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POLICY BRIEF

18-7 Can a Country Save Too Much? The Case of Norway

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Many countries have squandered their natural resource endowments. The International Monetary Fund (IMF) and the World Bank routinely hector developing economies to save and invest more of their revenues from resources such as oil and gold for the benefit of future generations after the resources run out. But, is it possible for a country to save too much of its resource revenues? This Policy Brief argues that Norway has done so through its Government Pension Fund Global (GPFG), which is now worth over US$1 trillion.

One appealing benchmark for a nation's saving out of revenues from nonrenewable resources would be to raise the consumption of the current and all future generations by an equal amount. By this standard, most resource exporters save too little, but Norway saves too much. During the first 50 years of oil extraction, Norway raised consumption of citizens alive at the time by considerably less than is projected for citizens living over the next 50 years. If Norway had distributed oil wealth more equally across generations starting with the first GPFG transfers in 1996, it would have raised annual consumption of each Norwegian resident by an average of US$3,000 (at constant 2010 prices and 2010 exchange rate) over the past 22 years. Even now, Norway could raise annual consumption of the current population by 18,000 kroner per capita (more than US$2,000 per capita), while keeping the contribution of oil wealth to future generations equally large. Norway has a population of 5 million and its GDP is 3.3 trillion kroner (US$400 billion), so this increase in consumption would amount to 3 percent of GDP.

Norway's excess saving imposes a cost on the rest of the world during periods of weak aggregate demand and ultralow interest rates. The world is finally exiting a prolonged economic downturn characterized by deficient aggregate demand. Some prominent economists worry that we are in an era of secular stagnation, in which aggregate demand may be chronically deficient (Summers 2013).[1] One way to shift aggregate demand from a country's trading partners to itself is to purchase large amounts of foreign assets to hold down the currency and support a large trade surplus by making exports cheaper and imports more expensive (Gagnon 2017). Such a policy boosts growth at home and retards growth abroad.

Norway is one of 20 countries identified as having manipulated their currencies to support excessive trade surpluses in recent years (Bergsten and Gagnon 2017). Norway's trade surplus is a direct consequence of its massive saving of oil revenues in foreign currencies. The potential for international conflict surrounding such policies is highlighted by the expressions of dismay from central bankers and finance ministers in most major economies when their currencies appreciated at various points in the past decade. No country wants a growing trade deficit when domestic growth is anemic. Yet for every surplus there must be an equal deficit. Norway is not one of the largest contributors to recent global trade imbalances in dollar terms. But, relative to the size of its economy, Norway's trade surplus is very large, making it an informative case study.

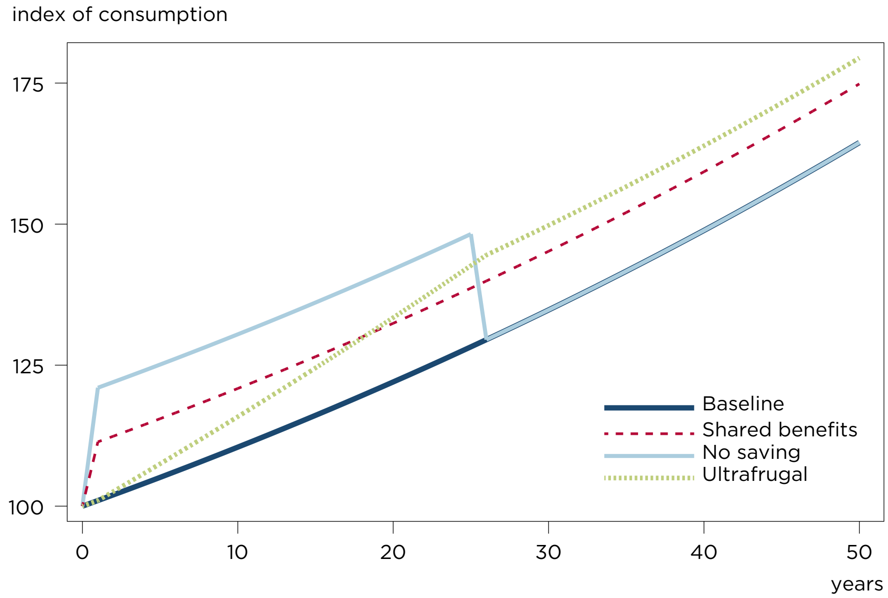
1. OPTIMAL SAVING OF NONRENEWABLE RESOURCE EXTRACTION

Equity among Generations

Perhaps the simplest and most intuitive approach to allocating revenues earned from nonrenewable natural resources is to increase national consumption equally across all years from the discovery of the resources into perpetuity. This approach applies the advice of James Tobin (1974) for universities and other charitable institutions to nation-states. Tobin put forward the principle of "equity among genera-

1. See also the Rethinking Macroeconomic Policy Conference at the Peterson Institute for International Economics, October 12–13, 2017, www.piie.com.

Figure 1 Alternative policies for consumption out of resource revenues



Source: Author's calculations.

Table 1 Fraction of resource revenues to save (*s*) under shared benefits policy

r (percent)	***T*=10**	***T*=25**	***T*=50**
1	0.91	0.78	0.61
2	0.82	0.61	0.37
3	0.74	0.48	0.23
4	0.68	0.38	0.14
5	0.61	0.30	0.09

r = real rate of return on saving; *T* = years of resource extraction

Source: Author's calculations.

tions" in his recommendation that universities should use their endowments to fund an amount of spending that can be maintained forever at a constant inflation-adjusted level. This principle builds on Milton Friedman's (1956) insight that an individual ought to spread out the consumption of a windfall across his remaining lifespan, which he termed the "permanent income hypothesis."

Figure 1 displays alternative policies for a country that discovers a nonrenewable natural resource. The heavy line displays the path of consumption in the absence of the discovery, normalized at 100 in period 0. On this path consumption is assumed to grow at a rate of 1 percent per year, reflecting productivity growth. Resource extraction is assumed to last 25 years at a constant rate of 20 units.[2] The thin line displays the path of consumption if none of the resource revenues are saved. Consumption rises by the full amount of resource extraction. After 25 years, consumption falls back to its baseline path.

The dashed line displays consumption under a "shared benefits" policy. Consumption rises by less than resource revenues but continues at the same increment relative to baseline even after the resource runs out, reflecting consumption of the real earnings on the accumulated savings. In figure 1, savings are assumed to generate a real return of 3 percent per year.

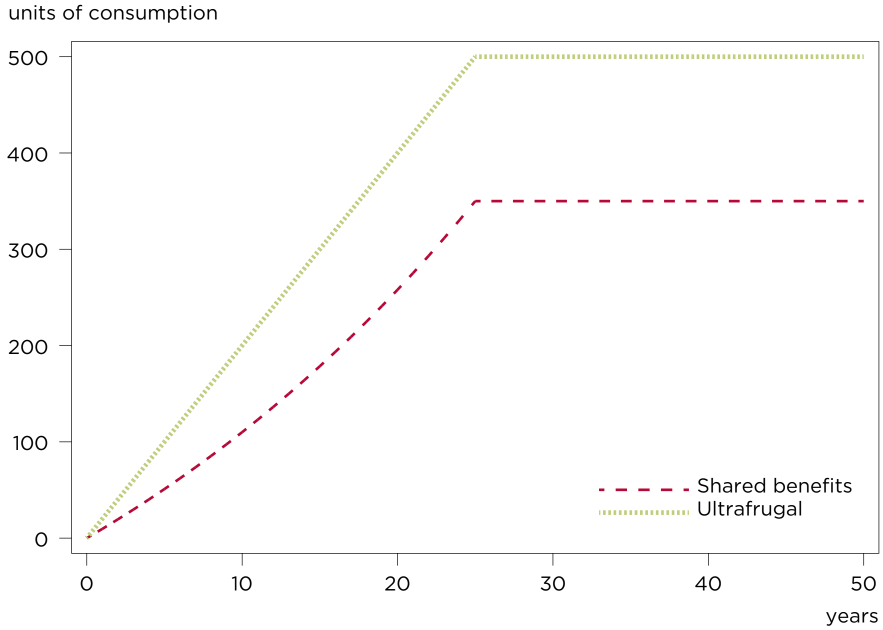
The dotted line displays an "ultrafrugal" policy in which none of the resource revenues are consumed directly but they are consumed indirectly starting in year 2 by an amount equal to the real rate of return on the accumulated stock of savings. The ultrafrugal policy benefits future generations more than the current generation because the stock of savings—and the associated income—grows over time, thus violating the principle of equity among generations.[3] As described in section 2, Norway has followed a version of the ultrafrugal policy since 1996.

Table 1 displays the fraction of resource revenues that is saved under the shared benefits policy for different values of the real rate of return on saving (r) and the years of expected resource extraction (T). When resource extraction ends in

2. For simplicity, resources are assumed to have no extraction costs and no effect on baseline production or consumption.

3. Note that the ultrafrugal policy and the shared benefits policy are identical if there is only one year of resource extraction. More generally, the shared benefits policy may be described as an adaptation of the ultrafrugal policy in which the resources remaining in the ground are added to the asset stock used to determine current consumption.

Figure 2 Asset stocks implied by alternative saving policies



Source: Author's calculations.

period T, assets will have reached a level sufficient to support the increment to consumption permanently. This condition is defined by equation 1,

$$r * (\text{Assets in period } T) = (1 - s) * (\text{Annual resource revenues in periods 1 through } T), \quad (1)$$

where s is the fraction of resource revenues to be saved and thus $1-s$ is the fraction to be consumed. In the central case in which the real rate of return is 3 percent and resource extraction is expected to last 25 years, 48 percent of resource revenues should be saved and 52 percent consumed. Resource production of 20 units per year implies an increase in consumption of 10.4 units. That in turn leads to a stock of assets that grows to 350 units when the resource runs out. With a real rate of return of 3 percent, consumption can continue on a path that is 10.4 units above baseline forever. Equations 2 and 3 describe the time path of consumption:

$$\text{Consumption}_t = (1-s)*(\text{Resource revenue})_t \text{ for } t \leq T \text{ and} \quad (2)$$

$$\text{Consumption}_t = r*\text{Assets}_{t-1} \text{ for } t > T. \quad (3)$$

Figure 2 displays the evolution of accumulated savings under the shared benefits and ultrafrugal policies for the central case of r=3 and T=25. The stock of savings grows steadily during the years of resource extraction. After extraction ceases, savings remain constant in real terms forever.

After the commodity price booms of the mid-1970s, a large literature evolved to examine optimal saving of nonrenewable natural resources.[4] By and large, studies start with a baseline result that the increase in consumption should be shared equally across generations. However, that result is modified by a number of considerations, such as (1) the specification of the social welfare function (that is, society's preferences around different consumption levels into the future), (2) uncertainty about future resource revenues or investment returns, (3) costs of adjustment in the structure of the economy driven by the increase in consumption, (4) importance of the tradable sector for economic development, (5) existence of extra social returns to domestic spending on health, education, and infrastructure, (6) problems of governance and corruption in government saving and spending, and (7) concerns about safeguarding fiscal space and reputation. Only the first three of these considerations seem relevant for Norway, and they are discussed below.[5] The remaining considerations are important for many developing economies.

A related issue is the manner in which saving is conducted. There are three broad options: (1) purchase foreign financial assets, (2) purchase domestic financial

4. For further reading, see Akram (2005), Berg et al. (2012), Cherif and Hasanov (2013), Matsen and Torvik (2005), Medas and Zakharova (2009), Primus (2016), and Truman (2010).

5. This assertion reflects a judgment that Norway's economy is at the global productivity frontier, that there are no constraints on its spending on health, education, and infrastructure, and that there are few concerns about corruption or inadequate fiscal space in Norway.

assets, and (3) build domestic physical assets such as roads, schools, sewer systems, etc. Truman (2010) discusses these issues in the context of sovereign wealth funds and they are also a key focus of Berg et al. (2012). For the purposes of this section, which form the saving takes does not matter. Section 2 describes the policies chosen by Norway.

A Reason to Save Less: Social Justice

Productivity in advanced economies has almost continuously improved since the Industrial Revolution. Thus, production in the nonresource economy is expected to rise over time, supporting a permanently rising level of baseline consumption as shown in figure 1.

In contrast to the principle of equity among generations, one might argue that considerations of social justice would call for resource revenues to benefit the current generation more than future wealthier ones.[6] The structure of tax and transfer systems in most advanced economies, which redistribute at least some income from wealthy to poor households, suggests that this view of social justice is widely held. There is thus a strong case to save less and consume more of the resource revenues during the early years of resource extraction. Taken to the extreme, however, future generations might receive no benefit from resources over which they had no control, an outcome that seems intuitively unfair.

Some Reasons to Save More

Investment Returns and Long-Run Growth

Ramsey (1928) explored the question of optimal national saving using his classic growth model. He considered the case of a social planner who maximizes the discounted sum of current and future utility.[7] In this model, a rising path of consumption is optimal when the rate of return on saving exceeds the discount rate. Blanchard and Fischer (1989, chapter 2) showed that, when the social welfare function has the property of constant relative risk aversion (CRRA), the optimal response to a windfall gain is to raise consumption across the current and all future periods by a fixed proportional factor. If consumption was rising before the windfall, then future generations receive a greater increase in the level of consumption than the current generation. The principle of equity among generations holds in the Ramsey model only when the discount rate equals the rate of return and consumption is not rising.

For the benchmark CRRA case of logarithmic utility, the optimal saving rate out of a windfall in the Ramsey model can be deduced from table 1 after subtracting the trend growth rate from the real rate of return. For example, if the real rate of return is 4 percent and the trend growth rate of consumption is 2 percent, then the optimal saving rate with 25 years of resource extraction is 61 percent, which is larger than it would be when trend growth is zero (38 percent).

CRRA utility has the appealing property that an additional unit of consumption is valued more highly when consumption is low than when it is high. Nevertheless, this preference for low-income generations is not sufficient to overturn the model's allocation of more gains to future wealthier generations when the rate of return is high. The Ramsey model thus stands in direct opposition to Rawls' theory of social justice, which calls for more gains to the current poorer generation.

A compromise between the principle of equity among generations and optimization in the Ramsey model is to allocate the gains in consumption equally across generations on a per capita basis. Allocating gains equally over time is a natural result if social welfare is based on aggregate consumption or consumption of extended families. But, if social welfare is based on individual consumption and population is growing, it makes sense to allocate more of the gains to future generations in order to raise per capita consumption equally.[8]

Table 1 can be used to determine the optimal saving rate if the goal is to raise consumption equally over time on a per capita basis. In that case, subtract the population growth rate from the real rate of return. For example, if the real rate of return is 4 percent and the population growth rate is 1 percent, then the optimal saving rate with 25 years of resource extraction is 48 percent, which is larger than it would be if the goal were to increase consumption equally over time without controlling for population (38 percent).

6. As described in Solow (1974), the philosopher John Rawls (1971) proposed that social welfare is determined by the utility of the poorest member of society. Rawls railed against "heavy sacrifices of the poorer generations for the sake of greater advantages for later ones that are far better off." Yet he recognized that, taken to extremes, his theory would imply no saving at all, which he rejected, saying only that "the problem of saving must be treated in another fashion."

7. Ramsey argued that the discount rate should be zero, which would imply an equal weight on the utilities of the current and all future generations. However, individuals appear to have a positive discount rate in that they weight future consumption less than current consumption and it may be argued that society as a whole shares this characteristic.

8. This ignores the question of the optimal population growth policy. It is surely desirable to stabilize population at some point or even to reduce it.

Risk

The derivation of the shared benefits policy is based on the assumption that resource revenues and investment returns are both constant over time and known with certainty. In reality, the future recoverable volume of resources, the price they can obtain in global markets, and the returns on invested savings are random variables that can be projected only with uncertainty. The uncertainty associated with the resource price is particularly important until the country enters the final years of resource extraction (Kjaer 2006).[9] If utility is concave in the level of consumption, so that a given increase in consumption does not raise utility as much as the same decrease in consumption reduces utility, then risk matters. A simple measure of risk is the variance of consumption around its expected value.

In the presence of risk, it is desirable to save somewhat more than in the riskless case, especially in the early years, to guard against future low resource revenues or investment returns. Thus, the increase of consumption to its long-run higher level could be phased in over a few years and the excess savings during this phase-in period used to build a buffer stock, or "rainy day" fund, to cushion consumption against periods of low prices or returns. For example, if consumption is increased by 20 percent toward the long-run level implied by the shared benefits policy in each of the first five years of resource extraction, the additional resource saving would suffice to build a buffer stock equivalent to 2.2 years of resource revenues (assuming a real rate of return of 3 percent). The objective would not be to permanently shield consumption from all future adjustments but to enable adjustments to be gradual.

Equation 4 represents a modification of equation 2 that reduces the variance of consumption in the presence of volatile and uncertain future resource revenues:

$$\text{Consumption}_t = (1-s)*[(T+1-t)/T]*(\text{Moving average of revenue})_t + r*\text{Assets}_{t-1} \quad \text{for } t \leq T \tag{4}$$

This modified shared benefits policy differs from equation 2 in two respects: First, the contribution of resource revenues to consumption gradually declines and the contribution of past savings gradually increases as the asset stock increases. With constant resource revenues, these effects exactly offset each other, leaving consumption identical to that implied by equation 2. When resource revenues fluctuate, the growing role of past savings introduces a stabilizing factor. Second, the initial increase in consumption is phased in gradually because the lagged moving average includes years of zero revenue during the first few years of resource extraction. This phase-in creates a somewhat higher stock of assets than under equation 2. Also, the use of the moving average of resource revenue smooths fluctuations in consumption directly. When extraction ceases ($t>T$), consumption depends entirely on the accumulated assets, as shown in equation 3.

Dutch Disease

Another consideration is the adjustment cost incurred as the incremental consumption tilts the economy toward production of nontradables instead of tradables. This adjustment is known as "Dutch Disease," reflecting the stagnation of the tradable sector in the Netherlands after the discovery of offshore natural gas in 1959.

When resource revenues are used to support consumption, demand increases for both tradables and nontradables. With a fixed labor force and a capital stock that is determined by global financial markets, the economy's nonresource production faces strict limits. Nontradables must be produced at home, but tradables may be imported. To increase production of nontradables, labor and capital must be drawn from the tradable sector, which shrinks.[10] Imports fill the gap created by the higher consumption of tradables and the lower production of tradables.

Adjustment costs are unavoidable if a resource discovery is to raise consumption over any horizon. But adjustment costs will be higher if consumption rises by more in the near term than in the long term, as would happen if little or none of the resource revenues are saved. The shared benefits policy minimizes the amount of adjustment needed over time. Saving more than in the shared benefits policy delays the initial adjustment but increases adjustment over time because it raises the long-run level of consumption.[11]

Table 2 displays a stylized example of economic adjustment under three benchmark saving policies. For simplicity,

9. To a limited extent, it may be possible to adjust the speed of resource extraction in response to perceived transitory fluctuations in the resource price, thereby reducing some of the cost of uncertainty. This possibility is not explored in this Policy Brief.

10. Some researchers argue that the Dutch Disease has a permanent cost in addition to any adjustment cost because the tradable sector is especially important for raising skills and technology in developing economies (Matsen and Torvik 2005). This view is not universally shared, and, in any event, it does not seem relevant for Norway, which is near the frontier of labor skills and technology.

11. Akram (2005) reaches the same conclusion in a model with no growth. He argues for saving more than the shared benefits policy when growth is positive, but his conclusion is based on an assumption that adjustment costs depend on changes in the *ratio* of nontradable to tradable production. If adjustment costs depend on changes in the *levels* of nontradable and tradable production, the shared benefits policy is optimal.

Table 2 Economic adjustments under different saving policies

Period	No saving		Shared benefits		Ultrafrugal	
	Production Tr/NonTr	Consumption	Production Tr/NonTr	Consumption	Production Tr/NonTr	Consumption
Period 0	50/50	100	50/50	100	50/50	100
Period 1	30/70	140	40/60	120	50/50	100
Period 5	30/70	140	40/60	120	48/52	104
Period 10	30/70	140	40/60	120	45/55	110
Period 15	30/70	140	40/60	120	42/58	116
Period 20	30/70	140	40/60	120	39/61	122
Periods 26+	50/50	100	40/60	120	35/65	130

Note: Production refers to tradables and nontradables in the nonresource sector. These results assume a real rate of return of 2.9 percent, no economic growth, no labor or capital required for resource extraction, and 25 years of resource revenues of 40 units per year.

Source: Author's calculations.

assume that no labor or capital is needed to extract the resource windfall and there is no economic growth. Prior to the resource discovery, the economy produces 50 units of tradables and 50 units of nontradables and trade is balanced so that consumption also consists of 50 units of each category. The resource revenues equal 40 units, extraction lasts for 25 years, and none of the resource is consumed at home.

The first two columns display the evolution of the nonresource economy under a policy of no saving. Consumption rises by the full amount of the resource revenues. The additional consumption is assumed to be split between tradables and nontradables in the same proportion as the initial consumption. To satisfy the additional consumption demand, domestic production of nontradables must rise to 70 units, thus reducing the capacity of the tradables sector to 30 units. Imports rise by 40 units, equal to resource exports, and trade remains balanced. When the resource runs out, the economy returns to its initial equilibrium. The adjustment cost must be borne twice, first in period 1 when tradables production falls to 30 and later in period 26 when tradables production returns to 50.

The middle two columns display the economy under the shared benefits policy with an assumed real rate of return of 2.9 percent. Half of the resource revenues are consumed and half saved via a trade surplus. The economic adjustment is only half as large as under the no saving policy. Moreover, the adjustment is permanent, and no second adjustment cost is incurred when the resource runs out.[12] *The shared benefits strategy minimizes the total amount of economic adjustment.*

The final two columns display the economy under the ultrafrugal policy. Adjustment under this policy is slower than under the shared benefits policy, but the overall amount of adjustment is somewhat larger. The costs of economic adjustment likely increase with both the size and speed of adjustment (Akram 2005). Thus, it is not clear whether the overall costs of adjustment are greater under the shared benefits policy or the ultrafrugal policy.[13]

A Proposed Optimal Policy: Modified Shared Benefits

The modified shared benefits policy (equations 3 and 4) represents a reasonable compromise between the goals of social justice and maximizing discounted utility with economic growth and uncertainty. To implement the policy on a per capita basis, the coefficient r should be interpreted as the rate of return minus the rate of population growth. Accordingly, the saving rate, s, is derived from table 1 under the assumption that r is the rate of return minus the rate of population growth.

2. NORWAY'S SAVING EXPERIENCE

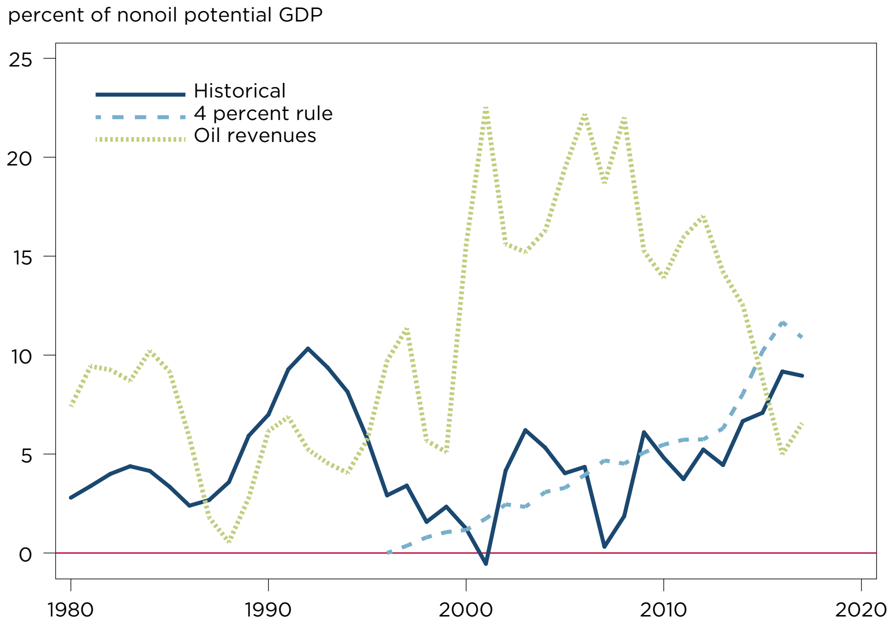
Oil Revenues and Fiscal Policy

Norway's oil industry was developed in the 1970s after the discovery of offshore oil in 1969. From the mid-1970s to the mid-1990s, oil revenues enabled Norway to run a fiscal surplus in most years, but there was no agreed rule on how much of the revenues was to be saved or spent (including spending in the form of tax cuts). By the end of 1995, general government assets exceeded liabilities; Norway's net debt was –13 percent of GDP, compared with 44 percent

12. The trade surplus switches to a trade deficit when the resource runs out, but the trade deficit is matched by an income surplus, leaving the current account in balance.

13. The modified shared benefits policy (with saving based on a moving average of resource revenues) has a smoother initial adjustment than the simple shared benefits policy, but it is less smooth than the ultrafrugal policy. The modified shared benefits policy slightly increases the total adjustment compared with the simple shared benefits policy because it increases total saving.

Figure 3 Oil sector contribution to Norway's fiscal spending, 1980–2017



Note: Prior to 1996, the solid line is the structural fiscal balance with reversed sign. Beginning in 1996, the solid line is oil revenues minus the net transfer of funds into the GPFG. The dashed line is 4 percent of the previous year's simulated GPFG balance, in which each year's contribution to the GPFG is given by oil revenues minus the dashed line and rates of return are assumed equal to their historical values.

Sources: IMF *World Economic Outlook* database, Norges Bank Investment Management, Norsk Petroleum, and author's calculations.

of GDP in neighboring Sweden and 41 percent of GDP on average in the advanced economies.[14] The low (indeed negative) net debt is one indicator of the extent to which Norway's government saved the oil revenues.

In 1990, the Norwegian Parliament voted to set up a special-purpose fund to save oil revenues net of extraction costs. Transfers to the Petroleum Fund of Norway began in 1996. The fund was renamed the Government Pension Fund Global in 2006. In 2001, the Parliament formulated the policy rule that all net oil revenues would flow into the GPFG and the expected real return on the GPFG would be used to support the government budget on average over the business cycle (Gjedrem 2008). This is essentially the policy labeled ultrafrugal in the previous section. For many years, the expected real return was estimated to be 4 percent (Gjedrem 2005, 2008). In 2017, the expected real return was marked down to 3 percent (Norwegian Ministry of Finance 2017). No allowance is made for population growth, so that the accumulated assets will eventually decline in per capita terms.

Figure 3 shows the contribution of the oil sector to Norway's fiscal spending. Beginning with the first transfers to the GPFG in 1996, the oil sector's contribution (the solid line) is directly measured as the difference between oil revenues and the net transfer of funds to the GPFG. Prior to 1996, there was no direct measure of spending out of oil revenues. The preferred measure of the Norwegian Ministry of Finance is the cyclically adjusted nonoil fiscal deficit, commonly referred to in Norway as the structural deficit.[15] The structural deficit reflects the spending of the oil revenues under the assumption that the structural deficit would be zero in the absence of oil revenues.[16]

How does Norway's actual spending of oil revenues compare with the government's stated rule? The dashed line

14. Data are from the IMF's *World Economic Outlook* database.

15. The IMF's cyclically adjusted fiscal balance for Norway is also based on the nonoil economy and excludes oil revenues. It is very close to that of the Norwegian government and is the series used here before 1996.

16. In countries without a major oil sector, the cyclically adjusted fiscal deficit is not constant and often does not fluctuate around zero. Nevertheless, after 1996, the Norwegian structural deficit has been close to, but less volatile than, the oil contribution displayed in figure 3 on average and is especially close in the years after 2010.

in figure 3 displays a strict interpretation of Norway's oil spending rule (the ultrafrugal policy). The dashed line is set equal to 4 percent of the value of the GPFG at the end of the previous year. Over time, however, the value of the GPFG used to determine the dashed line differs from its historical value according to whether the dashed line exceeds or falls below the solid line.[17] Spending starts at zero in 1996 because the GPFG did not exist in 1995. Spending under the strict rule grows faster than it did historically and ends up noticeably higher. Norway's actual spending of oil revenues appears to have been even more frugal than its stated policy. Indeed, actual spending turns out to have been very close to what would have been expected with a 3 percent spending rule (not shown), especially in the years since 2010.

Why has Norway chosen such a frugal policy? A perusal of reports and studies by Norges Bank Investment Management (the central bank's asset management unit, which manages the GPFG) and reports on the GPFG by the Norwegian Ministry of Finance reveals a thorough consideration of issues related to (1) maximizing returns, (2) minimizing risk, (3) safeguarding governance, and (4) investing with respect to social and environmental objectives, such as avoiding investment in manufacturers of certain types of weapons or in highly polluting firms. The GPFG's mission is taken to be saving oil wealth for future generations, but there is no discussion of how much saving is optimal in the context of intergenerational equity or social justice. The word "pension" in the GPFG's name suggests a link to the pension system, but the GPFG appears to have grown larger than had been anticipated at its conception, so that it has become a backstop for the entire fiscal budget.[18]

One discussion note in particular highlights a risk that might be used to justify a very high rate of saving (Norges Bank Investment Management 2016). The note conducts dynamic simulations of the future path of the GPFG under random shocks to oil revenues and investment returns assuming different portfolio allocations between equity and fixed income assets. Assuming that spending out of the GPFG follows a strict 4 percent rule, there is less than a 1 percent chance of a 50 percent decline in the value of the GPFG over a 10-year period. The GPFG is certain to survive indefinitely, but there is a small chance of a noticeable decline in value that would require a long-lasting reduction in spending out of the fund. The note goes on to consider the hypothetical case in which spending from the GPFG is used to stabilize overall government spending regardless of the size of the fund and without any endogenous response of taxes to low investment returns. In this case, there is more than a 50 percent probability that the GPFG would not survive 100 years; the GPFG would have a median longevity of around 60 years before the last dollar is spent.

No investment strategy can fully eliminate the risk of a sustained drop in oil wealth without sacrificing returns to an unacceptable degree. Moreover, the uncertainty introduced into national consumption from the GPFG is smaller than the uncertainty from economic fluctuations and productivity growth in the nonoil economy.[19] Asking the GPFG to fully stabilize government spending on its own is asking too much.

National Consumption under Alternative Policies

Historical Policy: Past and Projected

A rough and ready estimate of the contribution of the oil sector to national consumption in Norway is the oil sector's contribution to fiscal spending (figure 3). This approach aggregates public and private consumption. It assumes that households would increase their consumption by the full amount of any transfers or tax cuts funded by oil revenues. It ignores any effect of oil revenues on public investment, or, equivalently, it treats public investment as if it were public consumption. These assumptions are discussed below.

To project oil consumption into the future, the following assumptions are made. Net oil revenues through 2018 are based on data and projections from Norsk Petroleum. In 2019–30, they are assumed to be constant at the 2018 value in real terms.[20] Beginning in 2031 they decline gradually. After 2050 they are assumed to be zero (see figure 4). The

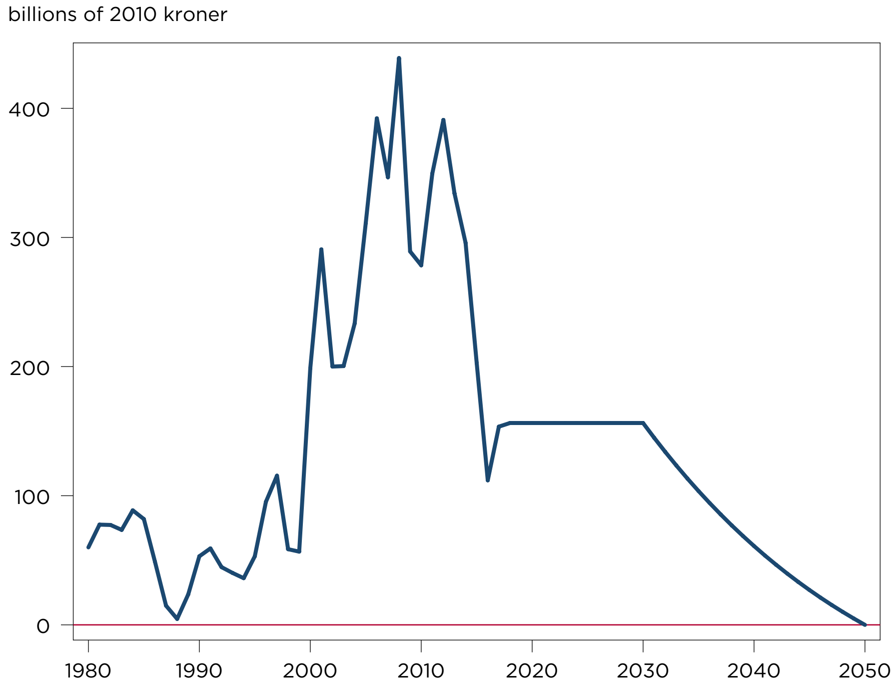
17. Thus, if the government spent less than 4 percent of the GPFG in year X, the GPFG at the end of year X would have been higher than it "should" have been. The dashed line is based on the level of the GPFG assuming a continuous spending level of exactly 4 percent of the previous year's GPFG. The GPFG then grows each year based on the historical rate of return times the assumed value at the end of the previous year.

18. I thank Ted Truman for this observation.

19. Expected earnings on the GPFG plus imputed earnings on unrecovered petroleum wealth represent only 11 percent of Norwegian national income (Norwegian Ministry of Finance 2017, 59). If real returns on the GPFG are as volatile as returns on a US portfolio of 70 percent equity and 30 percent short-term Treasury bills and if the standard deviation of Norwegian nonoil income is similar to that of US real consumption, the contribution to consumption volatility from the Norwegian nonoil economy would be roughly three times greater than the contribution from future returns on the GPFG. Data on US returns and consumption from 1889 through 2009 are available at www.econ.yale.edu/~shiller/data.htm (accessed on January 25, 2018). Standard deviations are calculated by the author.

20. This projection is broadly consistent with extraction forecasts of Norsk Petroleum through 2030 and crude oil futures prices through 2026 from the CME Group.

Figure 4 Historical and projected real oil revenues in Norway, 1980–2050



Sources: Norsk Petroleum, CME Group, and author's calculations.

decline after 2030 reflects both the exhaustion of proved and likely oil reserves and an assumed decline in the global price of oil owing to ever-tighter restrictions on carbon emissions.

For the years 2018–22, the contribution of the oil sector to national consumption is taken to be the structural fiscal deficit projected by the IMF. Beginning in 2023, the projected contribution is 3 percent of the value of the GPFG at the end of the previous year, consistent with the revised fiscal rule. The real rate of return on the GPFG is taken as the observed rate of return through 2017 and 3.7 percent thereafter, modestly higher than the Norwegian government's latest projection of 3 percent.

There are strong grounds to expect a rate of return greater than 3 percent. Norges Bank Investment Management (www.nbim.no) reports a historical average real rate of return on the GPFG between 1998 and 2017 of 4.2 percent in an international currency basket (deflated by international prices) and 4.5 percent in Norwegian currency (deflated by Norwegian consumer prices). (The latter measure is more relevant for the purpose of the GPFG, which aims to raise the real purchasing power of Norwegians.) Jorda et al. (2017) report a global average real rate of return on all assets from 1870 to 2015 of about 6 percent. However, given the sustained decline in government bond yields in advanced economies over the past three decades and the recent rise in global equity prices, it may be reasonable to expect somewhat lower returns in the future than in the past.

Future real yields on government debt are likely to be around 1 percent, down from more than 2 percent in past years.[21] Yields on medium-grade corporate bonds are around 1 percentage point higher than yields on government bonds (www.bloomberg.com). Earnings-price yields provide a reasonable estimate of sustainable real rates of return on equity (as long as earnings are not unusually elevated or depressed). The backward earnings-price yield on the MSCI global equity index (year-end 2017, from www.msci.com) is 4.6 percent and the forward earnings-price yield is 5.9 percent. The forward yield may reflect overly exuberant expectations, but the backward yield is not based on an unusually buoyant earnings outcome. Using the backward earnings yield and estimated real returns of 1 percent on government debt and 2 percent on private debt implies a future real rate of return on the GPFG equal to 0.725*4.6+0.275*1.25, or 3.7 percent.[22] If forward earn-

21. Holston, Laubach, and Williams (2016) estimate equilibrium short-term real rates of between –0.5 and 1.5 percent for Canada, the euro area, the United Kingdom, and the United States. It seems likely that these rates have been held down by economic slack and are more likely to rise over the longer term than to fall further. The yield on 30-year US Treasury bonds is just above 3 percent, which implies a real rate of return just above 1 percent if inflation remains near its target of 2 percent.

22. This calculation is based on the future target equity share of 70 percent plus real estate holdings of 2.5 percent, assum-

ings are given any weight, an even higher projected rate of return would be justified. Norges Bank and the Norwegian Finance Ministry project a more conservative overall real rate of return of 3 percent, based on fixed income returns of 0.75 percent and equity returns of 3.75 percent (Norwegian Ministry of Finance 2017, 46).

For the years after 2017, the simulations below assume a real rate of return of 3.7 percent, a trend population growth rate of 0.7 percent, and a spending rule of 3 percent of the previous year-end GPFG.[23] The goal is to stabilize *per capita* consumption. If one wished to stabilize total consumption, which is implicitly the goal of Norway's spending rule after the oil runs out, one could spend a higher fraction of the GPFG. It is an interesting coincidence that the Norwegian government's lower projected rate of return combined with its implicit goal of stabilizing total consumption (instead of per capita consumption) yields the same 3 percent spending rule used here.

The value of the GPFG reflects a conservative estimate of Norway's national oil savings for two reasons. First, the government of Norway had a much lower (indeed negative) net debt compared with other advanced economies prior to the start of the GPFG, and Norway's net general government debt excluding the GPFG remains negative.[24] Second, Norway has modestly higher public investment than other advanced economies; in 2016 public investment was 5.3 percent of Norwegian GDP, compared with 3.3 percent in the United States, 4.1 percent in Sweden, and 5.0 percent in Japan.[25] Public investment is a form of saving that is not captured by net debt or other financial asset measures.

This Policy Brief does not explore the effect of the GPFG on private saving in Norway. The theory of Ricardian equivalence suggests that when governments save more, households save less, reflecting their expectation of higher future transfers and lower future taxes (assuming government consumption is held on the previously expected path). Thus, in a Ricardian world, all resource-exporting economies should have equally high national saving rates regardless of whether their governments save the revenues or distribute them to households through taxes and transfers. However, resource-exporting economies whose governments save most of the revenues (Kuwait, Norway, and Qatar) consistently have far higher national saving rates than resource exporters whose governments do not save much (Angola, Australia, and Nigeria).[26] Indeed, most studies find little, or at most partial, evidence in favor of Ricardian equivalence (Friedman 2005). This Policy Brief therefore assumes that changes in Norway's public saving of oil revenues translate directly into changes in national saving and consumption.

Modified Shared Benefits (Counterfactual) Policy

This subsection describes a counterfactual scenario based on the modified shared benefits policy (equations 3 and 4) on a per capita basis. The counterfactual starts with the first transfers to the GPFG in 1996. The policy rule parameters are given by projected remaining oil extraction of T=40 years and an assumed real rate of return on investment minus population growth of r=3 percent.[27] To account for saving of oil revenues prior to 1996, a simulated GPFG is created in 1995 with an asset value equal to the difference between the average advanced economy net general government debt (41 percent of GDP) and Norway's net debt of –13 percent of GDP. The moving average of oil revenues is based on the current year and previous four years.

In the counterfactual scenario, the contribution of the oil sector to fiscal spending in 1996 equals 67 percent of moving-average oil revenues plus 3 percent of the simulated 1995 GPFG balance. In each subsequent year until 2030 the direct contribution to spending declines smoothly toward 10 percent of average oil revenues. From 2031 to 2050, the direct contribution declines smoothly toward 0 percent of oil revenues and the indirect contribution rises with the GPFG.

Effectively, the difference between the counterfactual shared benefits policy and Norway's fiscal rule is that the counterfactual policy applies the real rate of return to both the resources in the ground and the accumulated financial assets, whereas Norway's fiscal rule applies the real rate of return only to the financial assets.

ing that real estate returns are equal to equity returns. Fixed income returns are set at a weighted average of government returns (1 percent) and corporate returns (2 percent).

23. Population projections are from the United Nations *World Population Prospects: The 2017 Revision*. The average population growth rate over the next 50 years is 0.7 percent per year.

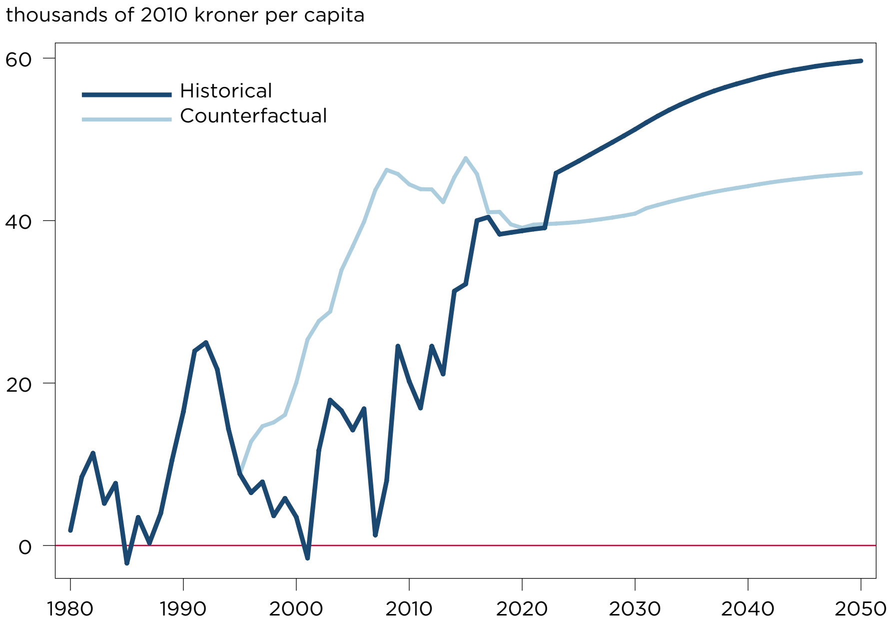
24. The IMF reports Norway's net general government debt at –2,734 billion kroner at year-end 2016. Norges Bank reports GPFG fixed income assets of 2,575 billion kroner at the same date. Thus, excluding debt assets held by the GPFG would still leave a negative net debt position of –159 billion kroner. The IMF does not include equity and real estate in its net debt measurement.

25. Data are from Haver Analytics. Public investment is not available for a number of advanced economies.

26. General government budget balances and national saving rates are from the IMF's *World Economic Outlook* database.

27. To prevent direct consumption (the first term on the right side of equation 4) from dropping to zero after 2036, the value of T is extended and the value of s increased in 2031 to allow a smooth decline of direct consumption through 2050.

Figure 5 Contributions to consumption of alternative oil-saving policies in Norway, 1980–2050



Note: The historical policy reflects IMF projections in 2018–2022 and a 3 percent spending rule after 2022. The counterfactual policy is the modified shared benefits policy starting in 1996.

Sources: IMF *World Economic Outlook* database, Norges Bank Investment Management, Norsk Petroleum, Statistics Norway, United Nations *World Population Prospects*, and author's calculations.

Comparison of Policies

Figure 5 displays the oil-sector contributions to fiscal spending, and thus national consumption, under the historical and counterfactual policies. Through 2017, the historical policy (the solid line) is identical to that shown in figure 3, except that it is expressed in inflation-adjusted units of Norwegian kroner per capita. From 2018 through 2022, consumption rises slowly because the IMF projections implicitly assume that Norway spends less out of the GPFG than would be implied by the 3 percent fiscal rule. After 2022, consumption jumps up a bit, following the strict 3 percent rule, and then rises smoothly toward its long-run increment of 60,000 kroner per capita at 2010 prices.

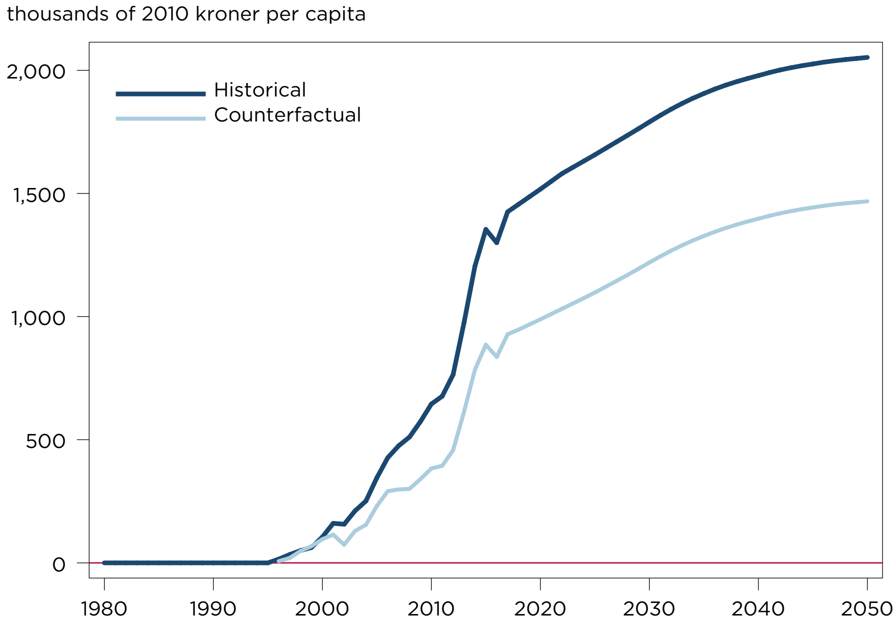
Under the modified shared benefits (counterfactual) policy, consumption rises in 1996 and remains above the historical policy through 2022. The increase in consumption over time reflects the fact that oil revenues grew unexpectedly fast over the first 10 years of the policy and the fact that returns on the GPFG have exceeded 3.7 percent in real terms. Consumption peaks in 2015 and then drops noticeably through 2020 before beginning to rise slowly again. The dip in consumption from 2015 to 2020 is smaller than some earlier dips in the historical policy. Beginning in 2023, consumption under the counterfactual policy slips below that of the historical policy and this gap widens a bit before leveling out in 2050.

Over the 22 years from 1996 through 2017, the counterfactual policy would have raised household consumption by nearly 9 percent on average, or 18,000 kroner per capita (at 2010 prices), equivalent to US$3,000 at the 2010 exchange rate.[28] This substantial increase in consumption would have come at the cost of reducing consumption over the 33 years from 2018 through 2050 by roughly 3 percent on average relative to the historical policy. In 2050, the legacy of past oil extraction is projected to increase per capita household consumption 16 percent under the counterfactual policy and 20 percent under the historical policy relative to a baseline without any oil extraction. These gains gradually diminish as a share of household consumption, reflecting the ongoing productivity gains that are projected to raise nonoil GDP continuously into the future.

Figure 6 displays the evolution of the GPFG under the historical and counterfactual policies. The GPFG now holds about 1 percent of all equities in the world. If other

28. This exercise assumes that all the fiscal benefits are passed to households through lower taxes and higher transfers, while public consumption is held constant.

Figure 6 GPFG under alternative saving policies, 1980–2050



Note: See note to figure 5.
Sources: See figure 5.

oil-producing countries were to save their oil revenues to the same degree as Norway, they would hold 50 percent of global equities with a large share of fixed income assets as well. Widespread adoption of Norway's saving policy by other resource exporters would have major implications for the global economy and financial markets, some of which are discussed in section 3.

Looking Forward

This analysis suggests that Norway has saved too much of its oil revenues since at least 1996. But, taking the lost consumption of previous years as a given, how should policy change to raise the consumption of current and future generations equally? Figure 7 compares a shared benefits (counterfactual) policy beginning in 2018 with the historical policy. As before, actual and expected returns are assumed to equal 3.7 percent in real terms. Future oil revenues are assumed to be known and equal to the assumed path discussed above.

The counterfactual policy is to consume 3 percent of the previous year's GPFG plus 40 percent of oil revenues in 2018, with the direct consumption of oil revenues declining steadily towards 0 percent by 2050 and the indirect consumption growing with the GPFG. This policy would increase consumption by about 15,000 kroner per capita in 2018 at 2010 prices (18,000 in current kroner or more than US$2,000 at the current exchange rate) compared with the historical policy rule.

3. INTERNATIONAL IMPLICATIONS

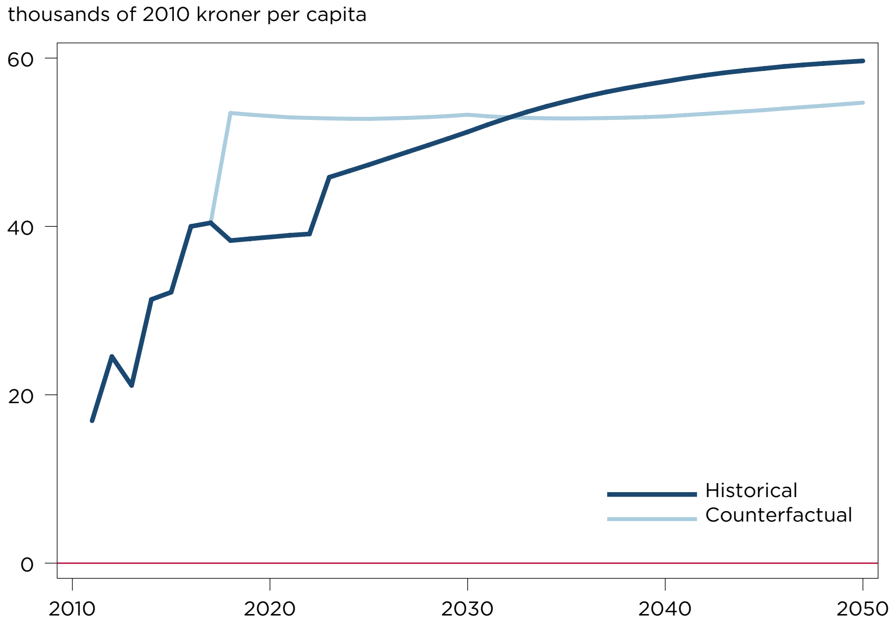
Official purchases of foreign-currency assets and fiscal surpluses both contribute importantly to external (current account) surpluses (Gagnon et al. 2017, Gagnon 2017). When a government runs a fiscal surplus and invests the surplus entirely in foreign assets, the current account rises by an amount nearly equal to the fiscal surplus. These estimates suggest that Norway's current account balance rises one dollar for each dollar of fiscal surplus that flows into foreign assets through the GPFG.[29] Figure 8 displays the very high correlation of Norway's fiscal balance, official financial flows, and current account balance.[30]

Economists are trained to think of the world as suffering from a shortage of capital. In such a world, Norway's massive savings would be a boon. In principle, the return on capital should be far higher in poor developing economies than in an advanced economy like Norway. In practice, however, the strategy of borrowing for development has been a disappointment (Rodrik 2008). Indeed, some of

29. This estimate is based on the baseline model in Gagnon (2017) under high capital mobility. Norway has high international capital mobility according to the data used in that study.

30. Official financial flows include the net acquisition of foreign assets by the GPFG and by Norges Bank through its foreign exchange reserves. The vast majority of the flows reflect the GPFG, as Norges Bank intervenes relatively little.

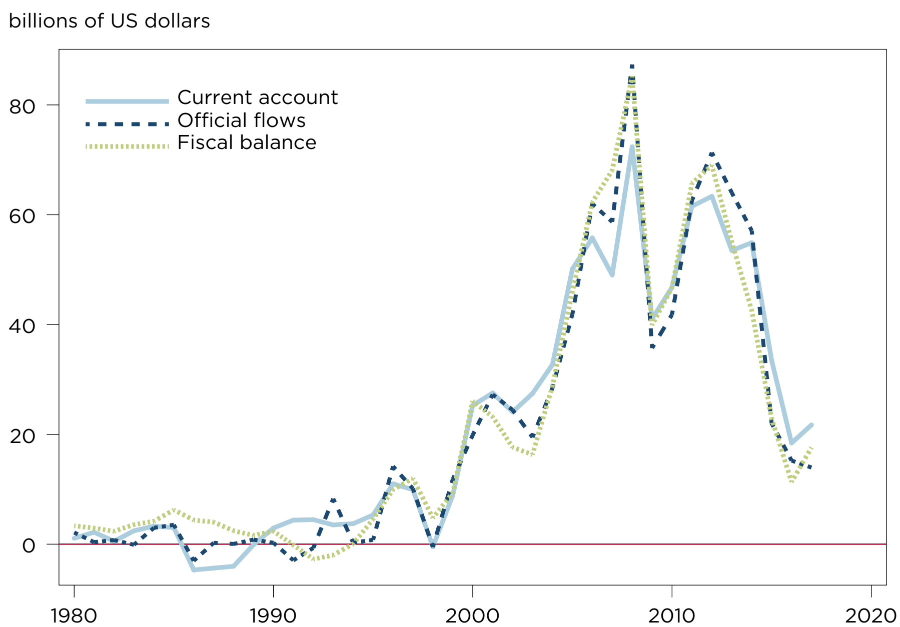
Figure 7 Projected contributions to consumption of alternative oil-saving policies in Norway, 2011–50



Note: The historical policy reflects IMF projections in 2018–2022 and a 3 percent spending rule after 2022. The counterfactual policy is the modified shared benefits policy starting in 2018.

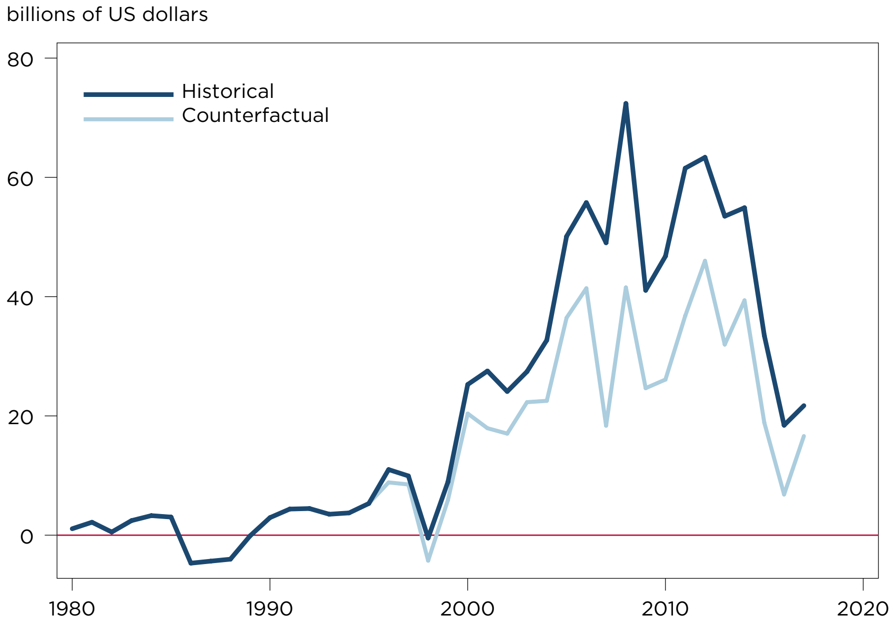
Sources: See figure 5.

Figure 8 Norway's current account and external saving, 1980–2017



Sources: IMF *World Economic Outlook* database, Gagnon (2017), Norges Bank, Norwegian Ministry of Finance, and author's calculations.

Figure 9 Effect of alternative oil-saving policies on Norway's current account, 1980–2017



Note: See note to figure 5.

Sources: IMF *World Economic Outlook* database, Norges Bank Investment Management, Norsk Petroleum, and author's calculations.

the most successful developers (Japan and China) grew rich without borrowing from abroad. Perhaps reflecting lessons learned in developing economies, most of the net flow of capital from surplus countries since the late 1990s has ended up in advanced economies, with the United States absorbing the lion's share. It is not clear that the marginal product of capital is much higher in the United States than Norway. More importantly, for most of the past decade, the United States struggled to recover from the 2008 financial crisis and recession. The flood of foreign capital into the United States, holding up the dollar and pushing down on US interest rates, was an important factor behind this weak recovery (Bernanke 2015).

In a world of anemic growth and chronically low real interest rates capital is not scarce. Whenever most economies are operating below potential, policy-driven capital outflows from, and trade surpluses in, countries like Norway impose a negative externality on the world, deepening and lengthening periods of economic weakness. This externality can cause international tensions and incite trade protectionism in the countries experiencing the corresponding trade deficits (Bergsten and Gagnon 2017). From the point of view of global welfare, there is a strong case under these circumstances for surplus countries to reduce their saving to a level below the level that may be optimal from the countries' own point of view in order to boost global economic activity.[31]

Figure 9 shows how much the current account would have changed under the counterfactual policy presented in figure 5. Over the 22 years from 1996 through 2017, Norway's current account surplus averaged $36 billion per year. If Norway's fiscal surplus and official flows (through the GPFG) had been reduced according to the modified shared benefits (counterfactual) policy, the statistical estimates suggest that Norway's current account surplus would have averaged only $23 billion, a reduction of more than one-third. This calculation involves a move to a policy that is optimal from Norway's own point of view. Taking into consideration weak global demand, there is a case for an even larger reduction in Norway's saving during the period from 2008 through 2016.

An alternative to saving the oil revenues in foreign assets would be to save domestically by buying Norwegian stocks and bonds and lending to Norwegian banks. Private financial markets would then determine how much of Norway's saving spilled over to other countries through a current account surplus and how much remained at home.

31. Countries that save little or none of their resource extraction arguably should increase their saving, but the same considerations suggest an optimal level of saving that is lower than it would be in the absence of any externality.

Investing the GPFG domestically would depress rates of return in Norway, encouraging private investors to seek higher returns abroad. A key issue is that of exchange rate risk. Under the current policy, the GPFG takes on all the exchange rate risk of saving abroad. If the GPFG invested entirely in domestic assets, private agents would be forced to take on exchange rate risk if they chose to allocate those funds abroad. Statistical results suggest that shifting GPFG flows from entirely foreign assets to entirely domestic assets would reduce their impact on the current account by around one-third to one-half (Gagnon 2017).

4. CONCLUSION

Many, perhaps most, resource-abundant economies save too little. Norway is a counterexample. Since at least 1996, Norway has saved more than was needed to raise consumption of all generations equally. During the slow recovery from the Great Recession of 2008, this high saving rate imposed a negative externality on the rest of the world. If slow growth and low interest rates are the new normal going forward, Norway's high saving is likely to continue to impose costs on its trading partners.

This Policy Brief proposes a counterfactual saving policy that would have increased Norway's household consumption by nearly 9 percent on average from 1996 through 2017. The proposed policy would have reduced Norway's current account surplus by more than one-third, or $13 billion per year on average, from 1996 through 2017. The problem is not only a relic of the past. Even now, Norway could raise current consumption by 18,000 kroner per capita (more than US$2,000 per capita), or nearly 3 percent of GDP, while keeping the contribution of oil wealth to future generations equally large.

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