendix.

3.4 Interest and Growth Assumptions

Because of the infinite time-horizon it is not straightforward to define the constant interest and growth rate, which are needed to predict the future revenues and expenditures of the

[4] These profiles were given to us by request.

public sector and to analyze the sustainability of this system. Norway's government assumes for its calculation of the present value of the GPF a standardized growth rate (*g*) of 1.5% and a discount rate (*r*) of 3.0% which we apply in our standard scenario with one exception, i.e. oil revenues (see above).

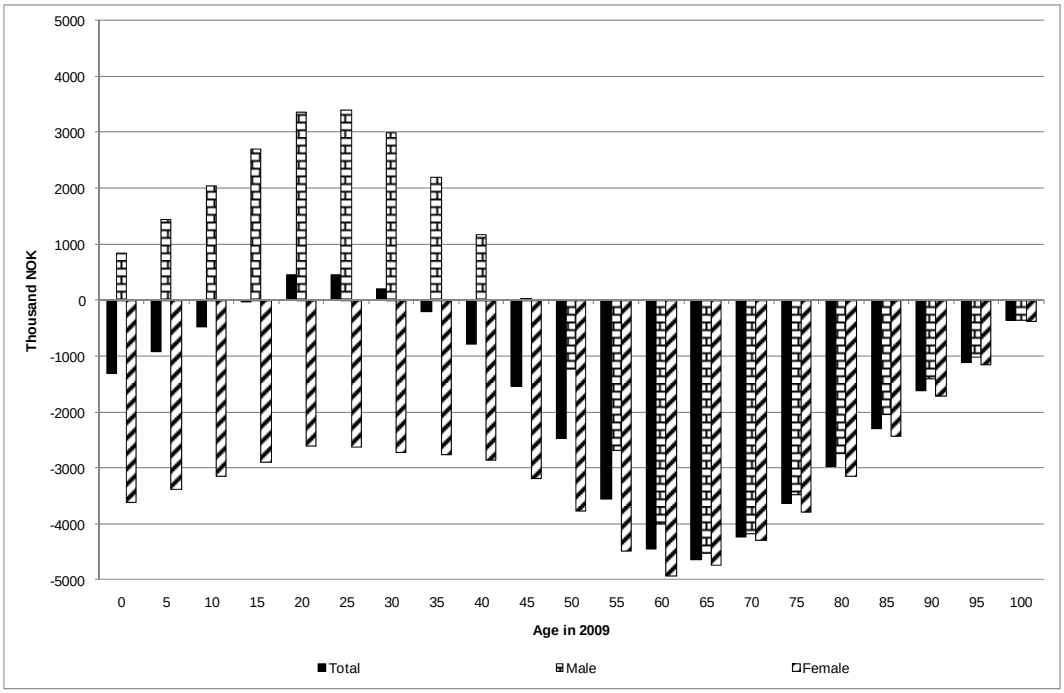
4. The sustainability of Norway's fiscal system

As described above, the Norwegian state is in the comfortable situation to have an explicit budget surplus at present. But this is mainly caused by the high oil revenues of the public sector and it is unrealistic to assume that this will be constant in the future. Furthermore, an expanding number of retirees is expected. These are entitled to benefits in the public pension system and they will receive a major part of the public health care transfers. Public pensions as well as public health care transfers are therefore expected to increase. The financial consequences of the described revenue-effect and the ageing-effect can be calculated by the method of Generational Accounting. The results of these calculations are shown in the following.

4.1 Generational Accounts

Figure 5 presents the Generational Accounts of Norwegians by gender in our base year, 2009, according to our standard scenario (*medium variant, g=1.5%, r=3%*). The sinus-shaped pattern is very common in OECD countries with strong pay-as-you-go systems. The young between 16 and 33 years finance the elderly generations from 34 years and older. Generational Accounts on average begin with minus 1,318,920 NOK for the present newborn and are at a maximum of 538,389 NOK paid by the representative 22 years old. This means that a 22 years old Norwegian (nearly half male/female) pays 538,389 NOK more in taxes and contributions over his/her remaining life-cycle than he/she will receive in transfers and subsidies from the Norwegian general government. This includes assigned oil revenues which are distributed evenly by (living) capita each year. The generation of 34 years is the first one which receives more than he/she pays in taxes over his/her remaining life-cycle. However, one should keep in mind that Generational Accounting is strict forward looking so living generations' accounts are not comparable. The major receiver is the generation of 65 years olds because after 65 years discounting lowers the Generational Accounts significantly. This pattern can generally be observed in many developed countries.

Figure 5: Generational Accounts of Norway 2009



Source: Own calculations

In one respect the Norwegian case is special. In spite of high female labor market participation rates in Norway, the Generational Accounts between men and women differ quite substantially in quantitative as well as qualitative terms until the age of 50 years. The calculations indicate that Norwegian men carry the fiscal burden of Norway's welfare state. Surely, this outcome depends on our chosen micro-profiles but also on the higher life expectancy of women and their lower income on average.[5]

4.2 The Fiscal Gap and other sustainability indicators

Our first sustainability indicator is the fiscal gap as defined in equation (7). It measures the sum of the Generational Accounts for living and future generations weighted with their (expected) cohort size, set in relation to base-year's GDP. As shown in Table 3 the value of the fiscal gap for the whole Norwegian public sector in our standard scenario (*medium variant, g=1.5%, r=3.0%)* is 694%.[6] This means that the Norwegian fiscal policies are not sustainable. The Norwegian fiscal gap can be derived as follows: The implicit debt of Norwegian fiscal policy (taxes not related to oil, social security contributions, expenditures for health and public pension, etc.) is 850% of GDP. Adding the explicit public debt with

[5] For example women receive the major share of family benefits while one could also assume that the incidence is really based on the child or the family (husband, wife, children) as a whole. Please consult Section 4.3.3 for a sensitivity analysis.

[6] In the literature, the fiscal gap is normally positive if a government is in debt i.e. if the demographic development puts a burden on public coffers. Hence, a negative algebraic sign imputes a net wealth over the long-term of the country's fiscal policy. Accordingly, in our other reported indicators we hold this terminology equivalent.

59% of GDP in 2009 results in a gross debt of 909% of GDP. One has to subtract from this amount the assets of the GPF worth 95% of GDP in 2009 and the present value of petroleum related future revenues which amount to 121%.

Table 3: Overview of components of the fiscal gap and other sustainability indicators 2009 (Population Scenario Medium Variant, g=1.5%, r=3.0%)

	Sustainability Indicators	Public Sector
in % of GDP of 2009	Implicit Debt	850
	Explicit Debt in 2009	59
	Petroleum Wealth	-121
	Fund Assets in 2009	-95
	Fiscal Gap	694
	Future Generations' Burden (in NOK)	2,831,500
in %	Revenue Gap	17.0
	Transfer Gap	14.4

Source: Own calculations

Our second indicator is the *future generations' burden*. To calculate this indicator, the *intertemporal public liabilities* and the number of people in future generations are set in proportion to each other (equation 9). This indicator implies that the entire adjustment is borne by future generations. The burden for future generations can be illustrated as an absolute difference between the generational account of the base-year and the generational account of the one year after base-year born agent. The future born generation in Norway would have to pay about 1,500,000 NOK per person more in taxes over their entire life-cycle than they would receive in transfers. On the other hand, the base-year born agent gets a net-transfer over his/her remaining life cycle of about 1,300,000 NOK. Therefore, the future born agent has to carry a high burden compared to the corresponding living generation. This is also reflected in our last two sustainability indicators, the *revenue* and *transfer gap*. Norway's government would have to raise all taxes (except those on petroleum activities) by 17.0% or could decrease all transfers by 14.4%.

4.3 Sensitivity analysis

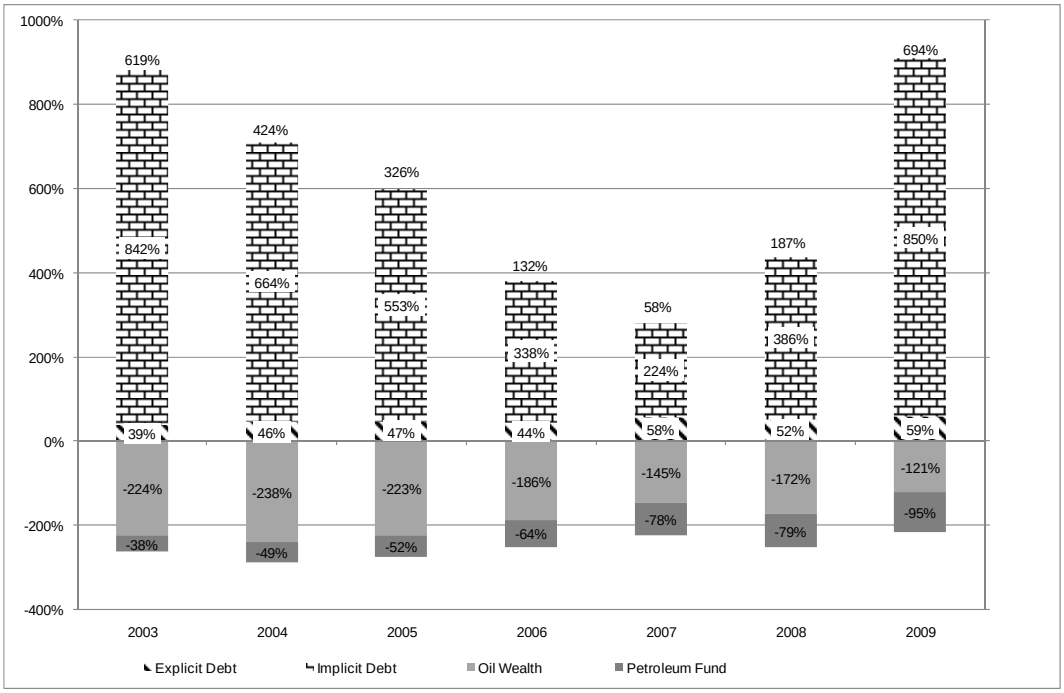
We now turn to robustness checks where we relax assumptions regarding choice of base year, discounting, economic and population growth, and the constant fiscal policy

assumption. While unusual in generational accounting exercises, the latter sensitivity analysis is natural since the Norwegian parliament has already passed legislation on a pension reform taking effect in 2011. We return to this issue in Chapter 5.

4.3.1 The fiscal gap over time

Figure 6 shows that the Norwegian fiscal gap moves with the business cycle over time.

Figure 6: Fiscal Gaps 2003 – 2009



Source: Own calculations

It is natural that the burden on future generations will be lower if all future years are boom years like 2007, and that it is higher if all future years are financial crisis years, like 2009. Sensitivity analyses comparing the more normal year 2005 with 2009 are illustrated in Table A-3 and Figure A-1 in the appendix. From Table A.3 we see that the future generations' burden, as defined in equation (9), remains substantial but decreases from 2.8 mill. NOK in 2009, to 1.1 mill. NOK in 2005.

4.3.2 Growth, discounting, and demography

To analyze the sensitivity of our results relating to our exogenous parameters interest and growth rate, r and g, and to our different population projections we calculate 15 different cases. Except our standard scenario, we test four more different settings around this combination: g=1.5 and r=4.0%, g=2.0 and r=4%, g=2.0 and. r=3.0% and g=1.0 and r=3.0%. Furthermore, we distinguish between three possible population scenarios

medium, high and *low variant*, as discussed above. Table 4 shows the *sustainability gap* for all possible population scenarios combined with the described growth and interest rate settings.

Table 4: Sensitivity Analysis of the Fiscal Gap (in % of GDP of 2009)

	Medium Variant	High Variant	Low Variant
g=1.5% r=4.0%	250.1	375.9	146.8
g=2.0% r=4.0%	423.9	648.3	251.1
g=1.5% r=3.0%	693.8	1126.5	389.0
g=2.0% r=3.0%	1381.7	2465.3	703.3
g=1.0% r=3.0%	387.1	599.4	223.8

Source: Own calculations

The basic interpretation of the results in Table 4 is straightforward. Increasing interest rates discounts future public liabilities more heavily, giving them lower weight, and thus reducing the present value of future generations' burden, and the fiscal gap.

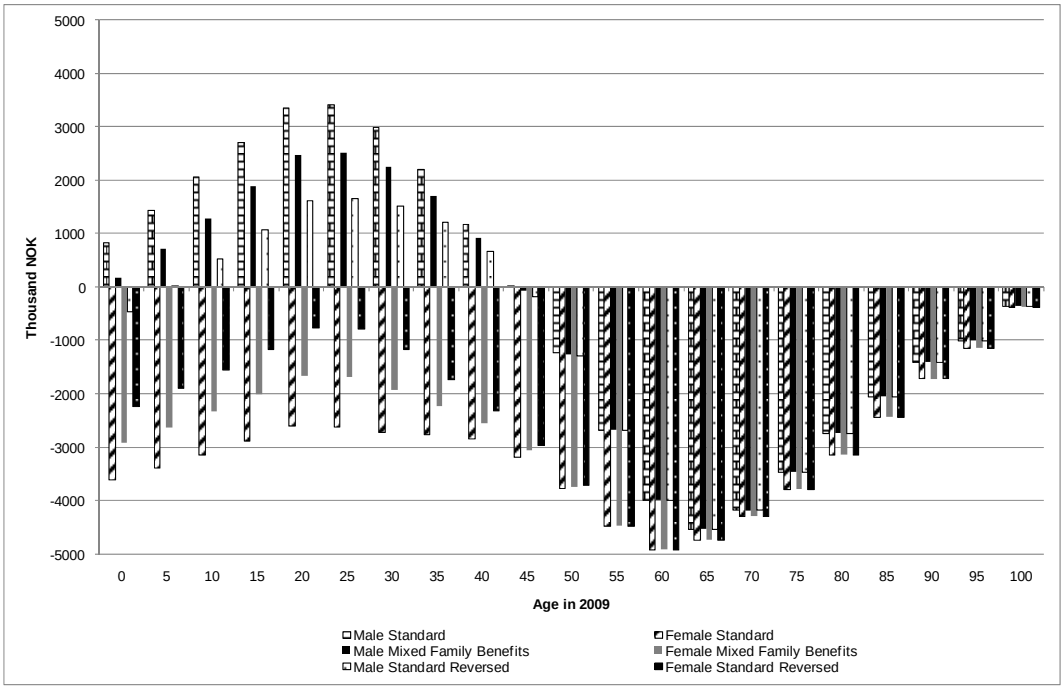
Increasing economic growth will increase both taxes and transfers. However, the generational account of a newborn is negative, indicating that transfers have a larger share of the expanding economy than taxes. Expanding the economic base through economic growth will therefore exacerbate the fiscal gap in the absence of policy changes to increase taxes relative to transfers.

The demographic profiles depend on migration, longevity, and fertility. Detailed impacts of migration lies outside the scope of the present analysis. Increased longevity clearly increases the fiscal gap through the need for higher transfers. Sometimes it is argued as if intergenerational economic imbalances can be alleviated through higher fertility rates. Again it turns out that when newborns have negative generational accounts, burdens on future generations increase with higher fertility. This effect is counteracted for a country with high explicit debt, since the explicit debt can be shared on a larger population. The Norwegian situation is different. The petroleum-wealth of the country implies that the smaller the future population is, the higher is the petroleum-wealth per person, and therefore the lower is the future burden per person.

4.3.2 Growth, discounting, and demography

A complete sensitivity analysis concerning our incidence assumptions (via the micro-profiles) is not possible even given the good Norwegian data available.

Figure 7: Generational Accounts with different scenarios concerning family benefits



Source: Own calculations

However, to further check the robustness of male vs. female generational accounts, we have built two new scenarios in Figure 7. Scenario "Mixed Family Benefits" distributes the family benefits in equal shares over men and women. This probably overestimates the male share since most single parents are single mothers. A final, more extreme, scenario "Standard Reversed" reverses the standard assumption. Here we use the female profiles for the males and vice versa. The generic result that men are the main contributors to the welfare state holds in every scenario.

5. The Norwegian Pension Reform

The Norwegian pension reform is to take effect from 2011. It seeks to dampen the expenditure effect due to growth in life expectancy, and to strengthen ties between former earnings, retirement decisions, and pension benefits, thus providing work incentives in particular for elderly workers. The reform comprises two major elements.[7] First, one tries to control for the growth in expenditures by applying the following set of indexing rules:

[7] For a comprehensive overview of all reform details see Risku and Vidlund (2008) and Ministry of Labour and Social Inclusion (2009).

Indexing Rule 1: Income dependent pension entitlements will be indexed by wage growth until retirement. The pension benefits, however, will be adjusted by wage growth minus 0.75 percentage points only. Pensions will thus not be increased completely in step with national wage increase rates. In other words, the purchasing power of a standard pension will be lower over time.

Indexing Rule 2: Pension payments will be adjusted with the life expectancy of the population at large. If life expectancy increases, a quasi-actuarial mechanism kicks in and reduces annual benefits as the expected length of the retirement period increases.[8] The indexation of pension benefits to changes in national life expectancy cuts pension generosity.[9]

The next element is to stimulate labor supply. This will be done by lowering the implicit tax by making the supplementary (income based) pension more actuarially fair with benefits calibrated to the entire working life. Furthermore, the new flexible retirement age (starting from 62 years) will be based on an actuarial adjustment of the yearly benefit. As it is not clear how individuals will behave to this new policy instruments,[10] we will follow the standard procedure of generational accounting and abstract from these reform elements in our calculations of fiscal sustainability.

Figure 8 shows the sustainability and redistribution effects resulting from Indexing Rule 1 and 2. Our simulations are made using the average gains in life expectancy with reference to the 56-year-old cohort in 2010. The reason for this choice is that the Reform is going to be effectuated from the generation born in 1954, i.e. for people that are 56 in 2010.[11] [12]

[8] The mechanism implemented is only quasi-actuarially fair, as the indexing of benefits does not include an actuarial consideration of life expectancy but only a consideration of average gains in life expectancy.

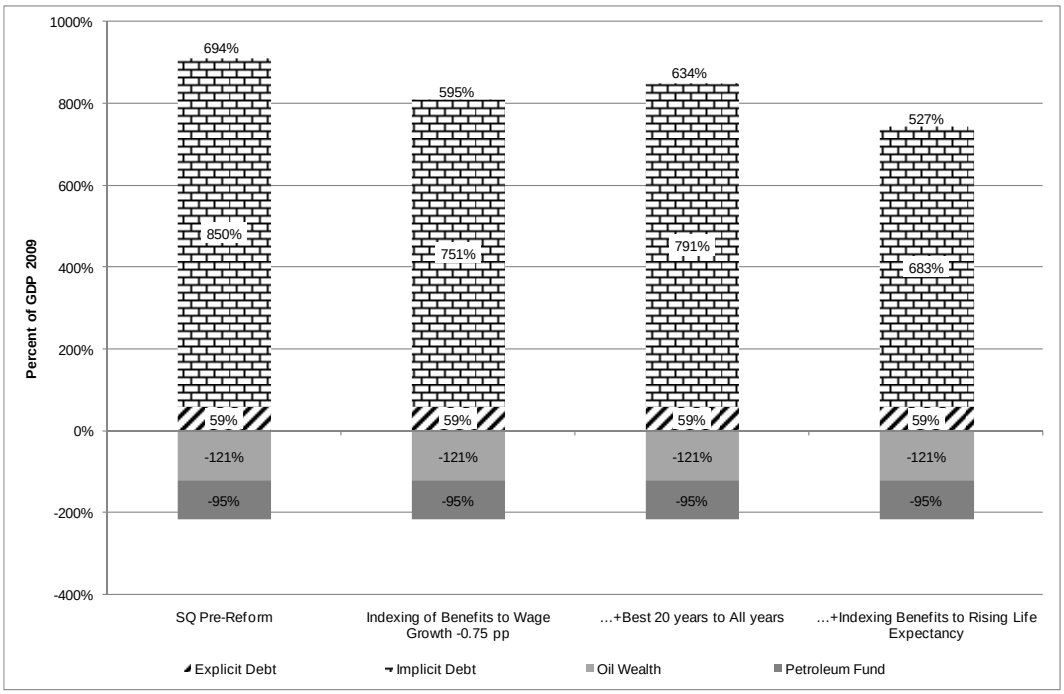
[9] If the average life expectancy rate increases, employees will have to stay longer in employment to be entitled to the same present value of total pension, or accept lower annual pension payments and thus a lower present value of total pension benefits. An increase in the expected number of retirement years reduces the annual benefit such that the present value of total pension benefits is nearly invariant to changes in current remaining life expectancy and retirement age.

[10] See Holmøy and Stensnes (2008) for a further discussion.

[11] Concerning the reference point, i.e. the 56-year-olds in 2010 for indexing pension payments with average gains in life expectancy, we want to remark that in the original pension reform plan the group of 67-year-olds was earmarked as reference. The effects of taking a younger reference group are smaller cuts in pension generosity but as a direct consequence also less sustainability. The reason for lesser cuts in generosity due to an indexing with average gains in life expectancy is straightforward as the gains in years of life are bigger when comparing the cohort passing into retirement with the group of 67-year-olds compared to the 56-year-olds.

[12] In the following analysis, the pension reform elements employed are in some respect idealized as the actual reform plan envisages a less brisk proceeding. The indexing with average gains in life expectancy e.g. is only to be installed as of 2018. In order to exemplify the reform-induced intragenerational effects, we nevertheless choose to completely implement the reform from 2010 onwards, as this illustrates (today) what actually happens on the intragenerational level (tomorrow). The intergenerational dimension is affected by

Figure 8: Fiscal gaps after pension reform

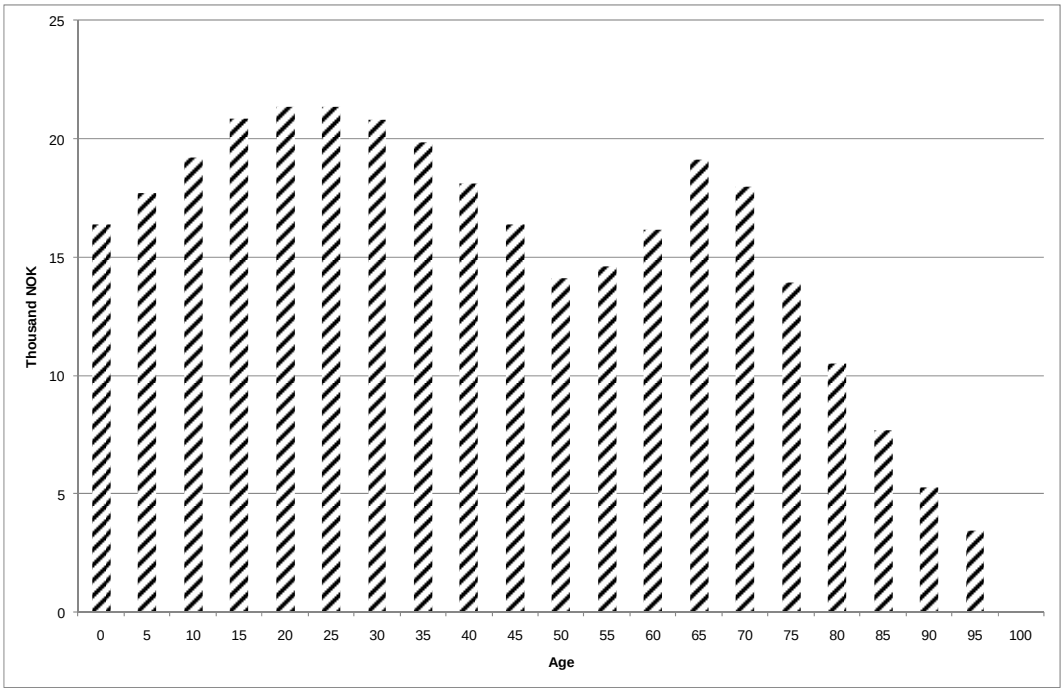


Source: Own calculations

We see that the fiscal gap in 2009 is substantially reduced from 694% of GDP to 527% of GDP after the pension reform. Note that reduced indexing of pensions with 0.75 percentage point reduces the fiscal gap by 99 percentage points of GDP (694%-595%), which is more than the value of the Government Pension Fund. This shows that seemingly small technical adjustments can have a great impact. The powerful impact in this case, follows from breaking the link between automatic growth in transfers when income and taxes grow. Counter-intuitively the change in the calculations of the endowments from the best 20 years to all years increases the fiscal gap. However, this is due to the setup of this reform measure which protects most participants from losses via a beneficiary change of the pension formula. Holmøy and Stensnes (2008) confirm these findings. The biggest impact has the indexing of benefits to the rising average life expectancy with savings worth over one GDP of 2009.

this procedure in a way that all results shown are too optimistic (or rather overestimated) concerning the sustainability impact of the reform.

Figure 9: Induced Burden of the pension reform per cohort in annuities



Source: Own calculations

As we have shown in the last paragraphs, the Norwegian pension reform reduces the burden for future generations significantly. However, this implies that living generations have to take some of the burden i.e. lower pension benefits. Figure 9 shows the level of this redistribution in annuities per cohorts. Interestingly, the picture is not clear cut. Laymen's intuition would probably state that the pensioners are hit the hardest by a pension reform but they are not. In fact pensioners over 80 years are the ones hit the least. Another surprisingly result is that next to the younger cohorts between 15 and 35 years the cohorts around 65 years face a relatively high burden. This can be explained by the different reform measures. The first new index rule is hitting the generations just before entering the benefit phase particularly because they face the longest benefit period while their entitlements do not increase much more. Secondly the generous change from the 20 best to all years in the benefit formula is not reducing the burden for those who are just entering the benefit phase. Thirdly the postponement of the second index rule is especially favorable for the cohorts around 55 years while the 65 years olds are not benefiting that much. However the largest burden is still borne by the even younger cohorts.

6. Summary and Conclusion

Norway is expected to face relatively strong pressure on its public finances due to an ageing population and the resulting increase in age-related public expenditure. A continuation of the current policy (as of 2009) will end in a long run gap between

government incomes and expenses. To close the gap, a 17% increase in taxes would be needed. However, this estimate is sensitive to the underlying assumptions taken. In particular, the estimate is changing for the choice of the base year. For example, if 2005 is chosen instead of 2009, the computed gap would be an 8 percentage point increase in taxes. With the pension reform enacted in 2011, Norway takes a step towards long-term fiscal sustainability. Due to life expectancy adjustment in benefits the pension scheme expenditure will in practice remain unaffected by the increased longevity. This is undoubtedly an effective way to retain fiscal sustainability. According to our results, the needed 17% increase in taxes (2009) is decreased to 12%. If 2005 is chosen as base year the needed 8% increase is diminished to 5%.

We have also looked at the intragenerational distribution. Here we find that men as a group bear the fiscal burden. They receive most pensions, but as a group they pay relatively more in the form of taxes. This conclusion holds even if men are attributed benefits connected to children. However, all our calculations are sensitive to assumptions regarding population projections. In our calculations we assume a fertility rate of 1.9. Increasing this birth rate worsen the fiscal balance. The same holds for increasing the assumed GDP-growth rate.

We started by asking whether Norway is overconsuming its petroleum wealth. This is a reasonable question to ask also in the light of the broad political consensus of trying to perpetuate the Government Pension Fund (GPF) to make the transitory petroleum income available also to future generations. In all our sensitivity analyses, there are no scenario where the GPF is not depleted. On the other hand, the recent pension reform shows that substantial improvements in the long term fiscal balance are possible. During some decades Norway has experienced a lucky streak with improving terms of trade in the new world economy, typically influenced by Chinese demand for inputs and strong competition in manufactured goods. Being an exporter of natural resources like oil, gas and fish, and a beneficiary of lower prices on manufactured goods, Norway has enjoyed a very favorable position. Our analyses suggest that Norway may be close to intergenerational fiscal balance provided that the luckiest of circumstances continue in the decades to come. Even under such favorable conditions, both the petroleum wealth and pension reform are necessary to secure sustainability. However, it is reasonable to believe that the lucky streak will come to an end also in the case of Norway. In that case it is necessary to keep on a continuous reform process to promote efficient markets, and to align expenditures and revenues to short- and long term constraints.

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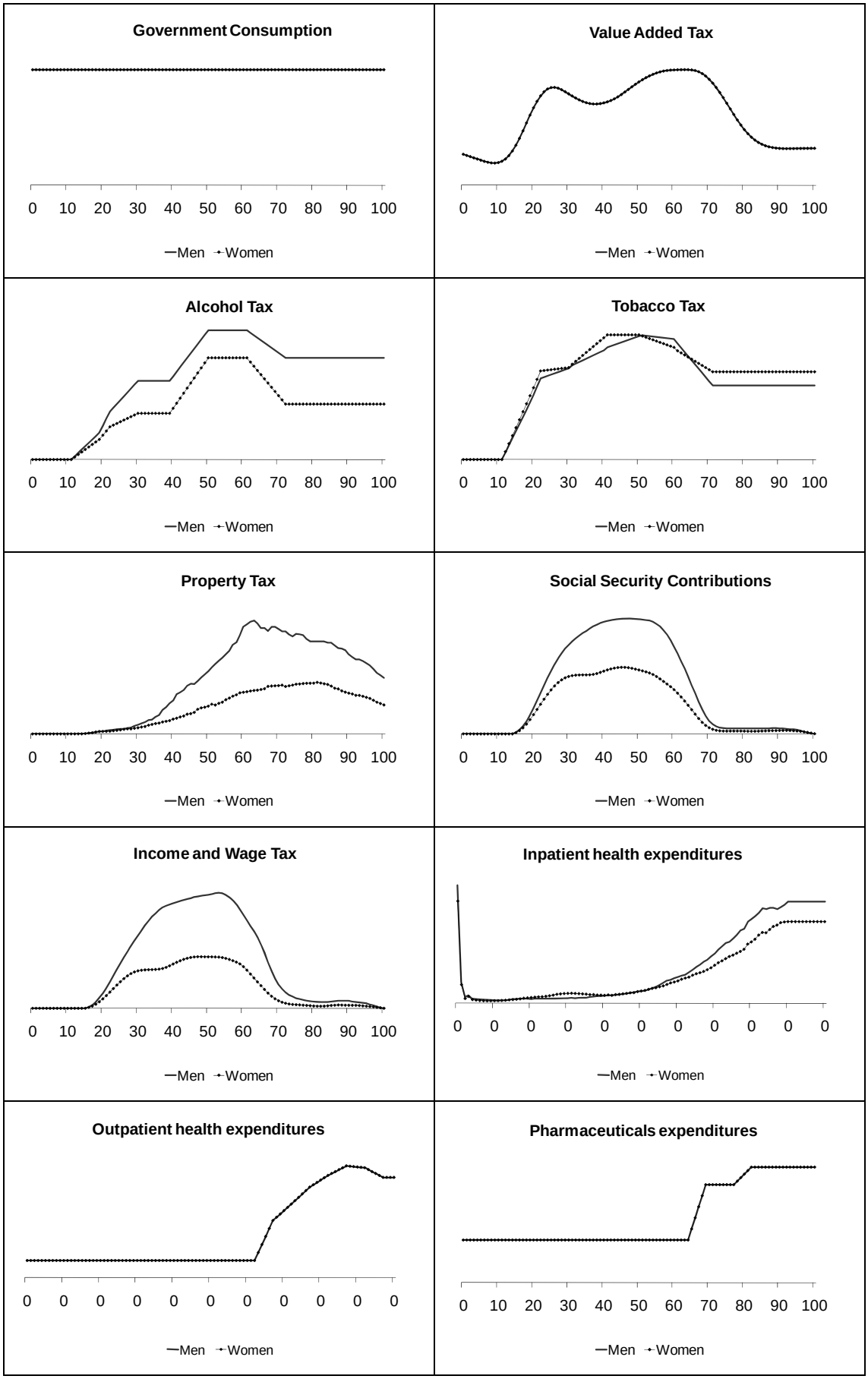
Appendix

Table A1: Sensitivity Analysis of the Sustainability Indicators

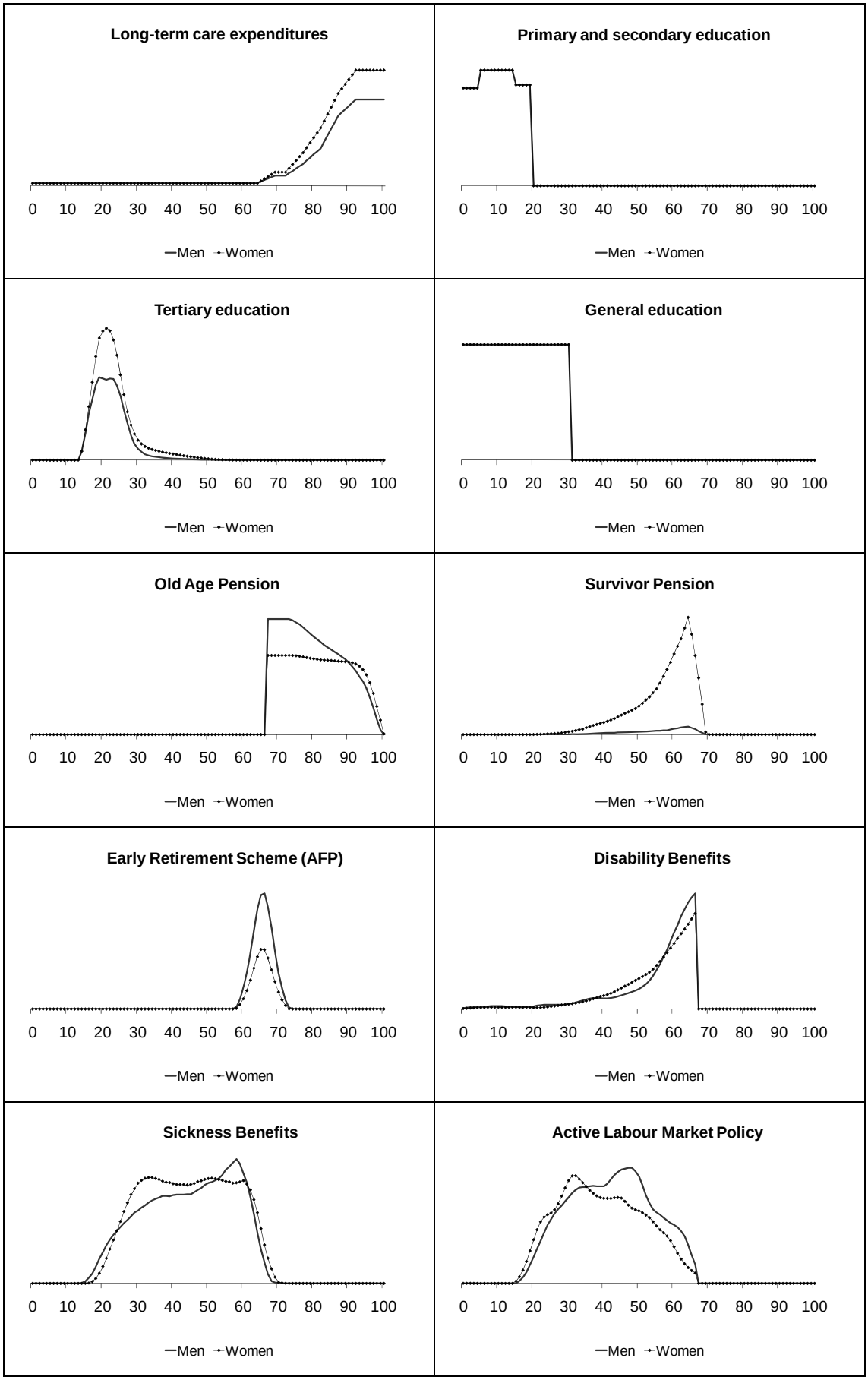
Spread	Indicators	Population Projection		
		Medium	**High**	**Low**
g=1.5% r=4.0%	*Fiscal gap (in % of GDP 2009)*	250.1	375.9	146.8
	Petroleum Revenues (in % of GDP 2009)	-107.8	-107.8	-107.8
	Future Generations' Burden (in Thousand NOK)	1793.2	1976.7	1567.2
	Revenue Gap (in %)	10.7	13.7	7.5
	Transfer Gap (in %)	9.5	11.9	6.9
g=2.0% r=4.0%	*Fiscal gap (in % of GDP 2009)*	423.9	648.3	251.1
	Petroleum Revenues (in % of GDP 2009)	-113.5	-113.5	-113.5
	Future Generations' Burden (in Thousand NOK)	2365.5	2539.6	2199.0
	Revenue Gap (in %)	14.2	17.7	10.6
	Transfer Gap (in %)	12.3	14.9	9.5
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	693.8	1126.5	389.0
	Petroleum Revenues (in % of GDP 2009)	-120.8	-120.8	-120.8
	Future Generations' Burden (in Thousand NOK)	2831.5	3048.3	2668.8
	Revenue Gap (in %)	17.0	20.9	12.9
	Transfer Gap (in %)	14.4	17.2	11.3
g=2.0% r=3.0%	*Fiscal gap (in % of GDP 2009)*	1381.7	2465.3	703.3
	Petroleum Revenues (in % of GDP 2009)	-128.1	-128.1	-128.1
	Future Generations' Burden (in Thousand NOK)	3587.6	3902.9	3415.1
	Revenue Gap (in %)	21.6	26.2	16.9
	Transfer Gap (in %)	17.7	20.7	14.3
g=1.0% r=3.0%	*Fiscal gap (in % of GDP 2009)*	387.1	599.4	223.8
	Petroleum Revenues (in % of GDP 2009)	-114.4	-114.4	-114.4
	Future Generations' Burden (in Thousand NOK)	2181.1	2376.8	1973.0
	Revenue Gap (in %)	13.0	16.4	9.4
	Transfer Gap (in %)	11.4	14.0	8.5

Source: Own calculations

Table A2: Age- and Sex-Specific Profiles



Continuation Table A2



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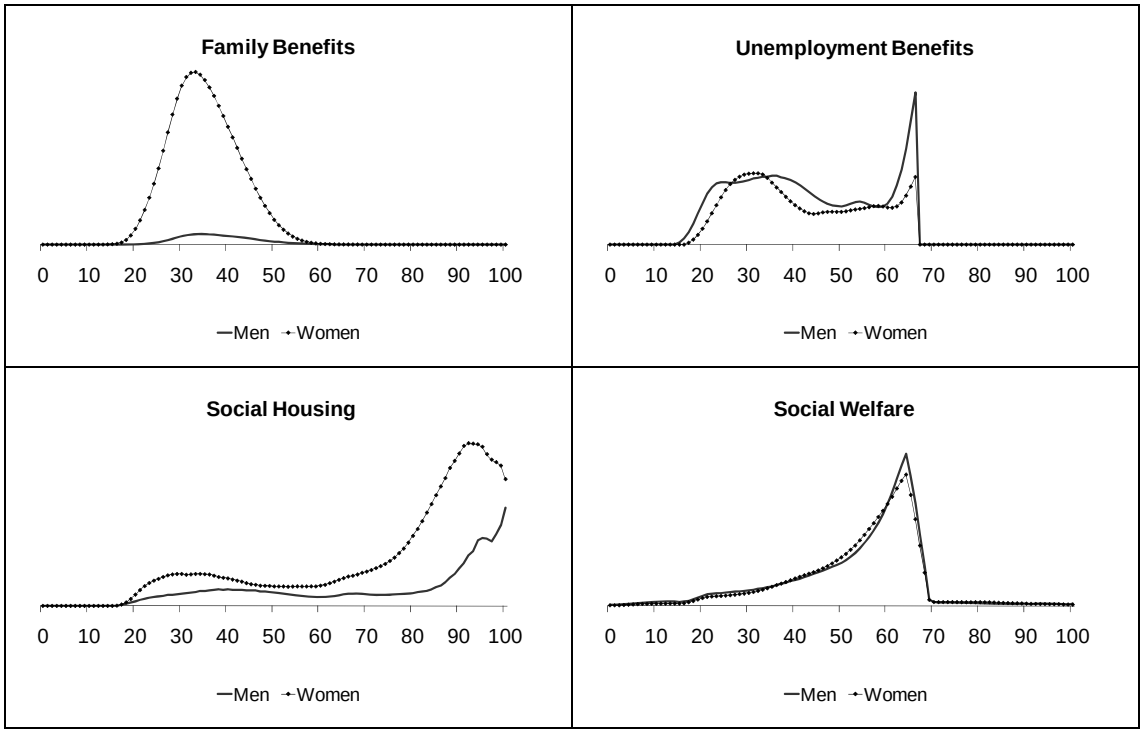


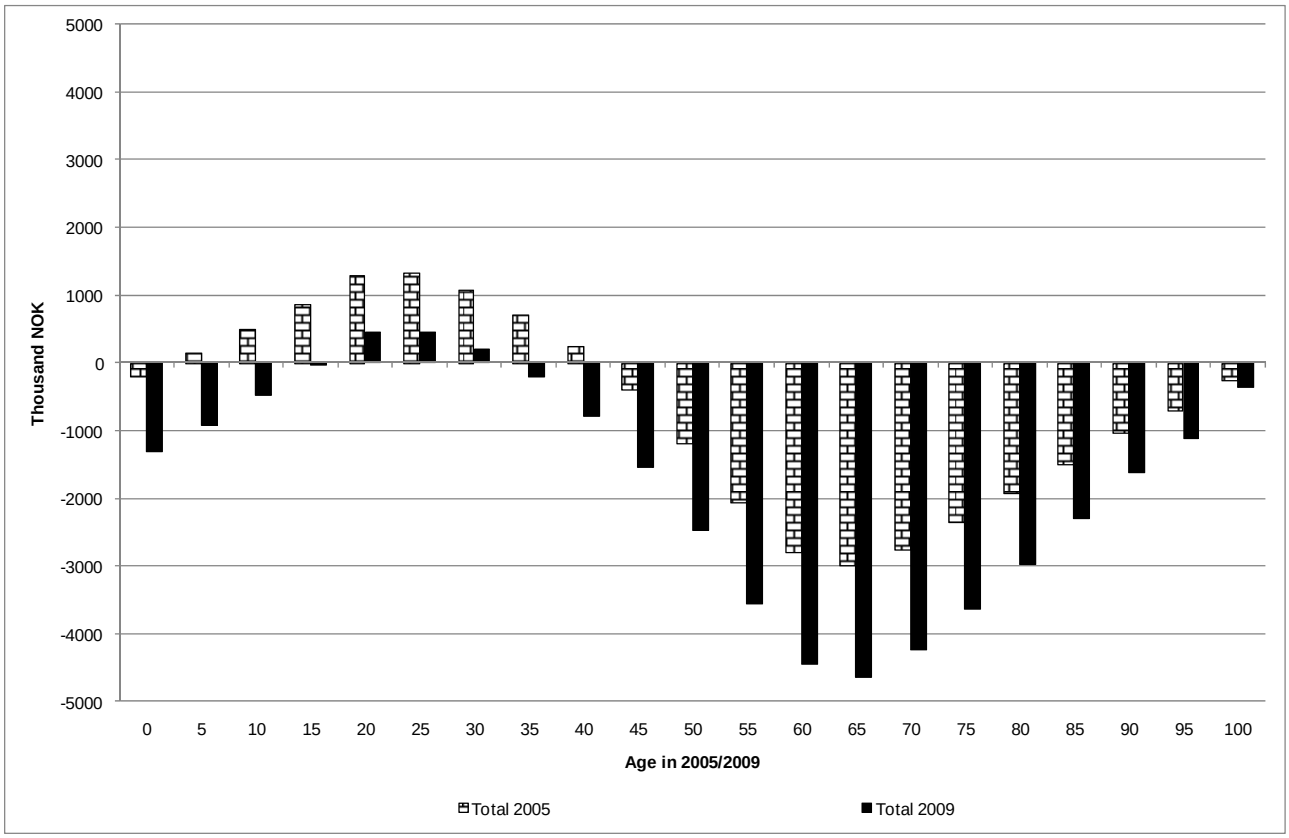
Source: See Section 3

Table A3: Indicators in Comparison – 2005 vs. 2009

Spread	Indicators	Year (Population Projection Medium)	
		2005	**2009**
g=1.5% r=3.0%	*Fiscal gap (in % of GDP 2009)*	325.7	693.8
	Petroleum Revenues (in % of GDP 2009)	-222.6	-120.8
	Future Generations' Burden (in Thousand NOK)	1136.3	2831.5
	Revenue Gap (in %)	7.9	17.0
	Transfer Gap (in %)	7.3	14.4

Source: Own calculations

Figure A1: Generational Accounts 2005 vs. 2009



Source: Own calculations

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