Norway: Selected Issues

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NORWAY

Selected Issues

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Approved by the European Department

May 10, 2007

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Overview

The Selected Issues paper accompanying the 2007 Article IV Staff Report covers two topics central to the surveillance of the Norwegian economy at this juncture. The first chapter analyzes prospects for inflation. Although capacity margins have narrowed rapidly in the past three years as a result of strong growth, overall inflation and, especially, core inflation have remained low. A key issue for monetary policy in the Norwegian flexible inflation-targeting framework, therefore, has been judging when and how fast inflation will rise to the 2.5 percent target. The first chapter provides estimates of underlying inflation, using a statistical technique to decompose inflation and a measure of core inflation into "common" and "idiosyncratic" components. It finds that overall inflation is not far from its underlying value, as estimated by the common component, while core inflation is below its underlying value. To the extent that the idiosyncratic component will dissipate, this suggests that core inflation will tend to rise. The second chapter considers medium-term and long-term fiscal policy in light of high oil prices and the prospect of substantial increase in pension outlays. It compares the current fiscal rule—a (central government structural) non-oil deficit equal to 4 percent of the assets of the Government Pension Fund - Global (GPF)—with three alternatives, each of which preserves more assets in the long term to pay for aging costs. It also analyzes the macroeconomic consequences of switching to such a rule, finding that the added revenue from saved petroleum income allows lower tax rates in the future, thereby stimulating long-term potential output.

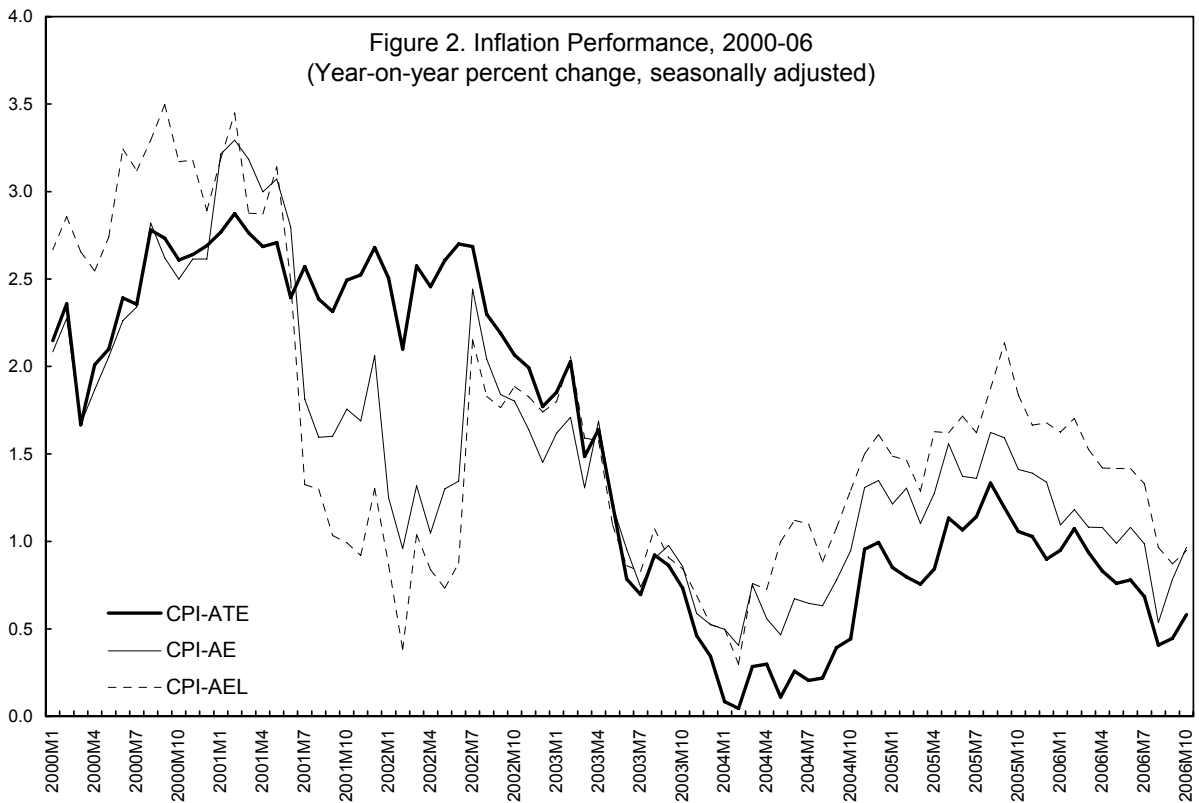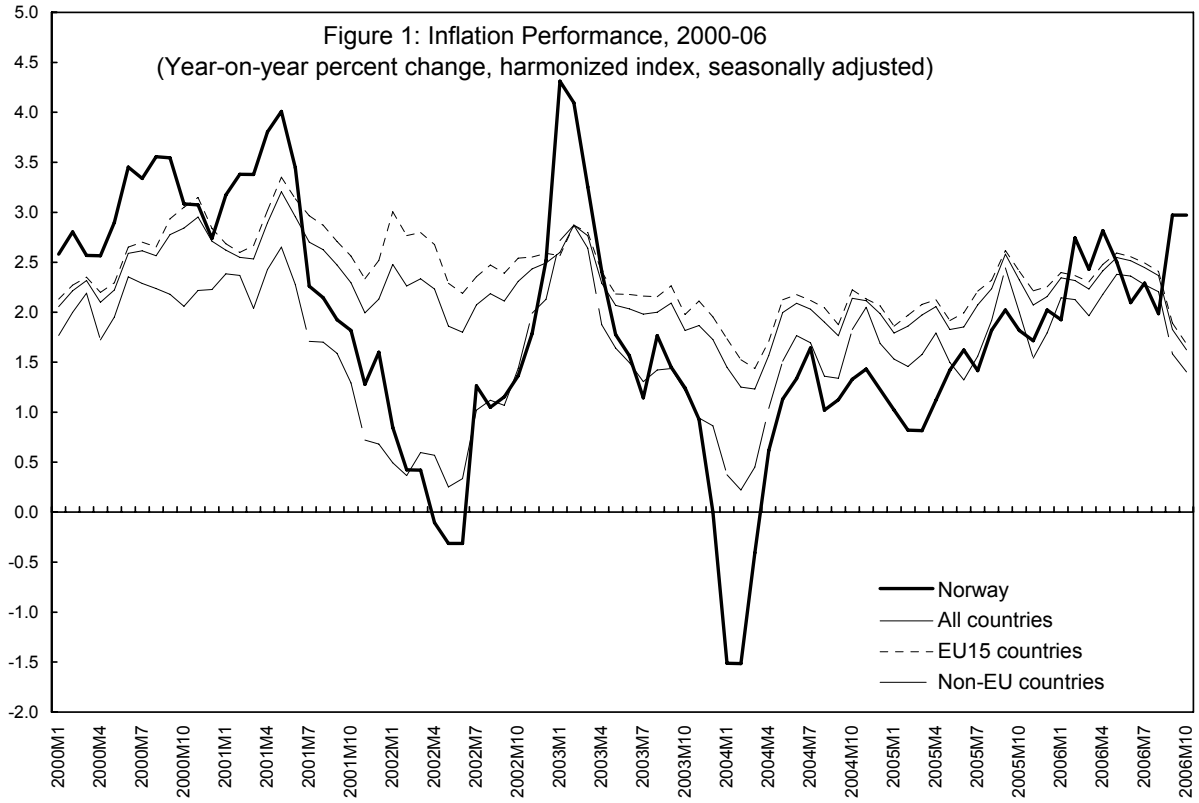# I. CORE AND IDIOSYNCRATIC INFLATION IN NORWAY[1]

A. Introduction

1.   In the past four years, inflation in Norway has been below the average in other countries (Figure 1), although a surge in energy prices has recently pushed it up. However, indicators of underlying (core) inflation continue to show a benign outlook (Figure 2), as both domestic and import prices have risen only modestly. Indeed, core inflation remains below the inflation target of 2½ percent established in 2001.

2.   Although immigrant workers will likely continue to ease labor-market tightness, and, hence, cost pressures, there are signs that the risks of overheating have intensified. In fact, the November 2006 Inflation Report notes that "high capacity utilization, rising wage growth and somewhat slower productivity growth are expected to lead to higher inflation, particularly from the second half of 2007 and into 2008."

3.   The challenge ahead is therefore one of cautiously managing an increase in inflation toward its target while avoiding overshooting and a consequent rise in the policy interest rate. To this end, Norges Bank (NB) would need to gauge underlying inflation pressures.

4.   This chapter focuses on underlying inflation. It looks at inflation and tries to distinguish between shocks that drive the underlying inflation process and are common (correlated) across countries or sectors—although their impact depends on their individual "load" and differences in economic structures and policies—and shocks that impact a single country, which, by definition, are uncorrelated with common factors. Among these idiosyncratic determinants of inflation one could think of specific features of the labor market, degree of competition in product markets, and, of course, specific policy actions such as direct and indirect taxation.

5.   The chapter is organized as follows. Section B briefly presents the data and the generalized dynamic factor model methodology. Section C reviews the results. Section D concludes.

B. Methodology and Data

6.   The analysis in this chapter is based on an application of the generalized dynamic factor model (GDFM) proposed by Forni and others (2000 and 2001). This is a statistical approach that extends principal component analysis and Stock and Watson's (1989) coincident and leading indicator approach. Factor analysis assumes that covariation among time series can be explained by a few unobserved shocks (factors). In factors models, therefore, a large number of covarying series are transformed into a smaller number of unobserved orthogonal series (common components) so as each additional factor

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[1] Prepared by Marco Rossi.

Figure 1: Inflation Performance, 2000-06
(Year-on-year percent change, harmonized index, seasonally adjusted)

Norway
All countries
EU15 countries
Non-EU countries

Figure 2. Inflation Performance, 2000-06
(Year-on-year percent change, seasonally adjusted)

CPI-ATE
CPI-AE
CPI-AEL

(component) explains as much as possible of the remaining variation in the observed series. The basic framework is that of a dynamic factor model in which the assumption of mutually orthogonal idiosyncratic components is relaxed to allow for some mild cross correlation. Each observed series is then represented as the sum of a common component and of a disturbance term (idiosyncratic component), which is uncorrelated with the common component. For each country and each sector, underlying inflation is proxied by the common component, which, although driven by the same factors, can differ across countries and sectors depending on their structure—that is, the impact on inflation depends on the "load" for each factor.

7.   The dataset comprises a panel of 19 countries, and 214 monthly series of CPI indices and their components over the period 1999–06.[2] Factor models can accommodate large panels and overcome the problem inherent in multivariate analysis when the time dimension is smaller than the cross-country dimension. The data set contains seasonally adjusted monthly inflation from January 1999 through October 2006, both for headline CPI inflation and for its components, with over 17000 data points.[3] The sources are the Harmonized Index of Consumer Prices (HICP) and national statistics.

8.   Each of these 214 series, spanning both countries and sectors, is decomposed into a part that is explained by a set of common factors and a residual part that reflects ideosyncratic influences. The first step in the analysis is to determine the number of common factors. A principal component analysis of the spectral density matrices of the

Figure 3. Cumulative Data Variability Explained by the First Ten Common Factors (Percent)

Source: IMF staff estimates.
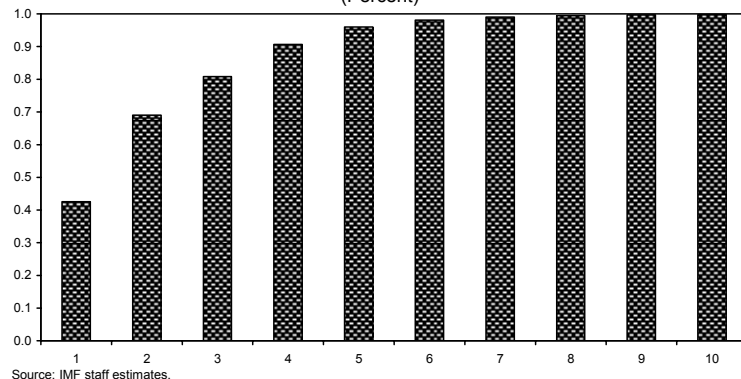
data (Figure 3) shows the share of the cumulative variance (cumulative eigenvalues) of the series that is explained by each successive principal components (eigenvector). Different thresholds can be set to identify the number of common factors (components). Here, this is chosen by stopping at the factor (eigenvalue) that improves upon the explained cumulative data variability by less than 10 percent at all frequencies. This yields three dynamic common components, which explain about 80 percent of the total data variability. From an economic point of view, a possible rationalization of this choice would be to look at the inflation

[2] In addition to Norway, the sample comprises EU15 countries, Canada, Japan, and the U.S.

[3] For Norway, different price indices were included in the data set in addition to the harmonized CPI index: the CPI-ATE, the CPI-AE, the CPI-AEL, and the all-items CPI (1998=100). All originally nonseasonally adjusted series were adjusted using additive Census X12.

process as generated by three underlying forces: demand, supply, and structural variables (although these forces cannot be identified with specific components).

9.   The next step is to determine the number of static factors. The relation among static and common factors, and lags is given by: number of static factors=number of common factors * (1+number of lags).
With 3 common factors and 12 as the number of lags (in light of the monthly frequency), the number of static factors is set at 39.

C. Developments in Underlying Inflation

10.   Figure 4 plots headline CPI explained by the three common factors and the static factors (henceforth, underlying inflation) and actual inflation for Norway. It suggests an increased importance of idiosyncratic factors in explaining the pickup in inflation in 2006, in contrast to what occurred the previous year. A closer look at the components of the CPI index indicates that food, housing, utilities and other fuels, and hotels and restaurants were the sectors that contributed the most to the rise in inflation (Figure 5).

11.   But which sectors are the most likely to experience price pressures looking ahead? (Table 1) reports the difference and ratio between underlying and actual inflation in Norway. While there are no clear signs that headline inflation should dramatically increase (the ratio of underlying to actual inflation is close to one and its average over the sample period), inflation may pick up in those sectors—such as alcoholic beverages and tobacco, clothing and footwear,[4] recreation and communication services, and the miscellaneous category—in which inflationary pressures have mounted as indicated by a ratio above its average and/or above its current level.[5] This would mean that idiosyncratic influences, which have contributed to lower inflation in these sectors, would dissipate, consistent with the view that they affect inflation only in the shorter term.

12.   Relatedly, one can look at measures of core inflation to provide additional insights into the inflation outlook. (Figure 6) decomposes various measures of core inflation into underlying core inflation and, as a residual, idiosyncratic core inflation. Although some of the items that are excluded from these measures of core inflation were responsible for the pickup in inflation in 2006, the results of this exercise suggest that underlying inflation is stronger than indicated by actual core inflation, and not as far below NB's target. As mentioned above, some items that are included in the various indices of core inflation that NB uses show mounting inflationary pressures.

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[4] The average ratio for this item of the CPI index would be 0.98 if 2001 were dropped.

[5] The impact on headline inflation will, of course, depend on the specific weight each item has in the CPI index.

Figure 4. Norway: Common and Actual Headline Inflation, 2000-06
(Year-on-year percent change, seasonally adjusted)
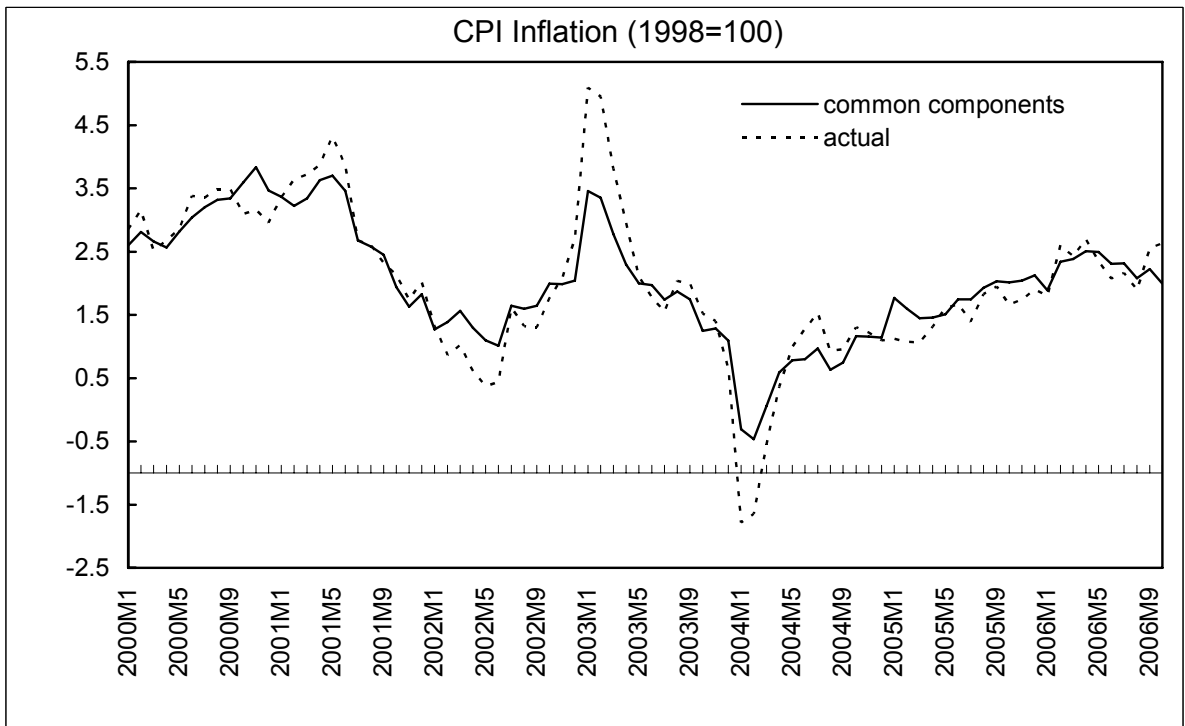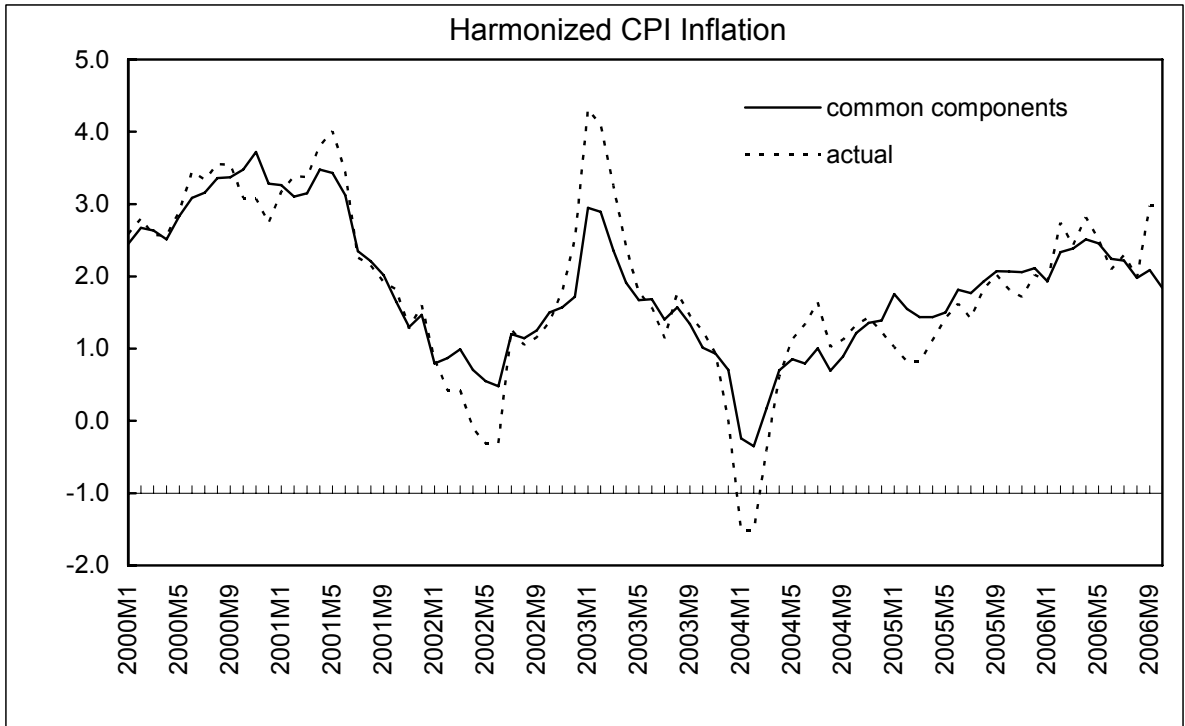
Sources: Eurostat; National authorities; and IMF staff estimates.

Figure 5. Norway: Common and Actual Inflation by Sector, 2000-06
(Year-on-year percent change, seasonally adjusted)
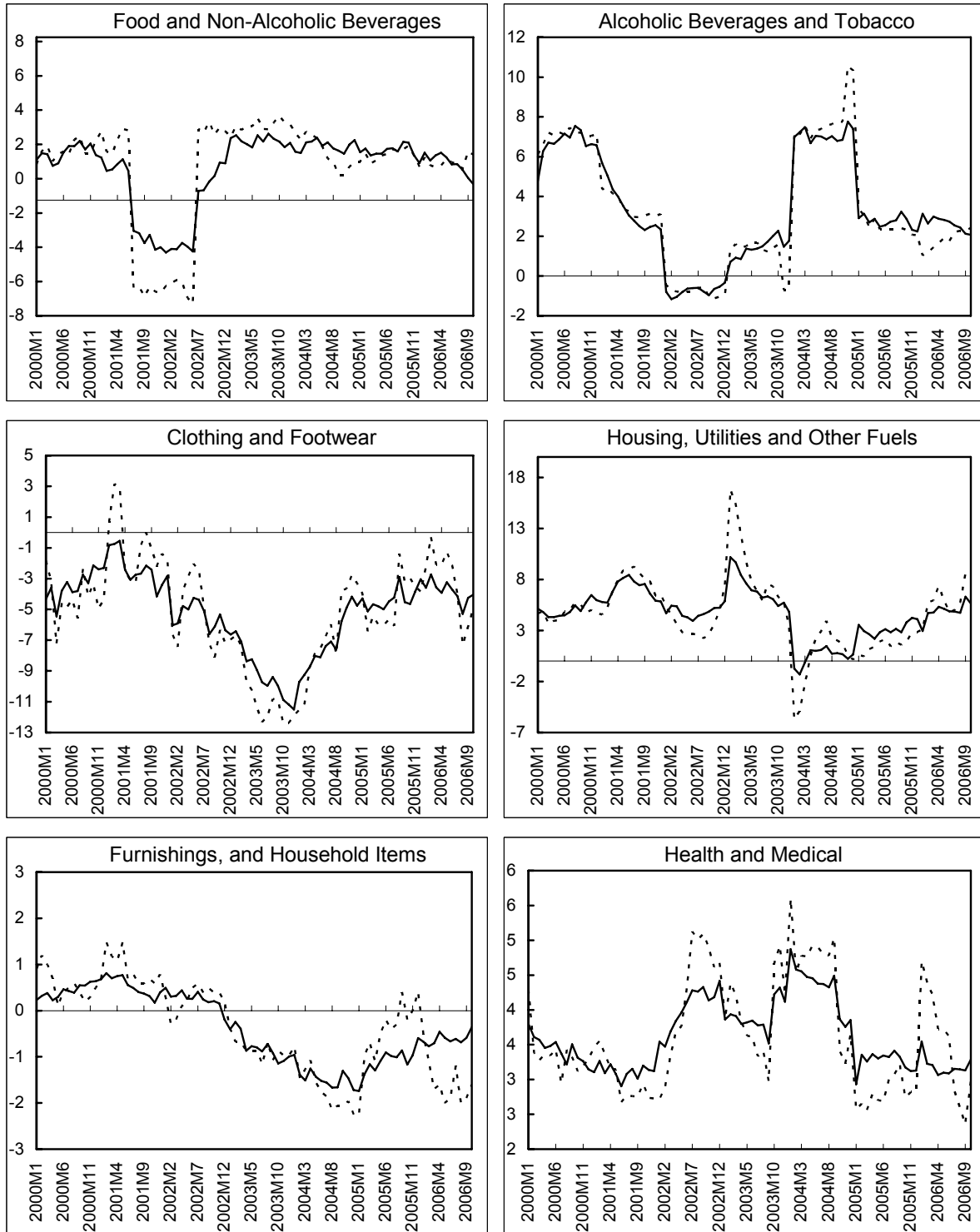
Sources: National authorities; and IMF staff estimates.
_____ common components
………………… actual

Figure 5 (continued). Norway: Common and Actual Inflation by Sector, 2000-06
(Year-on-year percent change, seasonally adjusted)

Sources: National authorities; and IMF staff estimates.
_____ common components
………………… actual

Table 1. Norway: Difference Between Underlying and Actual Inflation, 2000-06

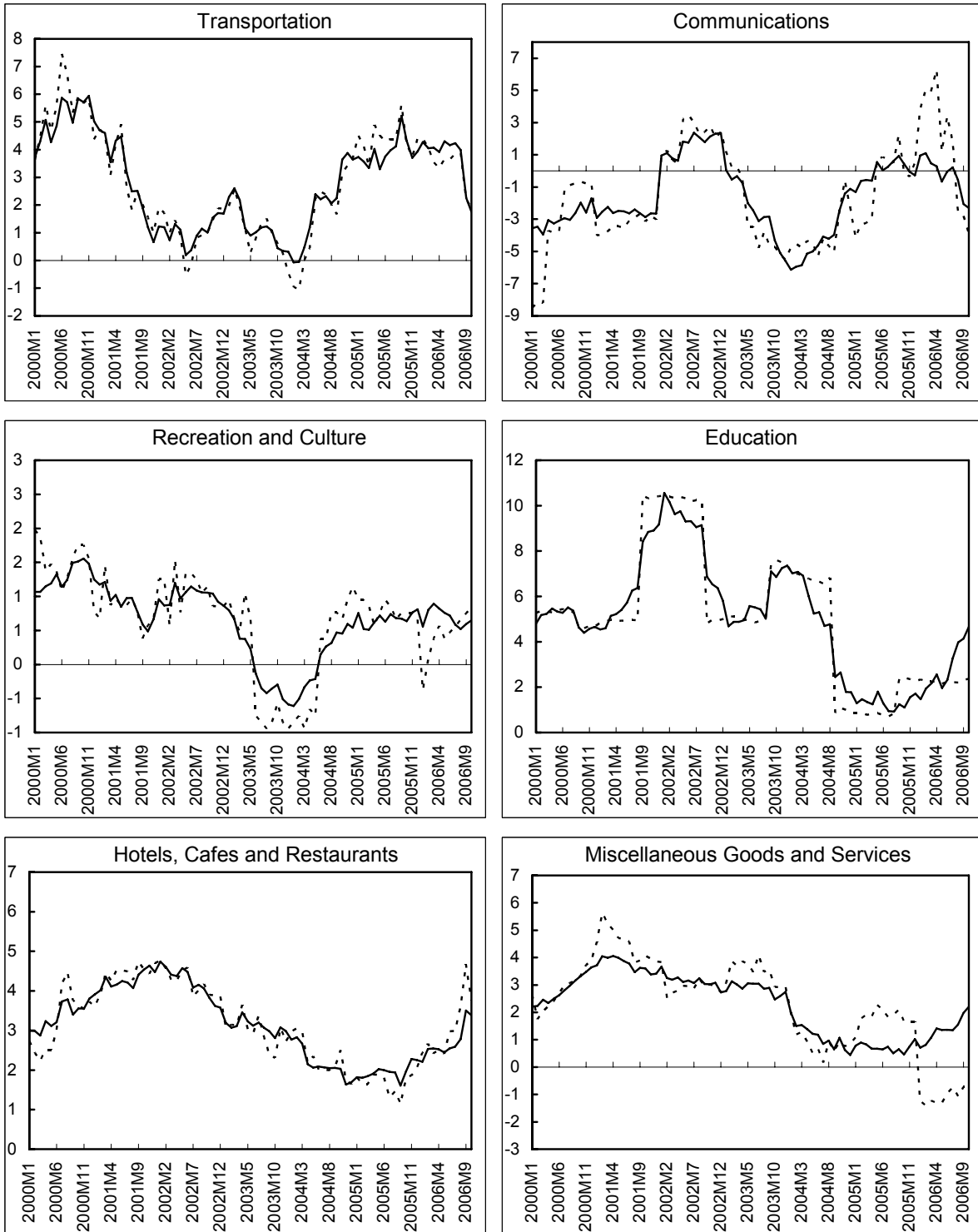|	2000	2001	2002	2003	2004	2005	2006	Average over sample period
	(Percent, differences in yearly averages)							
Headline CPI Index	0.02	-0.20	0.26	-0.42	0.13	0.26	-0.06	0.00
Components								
Food and Nonalcoholic Beverages	-0.11	0.72	-0.22	-0.87	0.34	0.25	-0.13	0.00
Alcoholic Beverages and Tobacco	-0.37	-0.10	0.05	0.33	-0.83	0.24	0.82	0.02
Clothing and Footwear	0.82	-1.55	-0.04	1.38	-0.37	0.26	-0.59	-0.01
Housing, Water, Electricity, Gas & Other Fuels	0.35	-0.44	1.11	-1.73	0.17	1.51	-1.15	-0.03
Furnishings, HH Equipment and Routine Maintenance	-0.14	-0.35	0.00	0.07	0.24	-0.61	0.94	0.02
Health and Medical	0.07	0.11	-0.16	-0.01	-0.20	0.45	-0.32	-0.01
Transportation	-0.33	-0.01	0.06	0.15	0.37	-0.45	0.26	0.01
Communications	0.50	0.72	-0.40	0.38	-0.21	0.67	-1.99	-0.05
Recreation and Culture	-0.20	0.02	-0.06	0.15	-0.02	-0.12	0.26	0.01
Education	-0.07	-0.20	0.02	-0.04	-0.21	0.00	0.59	0.01
Hotels, Cafes and Restaurants	0.12	-0.11	-0.01	0.14	-0.12	0.26	-0.34	-0.01
Miscellaneous Goods and Services	-0.02	-0.76	0.19	-0.60	0.23	-1.10	2.45	0.06
	(Percent, ratios of yearly averages)							
Headline CPI Index	1.01	0.93	1.20	0.83	1.28	1.17	0.97	1.06
Components								
Food and Nonalcoholic Beverages	0.94	0.61	1.14	0.74	1.19	1.16	0.89	0.95
Alcoholic Beverages and Tobacco	0.95	0.97	0.93	1.29	0.89	1.10	1.45	1.08
Clothing and Footwear	0.81	3.00	1.01	0.87	1.06	0.94	1.18	1.27
Housing, Water, Electricity, Gas & Other Fuels	1.07	0.94	1.30	0.80	1.59	1.90	0.81	1.20
Furnishings, HH Equipment and Routine Maintenance	0.76	0.60	1.02	0.91	0.86	2.25	0.39	0.97
Health and Medical	1.02	1.04	0.96	1.00	0.96	1.16	0.91	1.01
Transportation	0.94	1.00	1.05	1.14	1.23	0.90	1.08	1.05
Communications	0.85	0.78	0.81	0.87	1.05	0.08	-0.15	0.61
Recreation and Culture	0.87	1.03	0.95	0.11	0.81	0.85	1.60	0.89
Education	0.99	0.97	1.00	0.99	0.96	1.00	1.26	1.03
Hotels, Cafes and Restaurants	1.04	0.98	1.00	1.05	0.95	1.15	0.89	1.01
Miscellaneous Goods and Services	0.99	0.83	1.07	0.83	1.25	0.40	-1.28	0.58

Source: National authorities; Eurostat; and IMF staff calculations.

Figure 6. Norway: Core Inflation, 2000-06
(Year-on-year percent change, seasonally adjusted)

CPI-ATE

CPI-AE

CPI-AEL
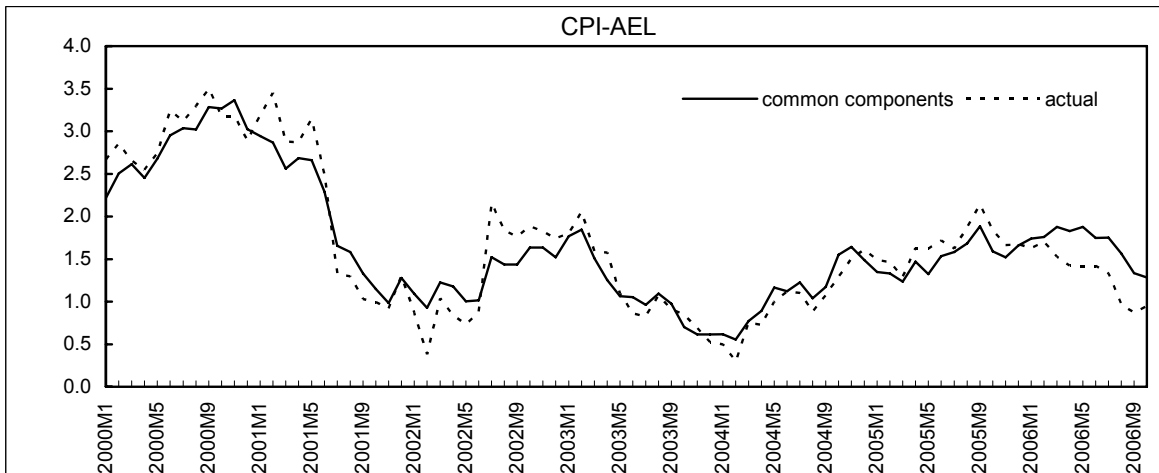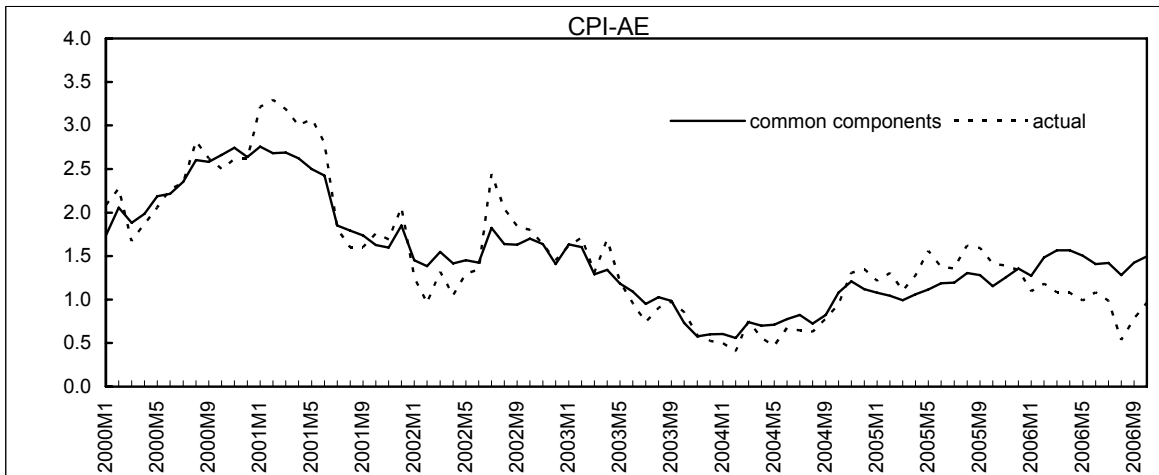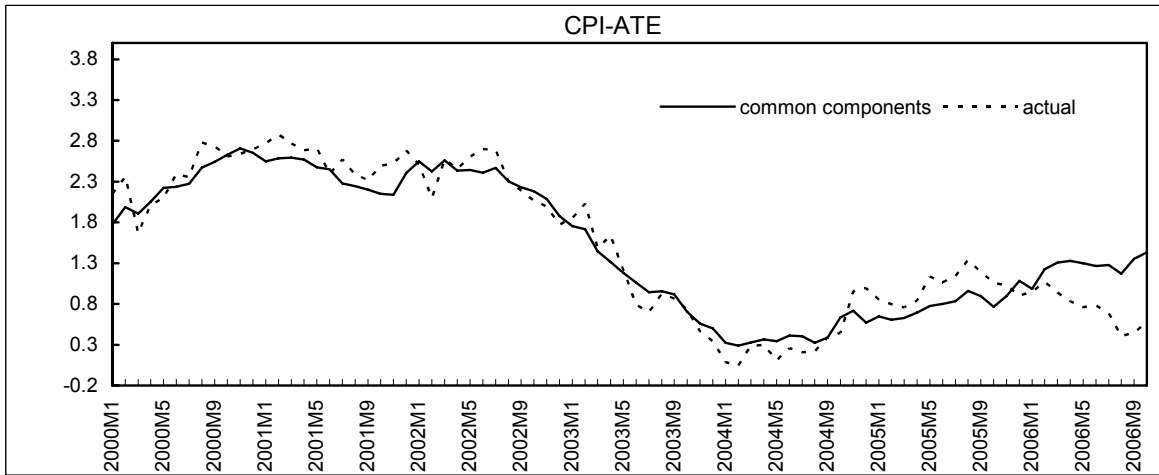
Sources: National authorities; and IMF staff estimates.

13.   A cross-country analysis reveals that underlying inflation in Norway explains
somewhat less than the average 65 percent of the variability of actual inflation for the whole
panel (Table 2). Variation across countries indicates that idiosyncratic shocks can have
substantial impact on local inflation developments. Figure 7 shows that, compared to
Norway, EU15 countries as a group appear to face stronger underlying inflationary pressures.
Finally, Figure 8 plots openness—proxied by the ratio of trade in goods and services to
GDP—against the share of total variability accounted for by the underlying component of
inflation, providing some evidence that the explanatory power of underlying inflation would
increase with country's openness.

Table 2. Inflation Variance

	Common components	Actual	Common components' share of actual inflation
	(Percent)		
Norway	0.9	1.4	59
Austria	0.1	0.2	40
Belgium	0.3	0.5	58
Denmark	0.3	0.4	71
Finland	0.9	1.1	84
France	0.1	0.1	42
Germany	0.1	0.3	39
Greece	0.1	0.2	43
Ireland	1.1	1.4	76
Italy	0.0	0.1	38
Luxembourg	0.7	0.9	75
Netherlands	1.3	1.8	73
Portugal	0.4	0.8	51
Spain	0.1	0.3	54
Sweden	0.3	0.6	57
Canada	0.3	0.7	48
Japan	0.1	0.2	53
U.K.	0.1	0.3	55
U.S.	0.6	0.7	80
Sample average	0.4	0.6	65

Sources: Eurostat; National authorities; and IMF staff calculations.

Figure 7. Common and Actual Headline Inflation, 2000-06
(Year-on-year percent change, harmonized index, seasonally adjusted)
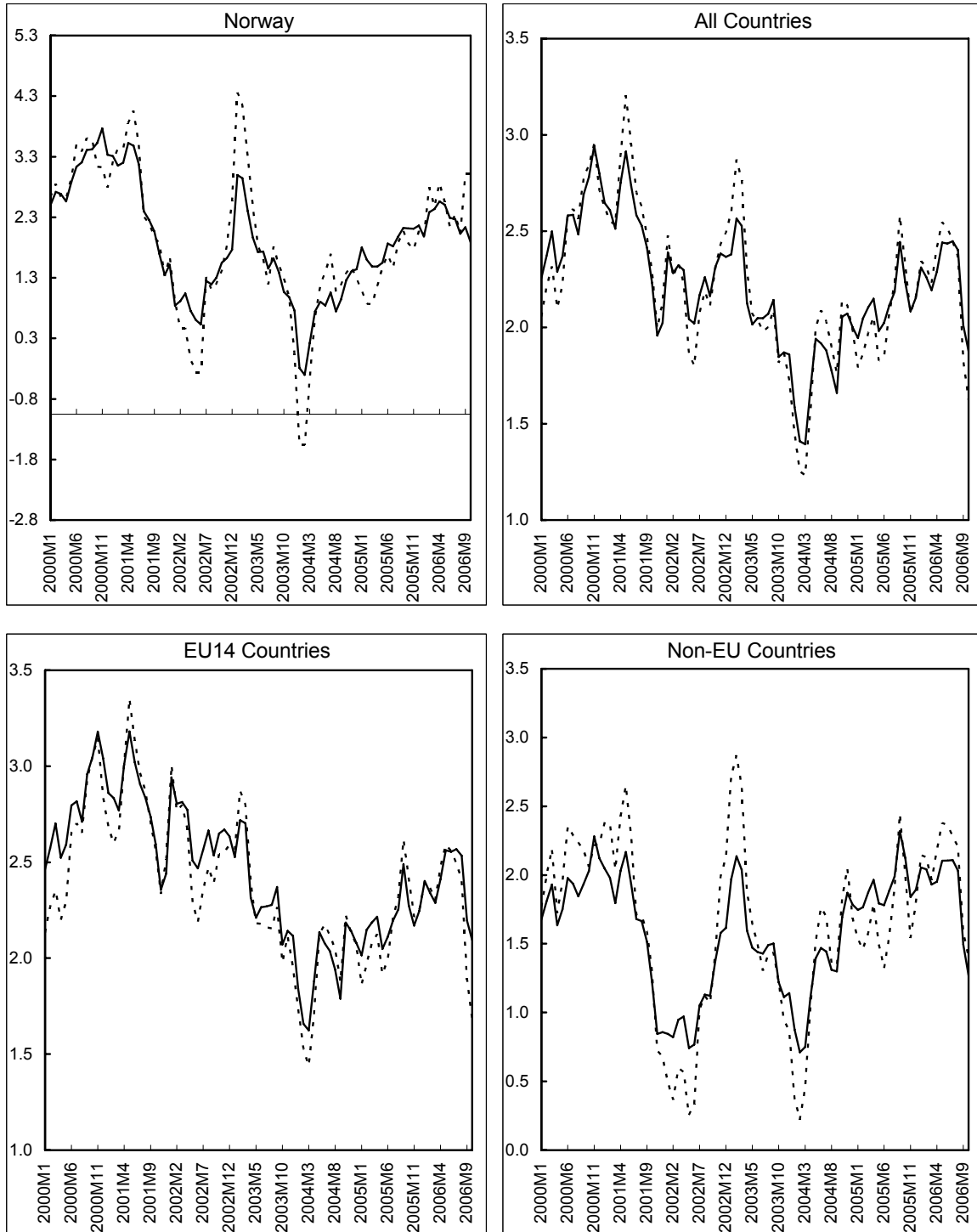

Sources: National authorities; and IMF staff estimates.
_____ common components
.... actual

Figure 8. Explanatory Power of Common Inflation and Openness
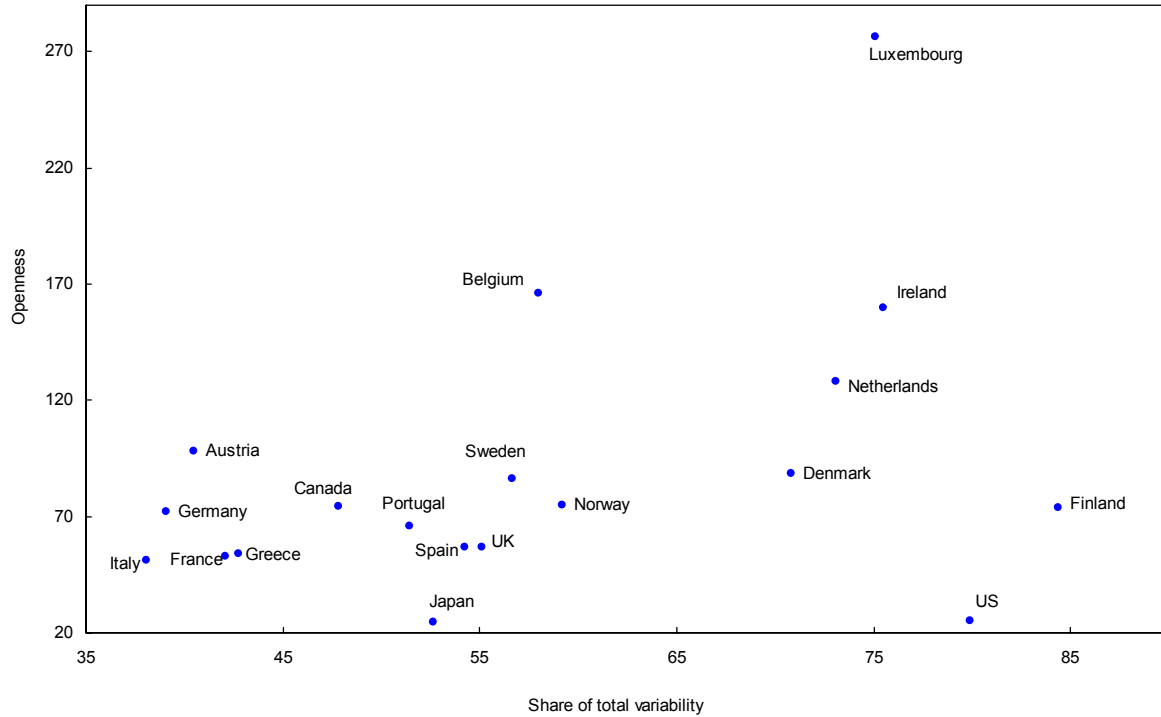
D. Conclusion

14.   "With the substantial number of businesses now facing capacity constraints, we can expect inflation to pick up. It is uncertain whether inflation will then rise quickly or only gradually near target."[6] The analysis of common and idiosyncratic components of inflation in this chapter confirms that inflationary pressures in Norway mounted in 2006. In fact, a comparison among underlying inflation, as defined in this chapter, and various measures of core inflation (CPI-ATE, CPI-AE, CPI-AEL) suggests that the rise in inflation may gain momentum, pointing to the need for additional caution in conducting monetary policy.

15.   The common component of inflation derived in this chapter is one possible measure of underlying inflation. A comparison with other measures of underlying inflation such as core inflation, the truncated mean, and the median, particularly with regard to their predictive power, would offer additional insights into the potential developments of inflationary pressures in Norway.

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[6] From the address by Governor Gjedrem at the meeting of the Supervisory Council of Norges Bank on Thursday,15 February, 2007.

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Forni, M., M. Hallin, M. Lippi, and L. Reichlin, 2000, "The Generalized Factor Model: Identification and Estimation," *Review of Economics and Statistics*, Vol. 82, No. 4, pp. 540–54.

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II. ALTERNATIVE FISCAL RULES FOR NORWAY[7]

A. Introduction

1.   Norway's fiscal position is enviable. Its large oil and gas revenues, as well as the policy of saving these revenues and investing them abroad through the Government Pension Fund - Global (GPF), have allowed Norway to run large budget surpluses and amass large net government assets. For example, in 2006, the budget surplus of the general government was estimated at 25.9 percent of its GDP.[8] At the end of 2006, net assets of the general government equaled 150.2 percent of GDP. Although the government's net cash flows from petroleum operations are expected to gradually decline, Norway is expected to run large fiscal surpluses for many years to come.

2.   However, Norway faces significant challenges in managing its oil wealth. Spending it, even on investment projects, would risk succumbing to the "Dutch disease," in which the traded goods sector is damaged by a high real exchange rate. Since 2001, fiscal policy and the disposition of the oil wealth has been governed by fiscal guidelines, including a rule that central government non-oil structural deficit should be 4 percent of the assets of the GPF, the assets of which are invested abroad (Box 1).[9] While this policy has so far been effective in limiting Dutch disease effects and insulating the budget from changes in petroleum prices and extraction rates (Jafarov and Moriyama, 2005), the rule implies an expansionary fiscal policy in the near term, as the GPF grows much faster than GDP.

3.   Moreover, in the longer term, Norway faces a significant fiscal challenge related to aging of its population. By 2050, Norway's population is expected to be considerably older, with the old-age dependency ratio projected to increase by more than 80 percent. Equivalently, the number of people of working age per person over the age of 65 is expected to decline from 4.4 in 2005 to 2.4 in 2050. According to projections in Norway's 2007 budget, old-age pension spending in percent of GDP will rise by about 10 percentage points over 2005–2050, more than in almost any other advanced economy, reflecting a system that is both generous and maturing. In addition, aging could cause additional spending on health and long-term care of 3.2 percent of GDP (OECD, 2003). Increased participation in the welfare programs also threatens fiscal sustainability.

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[7] Prepared by Etibar Jafarov (EUR) and Daniel Leigh (FAD).

[8] Unless otherwise specified, GDP in this paper refers to mainland GDP, which is all domestic production except from exploration of crude oil and natural gas, services activities incidental to oil and gas, and transport via pipelines; and ocean transport.

[9] Norway has been one of the first oil-producing countries measuring its fiscal policy stance based on non-oil budget balances. See Barnett and Ossowski (2003) on why this approach is more appropriate for countries with exhaustible resources.

Box 1. The Government Pension Fund – Global and Fiscal Guidelines

To manage Norway's oil wealth, the Norwegian authorities established the Government Petroleum Fund (since 2006, called the Government Pension Fund - Global; GPF) in 1990, and adopted fiscal guidelines in 2001 (effective for the 2002 budget). The GPF, which is formally a government account at Norges Bank, receives most of the petroleum revenue and invests it in financial assets abroad. Within the fiscal guidelines, the key rule sets the non-oil structural budget deficit of the central government to the long-run real return on the GPF, assumed to be 4 percent. The guidelines allow temporary deviations from the 4-percent rule over the business cycle and in the event of extraordinary changes in the value of the GPF. The GPF and fiscal guidelines were meant to serve a number of purposes: insulate the budget from changes in petroleum income; preserve assets for use by future generations; and avoid the potential crowding out effects (so-called Dutch disease effects) that rapid spending of oil wealth might bring (Skancke, 2003).

No transfers to the GPF took place until 1995 because of low net oil income and large oil-related investments. Since then, however, assets of the GPF increased rapidly, as both production and the price of oil picked up while the government's oil-related investments declined. At end–2006, the market value of the GPF was estimated at Nkr1,784 billion or about 114.1 percent of GDP. The 2007 budget projects that the market value of the fund will reach about 170 percent of GDP in 2009.

GPF Assets
(In percent of GDP)
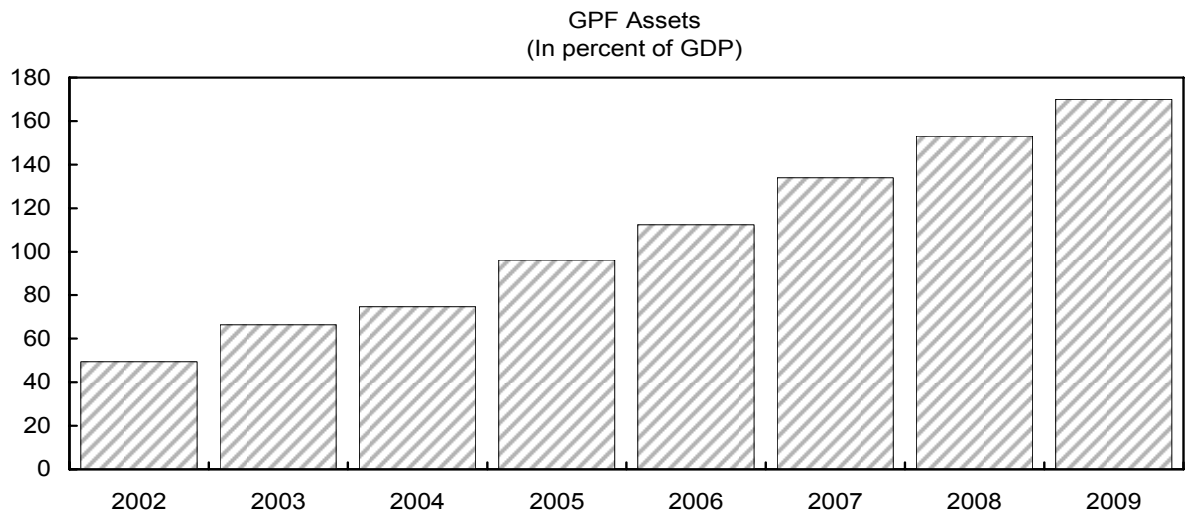
Sources: Ministry of Finance, 2007 budget; and IMF staff estimates.

The 4-percent rule has been breached every year since its inception, although the deviations from the rule have become smaller. The deviations from the rule in 2002–03, when the size of the GPF shrank because of sharp declines in stock markets and the economy experienced a downturn, could be justified under the fiscal guidelines. However, there was no justification for the deviations in 2004–06, a period of economic boom. The 2007 budget projects the relevant deficit to be very close to the level implied by the 4-percent rule.

4.   In light of these fiscal pressures, this paper assesses the fiscal rule in terms of its medium-term macroeconomic impact and the long-run sustainability of Norway's public finances. Oil prices are now much higher than had been envisaged when the fiscal rule was adopted. If sustained, this implies a larger fiscal expansion in the medium term than anticipated. At the same time, oil wealth accumulated under the 4-percent rule is not likely to be sufficient to cover aging costs over the longer term. Accordingly, the paper analyzes several reform measures, including alternative fiscal rules, that could help resolve these issues, in part by using the IMF's Global Integrated Monetary Fiscal Model (GIMF) to evaluate the macroeconomic effects of these measures.

5.   Two principal conclusions emerge from the analysis. First, no rule examined here dominates the others. Rather, each involves trade-offs in terms of long-term fiscal sustainability, short-term expansionary impulses, intergenerational wealth transfers, and long-term output gains. Thus, while Norway's oil wealth is unlikely to be large enough to cover the projected increase in old-age pensions of about 10 percent of GDP under any reasonable rule, alternative rules would require less fiscal consolidation than the 4-percent rule in the long term. Likewise, alternative rules could also yield a less expansionary fiscal stance than the 4-percent rule in the medium term. Second, analysis using GIMF suggests substantial long-run supply-side output gains associated with adopting an alternative rule that stabilizes the GPF as a share of GDP and saves significantly more oil revenue for future generations. These output gains accrue principally because the alternative rule permits lower taxes in the long run, which stimulates labor supply.

6.   The rest of the chapter is organized as follows. Section B presents long-run projections for Norway's oil revenues, and compares Norway's age-related spending pressures with those of other advanced industrial countries. Section C assesses fiscal sustainability under the existing 4-percent fiscal rule. Section D assesses fiscal sustainability under the three alternative fiscal rules, while undertaking a number of sensitivity tests. Section E assesses the macroeconomic consequences of adopting the alternative rules using GIMF. Section F concludes by summarizing the policy implications of the analysis.

B. Declining Oil Revenue and Age-Related Spending Pressures

7.   Norway's petroleum reserves and production are significant. The country started oil production in the North Sea in 1971, but petroleum operations did not create cash flows to the state until 1975. Norway is now the eighth largest producer of oil worldwide and the third largest exporter. Although oil production has recently started declining, rising gas production has offset this; currently, Norway is the third largest exporter of gas (Figure 1). The production of oil and gas (together) is expected to peak in 2008 and gradually decline thereafter, halving by 2030 (Figure 2).[10]

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[10] Hereafter, oil and gas revenues/production will be called oil revenues/production.

Figure 1. Norway: Production, Exports, and Reserves of Gas and Oil

Norway: Oil Production

Norway: Gas Production

Oil Reserves
(In percent of world reserves)

Gas Reserves
(In percent of world reserves)

Oil Exporters
(Million barrels per day)

Gas Exporters
(Billion cubic meters)
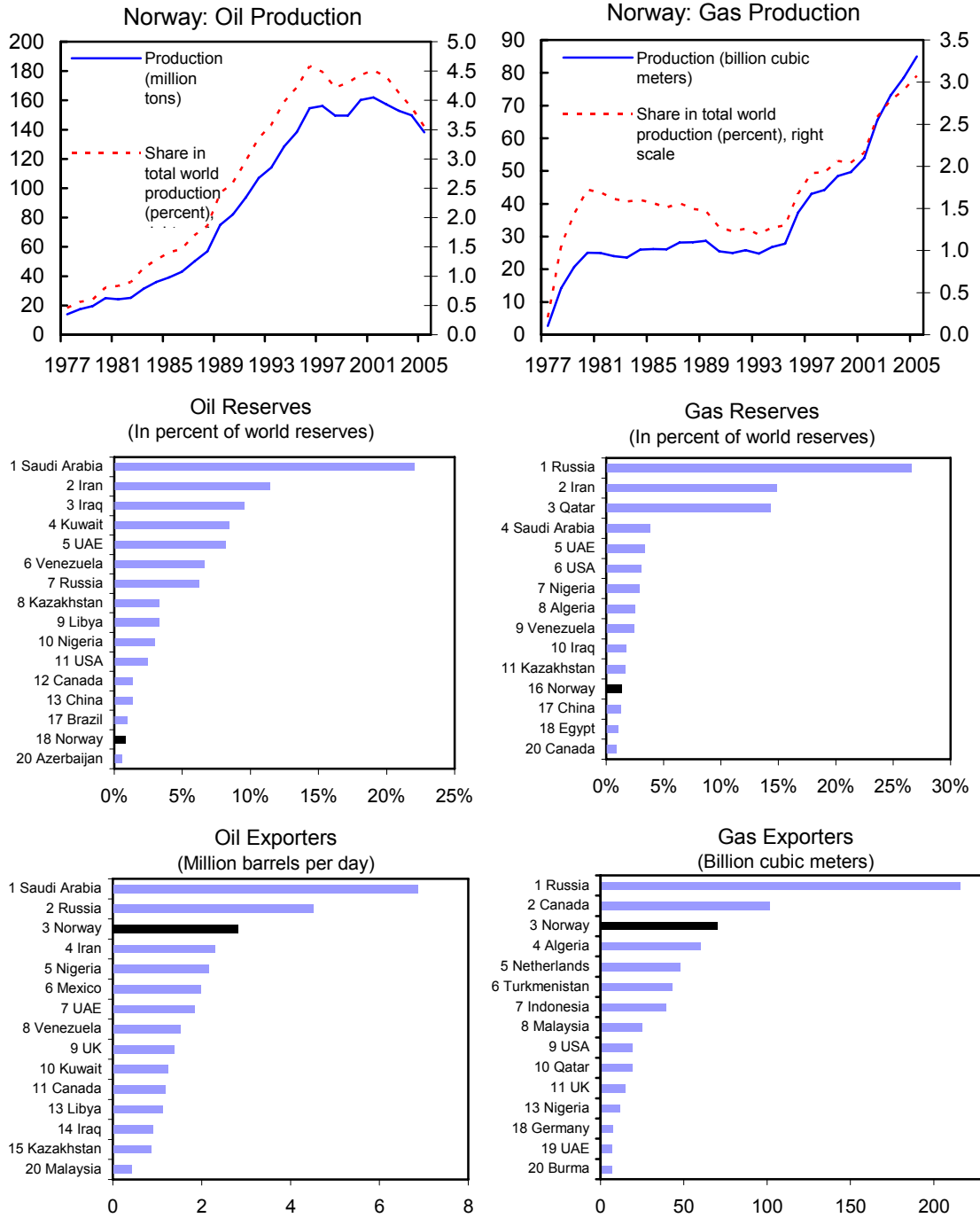
Sources: BP Statistical Review of World Energy June 2006; International Energy Annual, 2004; and Energy Information Administration (USA).

Figure 2. Norway: Oil Production and the General Government's Oil Revenues, 1995-2030

Oil Production (Mill. Sm^3)

Crude Oil Price (in 2007 prices)

Net Government Cash Flows From Petroleum Activities (in billions of 2007 kroner)
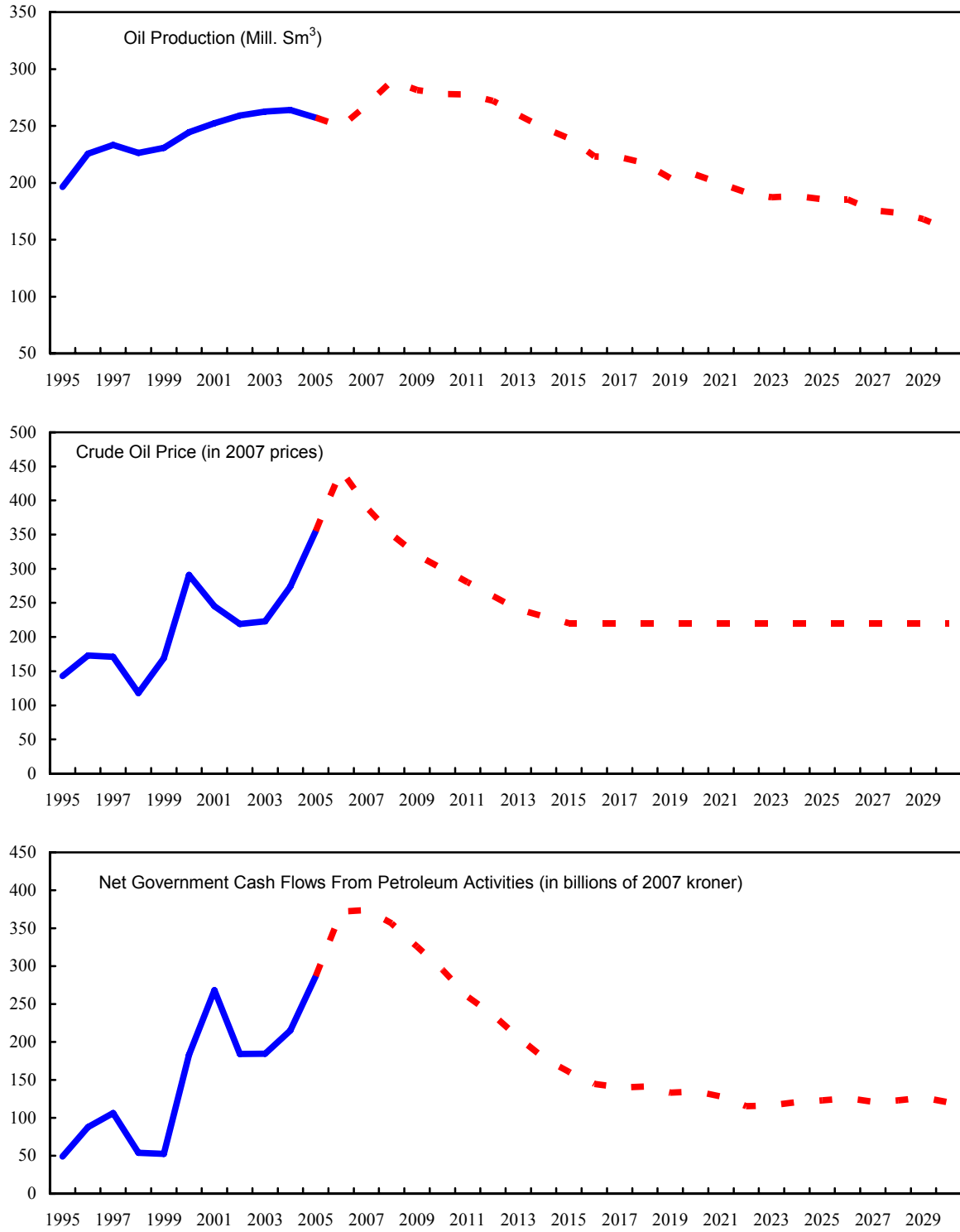
Source: Ministry of Finance, 2007 budget.

8. Reflecting increasing oil production and high oil prices, the Norwegian government's revenues from petroleum operations have surged.[11] For example, in 2000-06, on average, oil revenue was about 18.1 percent of GDP. As a result, the general government budget surplus (including the return on the GPF) averaged to 17.2 percent, whereas the non-oil budget (excluding the return on the GPF) was in deficit of 2.8 percent of GDP. In the 2007 budget, revenues from petroleum activities are expected to be about 23.1 percent of GDP, and the general government budget surplus is projected at 24.7 percent. However, Norway's oil revenues are expected to decline over time (Figure 2).

9. The 4-percent rule, together with high oil prices, implies a rapid increase in the non-oil primary deficit (NOPD) in the next few years. With a growing GPF, the 4-percent rule always meant some structural expansion, but fiscal impulses were expected to be small when the rule was introduced. For example, the 2001 budget projections for 2008–10, which assumed oil prices of Nkr185, implied an increase in the non-oil bud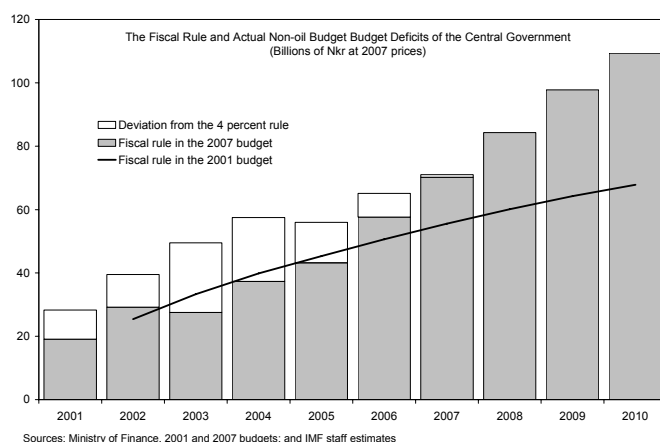get deficit of the central government of ¼ percent each year. However, the 2007 budget, which assumes oil prices of Nkr323-357 implies that the deficit will increase by some ¾ percent of GDP each year in the same period (Table 1). If this expansion were implemented through higher spending, real spending of the central government could rise by more than 4 percent a year. For comparison, the 2007 budget projects a 2¾ percent increase in real spending.

The Fiscal Rule and Actual Non-oil Budget Budget Deficits of the Central Government
(Billions of Nkr at 2007 prices)

Deviation from the 4 percent rule
Fiscal rule in the 2007 budget
Fiscal rule in the 2001 budget

Sources: Ministry of Finance, 2001 and 2007 budgets; and IMF staff estimates

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[11] The state receives revenues from oil enterprises through taxes (ordinary corporate income tax at 28 percent; special tax rate for oil producers at 50 percent of income; and the green gas emission (CO_2) tax), royalties, fees, its direct financial interest in the petroleum sector (SDFI), and dividends from state shares of Statoil and Norsk Hydro (see IMF 2001).

Table 1. Central Government Fiscal Position Under Different Oil Prices, 2002-10
(In percent of GDP; unless otherwise specified)

| | | | | | | Projections | | | |
| | | | | | | | Based on the 4-percent rule | | |
	2002	2003	2004	2005	2006	2007	2008	2009	2010
					Based on the 2007 National Budget projections				
Structural non-oil balance	-3.2	-3.6	-3.9	-3.6	-4.0	-4.4	-5.2	-6.0	-6.6
4 percent of GPF assets	-2.0	-1.9	-2.5	-2.8	-3.6	-4.4	-5.2	-6.0	-6.6
Non-oil expenditures	46.4	45.1	44.5	43.5	42.1	43.1	43.8	44.8	45.7
Increase in real terms									
(applying GDP deflator)	13.0	-1.5	3.1	2.0	1.3	2.8	4.4	4.5	3.9
Government Pension Fund (GPF) assets									
(in percent of GDP)	49.4	66.4	74.6	96.1	114.1	135.6	153.8	170.6	…
Oil price assumption (in Norwegian krones)	197.9	204.4	254.1	343.5	411.8	390.0	357.0	334.6	323.0
			Higher oil price scenario (20 percent more than in the 2007 budget projections)						
Structural non-oil balance	-3.2	-3.6	-3.9	-3.6	-4.0	-4.4	-5.4	-6.3	-7.0
4 percent of GPF assets	-2.0	-1.9	-2.5	-2.8	-3.6	-4.4	-5.4	-6.3	-7.0
Non-oil expenditures	46.4	45.1	44.5	43.5	42.1	43.1	43.9	45.1	46.1
Increase in real terms									
(applying GDP deflator)	13.0	-1.5	3.1	2.0	1.3	2.8	4.9	4.8	4.2
Government Pension Fund (GPF) assets									
(in percent of GDP)	49.4	66.4	74.6	96.1	114.1	140.1	162.3	182.3	
Oil price assumption (in Norwegian krones)	197.9	204.4	254.1	343.5	411.8	468.0	427.0	398.6	383.0
					Based on WEO projections				
Structural non-oil balance (WEO)	-3.2	-3.6	-3.9	-3.6	-4.0	-4.4	-5.0	-5.8	-6.5
4 percent of GPF assets	-2.0	-1.9	-2.5	-2.8	-3.6	-4.4	-5.0	-5.8	-6.5
Non-oil expenditures	46.4	45.1	44.5	43.5	42.1	43.1	43.6	44.6	45.5
Increase in real terms									
(applying GDP deflator)	13.0	-1.5	3.1	2.0	1.3	2.8	4.0	4.4	4.1
Government Pension Fund (GPF) assets									
(in percent of GDP)	49.4	66.4	74.6	96.1	114.1	133.6	151.0	168.7	185.2
Oil price assumption (in Norwegian krones)	197.9	204.4	254.1	343.5	411.8	384.1	416.2	422.3	427.8

Sources: Ministry of Finance; and IMF staff estimates.

Increasing Pension Spending and Decreasing Oil Revenue
(Percent of GDP)

Sources: Ministry of Finance, 2007 budget; and IMF staff estimates.

10.   On the other hand, Norway faces a fiscal challenge related to aging of its population. Specifically, Norway's old-age pensions are expected to increase sharply over the next several decades, reflecting rising longevity, the retirement of the baby boom generation, and generosity of the welfare programs (Box 2).
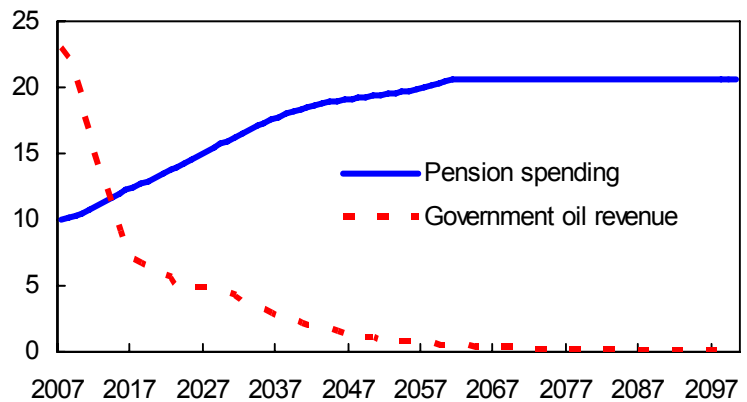
**Box 2. Decomposition of Changes in Old-age Pension Spending
(Based on OECD, 2003)**

From 2000 to 2050, age-related spending is expected to increase by 13.4 percentage points of GDP. Of this, 8 percentage points are due to old-age pensions, 3.2 percentage points are due to increases in health care and long-term care, and 1.6 percentage points are due to early retirement programs. Demographics account for about one-third of the 8 percent increase in pension spending. The rest is due to the full phasing-in of benefits, in part related to increases in female labor participation, and the generosity of the pension system created in 1967.

Projections of Age-related Spending in OECD Countries, 2000-2050 1/

	Total Age-related Spending		Old-age Pensions		"Early-retirement" Programmes		Health Care and Long-term Care		Child/Family Benefits and Education	
	level 2000	change 2000-50	level 2000	change 2000-50	level 2000	change 2000-50	level 2000	change 2000-50	level 2000	change 2000-50
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	(Levels in percent of GDP, changes in percentage points)									
Australia	16.7	5.6	3.0	1.6	0.9	0.2	6.8	6.2	6.1	-2.3
Austria 2/	[10.4]	[2.3]	9.5	2.2	...	...	[5.1]	[3.1]	...	...
Belgium	22.1	5.2	8.8	3.3	1.1	0.1	6.2	3.0	6.0	-1.3
Canada	17.9	8.7	5.1	5.8	...	...	6.3	4.2	6.4	-1.3
Czech Republic	23.1	6.9	7.8	6.8	1.8	-0.7	7.5	2.0	6.0	-1.2
Denmark 3/	29.3	5.7	6.1	2.7	4.0	0.2	6.6	2.7	6.3	0.0
Finland	19.4	8.5	8.1	4.8	3.1	-0.1	8.1	3.8	...	...
France 4/	[18.0]	[6.4]	12.1	3.9	...	...	[6.9]	[2.5]	...	...
Germany	[17.5]	[8.1]	11.8	5.0	...	...	[5.7]	[3.1]	...	...
Hungary 5/	7.1	1.6	6.0	1.2	1.2	0.3	...	...	...	...
Italy	[19.7]	[1.9]	14.2	-0.3	...	...	[5.5]	[2.1]	...	...
Japan	13.7	3.0	7.9	0.6	...	...	5.8	2.4	...	...
Korea	3.1	8.5	2.1	8.0	0.3	0.0	0.7	0.5	...	...
Netherlands 6/	19.1	9.9	5.2	4.8	1.2	0.4	7.2	4.8	5.4	0.0
New Zealand	18.7	8.4	4.8	5.7	...	...	6.7	4.0	7.2	-1.3
Norway	17.9	13.4	4.9	8.0	2.4	1.6	5.2	3.2	5.5	0.5
Poland 5/	12.2	-2.6	10.8	-2.5	1.4	-0.1	...	...	...	...
Spain	[15.6]	[10.5]	9.4	8.0	...	...	[6.2]	[2.5]	...	...
Sweden	29.0	3.2	9.2	1.6	1.9	-0.4	8.1	3.2	9.8	-1.2
United Kingdom	15.6	0.2	4.3	-0.7	...	...	5.6	1.7	5.7	-0.9
United States	11.2	5.5	4.4	1.8	0.2	0.3	2.6	4.4	3.9	-1.0
Average of countries above 7/	**21.2**	**5.8**	**7.4**	**3.4**	**1.6**	**0.2**	**5.9**	**3.1**	**6.2**	**-0.9**
Portugal 8/	15.6	4.3	8.0	4.5	2.5	-0.4	...	...	...	...

1/ Data for health care shown in parentheses are drawn from EPC (2001). They are the results of an EC exercise using a common methodology for all countries. The projections are based on the same macroeconomic assumptions as in OECD(2001) Table 3.1. These health and long-term care projections assume that costs per capita rise in line with productivity/wages. They do not allow for technological change or other non-age-related factors.

2/ Total pension spending for Austria includes other age-related spending which does not fall within the definitions in 3-10. This represents 0.9 percent of GDP in 2000 and rises by 0.1 percentage point in the period of 2050.

3/ Total for Denmark includes other age-related spending not classifiable under the other headings. This represents 6.3 percent of GDP in 2000 and increases by 0.2 percentage point for 2000 to 2050.

4/ For France, the latest available year is 2040.

5/ Total includes old-age pensions spending and "early-retirement" programmes only.

6/ "Early-retirement" programmes only include spending on persons 55+.

7/ Sum of column averages. OECD average excludes countries where information is not available and Portugal where the data are less comparable than for other countries.

8/ Portugal provided an estimate for total age-related spending but did not provided expenditure for all the spending components.

Source: Adapted from Table 2 on p. 35 in "Policies For An Ageing Society: Recent Measures And Areas For Further Reform," OECD, Economics Department Working Papers No.369. Paris: OECD

11.   Statistics Norway's latest population projections suggest that from 2005 to 2050 the life expectancy for men and women will grow by about 7.4 and 6 years, correspondingly. The number of persons over age 67 (the official age of retirement) will remain broadly stable up until the end of this decade, but will then grow substantially. On the other hand, the fertility rate has fallen over the past few decades and is expected to remain at the current

level of 1.8. As a result, the old-age dependency ratio, defined as the ratio of the number of aged persons (defined here as persons above 64) to the number of working-age persons (20–64 year olds), is expected to increase from 24.7 percent in 2005 to 45.4 percent in 2060 (a 20.6 percentage point increase). The dependency ratio for very old people (above age 79) will more than double during 2010–50, with the sharpest increases taking place after 2025, when the baby boom generation retires.

Sources: Statistics Norway; and IMF staff estimates.
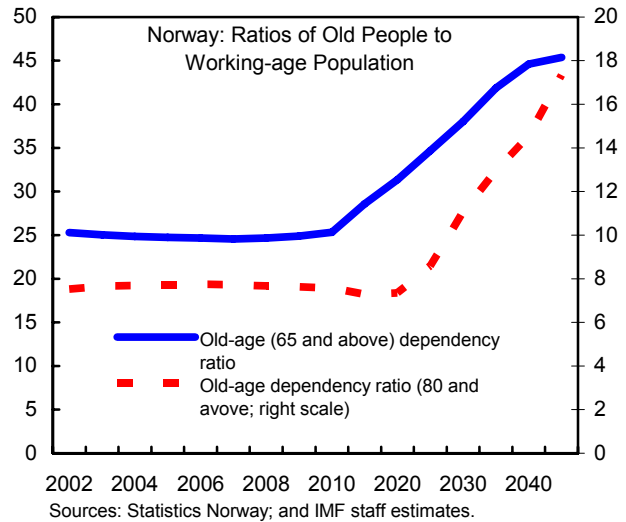
12.   Norway's demographic outlook is not worse than that of many other advanced industrial countries. For example, Norway's old-age population growth is close to the G7 average based on projections published by the United Nations (2007). The dependency ratio in Norway is also expected to evolve in line with the G7 average (Figure 3).
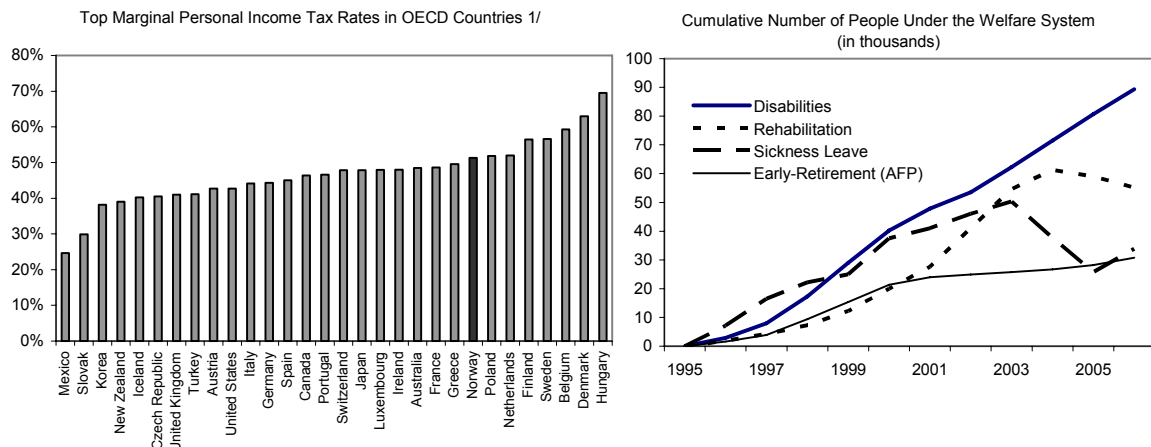
Figure 3. Old-age Demographics in Norway and G7 Countries
(Cumulative increase, percent)
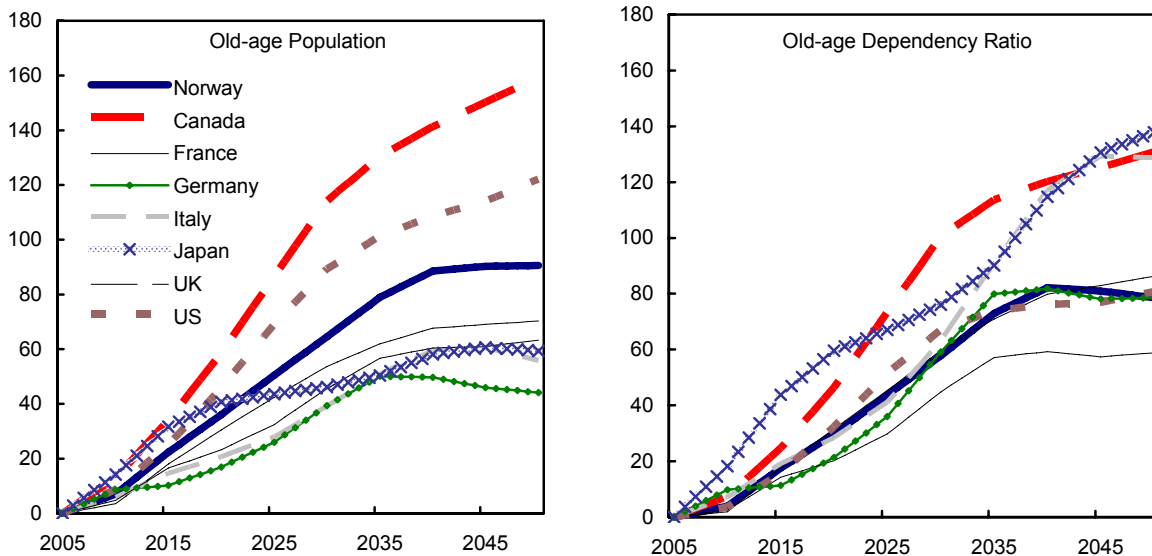
Source: United Nations (2007).

13.   In addition to purely demographic factors, the continued maturation of the earnings-related pay-as-you-go pension system will be an important factor contributing to the sharp increases in pension spending. Most of this maturation will take place in the next two decades. The Norwegian social security system is currently immature because it was introduced only as late as 1967, and 40 years of service is required to receive a full pension. Thus, people born in 1940 and reaching retirement age in 2007 will be the first cohort to qualify for maximum benefits. Only beyond 2030, when most pensioners become qualified for maximum benefits, will the ratio of average pension benefits to the wage level reach its steady state (Fredriksen and Stolen, 2005). Female labor participation, growing since the 1970s, also contributes, since increasing participation of women has so far boosted fiscal revenues more than spending, which has resulted in declines in pension spending in percent of GDP. However, as these cohorts of women retire, pension spending will increase rapidly.
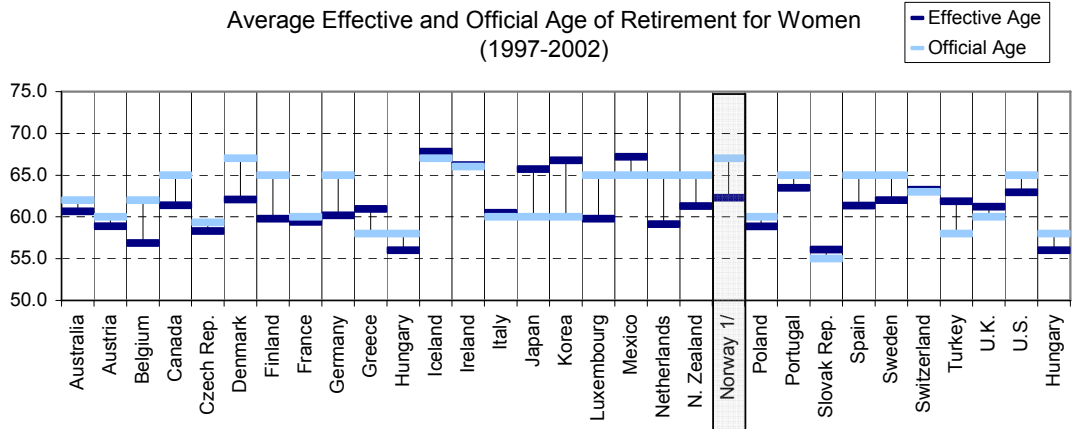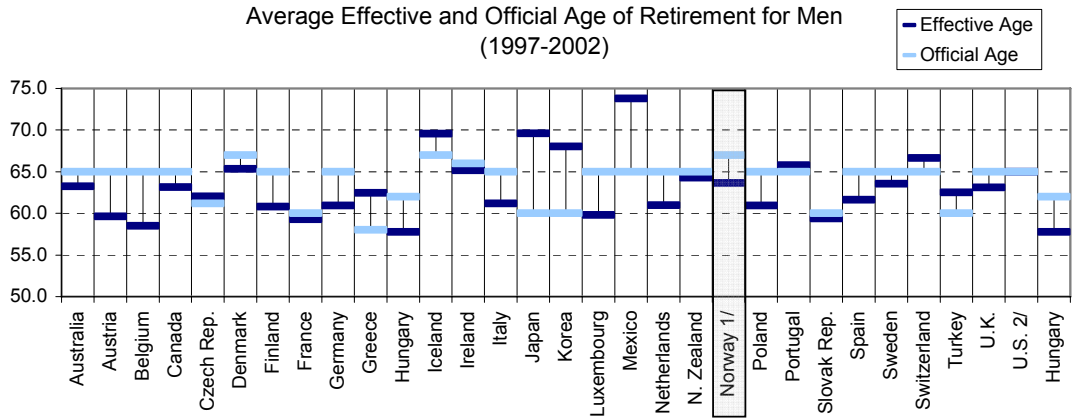
14.   Regarding the generosity of the pension system in Norway, by European standards, replacement rates are not particularly high, and the statutory retirement age of 67 is high (Figure 4). However, easy access to early retirement, disability benefits, and sick leave, together with high tax rates on labor income, have taken their toll on public finances and labor supply. In particular, the effective retirement age, especially for men, has been declining while the number of disability cases and days lost owing to sickness have been increasing (Bellone and Bibbee, 2006).

Top Marginal Personal Income Tax Rates in OECD Countries 1/

Cumulative Number of People Under the Welfare System (in thousands)

Sources: OECD Tax Database, data as of year 2005; Ministry of Finance: The 2007 National Budget; Statistics Norway.
1/ The all-in (top marginal) tax rate, calculated as the additional central and sub-central government personal income tax, plus employee social security contribution, resulting from a unit increase in gross wage earnings. The all-in rate takes account of the same aspects as the combined rate, but does in addition include employee social security contributions and if they are deductible in central government taxes etc.

Figure 4. Generosity of the Pension System in OECD Countries

Average Effective and Official Age of Retirement for Men (1997-2002)

Average Effective and Official Age of Retirement for Women (1997-2002)

Average Gross Replacement Rates (2002)

Note: 1/ According to the MOF, in 2005 the total effective age of retirement in Norway was 59.
2/ Official and effective age for men in the U.S. were the same.
Source: OECD, *Society at a Glance: OECD Social Indicators,* 2005 Edition and *Pensions at a Glance: Public Policies Across OECD Countries,* 2005 Edition.

15.   The Norwegian parliament has agreed to reforms that would reduce old-age pension spending. Key cost-cutting reforms are (i) basing benefits on lifetime earnings, instead of the best 20 years, as now; (ii) adjusting benefits for life expectancy; (iii) indexing benefits to the simple average of wages and prices, rather than to wages, as now (except for a minimum pension, to be indexed to wages); and (iv) making individual benefits actuarially neutral, with the replacement rate depending on retirement age and a flexible retirement age as early as 62. These reforms could reduce future pension spending by about 3 percent of GDP. Furthermore, the government has been negotiating with the social partners reforms that could reduce participation in the welfare programs.

### C. Fiscal Sustainability Under the 4-Percent Fiscal Rule

16.   This section assesses the long-run sustainability of Norway's public finances under the 4-percent fiscal rule. The simulations assume that the NOPD is set equal to 4 percent (the real return) of GPF assets in each year, petroleum revenue evolves according to the 2007 national budget (Figure 2), and real GDP grows by 2¼ percent a year, in line with the authorities' projections of potential GDP growth. Sensitivity tests illustrate how alternative assumptions regarding oil revenue, the real interest rate, and GDP affect the results.

17.   In percent of mainland GDP, the 4-percent rule under current projections implies a hump-shaped non-oil budget deficit and GFP assets. Specifically, GPF assets will peak at 240 percent of GDP in 2022 and decline thereafter. Similarly, the NOPD is projected to increase from 5.2 percent of GDP in 2006 to a peak of 9½ percent of GDP in 2023, and to decline thereafter (Figure 5). Note that the increase is sharper than the decline, reflecting large total budget surpluses in the medium term.

18.   The broad picture of declining GPF as a share of GDP under the 4-percent rule is robust to alternative oil revenue, interest rate, and growth assumptions. For example, in the long term, 20 percent higher/lower oil revenues and 50 basis points higher/lower yield on government assets would change the NOPD path, but the broad picture of a rise in the medium term followed by a gradual decline remains (Figure 5).

19.   Given the projected increase in pension spending, sticking to the 4-percent rule implies sharp cuts in non-pension spending or sharp increases (in percent of GDP) in taxes in the long term. On current projections, in 2060, income from the GPF would cover only about 2 percentage points of the projected 10 percentage point of GDP increase in pension spending. Accordingly, the 4-percent rule would require about an 8 percentage point cut in non-pension spending or the same size increase in taxes in the same period. More fiscal tightening would be needed in the longer term as the income from the GPF in percent of GDP declines over time. Alternatively, in the absence of action, the rule would not be met, and the fiscal position would deteriorate in the long run (Figure 6).

Figure 5. Fiscal Position of the General Government Under the 4-percent Rule
(In percent of GDP)
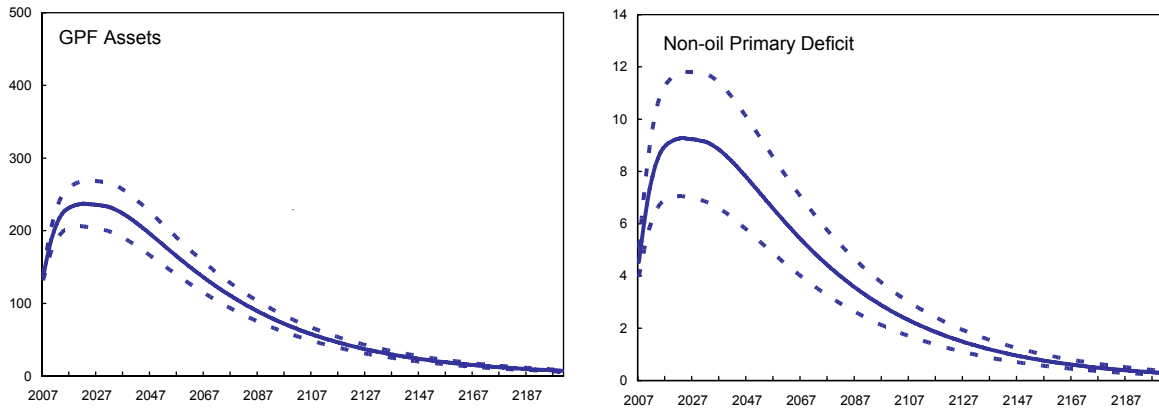
Source: IMF staff estimates. Until 2030, the baseline scenario is based on the 2007 budget projections of oil prices and revenues. Thereafter, oil production is assumed to decline gradually. The upper/lower band corresponds to 20 percent higher/lower oil prices and 50 basis points higher/lower yield on government assets.

Figure 6. Fiscal Position of the General Government 1/
(In percent of GDP)
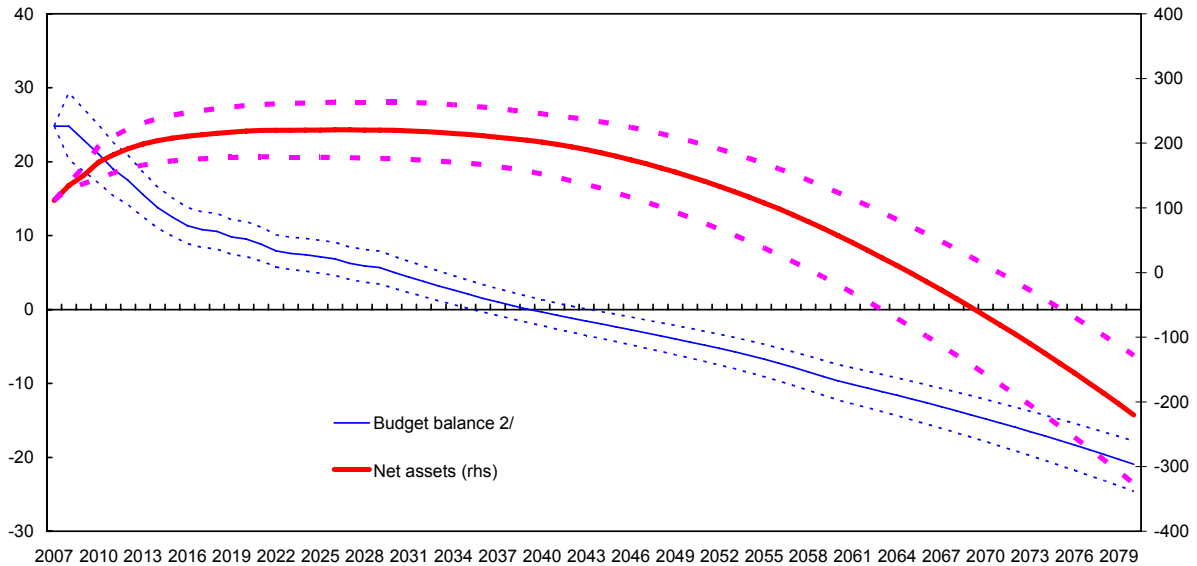
Sources: Ministry of Finance; and IMF staff estimates.
1/ Baseline scenario is based on the 2007 budget projections of oil prices and revenues. Non-oil budget revenues and non-pension spending are assumed to remain unchanged from the 2007 levels. The upper and lower bands correspond to 20 percent higher and 20 percent lower oil prices, respectively.
2/ Includes oil revenues and interest on net assets.

20.   These conclusions are broadly consistent with those of other studies. For example, the government's 2007 budget projections suggest that under the 4-percent rule GPF assets are unlikely to become large enough to fully fund the expected rise in public spending associated with population aging. These projections include simulations suggesting that meeting the 4-percent rule would require significant financial tightening even under higher-than-assumed oil prices and higher labor-force participation rates (Figure 7). The IMF (2005), Heide and others (2006), as well as the OECD's latest report draw similar conclusions.
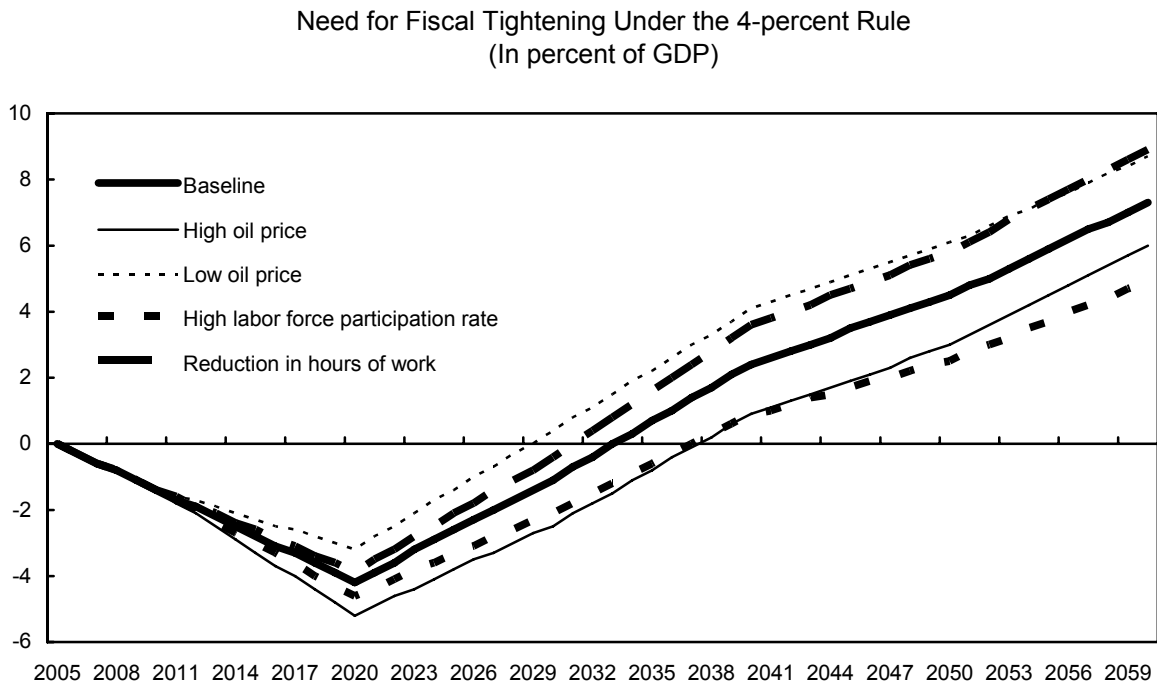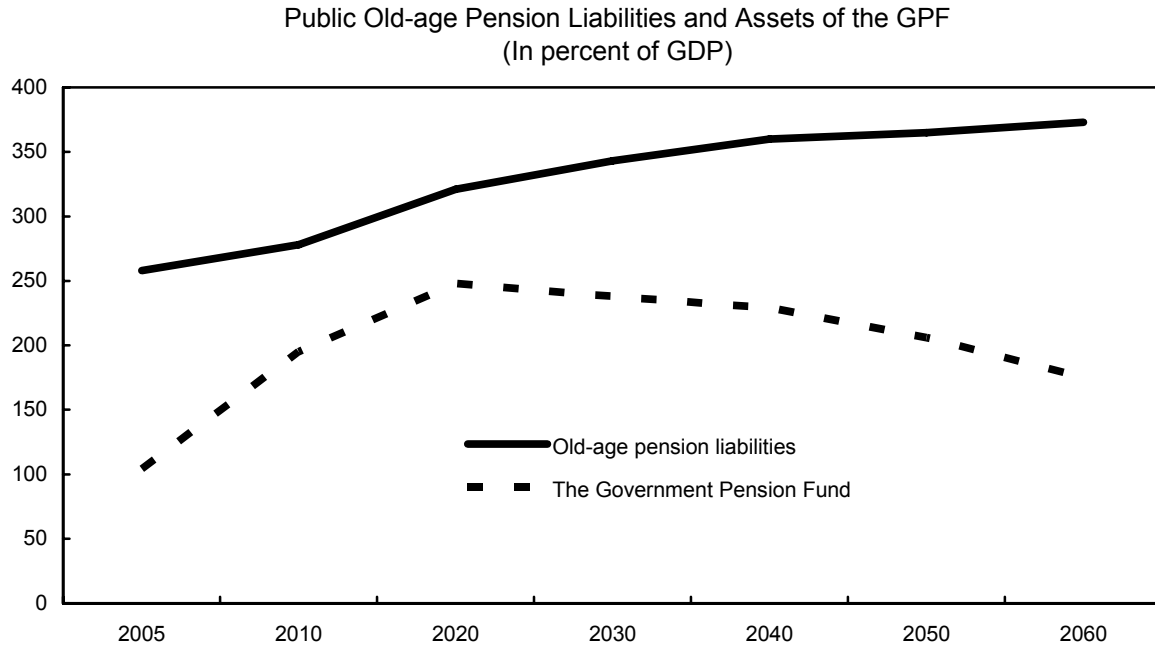
D. Alternative Fiscal Rules

21.   This section assesses fiscal implications of three alternative fiscal rules, each of which preserve the GPF as a proportion of GDP, compared with the 4-percent rule that preserves the real value of the GPF. The first alternative rule targets a constant permanently sustainable NOPD in percent of GDP, based on Friedman's (1957) Permanent Income Hypothesis (PIH). The second alternative rule is similar to the 4-percent rule, except that it limits the NOPD to the growth-adjusted return on the GPF, rather than to the full 4 percent return. The third alternative rule targets a level for GPF assets of 250 percent of GDP, which is close to the projected peak under the 4-percent rule. The choice of these rules is motivated by the objective of avoiding either a sharp fiscal consolidation or an increase in public debt in the future when, as expected, age-related expenditures increase.[12] All the simulations presented in this section rely on the same assumptions regarding government revenue, growth and interest rates as those in Section C.

The Permanent Income Rule

22.   The PIH implies that the government does not spend out of current income, but out of permanent income or total wealth. In its simplest form, the government's permanent income is the annuity value of its net wealth, defined as the sum of its net assets and the discounted present value of future expected petroleum revenues. Here, the problem is formulated in terms of GDP, through using the interest-rate growth differential, rather than the real return on the GPF. This approach, by construction, ensures that the government accumulates sufficient financial assets to sustain a constant fiscal deficit as a share of GDP once oil reserves are depleted.

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[12] The alternative rules are not necessarily meant to be welfare optimizing. This paper does not analyze inter-generational equity impact of these alternative rules. Heide and others (2006) argue that higher pre-funding of future spending favors future generations, who would be better off even without such redistribution because of economic growth.

Figure 7. Norway: Old-Age Pension Liabilities and Need for Financial Tightening

Public Old-age Pension Liabilities and Assets of the GPF
(In percent of GDP)

Need for Fiscal Tightening Under the 4-percent Rule
(In percent of GDP)

Sources: Ministry of Finance, 2007 budget; and IMF staff etsimates.

23.   Formally, the permanent income rule implies setting the NOPD according to:

$$(1) \quad \frac{NOPD}{MGDP_t} = \frac{r-\gamma}{1+r} \cdot \sum_{s=t}^{\infty} \left(\frac{1+\gamma}{1+r}\right)^{-(s-t)} \cdot oil_s + \frac{r-\gamma}{1+\gamma} \cdot \frac{GPF}{MGDP_{t-1}}$$

where r denotes the real interest rate; γ real GDP growth; *GPF* the value of GPF assets; and *oil* government oil revenue in percent of GDP. The equation thus involves computing the present discounted value of all future oil revenue using the growth-adjusted interest rate as the discount factor.[13] The IMF has recommended this approach to setting targets for the NOPD to oil-producing countries such as Gabon.[14]

24.   The permanently sustainable NOPD (PSNOPD) is estimated at 6.0 percent of GDP (Figure 8). Compared to the 4-percent rule, the non-oil deficit is smaller in the coming several years (that is, the large run-up in the deficit is avoided), in exchange for more assets being available in the long run. Accordingly, in the long term, income from the oil wealth under the permanent income rule covers more of the projected increase in pension spending. However, given the large size of the pension increase, fiscal sustainability under the permanent income rule would still require significant cuts (about 8 percent of GDP) in non-pension spending or increases in taxes. Under the rule, GPF assets are expected to increase to 350 percent of GDP by 2080, and to remain constant thereafter.

25.   The result that the NOPD and GPF assets are higher under the permanent income rule in the long run than under the 4-percent rule is robust to alternative oil revenue and interest rate and growth projections. However, the levels of permanently sustainable deficit levels are quite sensitive to changes in these assumptions. For example, 20 percent higher/lower oil revenues and 50 basis points higher/lower yield on government assets would increase/reduce the NOPD-to-GDP ratio by more than 2 percentage points (Figure 8).

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[13] For the derivation of Equation (1), and its application to a number of oil producing countries, see, for example, Barnett and Ossowski (2003), Leigh and Olters (2006), and Carcillo, Leigh, and Villafuerte (2007). Tersman (1991) applies a similar framework for Norway.

[14] See IMF (2006) for recommendations to Gabon made in the context of the 2006 Article IV consultations.

Figure 8. Fiscal Position of the General Government Under the 4-percent and
Permanent Income Rules
(In percent of GDP)
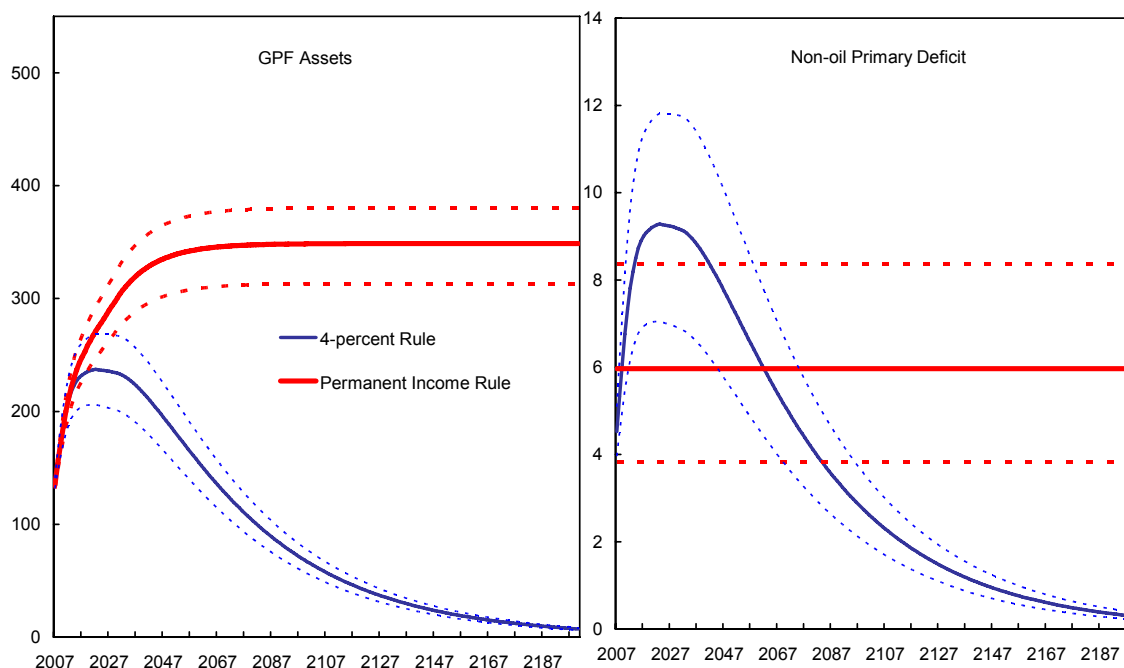
Source: IMF staff estimates. Until 2030, the baseline scenario is based on the 2007 budget projections of oil prices and revenues. Thereafter, oil production is assumed to decline gradually. The upper/lower band corresponds to 20 percent higher/lower oil prices and 50 basis points higher/lower yield on government assets.

26.   A significant practical drawback to the PIH rule is its forward-looking nature. Permanent income is not observable, but must be estimated using projections for petroleum revenue, interest rates, and economic growth into the far future. Thus, if the world oil price changes, then the effect on permanent income will have to be estimated, and this would depend on, among other things, the degree to which the price change is expected to be permanent. Fiscal policy would have to adjust to the corresponding sustainable non-oil deficit path. By contrast, the 4-percent rule is backward looking and avoids such problems.

A Growth-adjusted Rule

27.   Another alternative fiscal rule would stabilize the GPF in terms of GDP, rather than in real terms. This rule can be thought of as a variant of the 4-percent rule, in that the "real return" that is spent is adjusted for economic growth. Under the assumptions of Section C, this growth-adjusted return is 4 percent less real GDP growth (2¼ percent), or 1¾ percent.

28.   **Under the growth-adjusted rule, the NOPD would be smaller than that under the 4-percent rule in the near term, but larger in the long term**. The permanently sustainable NOPD under the growth-adjusted rule is calculated at 7.0 percent of GDP, with the NOPD gradually expanding toward that level over 70 years (Figure 9). Note that this

deficit is somewhat larger than the 6.0 percent under the permanent income rule, because more of the oil wealth is saved under the growth-adjusted rule: GPF assets increase from about 115 percent of GDP to a constant 410 percent of GDP by 2080.

Figure 9. Fiscal Position of the General Government Under the 4-percent and
Growth-adjusted Income Rules
(In percent of GDP)
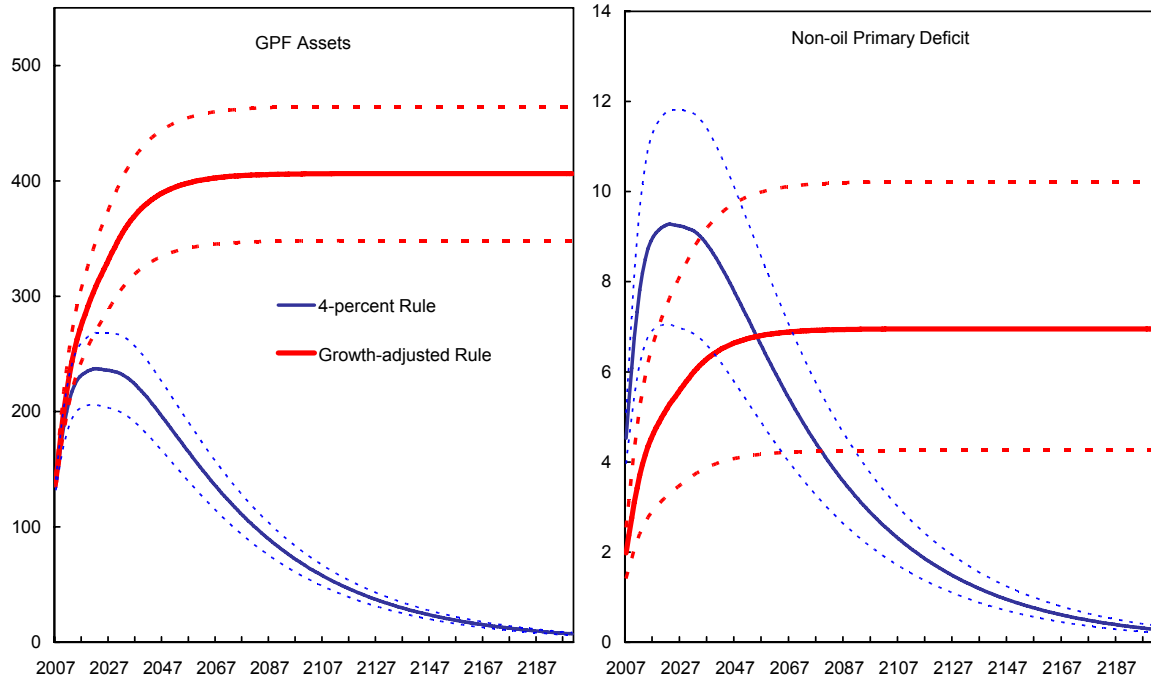
Source: IMF staff estimates. Until 2030, the baseline scenario is based on the 2007 budget projections of oil prices and revenues. Thereafter, oil production is assumed to decline gradually. The upper/lower band corresponds to 20 percent higher/lower oil prices and 50 basis points higher/lower yield on government assets.

An Asset-targeting Rule

29.   A potential disadvantage of both the PIH and growth-adjusted rules is the very large size of the GPF, which may be difficult to justify. An alternative would be to target a "reasonable" long-term asset level. For purposes of illustration, a steady-state GPF of 250 percent of GDP—close to the peak projected under the 4-percent rule—is simulated. A number of deficit paths could achieve this outcome, but here it is assumed that the deficit follows the 4-percent rule until the asset target is achieved, then switches to the adjusted-growth rule.

30.   Under the asset-targeting rule, the long-term NOPD would be about 4.4 percent of GDP (Figure 10). This is less than under the 4-percent rule in 2022–2080, but greater thereafter. The asset-targeting rule, however, also incorporates a forward-looking component: the target itself. Consequently, changes to oil prices, for example, would have to be assessed to determine their effect on achieving the rule. Also, the NOPD (in the simulation) or the

path of GPF assets could be quite sensitive to oil price shocks, implying a procyclical fiscal policy.

31.   The path for the NOPD and GPF assets under the target rule can also be interpreted as a growth-adjusted rule, but with a different (slower) transition from the 4-percent rule. Under this interpretation, there is no forward-looking aspect, and no need to adjust fiscal policy in the wake of oil price changes. However, such changes would, as under the growth-adjusted rule, result in a different steady-state asset-to-GDP ratio, and a different adjustment to compensate for rising aging costs.

Figure 10. Fiscal Position of the General Government Under the Asset-targeting Rule
(In percent of GDP)
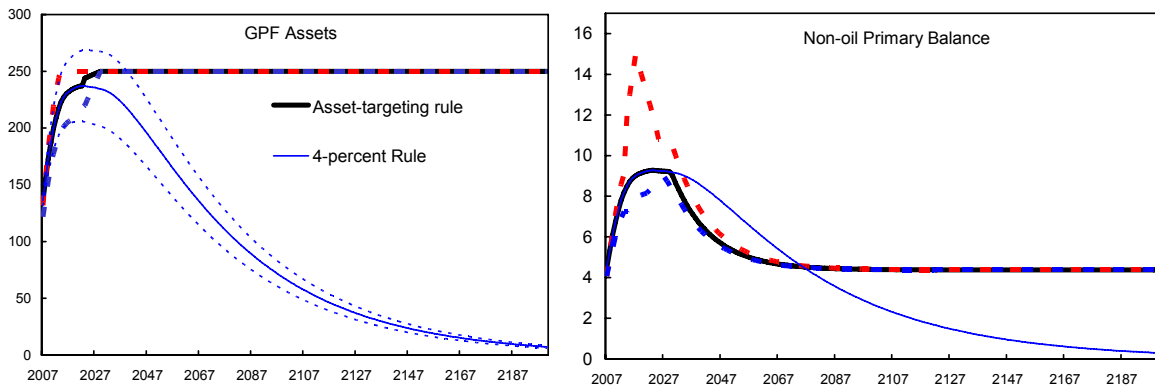
Source: IMF staff estimates. Until 2030, the baseline scenario is based on the 2007 budget projections of oil prices and revenues. Thereafter, oil production is assumed to decline gradually. The upper/lower band corresponds to 20 percent higher/lower oil prices and 50 basis points higher/lower yield on government assets.

E.   The Macroeconomic Consequences of the Growth-adjusted Rule

This section focuses on macroeconomic consequences of the growth-adjusted rule of the previous section. The analysis uses GIMF, a general equilibrium model developed at the IMF to examine monetary and fiscal policy issues in a multi-country setting. The model includes the following features (which, among other things, renders it non-Ricardian): overlapping generations of consumers with finite horizons, distortionary taxation, and liquidity constrained consumers who do not have access to financial markets and thus have to vary their consumption one-for-one with after-tax labor income. As such, the model is well equipped to analyze fiscal policy issues that involve permanent changes in government assets or debt. The model includes a large menu of fiscal policy tools, including labor income taxes, VAT, corporate income taxes, government consumption, and productive infrastructure expenditures. The model also includes a number of nominal and real rigidities, and a central

bank that manipulates interest rates to achieve an inflation target of 2.5 percent a year.[15] For the purposes of this paper, the underlying parameters of the model are calibrated to fit the key features of Norway's economy. For example, the real return on government assets is calibrated at 4 percent a year. The model also contains a second region, the rest of the world, where long-run productivity growth is 2.25 percent a year. Kumhof and Laxton (2007) provide a detailed presentation of the model, and apply it to study the effects of fiscal deficits in the United States.

32.   The objective of the analysis is to compare the evolution of key macroeconomic variables under the growth-adjusted rule with economic performance under the existing 4-percent rule. As discussed in Section D, the 4-percent fiscal rule involves a fiscal expansion (as measured by the NOPD) in the near term and a fiscal contraction in the long run, with GPF assets peaking in 2021 before gradually declining as a share of GDP. In contrast, under the growth-adjusted rule, the NOPD is smaller in the near term, but a larger accumulation of GPF assets occurs. Therefore, in comparison with the 4-percent rule scenario, the growth-adjusted rule scenario involves a smaller NOPD in the near term, but a larger, permanently sustainable NOPD in the long run. The simulations focus on the macroeconomic consequences of these alternative paths for GPF assets and the NOPD.

33.   While there are a large number of possible ways to design the composition of fiscal adjustment in the near term, and the expansion in the long run under the growth-adjusted rule, the discussion focuses on the following scenario:

- During the first 60 years, the 4-percent rule implies an NOPD that is larger than under the growth-adjusted rule, and this expansion is implemented by an increase in government spending (Figure 11).

- In the long run, when the 4-percent rule implies an NOPD that is declining relative to GDP, the reduction in the fiscal deficit is achieved by increasing labor income taxes (Figure11).

- The growth-adjusted rule reverses these responses: compared to the baseline of the 4-percent rule, government spending is lower in the short term, and taxes are lower in the long run.

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[15] In particular, monetary policy follows a forward-looking reaction function that targets the one-year ahead forecast of domestic inflation, and contains an interest rate inertia component in line with the monetary policy literature.

Figure 11. Government's Fiscal Position Under the 4-percent and Growth-adjusted Rules

Non-oil Primary Deficit/GDP

Non-oil Revenue/GDP

4-percent rule

Growth-adjusted rule

GPF Assets /GDP

Government Spending/GDP
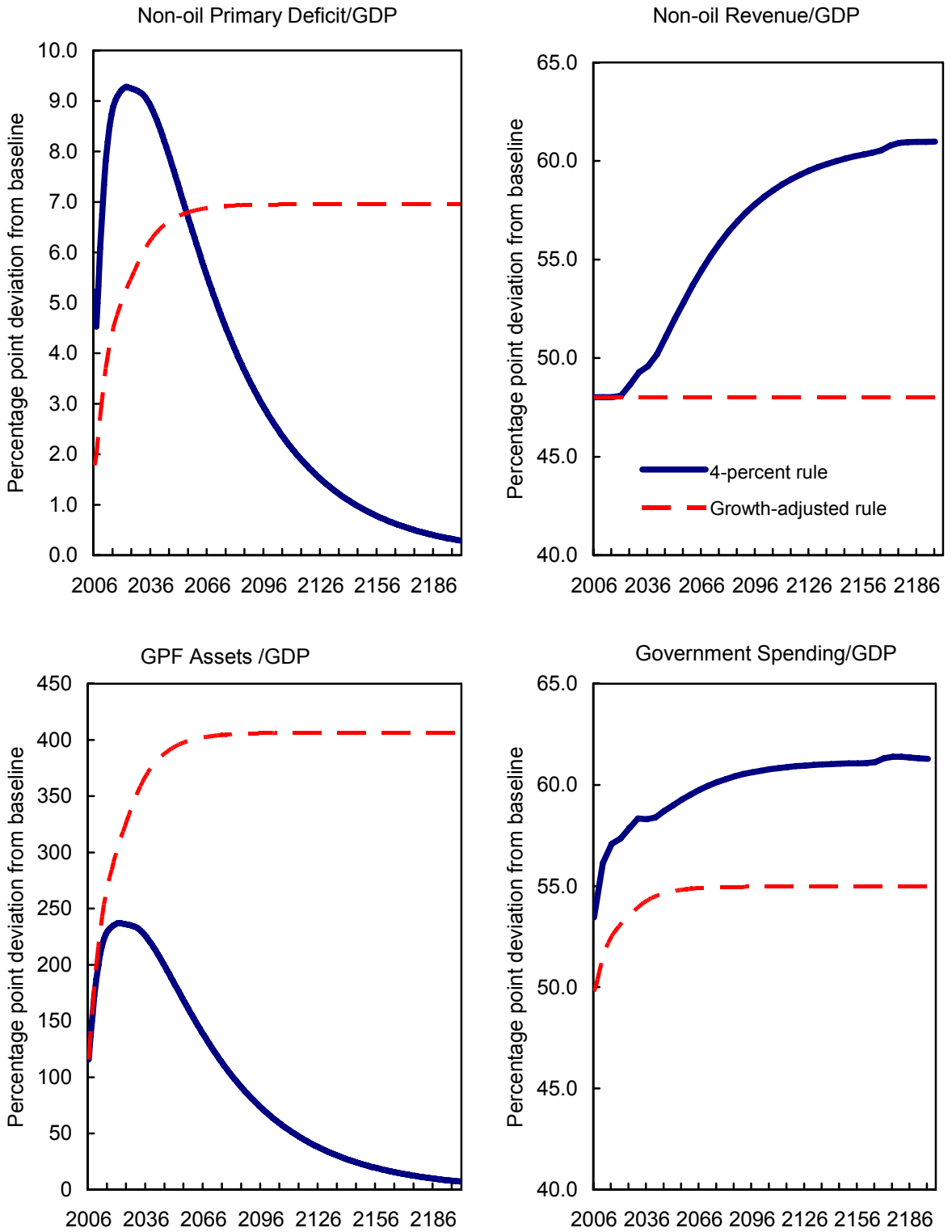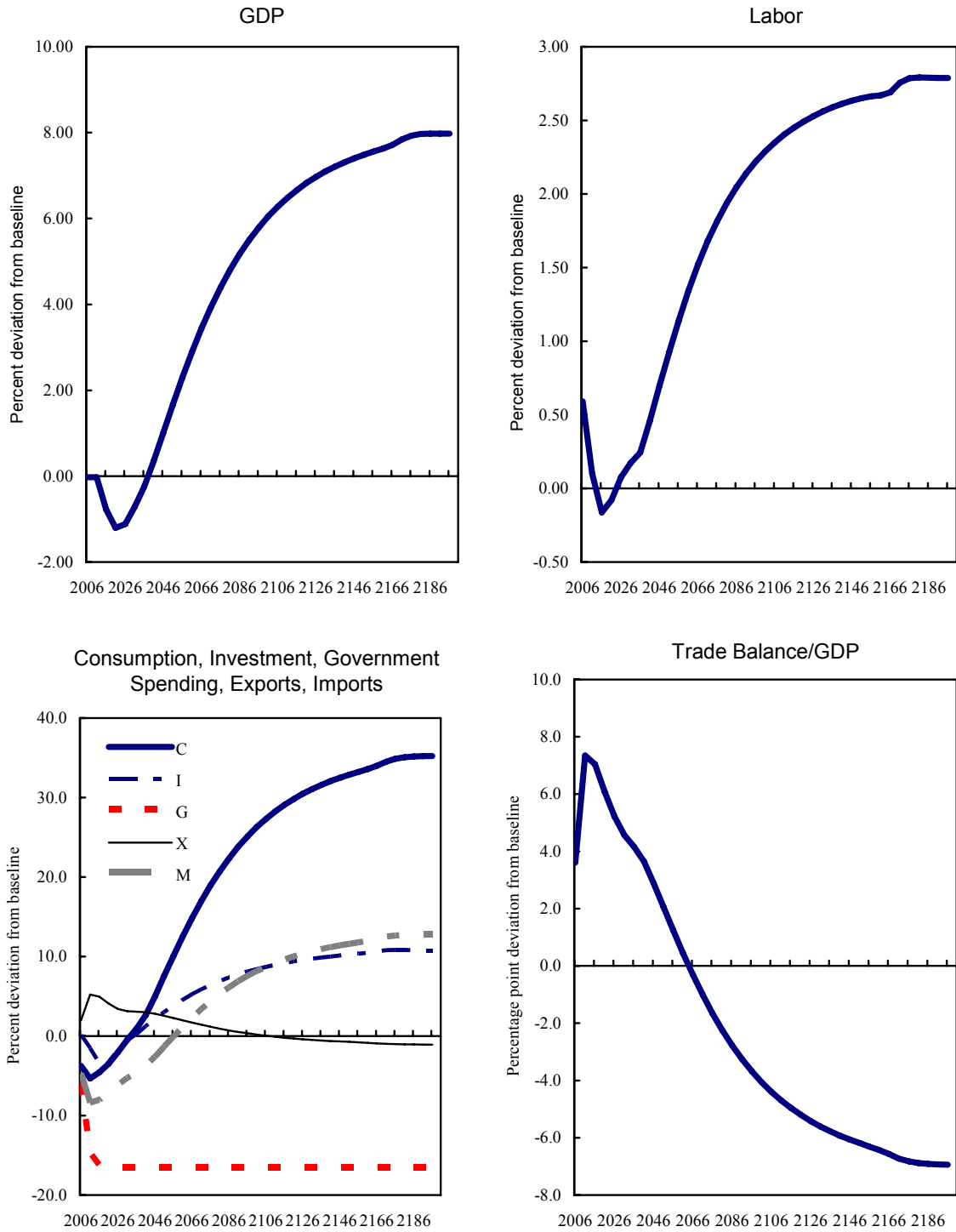
Source: GIMF simulations.

The following main results emerge from the analysis:

- In the near term, compared with the 4-percent rule scenario, the tighter fiscal position under the growth-adjusted rule requires lower government spending, implying lower aggregate demand, and lower inflation (Figures 12 and 13).

- However, the near-term effects of the fiscal consolidation on aggregated demand are in part off-set by two factors. First, the central bank responds to the decline in inflation by reducing real interest rates. This monetary expansion stimulates consumption, investment, and labor effort (Figure 12), and brings about a depreciation of the krone, which stimulates net exports. Second, the reduction in government consumption is associated with a non-Keynesian increase in private consumption. In particular, households anticipate that the persistent decline in government consumption will enable reductions in labor income taxes in the future, and respond to this increase in their permanent disposable income by increasing consumption today.[16]

- In the long term, supply-side output gains are associated with the growth-adjusted rule, because the larger stock of GPF assets permits a reduction in labor income taxes, which stimulates labor supply, and enables higher levels of private consumption.

34.   One gauge of whether the long-run gains of adopting the growth-adjusted rule warrant the near-term aggregate demand moderation is the discounted value of real consumption. As mentioned, while a formal welfare analysis of the growth-adjusted rule, which would account for changes in both household consumption and leisure, is beyond the scope of this paper, it is possible to evaluate the present discounted value of the additional consumption from the model simulation described above. As Table 2 suggests, the present discounted value of adopting the growth-adjusted rule, in terms of the additional private consumption obtained, is positive for real discount rates up to 4.3 percent a year. At a real discount rate of 4 percent, there is little difference between the 4-percent rule and the growth-adjusted rule.

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[16] Note, however, that households without access to financial markets do not increase consumption in response to the future expected reduction in the tax burden.

Figure 12. Adopting the Growth-adjusted Rule: Economic Activity
(Deviation from the baseline 4-percent rule scenario)

GDP

Labor

Consumption, Investment, Government
Spending, Exports, Imports

Trade Balance/GDP

Source: GIMF simulations.
Note: Baseline scenario corresponds to the current 4-percent fiscal rule.

Figure 13. Adopting the Growth-adjusted Rule: Inflation and Monetary Policy
(Deviation from baseline 4-percent rule scenario)
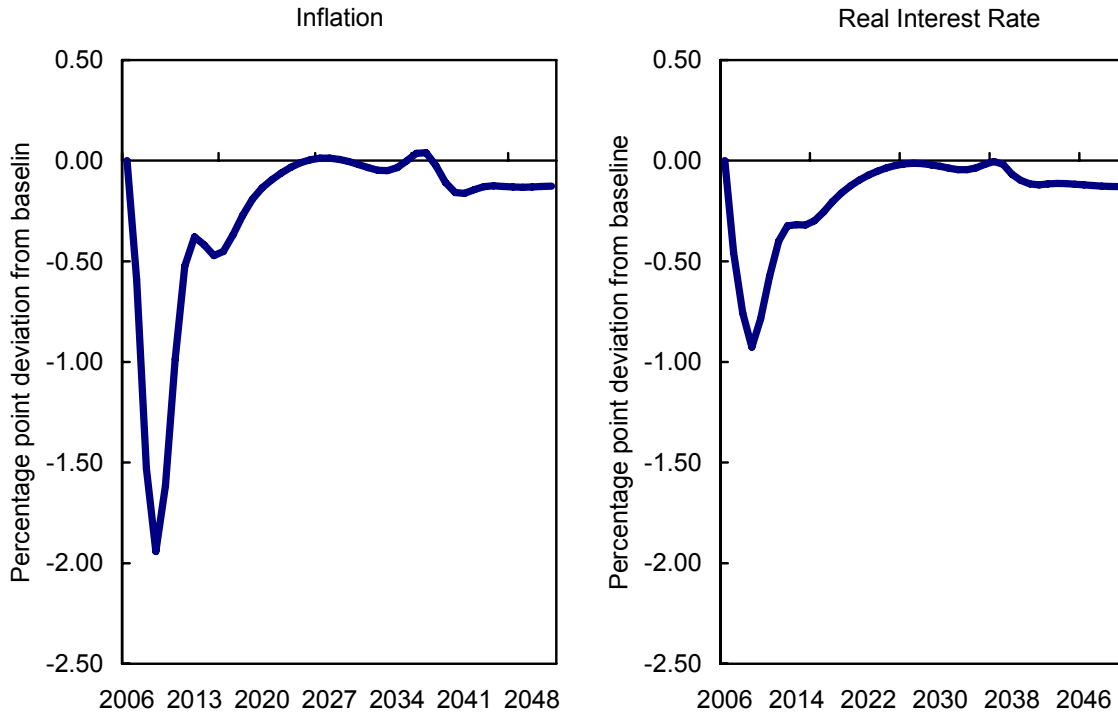
Source: GIMF simulations.
Note: Baseline scenario corresponds to the current 4-percent fiscal rule.

Table 2: Present Discounted Value of Future Consumption
(Deviation from Baseline)

Discount rate (percent per year)	Value
1	1647
2	389
3	108
4	16
5	-19

Note: baseline corresponds to current 4-percent fiscal rule scenario.
Value reaches zero at discount rate of 4.3 percent.

F. Conclusions

35.   The 4-percent rule has been successful in restraining non-oil budget deficits, insulating the budget from shocks to oil markets, and preserving considerable wealth for future generations. It is well understood and accepted in Norway and has the intuitive appeal that it preserves the real value of oil wealth for future generations, consistent with the view that natural resource exploitation is not wealth production, but rather wealth transformation.

However, it implies an expansionary fiscal policy in the near term, especially given higher oil prices than were anticipated in 2001 when the fiscal guidelines were put in place. It also implies declines in revenue from the GPF, in relation to GDP, in the long run, whereas fiscal demands (especially pensions) will rise in relation to GDP. The analysis in Section C suggests that without reforms to curb pension or non-pension spending, or to increase tax revenues, the 4-percent rule cannot be maintained. Under such a scenario, the overall budget surplus would vanish in 3–4 decades and the GPF would be exhausted in 5-6 decades.

36.   Alternative rules have both advantages and drawbacks relative to the 4-percent rule. All of them ultimately maintain the GPF in relation to GDP, rather than in real value, and therefore have the advantage of maintaining a sustainable revenue stream, in terms of GDP. They do not, however, obviously dominate the 4-percent rule. For example, while the permanent-income rule and the growth-adjusted rule both mitigate the short-term run-up in the deficit, they also involve a much larger transfer of wealth to future generations. The resulting very large GPF may be difficult to sustain politically, and under the assumptions of the simulations, in effect involves transfers from the current (relatively poor) generations to future (relatively rich) ones. The former also poses the political challenge of adjustment in the event of shocks to, notably, oil prices. The wealth-targeting rule avoids the much larger transfers, but at the cost of a steeper increase in the medium-term deficit.

37.   The analysis using GIMF suggests substantial long-run output gains associated with adoption of the growth-adjusted rule. These output gains accrue principally because the alternative rules permit lower taxes in the long run, which stimulate labor supply. However, this does not necessarily mean that the alternative rules are welfare optimizing.

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