Volume Title: Generational Accounting around the World

Volume Author/Editor: Alan J. Auerbach, Laurence J. Kotlikoff and Willi Leibfritz, editors

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-03213-2

Volume URL: http://www.nber.org/books/auer99-1

Publication Date: January 1999

Chapter Title: Generational Accounting and Depletable Natural Resources: The Case of Norway

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Chapter URL: http://www.nber.org/chapters/c6698

Chapter pages in book: (p. 369 - 396)

16 Generational Accounting and Depletable Natural Resources: The Case of Norway

Erling Steigum, Jr., and Carl Gjersem

16.1 Introduction

Based on a new data set, this paper applies the generational accounting method (Auerbach, Gokhale, and Kotlikoff 1991) to assess the generational impact of current fiscal policies in Norway in terms of net lifetime tax burdens on present and future generations.

Norway has a small population but is endowed with large natural resources. The country has been a producer of oil and natural gas since the 1970s and is now the third largest exporter of oil in the world. More than 80 percent of Norway's petroleum revenues represent government income. Like the other Scandinavian countries, Norway is also a welfare state with a large public sector and a fairly even distribution of income. Most transfers and welfare benefits are financed on a pay-as-you-go basis.

Both GDP and employment growth rates have been relatively high during the past 25 years. Most of the net employment growth can be accounted for by public sector employment, which has increased by 80 percent since 1970.[1] The labor force participation rate is also relatively high, and the rate of unemployment has on average been quite low. Another remarkable fact is that the business cycles in Norway have been larger during the past 15 to 20 years than in the earlier postwar period, despite the automatic stabilizers built into the welfare system. Note, however, that both automatic stabilizers and countercyclical fiscal policy could bias the assessment of the long-run generational impact of

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Thanks are due to Laurence J. Kotlikoff for helpful discussions and to the Norwegian Research Council for financial support. Opinions expressed are those of the authors and not those of the Ministry of Finance.

1. At the same time, there has been a remarkable increase in the female participation rate from 44.7 percent in 1972 to 64 percent in 1995 (percentage of those in the age group 16–74).

current fiscal policies because tax revenues, transfers, and other public spending (e.g., on labor market programs) are sensitive to the business cycle and the short-run fiscal policy stance.

The government has long-term fiscal challenges similar to those facing most other OECD countries, such as population aging and increased social security spending when the baby boom generations retire. What makes Norway different is the government's considerable wealth in terms of oil, other energy resources, and net financial assets. The government now runs substantial budget surpluses. The temporary nature of the government's oil revenues represents a special challenge for fiscal planning in addition to the usual problems highlighted in the generational accounting literature.[2] A natural way to deal with this problem is to include an estimate of the government's petroleum resource wealth in the government's intertemporal budget constraint. Indeed, we think that the generational accounting method is a particularly useful tool for long-term fiscal planning and policy analysis in a resource-rich welfare state like Norway.

The method of generational accounting was first applied in Norway for the year 1992 (see Auerbach et al. 1993). This was before the Norwegian economy had recovered from the recession of the late 1980s. Due to the recent recovery, fiscal policy has changed from an expansive policy in 1990–93 to a much more austere policy from 1994 onward. The generational accounting method was discussed and applied in the *National Budget 1995* (released in October 1994), the annual economic policy document of the government. Since then, generational accounting has been used by the government on a regular basis to assess the long-run fiscal balance. The estimated generational imbalance between present and future generations has been reduced remarkably compared with the first results reported by Auerbach et al. (1993). At the present, there is probably generational balance.

The rest of this paper is organized as follows. Section 16.2 looks back on the recent history of the welfare state and fiscal policy in Norway and discusses the ideas behind the State Petroleum Fund, which was established in 1990 to prevent excessive spending of temporary petroleum revenues. In section 16.3, we give a brief description of the data underlying our projections of population, public expenditures and receipts, and government wealth. Section 16.4 reports new results from applying the generational accounting method with 1995 as the base year. Also some sensitivity analysis are reported. Section 16.5 analyzes the impact of alternative policies that hypothetically could equalize the growth-adjusted net tax burdens of present and future generations. Section 16.6 summarizes our results.

2. For a recent study of this problem, see Steigum and Thøgersen (1995), who simulate a computable overlapping generations model to illustrate the intergenerational welfare effects of consuming the entire petroleum wealth in the course of the next 40 years.

16.2 Fiscal Policy: Brief History and Present Challenges

16.2.1 The Norwegian Welfare State

The government now spends almost 30 percent of GDP on social protection in the form of various transfers to households, health care, labor market programs, and so forth (see Risa 1996). In addition, the government's expenditures on education total 6.6 percent of GDP. The public sector supplies most educational and health services, including higher education. Consumers pay very little for these services.

The Norwegian welfare state is of recent origin. In 1960, total government spending was 26.4 percent of GDP, which was slightly *lower* than the corresponding number for the United States. The universal and partly earnings-related social security pension scheme was introduced in 1967 and is still maturing. The principle of universalism has been a characteristic of the Scandinavian welfare states. For example, both child support and the old-age pension are universal benefits in Norway. Still, there is a trend away from universalism and toward more targeting in some areas.

The expansion of welfare programs was particularly fast in the 1970s. For example, in 1978 Norway established one of the most generous sickness benefit schemes in the world, involving 100 percent compensation from day one. Government spending on several public assistance programs increased rapidly in the 1980s as well, notably disability pensions, sickness benefits, unemployment benefits, lone parents' allowances, and means-tested municipal economic assistance. This development has caused concern among policymakers. In the 1990s, the government formulated a broad strategy to strengthen the economic foundation and sustainability of the welfare state. An important element of this strategy was the "working approach," aimed at promoting employment and reducing welfare dependency. For example, measures have been taken to curb the growth in spending on unemployment benefits and disability pensions through various labor market programs designed to enhance human capital and increase labor force participation. In recent years, reforms to make the old-age pension system partially funded have also been discussed.[3]

16.2.2 Macroeconomic Planning and Fiscal Policy

In the postwar period, economic policy thinking in Norway has been marked by a strong belief in macroeconomic planning and economic policy activism, beliefs and ideas that can be traced back to the intellectual influence of Nobel laureate Ragnar Frisch (1896–1973) on several generations of Norwegian

3. The implications of such reforms for intergenerational distribution of welfare have also been examined, using calibrated overlapping generations models of the Norwegian economy (see Steigum 1993; Raffelhüschen and Risa 1995).

Table 16.1 Net Saving Rates in Norway, Europe, and the United States (percent)

Country/Region and Sector	1970–79	1980–89	1990–94
Norway			
National	11.6	12.3	7.3
Government	7.0	7.6	4.7
Private sector	4.6	4.7	5.5
European countries[a]			
National	13.2	8.3	6.6
Government	1.8	−0.4	−1.6
Private sector	11.4	8.7	8.2
United States			
National	8.5	4.4	2.7
Government	−0.6	−3.0	−3.5
Private sector	9.0	7.4	6.2

Source: Leibfritz et al. (1995, annex 5, table A9).

Note: The definition of public saving captures neither increased social security debt nor changes in the government's petroleum wealth.

[a]Germany, France, Italy, United Kingdom, Austria, Belgium, Denmark, Finland, Norway, and Sweden. Weighted average (1991 GDP weights).

economists.[4] The unique Norwegian system of macroeconomic planning, which was developed in the 1950s and 1960s, may explain why the Norwegian capital market remained particularly underdeveloped for decades, until a long overdue financial deregulation policy was launched in the 1980s. Before the financial deregulation, real rates of interest were kept artificially low—after-tax rates even negative most of the time—private saving was small, and credit rationing and liquidity constraints were widespread. In this institutional setting, fiscal policy was quite potent.

An important fiscal policy goal was to generate enough saving to fulfill the government's ambitious goals with respect to capital accumulation and investment allocation on sectors. The government therefore ran substantial surpluses during most of the postwar period. Table 16.1 highlights the important role of public saving. In the 1980s, government net saving (conventionally measured) was on average 7.6 percent of GDP in Norway, and negative (on average) in Europe.

16.2.3 Oil Revenues: A New Challenge for Fiscal Policy

In the pre-oil period 1950–70, the governments (mostly social democratic ones) were fairly successful in managing the economy, at least in terms of macroeconomic stability.[5] After Norway became a producer of oil and natural

4. Frisch also had very pessimistic views on the social benefits of decentralized resource allocation through the market economy.

5. A likely social cost of the macroeconomic planning system was a low real rate of return from domestic investment.

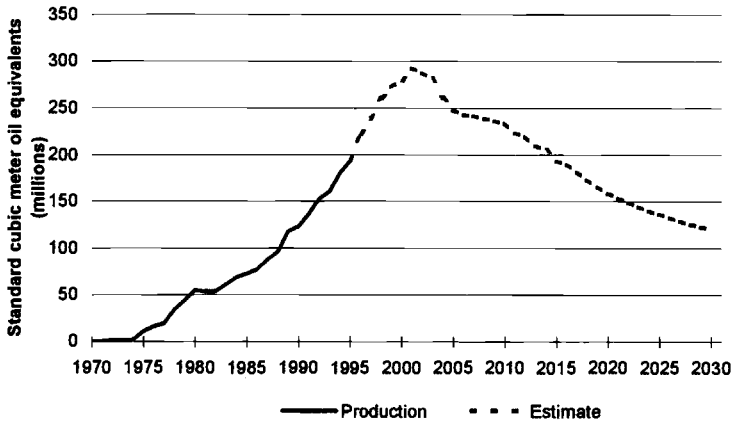

Fig. 16.1 Production of oil and natural gas
Note: See appendix table 16B.1 for data.

gas, however, it turned out to be much harder to manage and stabilize the economy. Norway's macroeconomic problems after OPEC I in 1973–74 were however of a different nature than the stagflationary problems of the oil-importing European countries: in Norway, the main problem after OPEC I was inflationary pressure from very fast growth of domestic aggregate demand. This was due to the positive wealth effect of the oil price shock, a lenient macroeconomic policy to counteract the effects of the international recession, and the aggregate demand effect of a very high rate of investment in the petroleum industry.

Figure 16.1 illustrates the rapid growth of petroleum production since 1975, as well as a projection of petroleum production to 2030. The growth rate of petroleum production has been unexpectedly high during the past 10 years, partly because technological progress has been rapid. The production of oil and natural gas is expected to peak shortly after 2000 and then decline in subsequent decades.

The government's net cash flow from the petroleum sector has been very volatile. It increased dramatically in 1980 due to OPEC II and then fell to almost zero as a result of the oil price plunge in 1985–86. Figure 16.2 shows the government's projection of the net cash flow for the years 2001, 2010, and 2030, as well as for some previous years. In the past 10 years, increased oil production as well as lower operating costs explain most of the remarkable growth of the government's net cash flow from the petroleum sector. Increased production and a lower rate of investment are expected to increase the government's net cash flow to 9 percent of GDP in the year 2001. From then on, the net cash flow is expected to decline. The projection of the net cash flow in figure 16.2 is consistent with the estimates of the government's petroleum wealth used in our calculations of generational accounts.

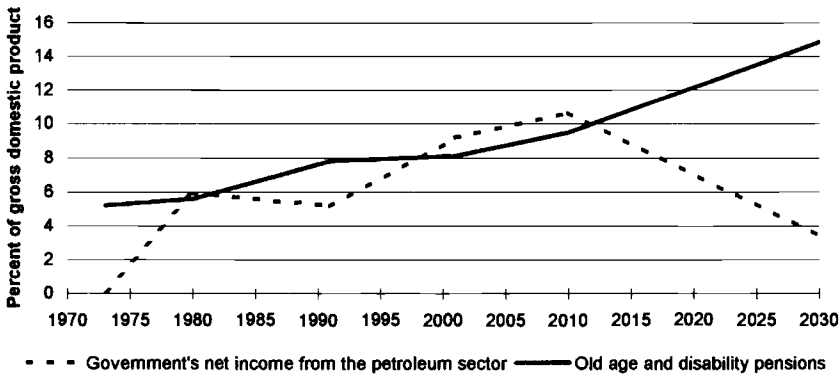

Fig. 16.2 Projected government net income from petroleum sector and old-age and disability pensions
Note: See appendix table 16B.2 for data.

Figure 16.2 also shows a rapid increase in the projected spending on social security pensions as a percentage of GDP in the next century, due to demographics as well as the maturing process of the earnings-related pension scheme. The figure illustrates the expected decline in the importance of the net cash flow from the petroleum sector as a financial resource for the Norwegian welfare state in the future. Since neither changes in petroleum wealth nor social security debt are captured by the conventional budget surplus concept of the government, the latter is a particularly misleading indicator of long-run fiscal balance in the case of Norway.

16.2.4 Business Cycles and Fiscal Policy

Both OPEC I and II had tremendous impacts on Norway's economy. After OPEC I in 1973–74, the fast growth of aggregate demand and huge capital imports led to macroeconomic policy restraint that slowed down the growth in aggregate demand at the end of the decade. The combination of this policy and OPEC II had a very large effect on the external balance, which turned into large surpluses in the current account in the first half of the 1980s. Figure 16.3 indicates that the Norwegian economy has been exposed to larger macroeconomic fluctuations after 1980 than before. This figure shows employment as well as the value added of mainland Norway, that is, GDP net of the petroleum industry and shipping.

The large business cycle in the late 1980s can be traced back to the "credit boom" in the aftermath of the financial deregulation policy in 1984-85.[6] This boom, together with the oil price shock in 1986 and the subsequent deterioration of the current account, triggered a countercyclical fiscal and monetary

6. For a discussion of the financial deregulation as well as the fiscal and monetary policy that fueled the credit boom in the 1980s, and the subsequent banking crisis, see Steigum (1992).

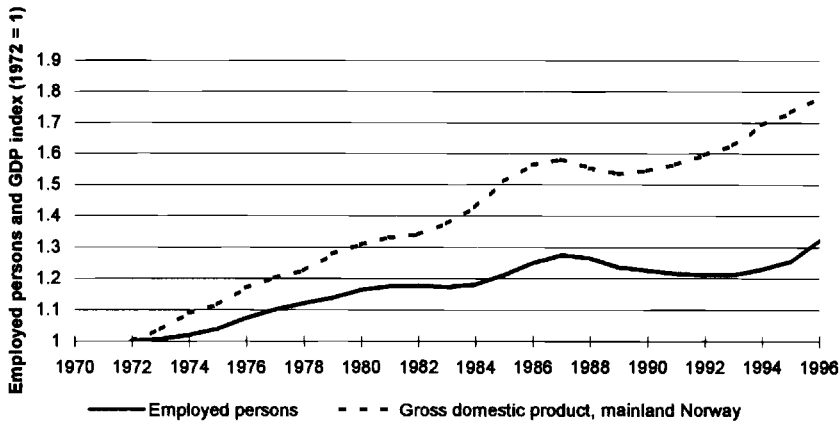

Fig. 16.3 Aggregate employment and GDP for mainland Norway
Note: See appendix table 16B.3 for data.

policy. The credit boom was followed by a quite deep and protracted recession, despite a shift in fiscal policy to boost consumer spending in the beginning of the 1990s. A new business cycle upturn began in 1993, and at present the Norwegian economy is again booming and indeed is running the risk of overheating.

The inflation in the 1970s and 1980s undermined the income tax system and gave rise to large tax wedges in labor and capital markets. In addition to excessive marginal tax rates on labor income, the combination of inflation and unlimited tax deductions of nominal borrowing costs—as well as the government's regulation of nominal interest rates—led to persistently negative after-tax real rates of interest. Marginal tax rates were gradually reduced in the late 1980s, however, and a tax reform was put into effect in 1992. The tax reform broadened the income tax base and reduced the statutory tax rate on nominal capital income to 28 percent, and the maximum marginal tax rate on labor income to 49.5 percent. In addition to its negative effects on economic efficiency and resource allocation, the former tax system also contributed to macroeconomic instability, in particular by excessively stimulating spending financed by credit. Both the volatile petroleum revenues of the government and its countercyclical fiscal policy have contributed to large cycles in the government's budget surplus (see fig. 16.4).

A comparison of figures 16.2 and 16.4 shows quite clearly the influence of the petroleum cash flow on the government's net investment in financial assets. For example, in the period 1981–85 the oil price was very high, leading to a rapid accumulation of government financial assets. When we control for petroleum revenues, however, the government's budget surplus is also very sensitive to the business cycle. During the recessionary period 1988–92, falling tax revenues as well as increased spending on unemployment benefits and labor market

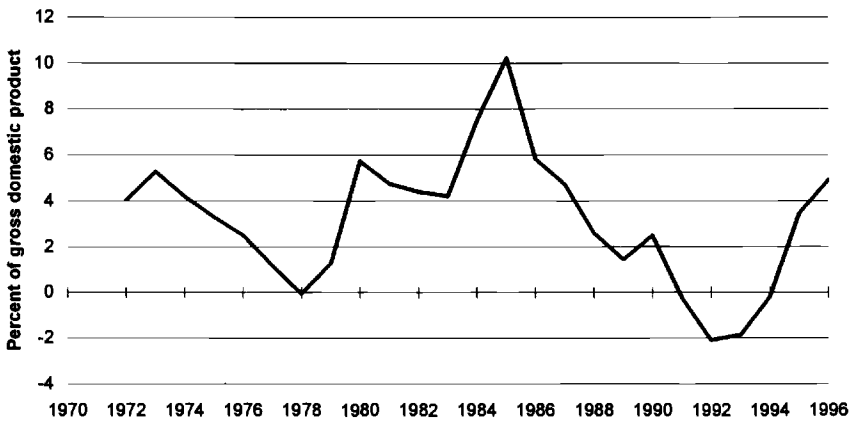

Fig. 16.4 Government net investment in financial assets
Note: See appendix table 16B.4 for data.

programs had a very strong impact on the overall budget balance (see fig. 16.4). Correspondingly, strong employment growth and declining unemployment in recent years have contributed to a remarkable improvement in the budget balance. The surprising cyclical instability of the Norwegian economy during the past 15 to 20 years explains why most of the focus of fiscal policy has been on macroeconomic stability.[7] Still, in recent years there has also been greater awareness of the uncertainties surrounding the government's future petroleum revenues as well as the projected increase in social security pensions and other welfare spending beyond the year 2010, as illustrated in figure 16.2.[8]

16.2.5 The State Petroleum Fund

The large fluctuations in the government's petroleum revenues since the late 1970s have to some extent been absorbed by changes in the government's stock of net financial assets (see figs. 16.2 and 16.4). Still, there has been a growing awareness of the danger that the temporary oil revenues will be spent too quickly. This concern is partly based on previous policy mistakes and partly on the parliamentary situation in Norway, which leads mostly to minority governments. As in most other countries with large public sectors, Norwegian governments are exposed to strong pressure from many influential special interest groups dependent on subsidies, transfers, and other public spending.

As an institutional response to political pressure to spend petroleum revenues quickly, the government established the State Petroleum Fund in 1990.

7. In Norway as in most other small European countries, it is fiscal and not monetary policy that is considered most effective for domestic macroeconomic stabilization. After the financial deregulation, monetary policy in Norway has been geared to stabilization of the exchange rate.

8. This particular illustration first appeared in the government's Long Term Programme in 1993 and has been presented in several national budgets afterward.

Table 16.2 Norway's Demographic Transition

	1995	2015	2050	2100
Population (millions)	4.38	4.78	5.16	5.19
Working age (%)	60.9	61.1	57.4	56.8
Elderly (%)	15.9	17.2	22.2	23.1
Elderly dependency ratio[a] (%)	26	29	40	41

Source: Statistics Norway, *Population Projections 1996–2050: National and Regional Figures*, NOS C H14 (Oslo, 1997), and authors' calculations.

[a]The ratio of those aged 65 or older to those aged 19 to 64.

The goal of the fund is to avoid excessive spending of petroleum revenues and promote a gradual transformation of oil wealth into foreign assets. The fund is likely to make the government's decisions to spend or save petroleum revenues more *visible*. For example, according to the rules of the fund, it is not possible to increase the fund without a budget surplus of the central government. Moreover, future budget deficits will lead to a corresponding decline in the size of the fund. This prevents the creation of an "artificial" fund financed by public borrowing. The year 1995 was the first in which the government ran a budget surplus since the State Petroleum Fund was formally established. Investment in the fund in 1995 was quite small, however; but in 1996 the size of the investment is projected to reach 4.5 percent of GDP. According to the medium-term projection of the government's receipts and expenditures reported in the *National Budget 1997*, the Petroleum Fund will grow rapidly in the rest of the 1990s.

16.3 Data

In this section we revise and update the description of the data sources in Auerbach et al. (1993). More details are given in appendix A. To form generational accounts for current and future generations, we need (1) projections of the population by age and sex, (2) projections of average net taxes for each member of each generation in each year in which as least some of its members will be alive, (3) an estimate of the initial stock of government net wealth, and (4) projections of future government spending on goods and services that are not distributed on age groups.

16.3.1 Population Projection

The projection of population by age and sex from 1995 through 2200 has been provided by Statistics Norway. It builds on recent trends in fertility, mortality, and net immigration. In 1995, Norway's population was 4.38 million, and—as in almost all OECD countries—the population is on average getting older. Table 16.2 shows how this aging process will play out through the next century. The projections assume that the current fertility rate of 1.86 percent

Table 16.3 Public Expenditures and Receipts, 1995 (percent of GDP)

Receipts	
Direct and indirect taxes and social security contributions	42.6
Petroleum taxes	3.0
Indirect taxes, mainland Norway	15.4
Direct taxes and social security contributions, mainland Norway	24.2
Income from capital and wealth	8.6
Total receipts	51.2
Expenditures	
Consumption of goods and services	20.7
Net investment	2.1
Transfers	22.0
Interest payments	2.9
Total expenditures	47.7
Surplus	3.5

Source: National Budget 1997.

will prevail in future years, and that life expectancy at birth will continue to increase, leading to an expected life span of 80 years for males and 84.5 years for females by 2050. The annual net flow of immigrants is assumed to be 7,000 individuals (0.16 percent of total population in 1995). The percentage of Norwegians over age 65 is now 15.9, but by 2050 that figure should hit 22.2. The elderly dependency ratio of 0.26, already quite high, is expected to increase sharply after 2015, reaching 0.40 by the year 2050.

16.3.2 Public Expenditures and Receipts

Our projections of average future taxes and transfers by age and sex begin with the 1995 official totals for all levels of government. Table 16.3 shows the principal components of the Norwegian government's expenditures and receipts in 1995 (both central and local government), based on national accounts definitions. The 1995 budget surplus was positive, 3.5 percent of GDP, after several years of deficits. Looking first at the receipts, we see from table 16.3 that indirect taxes amount to 15.4 percent of GDP. The value-added tax rate is now 23 percent. In addition, there are substantial consumption taxes (excise taxes) on cars, gasoline, alcohol, tobacco, and some other commodities. Excluding petroleum taxes, direct taxes and social security contributions represent 24.2 percent of GDP, most of which are taxes on labor income. Direct taxes on labor income are progressive. Social security contributions are partly a payroll tax and partly a direct tax on labor income. There is full tax deductibility of nominal borrowing costs. Traditionally, households have been heavily indebted. The net tax revenues from capital income have therefore been small and even negative. There is also a progressive wealth tax that may have significant adverse incentive effects on private saving. Property taxes are a minor

item. Because the Norwegian government's wealth is huge, income from capital and wealth is large, 8.6 percent of GDP. This number does not include petroleum taxes, however. On the other hand, interest on the government's debt (2.9 percent of GDP) is not deducted; see the last item under "expenditures." The government in Norway is an important financial intermediary, channeling loans through special government financial institutions, called state banks, funded through government bond issues. The gross debt of the government was 42 percent of GDP in 1995. Still the government has positive net financial assets.

Turning to the government expenditures in table 16.3, we see that transfers total 22.0 percent of GDP. Subsidies, primarily agricultural, represent 4.0 percent. In 1995, public expenditures on social security pensions (old-age and disability pensions) amounted to 8 percent of GDP. Social security spending is expected to grow rapidly in the future (see fig. 16.2). Public consumption represented 20.7 percent of GDP in 1995. About 31 percent of total employment is in the public sector, including education and health care organized by local governments. In 1995, public spending on education and health amounted to 6.6 and 6.4 percent of GDP, respectively. To calculate generational accounts, it is assumed that net per capita general government spending (not distributed on age groups as transfers) keeps in line with the productivity growth rate.

16.3.3 Taxes and Transfers

To construct age profiles, taxes are categorized as value-added taxes (VAT), auto excise and gasoline taxes, as well as alcohol, tobacco, and some other excise taxes (EX), social security contributions (SST), and income taxes (YTX), which also include the wealth tax. In table 16.4, the 1995 per capita value of each category, distributed by sex, are presented.[9] Observe that SST and YTX exclude taxes on pension income paid by retirees. Correspondingly, pensions are defined as after-tax pensions. Military service is mandatory for males in Norway. We have not, however, tried to estimate the implicit tax on males (and the corresponding addition to expenditures on defense).

The two far most important tax categories are YTX and SST. On a per capita basis, each Norwegian pays $3,461 in income and other direct taxes (not counting direct income taxes from pensions) and $3,320 in social security contributions (including payroll taxes). The third largest category is VAT ($2,086). Males pay more direct taxes and social security contributions than females, who generally have lower participation rates, more part-time work, and lower hourly compensation. Also, the progressive nature of direct income taxes con-

9. Two minor simplifications have been done in the accounts since the first report by Auerbach et al. (1993). In the present version we do not estimate separate time profiles for alcohol and tobacco excise taxes or for the wealth tax.

Table 16.4 **Taxes and Transfers and Public Expenditures Related to Age Groups, 1995 (U.S. dollars per capita)**

	Males	Females	Sum
Taxes			
Value-added taxes (VAT)	1,035	1,051	2,086
Auto, gasoline, tobacco, and alcohol taxes (EX)	702	713	1,415
Social security contributions (SST)	2,133	1,187	3,320
Income taxes and other direct taxes (YTX)	2,398	1,063	3,461
Sum taxes	6,268	4,014	10,282
Transfers and Expenditures Related to Age Groups			
Transfers			
Old-age pensions, after direct tax (PEN)	908	1,117	2,025
Disability pensions (DIS)	373	348	721
Sickness allowance (SIK)	256	362	618
Family allowance (FAM)	13	406	419
Unemployment (UNM)	343	230	573
Other social security benefits (OTH)	436	600	1,036
Sum transfers	2,329	3,063	5,392
Expenditures			
Old-age support (OLD)	254	439	693
Health benefits (HOS)	374	581	955
Education (EDU)	1,086	1,105	2,191
Sum expenditures	1,714	2,125	3,839
Sum transfers and expenditures	4,043	5,188	9,231
Net Taxes			
Net taxes	2,225	−1,174	1,051
Net taxes excluding EDU	3,311	−69	3,242

Sources: Various data sources, see appendix A.

Note: The numbers in all three columns are aggregates divided by the entire population (4.38 million).

tributes to the large gender difference in tax payments. Existing data do not permit a distribution of VAT and other indirect taxes by sex. Individual tax payments of VAT and EX for each age cohort are therefore assumed to be the same for males and females.

Due to data limitations, there are tax categories that we have not distributed by age and sex, in particular corporate taxes and VAT paid by firms and the public sector itself. Neither are petroleum taxes and taxes paid by hydroelectric power companies included in table 16.4. This is due to the fact that we capitalize the petroleum and hydroelectric power wealth owned by the government and define these as part of total government wealth (see below). In our calculations of generational accounts, the petroleum and energy taxes referred to above are therefore accounted for by the rate of return on government wealth.

In the Norwegian generational accounts, government expenditures on edu-

cation and some categories of public spending on health and public services to retirees are treated in the same way as transfers to specific age cohorts. Transfer payments distributed by age and sex are categorized as direct old-age-related spending (old-age support, OLD), spending on health benefits that can be traced to age groups (HOS), education (EDU), old-age pensions (PEN; after tax, but including survivors' pensions), disability pensions (DIS), sickness and childbirth benefits (SIK), universal child support (FAM), unemployment benefits and labor market programs (UNM), and other social security benefits (OTH).[10] The per capita values of these categories are also shown in table 16.4. The most important transfer category is PEN, but EDU is very important too. In the generational accounts of some countries, educational spending by the government is not treated as transfers. Since the label of this spending category makes a lot of difference to the accounts, we also present calculations of generational accounts without distributing EDU by age. The other quantitatively important transfer categories are DIS, SIK, FAM, and UNM. The social security system in Norway does not have a general early retirement scheme, and the normal retirement age is 67 years. As a consequence, many individuals above age 60 (particularly males) receive disability pensions and sickness benefits. In addition to unemployment benefits, a substantial part of UNM is spending on labor market programs.

Looking at the distribution of transfers by sex, females have a larger share than males for most categories, the main exception being UNM. Even though the pension scheme is partly earnings related, it gives more transfers to females in the aggregate, due to their longer life expectancy.

Table 16.4 also shows per capita net taxes, which are only \$2,225 for males and −\$1,174 for females, in sum \$1,051. The latter is a very low number compared to the gross per capita taxes in table 16.4, and it illustrates the importance of welfare spending in Norway. The size of the net tax is very sensitive to whether we label public educational spending as transfers or general government spending. In the latter case, the net per capita tax increases to \$3,311 for males and −\$69 for females, in total \$3,242 (see table 16.4).

16.3.4 Government Wealth

Our measure of government net wealth is the sum of four components: (1) petroleum wealth, (2) hydroelectric power wealth, (3) shares and equity capital, and (4) other financial assets (net). Existing data on public wealth are incomplete and generally not based on market values. Our calculations of generational accounts depart from the conventional definition of wealth in the national accounts, primarily because we include natural resource wealth. Since Norway's petroleum wealth is not marked to market, the petroleum wealth estimate is calculated as the present value of expected net future cash flow to the

10. Other social security benefits include among other things rehabilitation benefits and lone parents' allowances.

government.[11] In our estimate, future oil prices have been adjusted for risk. The generational accounts presented in tables 16.5 through 16.9 are based on the petroleum wealth estimate in the *National Budget 1997* (released in October 1996), which was 124 percent of GDP (5 percent real rate of interest). In February 1997 the government's estimate of the future time path of oil production was revised upward to a considerable extent, increasing the former petroleum wealth estimate by 29 percent. We shall return to how the revised petroleum wealth affects our results below.

16.4 Basic Findings and Sensitivity Analysis

16.4.1 Basic Findings

Table 16.5 presents the generational accounts for all present and future generations in 1995 under the base-case assumptions (real rate of interest, 5 percent; productivity growth rate, 1.5 percent). The accounts are the present values of the sum of net taxes over the expected remaining lifetime of each generation, assuming that the fiscal policy rules in 1995 apply to all present generations (the 1995 cohort and all older cohorts). Following the generational accounting methodology explained in Auerbach et al. (1991, 1993), the average (growth-adjusted) account for future generations is calculated as a residual from the intertemporal budget constraint of the government.

Comparing the first and last rows of the last column, we see that future generations face a net lifetime tax burden exceeding the account for newborns in 1995 by about $55,900. It is not meaningful to use the percentage difference as a measure of intergenerational tax burden shifting, however, because the average account for newborns in 1995 is close to zero, only $1,400. The low value of the newborns' account is due to the fact that we distribute government educational spending on age groups. For the 5-year-old cohort, the account is even negative. For older generations in 1995 the accounts become larger, reaching a maximum of about $130,000 for 30-year-olds. The average account turns negative for those who are 50 years old in 1995, hitting a minimum for the 70-year-old generation, amounting to about −$180,000.

The gender difference in table 16.5 is significant. The average accounts for newborn boys and girls in 1995 differ by about $170,000. The maximum difference between males and females occurs for 25-year-olds. Then the average account for males is $248,500 and for females only $1,400. For generations older than 60 years, the difference is much smaller. The gender difference can be understood by looking at the more detailed information presented in table 16.6, which splits the base-case results into components of payments and re-

11. Our method does not deal explicitly with the problem of cash-flow risk, which is substantial in the case of petroleum cash flow. Moreover, since the government is not able to diversify away the risk, the precautionary savings motive could be important for Norwegian fiscal policy. This is not captured by the concept of fiscal balance in the present paper.

Table 16.5 **Accounts for All Present and Future Generations: Base Case (thousands of U.S. dollars)**

Generation's Age in 1995	Males	Females	Weighted Sum
0 (newborns)	64.9	−65.8	1.4
5	66.7	−85.5	−7.5
10	104.9	−80.2	14.7
15	163.6	−53.2	58.4
20	225.3	−16.6	106.3
25	248.5	1.4	127.1
30	244.5	8.0	129.6
35	218.0	9.5	116.2
40	172.3	4.9	90.3
45	97.8	−23.1	38.9
50	13.1	−59.1	−22.3
55	−40.5	−106.0	−73.0
60	−124.5	−145.5	−135.3
65	−156.1	−184.1	−170.6
70	−163.2	−194.0	−179.6
75	−150.9	−184.1	−170.0
80	−131.1	−169.7	−155.1
85	−115.8	−150.9	−139.4
90	−101.0	−130.5	−122.6
95	−82.7	−100.4	−96.7
Future generations (account for newborns in 1996)[a]			57.3

Notes: Only the accounts for one-fifth of the present generations are shown. Government spending on education is distributed on age groups. Productivity growth rate assumed to be 1.5 percent; real rate of return, 5 percent; exchange rate, 6.33 kroner per U.S. dollar.

[a]All future newborn generations have the same growth-adjusted account.

ceipts for males and females. Comparing the upper and lower parts of table 16.6, we see that males pay much more in social security taxes (SST) and direct income taxes (YTX) over their lifetimes than females. This is due to lower labor force participation, lower average working hours, and the lower average hourly wage for women than men. In addition, women receive higher lifetime benefits than men, particularly universal child support (FAM),[12] sickness and childbirth benefits (SIK), and health benefits (HOS). Both the higher health benefits and the higher present values of women's pensions (PEN) are mainly due to women's greater longevity.

Looking more closely at the various transfers from the government, the two

12. For simplicity, universal child support has been included in the accounts of the parents (mostly mothers). We could alternatively have distributed these benefits on their children, in which case the gender difference in the accounts of newborns would have been reduced by approximately $20,000, i.e., about 14 percent. On the other hand, the gender difference would probably have been much larger if the implicit military service tax on males had been accounted for.

Table 16.6 **Composition of Accounts for All Present Generations: Base Case (present value of receipts and payments in thousands of U.S. dollars)**

Generation's Age in 1995	Net Payment	Payment				Receipts								
		VAT	EX	SST	YTX	OLD	HOS	EDU	PEN	DIS	SIK	FAM	UNM	OTH
						Males								
0	64.9	54.7	37.1	82.2	87.1	6.7	14.9	102.7	17.1	12.7	9.2	0.5	15.0	18.0
10	104.9	60.1	40.8	116.3	123.4	9.6	18.1	106.0	24.5	17.2	13.1	0.7	21.2	25.4
20	225.3	64.1	43.5	153.5	164.2	12.4	20.8	31.6	33.4	23.0	17.5	1.0	27.6	32.7
30	244.5	57.7	39.1	158.3	179.8	15.2	22.3	6.7	43.3	28.8	20.6	1.2	21.8	30.7
40	172.3	49.8	33.8	133.1	162.9	19.7	25.1	1.8	63.0	36.1	20.5	0.8	16.0	24.4
50	13.1	39.2	26.6	88.1	116.0	25.7	26.3	0.1	112.4	41.5	18.3	0.2	12.6	19.6
60	−124.5	27.3	18.5	38.3	62.4	34.4	27.0	0	148.0	33.3	9.1	0.1	9.6	9.7
70	−163.2	16.2	11.0	6.1	21.6	45.3	20.8	0	148.7	0.1	0.2	0	0.2	2.7
80	−131.1	8.5	5.8	2.6	8.0	62.4	8.0	0	82.6	0	0	0	0	3.0
90	−101.0	4.4	3.0	1.6	3.2	70.1	4.5	0	38.3	0	0	0	0	0.3
						Females								
0	−65.8	56.0	38.0	50.2	42.8	9.8	23.4	107.3	23.7	12.0	17.0	19.3	10.8	30.3
10	−80.2	62.2	42.2	71.1	60.7	12.8	30.8	112.2	33.9	17.1	24.1	27.4	15.3	42.7
20	−16.6	66.3	45.0	92.7	79.8	16.6	37.1	37.5	44.4	22.8	31.8	36.3	20.1	53.7
30	8.0	59.8	40.6	88.4	80.5	20.6	32.2	10.2	56.5	28.2	26.6	35.0	15.5	36.4
40	4.9	52.1	35.3	72.2	70.1	27.3	29.5	4.1	73.1	34.0	13.7	13.1	10.3	19.8
50	−59.1	41.9	28.4	46.3	48.2	36.4	30.7	0.4	90.9	35.7	10.3	1.3	7.0	11.1
60	−145.5	30.5	20.7	18.8	21.8	49.9	33.6	0	117.6	24.0	3.7	0	3.2	5.4
70	−194.0	19.1	12.9	2.9	5.2	65.3	30.6	0	135.0	0	0	0	0	3.1
80	−169.7	10.3	7.0	1.4	2.0	82.8	17.2	0	86.6	0	0	0	0	3.8
90	−130.5	5.0	3.4	0.8	0.7	81.2	9.2	0	44.4	0	0	0	0	5.8

Notes: Only the accounts for one-tenth of the present generations are shown. Government spending on education is distributed on age groups. Productivity growth rate assumed to be 1.5 percent; real rate of return, 5 percent; exchange rate, 6.33 kroner per U.S. dollar.

most important are education (EDU) for the youngest cohorts and pensions (PEN) for the oldest. Since the average present value of education is more than $100,000 at birth, it makes an enormous difference to the accounts for newborns whether educational spending is treated as a transfer or not. For the old cohorts, various old-age benefits (OLD) supplied by local governments are also very important for the generational accounts in addition to social security pensions.

16.4.2 Sensitivity to Alternative Assumptions

Table 16.7 shows the results of sensitivity tests with respect to the growth and real interest rates. The accounts of present and future generations (represented by newborn cohorts) have been calculated for nine combinations of growth and interest rate assumptions. In panel A of table 16.7, educational spending has been treated as age-specific transfers just as in tables 16.5 and 16.6. In panel B government spending on education is not treated as a transfer but is included in general government spending. It is hard to judge the interest rate sensitivity of intergenerational tax shifting just from the present values themselves. In panel A, for example, the lifetime net tax burdens of both present and future generations decrease when the interest rate increases, and because the former are either very small or negative, it is not meaningful to compute relative differences. For the same reason, it is also difficult to evaluate how the three different assumptions of growth rates affect our results just by looking at panel A of table 16.7. We therefore turn to panel B.

Panel B of table 16.7 reports the results when government spending on education is not treated as age-specific transfers. This change in labeling alters the definition of "net tax" and increases the size of net taxes for all cohorts who receive subsidized education. To explain how this will change the results, observe that if the age-group distribution of the population is stationary, present and future aggregate government spending will not be altered by the new labeling. Therefore, the difference between the accounts of future and present generations will not change as a result of the new labeling of educational spending. In other words, since fiscal policy does not change, the intergenerational tax shifting must be the same. Note, however, that it is the difference in terms of *present values* that will be invariant under a change in how educational spending is labeled. Clearly, the *relative* difference (percentage change) will decrease, since the new definition of net taxes in panel B involves (much) higher present values of lifetime net tax burdens for newborns than under the former (panel A) definition of net taxes. The relabeling explains almost all of the dramatic fall in relative changes when we go from panel A to panel B in table 16.7. For example, in the base case the relative change in the accounts falls from 4,018 percent in panel A to 60.7 percent in panel B.

The distribution of age groups in the Norwegian population is not stationary over time, however. Due to population aging, the relative size of the young age groups will decrease over time. Since the projection of future general govern-

Table 16.7 **Sensitivity to Assumptions about Growth and Interest Rates: Accounts for Newborns in 1995 and Future Generations (thousands of U.S. dollars)**

	$g = 1$			$g = 1.5$			$g = 2$		
	$r = 3$	$r = 5$	$r = 7$	$r = 3$	$r = 5$	$r = 7$	$r = 3$	$r = 5$	$r = 7$
				A. Education Distributed on Age Groups					
Present generations	8.6	−2.5	−13.3	5.3	1.4	−11.2	−5.9	5.1	−8.7
Future generations	125.7	22.1	−40.6	169.9	57.3	−15.7	212.0	94.6	10.6
Difference	117.0	24.6	−27.3	164.6	55.9	−4.5	217.9	89.5	19.3
Percentage change[a]	1,344	–	–	3,082	4,018	–	–	1,717	–
				B. No Distribution of Education on Age Groups					
Present generations	138.3	95.2	61.9	145.2	106.3	69.1	145.1	117.8	77.4
Future generations	270.1	128.8	40.4	327.8	173.5	71.7	381.3	220.3	104.9
Difference	131.7	33.6	−21.5	182.6	67.2	2.5	236.3	102.5	27.5
Percentage change[a]	92.9	34.0	−35.0	121.8	60.7	2.6	156.9	82.9	33.4

Note: g is productivity growth rate (percent); r is real rate of interest (percent). Exchange rate assumed to be 6.33 kroner per U.S. dollar.

[a]Growth adjusted.

ment spending (excluding all age-specific transfers) is linked to the development of the *total* population, the sum of future general spending and transfers will be slightly higher when educational spending is relabeled as general government spending. This small change in future fiscal policy explains why the difference between the accounts of future and present generations is larger in panel B than in panel A of table 16.7 for each of the nine combinations of growth and interest rates. For example, in the base case the difference is $55,900 in panel A and $67,200 in panel B. This difference is due to the fact that projected future government spending is somewhat higher in the latter case.

Returning to the question of interest rate and growth rate sensitivity, we can now look at how the relative change between the accounts of present and future generations varies in the nine cases in table 16.7 (panel B). Clearly, we see that in this sense our results are indeed very sensitive to the choice of an interest rate. For example, the 60.7 percent difference in net lifetime tax burdens between present and future generations in the base case increases to 121.8 percent when the rate of interest is 3 percent instead of 5, and it drops to 2.6 percent when the interest rate is 7 percent. Likewise, if the growth rate is 1 percent instead of 1.5 (and the interest rate is 5 percent), the relative difference in generational accounts drops from 60.7 to 34 percent, and if the growth rate is 2 percent, the relative difference increases to 82.9 percent. An important factor behind the interest rate sensitivity is the large wealth of the Norwegian government. A high real rate of interest implies high capital income to the government, counteracting any shifting of tax burdens from present to future generations. In countries where the government is heavily indebted (e.g., Italy), introducing a higher real rate of interest therefore has the opposite intergenerational effect, increasing the tax burdens of future generations relative to the tax burdens of the present.

The large wealth of the government can also explain the positive relation in table 16.7 between the growth rate and the relative difference between the accounts for future and present generations. For a given real rate of interest, a higher growth rate warrants a permanently higher budget surplus to keep the share of capital income in total government income constant. Of course, changes in growth and interest rates have other effects on intergenerational tax shifting besides those stemming from the large income from government wealth, but due to the size of the latter, it is likely that the changes in capital income have a dominant impact on the sensitivity results reported in table 16.7.

Table 16.8 shows the results of some further sensitivity analysis. The first alternative, in column (2), takes into account the medium-term "technical" projection of government expenditures to 2000 reported in the *National Budget 1997*. The medium-term projection assumes a soft landing of the Norwegian economy from the present boom as well as low growth of government spending to keep wages and prices from accelerating. Government spending on unemployment benefits and labor market programs is assumed to decrease due to

Table 16.8 **Sensitivity to Alternative Assumptions: Accounts for Newborns in 1995 and Future Generations (thousands of U.S. dollars)**

	Base Case (1)	Medium-Term Projection[a] (2)	No Demographic Change (3)	Zero Net Financial Assets (4)	50% Reduction in Petroleum Wealth (5)
Present generations	1.4	7.7	14.3	1.4	1.4
Future generations	57.3	35.1	1.2	66.2	112.4
Difference	55.9	27.4	−13.1	64.8	111.0
Change in spending to equalize burdens (% of GDP)	−1.9	−0.95	+0.5	−2.2	−3.8

Notes: Government spending on education is distributed on age groups. Productivity growth rate assumed to be 1.5 percent; real rate of return, 5 percent; exchange rate, 6.33 kroner per U.S. dollar.

[a]A "technical" projection of the government's budget to 2000, reported in the *National Budget 1997.*

expected lower unemployment. The fiscal policy is therefore tighter than in the base-case calculations, decreasing the accounts for future generations. The difference between the accounts for future and present generations decreases from $55,900 in the base case to $27,400, reducing the necessary spending cut to equalize net lifetime tax burdens from 1.9 percent of GDP in the base case to 0.95 percent.

Column (3) in table 16.8 summarizes the results of a counterfactual experiment in which the future demographic structure is identical to the present structure. This leads to slightly lower accounts for future generations than for present newborns. In this sense, population aging "explains" the entire generational imbalance in the base case. Column (4) looks at what happens if the net financial assets of the government in 1995 are removed from the accounts. The increase in intergenerational tax shifting is $8,900 in terms of increased present value of net lifetime taxes on future generations, requiring a spending cut of 2.2 percent of GDP to equalize the net tax burdens.

Column (5) of table 16.8 summarizes the results when the petroleum wealth of the government is reduced by 50 percent. This is not a very unlikely shock. For example, the oil price shock in the winter of 1985–86 more than halved the petroleum wealth between 1985 and 1986. Table 16.8 shows that the intergenerational impact is huge, increasing the necessary spending cut to equalize burdens from 1.9 percent of GDP in the base case to 3.8 percent of GDP.

In section 16.3 we reported the recent increase in the petroleum wealth estimate due to higher expected oil production in the future. Adopting the new petroleum wealth, the necessary spending cut to equalize the net tax burdens of present and future newborns is reduced from 1.9 to 0.8 percent of GDP.

16.5 The Generational Impact of Alternative Policies

In section 16.4, we showed that a permanent spending cut amounting to 1.9 percent of GDP would restore the generational accounts of newborns and future Norwegians to fiscal balance in the sense that the growth-adjusted present value of net lifetime taxes of future newborns is brought in line with the account of the 1995 newborns in the base case (see table 16.8).[13] In this section, we discuss the effects on present generations of increasing taxes or reducing pensions to restore long-run fiscal balance. The following three alternatives will be considered: (1) an increase in VAT revenues by 1.8 percent of GDP, (2) an increase in direct income tax revenues (YTX) by 1.8 percent of GDP, and (3) a cut in social security pensions (PEN) by 1.3 percent of GDP. Alternative 1 involves an increase in the VAT rate from 23 to 27.6 percent, and alternative 2 corresponds to an increase in direct taxes from 24.1 to 27.9 percent of total wage income. Finally, the reduction in PEN amounts to a cut in after-tax pensions by 24.3 percent. Table 16.9 shows the effects of the three alternative policies.

In the case of increased VAT, we see that an increase of the growth-adjusted account for newborns in 1995 to $18,500 is sufficient to obtain full long-run fiscal balance. Increasing YTX to achieve fiscal balance, involves a slightly lower account for both present and future newborns ($13,700), and reducing PEN leads to an even lower account for present and future newborns ($6,800). Considering how different generations living in 1995 are affected, the cut in pensions has a much larger effect on those over 50 years old than the corresponding increases in VAT and YTX in table 16.9. For a 70-year-old individual in 1995, for example, the present value of net taxes will be $38,000 higher than in the base case, and more than $30,000 higher than under the two alternative policies in table 16.9. This of course benefits the younger generations in 1995 as well as all future generations, if the alternatives are increases in VAT or YTX. Such cuts in current pensions are, however, politically very unlikely. For example, in 1992 the rules of the earnings-related pension system were changed, affecting only pensions far in the future. Taken in isolation, this policy change probably *increased* the imbalance between the net tax burdens of present and future generations. A more likely future reform, however, is to remove some exclusive tax benefits for retired individuals, benefits that were introduced before the social security reform in 1967.

There are also some minor differences between increasing VAT and YTX to achieve fiscal balance. The increase in direct taxes will affect those 15 to 60 years old somewhat more than it will the youngest and oldest age cohorts. In the past it appears to have been easier for Norwegian politicians to increase

13. In the autumn of 1998, the oil price fell to half of its average 1997 level. This new information has not been taken into consideration in tables 16.5 through 16.9.

Table 16.9 **Eliminating the Generational Imbalance: Accounts for All Present and Future Generations (thousands of U.S. dollars)**

Generation's Age in 1995	Base Case	Increasing VAT by 1.8% of GDP	Increasing YTX by 1.8% of GDP	Reducing PEN by 1.3% of GDP
0	1.4	18.5	13.7	6.8
5	−7.5	10.1	6.9	−1.1
10	14.7	33.6	32.2	22.6
15	58.4	78.4	79.0	67.6
20	106.3	126.5	129.4	116.8
25	127.1	146.6	151.6	139.1
30	129.6	147.8	154.4	143.0
35	116.2	133.2	140.2	132.3
40	90.3	106.0	112.4	108.6
45	38.9	53.2	58.3	62.3
50	−22.3	−9.7	−6.7	5.3
55	−73.0	−62.3	−61.3	−43.9
60	−135.3	−126.3	−127.5	−99.5
65	−170.6	−163.6	−166.1	−130.8
70	−179.6	−174.3	−177.4	−141.6
75	−170.0	−165.9	−168.7	−138.8
80	−155.1	−152.1	−154.4	−132.1
85	−139.4	−137.2	−139.0	−123.0
90	−122.6	−121.2	−122.4	−111.1
95	−96.7	−95.7	−96.7	−88.7
Future generations	57.3			

Notes: Government spending on education is distributed on age groups. Productivity growth rate assumed to be 1.5 percent; real rate of return, 5 percent; exchange rate, 6.33 kroner per U.S. dollar.

the VAT rate and other indirect taxes than direct taxes on labor and capital. The VAT rate was increased from 20 to 23 percent in the early 1990s. Norway also has the future option of broadening the VAT base to include services in the same manner as Sweden did some years ago.

It is worth emphasizing that the estimated size of the generational imbalance is much smaller in the present paper than in Auerbach et al. (1993). As we saw in section 16.4 above, it is also very sensitive to the projected real interest rate and the rate of productivity growth.

16.6 Conclusions

As a consequence of the government's large petroleum revenues, as well as of the expected increase in pensions and other welfare spending due to population aging, the government's budget surplus is quite misleading as an indicator of long-run fiscal balance. In a country like Norway, therefore, generational accounting appears to be a particularly useful method to assess the generational impact of current fiscal policy.

Adopting the base-case assumptions, the estimated imbalance in net tax bur-

dens between future generations and present newborns in 1995 is relatively small. For example, a permanent spending cut of 1.9 percent of GDP would be sufficient to restore long-run fiscal balance in the sense that the growth-adjusted present value of net lifetime taxes of future newborns is reduced and brought in line with the account for the 1995 newborns. If we adopt the medium-term projections of public spending and taxes in the *National Budget 1997,* the corresponding spending cut to achieve long-run fiscal balance is reduced to 1 percent of GDP. Also the recent increase in the petroleum wealth estimate reduces the generational imbalance significantly. We considered three different policies that would also restore long-run fiscal balance in the sense explained above. These were an increase in VAT revenues, an increase in direct income taxes, and a cut in pensions. The generational imbalance in 1995 is much smaller than in a previous study based on 1992 data. This is due both to the strong recent business cycle upturn and to a shift to a more austere fiscal policy. Using the most recent information on the government's wealth and its fiscal policy for 1997, there is probably generational balance in 1997.

In addition to the sensitivity to the present business cycle, our results are sensitive to the choice of assumptions about future rates of interest and productivity growth. If the real interest rate is lower than the base-case assumption of 5 percent, the generational imbalance increases. The interest rate sensitivity is mainly a consequence of the large public petroleum wealth, because a higher real rate of interest will increase permanent income. We also looked at the effects of a reduction in petroleum wealth by 50 percent. Adopting the base-case assumptions, such a reduction would increase the necessary spending cut to achieve long-run fiscal balance from 1.9 to 3.8 percent of GDP. The government's considerable exposure to oil price risk therefore represents an additional element of uncertainty in our assessment of the generational impact of current fiscal policy in Norway.

Appendix A
Data Sources

Age Profiles

We distribute the 1995 totals of each tax and transfer by age and sex based on corresponding distributions in cross-sectional survey data. Age and sex profiles for SST, YTX, WTX, PEN, DIS, SIK, FAM, UNM, and OTH are all constructed on the basis of the 1994 Income and Wealth Survey, which contains cross-sectional information on 41,112 individuals (1 percent of the population). Individual tax returns are linked to the data collected by the survey. The estimated age profiles were smoothed, using a seven-period moving average, with weights reflecting the number of observations in each age group.

Due to the future maturing of the old-age pension scheme, the estimated age

profiles from cross-sectional data will drift upward over time. To account for the expected average growth in future per capita old-age pensions, we use estimates provided by the microsimulation model MOSART developed by Statistics Norway.

Our age-sex profile for VAT is estimated from the 1990 Survey of Consumer Expenditures. This is a survey of 1,201 households containing 3,216 individuals. In distributing household consumption, we assumed that each child under age 17 consumed 70 percent of what adults consume. Various excise taxes on gasoline and cars, as well as excises on tobacco, beer, and other alcoholic drinks are aggregated into one single age profile based on the 1990 Survey of Consumer Expenditures, corresponding to EX in table 16.4.

For education (EDU), we adopted coverage rates and costs per student of various educational institutions based on public education statistics. While the age and sex profiles for primary and secondary education are quite accurate, we had to resort to a subjective estimate of profiles for college education.

Due to incomplete and missing data, most public health expenditures are not distributed by age and sex. The OLD category in table 16.4 represents public spending on old-age homes, wards, and dwellings; home nursing and assistance; and other public support to retirees living in their own homes. This profile is based on the MAKKO model.[14] The age profile of public hospital services (HOS) has been constructed using coverage rates and average nursing time data from public hospital statistics.

Government Wealth

The petroleum wealth estimate is calculated as the present value of expected net future cash flow to the government, assuming a given time path of oil prices and field-specific natural gas prices, investment outlays, and production costs, as well as a projection of the future speed of reserve depletion (source: Ministry of Finance). The revenues are both petroleum taxes paid by the oil companies and capital income from the government's ownership of oil and gas fields in the North Sea. Since future oil prices, production costs, reserves, and other factors are highly uncertain, estimates of petroleum wealth are very sensitive to assumptions. When performing sensitivity analyses, the wealth estimate as well as the permanent petroleum income will depend on the chosen real rate of interest.

Hydroelectric power wealth has also been estimated as a present value of a projection of future public revenues from this sector. Due to incomplete data, the estimate is very crude. The estimated value of shares and equity capital owned by the government has been provided by the Ministry of Finance. Another important asset is the public telephone company. Its value is estimated simply on the basis of a crude net cash-flow estimate. We have not attempted to estimate the values of other public enterprises.

14. MAKKO has also been developed by Statistics Norway.

Appendix B

Table 16B.1 Production of Oil and Natural Gas

Year	Production Estimate (million standard m^3 oil equivalents)	Year	Production Estimate (million standard m^3 oil equivalents)	Year	Production Estimate (million standard m^3 oil equivalents)
1972	1.9	1992	153.2	2012	219.9
1973	1.9	1993	160.8	2013	209.4
1974	2.0	1994	180.3	2014	205.2
1975	11.0	1995	193.4	2015	193.9
1976	16.2	1996	222.4	2016	190.7
1977	19.3	1997	238.7	2017	182.2
1978	34.9	1998	260.6	2018	173.9
1979	43.9	1999	272.0	2019	165.9
1980	55.0	2000	279.5	2020	159.1
1981	53.9	2001	292.3	2021	154.0
1982	54.1	2002	287.3	2022	149.2
1983	61.1	2003	281.4	2023	144.7
1984	68.8	2004	260.6	2024	140.5
1985	72.9	2005	247.4	2025	136.5
1986	77.5	2006	242.7	2026	132.9
1987	87.9	2007	241.4	2027	129.4
1988	96.4	2008	239.3	2028	126.2
1989	118.0	2009	236.2	2029	123.2
1990	123.4	2010	233.7	2030	120.4
1991	136.8	2011	223.3		

Note: Numbers after 1995 are projections.

Table 16B.2 Projected Government Net Income from Petroleum Sector and Old-Age and Disability Pensions (percent of GDP)

Year	Government Net Income from Petroleum Sector	Old-age and Disability Pensions
1973	0.1	5.2
1980	5.95	5.57
1991	5.17	7.8
2001	9	8.11
2010	11	9.47
2030	3	14.86

Table 16B.3 Aggregate Employment and GDP for Mainland Norway (1972 = 1)

Year	GDP, Mainland Norway	Employed Persons	Year	GDP, Mainland Norway	Employed Persons
1972	1.00	1.00	1984	1.43	1.18
1973	1.04	1.01	1985	1.51	1.21
1974	1.09	1.02	1986	1.56	1.25
1975	1.12	1.04	1987	1.58	1.27
1976	1.17	1.07	1988	1.55	1.27
1977	1.20	1.10	1989	1.54	1.24
1978	1.23	1.12	1990	1.55	1.23
1979	1.28	1.14	1991	1.57	1.22
1980	1.31	1.16	1992	1.60	1.21
1981	1.33	1.18	1993	1.63	1.21
1982	1.34	1.18	1994	1.69	1.23
1983	1.38	1.17	1995	1.73	1.25

Table 16B.4 Government Net Investment in Financial Assets

Year	Net Investment (% of GDP)	Year	Net Investment (% of GDP)	Year	Net Investment (% of GDP)
1972	4	1981	5	1990	2
1973	5	1982	4	1991	0
1974	4	1983	4	1992	2
1975	3	1984	7	1993	2
1976	3	1985	10	1994	0
1977	1	1986	6	1995	3
1978	0	1987	5	1996	5
1979	1	1988	3		
1980	6	1989	1		

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