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"HOW TO" OF FISCAL SUSTAINABILITY IN OIL-RICH COUNTRIES: THE CASE OF AZERBAIJAN

Luca Bandiera[*], *Nina Budina*[*] and *Sweder van Wijnbergen*[**]

Assessing fiscal sustainability – i.e. *considering whether or not a country can maintain its current fiscal policies without running into solvency problems and possible default – requires projections on a government's future revenue stream, expenditures and contingent liabilities within a macroeconomic framework. Such an exercise is always subject to uncertainty. In commodity-rich countries dependent upon resource revenues, this is intensified by unpredictable and volatile commodity prices. We apply the Framework for Fiscal Sustainability and Managing Uncertainty to Azerbaijan: we explore the link between non-oil primary deficit and Oil Fund allocation rules and assess their impact on fiscal sustainability in Azerbaijan and allow for explicit analysis of the effects of uncertainty through scenario analysis and full stochastic analysis allowing Value-at-Risk assessments.*

1 Introduction

Traditional fiscal sustainability approaches consider the overall fiscal accounts. However, for oil-rich countries a distinction between the oil and non-oil fiscal position is desirable because oil-related revenues are not like traditional sources of government revenue for the following reasons:[1]

First, oil is an exhaustible asset. In extracting and selling oil, the government can be thought of as converting a physical asset ("below ground") into an economic or financial asset ("above ground"). Hence, to maintain its level of wealth, the government should invest oil revenues in projects that yield a competitive economic rate of return. Second, oil reserves depletion should explicitly consider the intergenerational equity. It is reasonable that the benefits from taxation should accrue to the generation incurring the taxes. But since oil is an asset which is naturally endowed to a country, its benefits net of extraction costs ought to be shared across generations.

Finally, oil income is highly volatile**.** In many oil-rich developing countries, oil-related revenues account for the lion's share of government revenues as shown in Table 1; but oil income is highly volatile even when quantities are relatively easy to predict, because oil *price volatility* is high. Experience has shown that high volatility slows down productivity growth by a substantial margin, in particular in countries with a relatively underdeveloped financial sector. Hence many oil-producing countries aim at reducing spending volatility below the levels of oil revenue volatility by diverting a stable flow of resources from oil revenues to the budget, and allocating the remainder to a stabilization fund.

Assessing fiscal sustainability – *i.e.* considering whether or not a country can maintain its current fiscal policies without running into solvency problems and possible default – requires projections on a government's future revenue stream, expenditures and contingent liabilities within a macroeconomic framework. Such an exercise is always subject to uncertainty. Given the special features of oil-rich countries, managing volatility during oil price booms makes it advisable to

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[1] The non-oil fiscal position is (total revenues minus oil-related revenues) – (total expenditure minus oil-related expenditure), *i.e.* the budget surplus if the oil sector did not exist.

Table 1

Relative Petroleum Dependence for Selected Oil-producing Countries, 2005

Country	percent of GDP[1]	percent of Government Revenues	percent of Goods Exports
Nigeria	53.1	84.4	87.6
Azerbaijan	42.2	38.9	90.0
Kazakhstan	30.5[2]	36.8	61.5
Norway	23.2	25.8	64.6
Russia	15.3[2]	12.7	48.1
Indonesia	10.2	28.0	10.9
Mexico	1.3	37.8	14.9

[1] Mining as percent of GDP.
[2] Oil exports as percent of GDP.
Source: WDI, WEO, IMF Art. IV and Macro Framework, and Country Statistics Reports.

divert at least some of the current oil revenues to an Oil Stabilization Fund (OSF), which many countries are doing today. Hence, the analysis needs to incorporate an OSF and an OSF allocation rule. Fiscal policy is captured by restrictions on the size of the non-oil primary deficit (NOPD) of the public sector plus the rule for allocating current oil revenues between the OSF and the budget. Fiscal sustainability analysis would then examine the impact of the non-oil primary fiscal deficit and OSF allocation rules on net debt levels, including monies saved in the OSF under various scenarios for the oil price.

We apply the FSA tool to the case of Azerbaijan, which is interesting on its own right but can also offer some lessons to other oil-rich countries. Azerbaijan faces a major challenge of managing its sudden high but temporary oil wealth. Because of the temporary nature of Azerbaijan's likely oil and gas revenues, intergenerational fairness is a major issue, as are concerns about post oil economic performance. Finally the highly volatile nature of oil revenues add further policy challenges; if it would translate in highly volatile spending levels and associated volatility of the real exchange rate, an effective tax on private investment would result with negative consequences for economic growth.

2 The Fiscal Sustainability Analysis (FSA) tool

Many oil-rich countries (ORCs) have attempted to use oil funds and/or fiscal rules to de-link public expenditure from volatile oil revenue and to accumulate large foreign exchange reserves/oil fund assets to lower vulnerability to financial crises and debt overhang problems. Experience has shown that high current oil income is in no way a guarantee that these countries will not at times have to face crisis circumstances in the future. Thus, managing fiscal risks from oil revenue uncertainty is a key challenge facing policy makers in ORCs. This section extends further the analytical framework for assessing the sustainability of fiscal strategies in ORCs (see Budina and van Wijnbergen, 2008).

Any framework needs to go beyond the routine consistency checks that form the bread and butter of fiscal sustainability analysis (FSA).[2] First of all, doing an FSA in the presence of an oil fund rule requires explicit incorporation of non-oil deficit rules to make the oil fund a meaningful exercise.[3] This requires modifying the government budget constraint and the resulting public debt dynamics equation to isolate the impact of oil on public finances and to reflect the special features of oil discussed above.

2.1 *Incorporation of the impact of oil on public finances*

The first step in such an approach is to create a baseline scenario of the likely future time path of the oil producer's net financial asset position, using the flow budget constraint equation. This baseline uses the flow budget equation to update future net financial assets as a share of GDP, based on macroeconomic projections of key determinants of public debt dynamics, such as growth, inflation, projected primary surpluses, and interest rates, as well as our projections for the oil fiscal revenues, which involve projections or assumptions of remaining oil reserves, the future rate of oil extraction, future oil prices, and taxation regimes. Customizing the forward looking approach to ORCs requires modifying the government budget constraint and the resulting public debt dynamics equation to isolate the impact of oil on public finances and to reflect the special features of oil.

Before going into the details, we should consider one important point. To ensure consistency among debt stocks, deficits, and revenue from seigniorage, it is necessary to consolidate the general government accounts with the central bank's profit and loss account (Anand and van Wijnbergen, 1988 and 1989). Otherwise, seigniorage, an important source of revenue in most developing countries will not show up in the budget dynamics, and debt may be mismeasured by failing to take into account assets held by the central bank.[4] This is especially important if the savings from current oil revenues are deposited at the central bank. Public sector foreign debt is then measured net of the (net) foreign asset holdings of the central bank and net of the assets of the oil fund, if those are deposited outside the central bank. Similarly, deficits and the ensuing liabilities for the state may be seriously mismeasured if the quasi-fiscal deficit of the central bank is excluded. Such mismeasurement is a major shortcoming of the recent International Monetary Fund approach to sustainability (IMF, 2002 and 2003). Similarly, if the oil fund is set up as an extrabudgetary fund, then one should consolidate the oil fund operation in the general budget. This consolidation may be especially important if the fund is authorized to undertake expenditure outside the consolidated budget.

After that consolidation, the analysis is structured around the net debt and OSF updating equations, tracing debt-to-output ratios and the OSF assets over time under different non-oil primary deficit and OSF allocation rules depending on the country's oil revenue profile (see Box 1). The model can be used to analyze specific scenarios for given assumptions about driving variables such as domestic and foreign real interest rates, the real exchange rate, inflation and world oil prices. These scenarios are useful to test robustness under extreme events and the impact of specific once-off shocks.

A simplified scheme of the proposed practical framework, which also accommodates a fiscal strategy for de-linking public expenditure from current oil revenue, is presented in Figure 1. As

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2 See Burnside (2005) for a good overview of the traditional Word Bank approach.

3 See Davis, Ossowski and Fedelino (2003) for a discussion of fiscal policy formulation in ORCs, and see Baunsgaard (2003) for a discussion of possible fiscal rules for Nigeria.

4 For debt decomposition derivation in discrete time, see the annex to this chapter.

Box 1
Net Public Debt and OSF Assets Dynamics

The difference equation for the net public debt-to-GDP ratio, *d* (measured net of the net foreign assets, public debt holdings of the central bank, and oil fund assets) has the following components:

$$\dot{d} = f - Roil_{SB} + (r-g)d + \alpha \hat{e} d - (Roil - Roil_{SB}) + OF \qquad (1)$$

(a) the fiscal rule is captured in the projections of the non-oil primary deficit net of seigniorage revenues, *f* (in percent of GDP); (b) growth adjusted real interest rate payments on net public debt (*g* is the real GDP growth rate; *r* is the real interest rate on public debt, (c) Capital gains or losses on net external debt due to exchange rate changes (*e* is the real exchange rate, $\frac{EP^*}{P}$ with obvious definitions of variables and α is the share of foreign currency denominated debt in total public debt), (d) **actual** oil revenues and (e) O(ther) F(actors), such as fiscal costs related to cleaning up the financial sector.
The model also includes a difference equation for the OSF assets-to-GDP ratio, *OSF*:

$$\dot{OSF} = (Roil - Roil_{SB}) + (r - g + \hat{e})OSF \qquad (2)$$

The first term in brackets measures the net OSF asset accumulation, or the excess oil revenue over and above that used to finance the non-oil primary deficit, while the second term measures growth adjusted real interest rate earnings on the OSF assets-to-GDP ratio, also accounting for capital gains/losses due to exchange rate changes.

Note: Equation (1) and (2) are presented in continuous time. For discrete time derivation, see Annex 1.

shown in the figure, besides the traditional automatic debt dynamics, the path of (gross) public debt depends on the projected stream of oil-related fiscal revenues, the level and the trajectory of the non-oil deficit, and the targeted level of foreign exchange reserves (the oil fund).

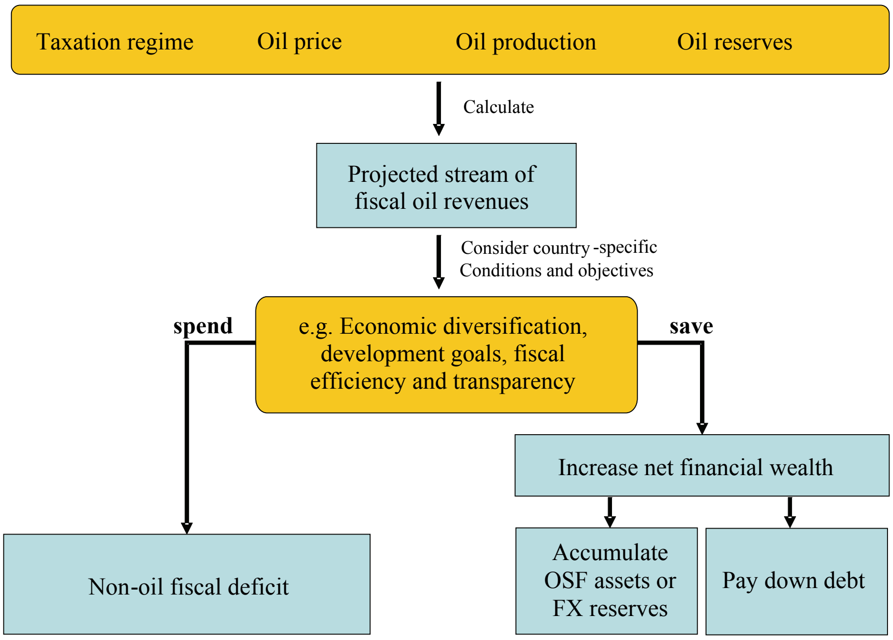
The country's oil revenue profile crucially influences the decision about how much to spend out of current oil income. Hence, the FSA analysis also requires estimates of proven reserves, extraction profiles that would determine the nature and the shape of the oil wealth (temporary permanent), long term oil price projections and a fiscal framework that can estimate/project future stream of oil fiscal revenue. Furthermore, since oil income is volatile, check the sensitivity to changes in oil prices/extraction profiles, new oil discoveries and changes in taxation regime is very important.

Next, once estimates of oil wealth become available, a key stage in the FSA analysis is how to set up meaningful fiscal rules for oil-producing countries, rules that would enable fiscal policy to manage volatility, to minimize possible Dutch disease considerations and to lower vulnerability to crises. One component of such a fiscal rule, which triggered significant attention relates to designing Oil Fund Accumulation rules. As discussed in Box 1, the essence of Oil Fund Accumulation Rules is captured by specifying the oil transfer to the budget – $Roil_{SB}$.[5]

[5] Note the FSA tool assumes that oil fiscal revenue in any given year are first deposited to the Oil Fund and then the amount of oil revenue to be used towards non-oil deficit financing is transferred from the Oil fund to the budget.

Figure 1

Fiscal Sustainability Framework for Oil-rich Countries



In countries with **limited proven oil reserves,** the oil windfall is going to be short-lived. Saving more out of the current oil revenue boom would dampen volatility while also allowing future generations to share in the oil even if the oil reserves may have been exhausted before they come on stage. The best approach to achieving both goals is to limit spending out of oil income to levels that can be sustained indefinitely by accumulating savings/paying down debt in high revenue years and dissaving in low income years in line with the *Permanent Income* from oil (see van Wijnbergen, 2008). Such a rule would be suitable for a country like Azerbaijan, which is expected to run out of oil around 2025 as shown in Figure 2. The approach would require limiting the non-oil primary deficit to the permanent income equivalent of the oil income, which has been estimated at approximately $5 billion in 2007 prices (the horizontal line in Figure 2). This would shift spending out towards the future, thereby reducing the real exchange rate pressure and stretching the spending boom.

For countries with large proven reserves, limiting budget transfers out of oil income to revenues calculated at a long term average (reference) price rather than the current high price has similar effects to the PI approach. Oil stabilization funds (OSFs) maybe set up to save oil revenues above the reference price. Such a rule has three advantages: simplicity and hence ease in implementation; imparting a measure of fiscal discipline with regard to the non-oil deficit; and breaking the link between government spending and current oil prices, thereby lowering the volatility of the real exchange rate and minimizing Dutch disease. Importantly, an OSF based on a reference oil price should ensure that the non-oil primary fiscal deficit does not exceed the oil revenues transferred to the budget at the reference price. Nigeria after 2003 and Russia have been successful in reducing expenditure volatility by using such a rule and by accumulating assets in an OSF.

Another possible OSF rule that is implemented in the FSA tool is the "bird in hand" rule, which has been used in Norway. This rule implies limiting the oil transfer to the budget to the annual financial return on the assets deposited in the OSF. As in the PI case, oil assets accrue entirely to the oil saving fund, but the rule is simpler than calculating the PI equivalent (the two OSF rules would be equivalent for a country that has exhausted completely its oil reserves). Finally, the FSA framework also allows for OSF rules that target the net accumulation of oil fund assets (which leaves as a residual the oil transfer to the budget).

Oil fund accumulation rules 1 to 3 above aim at stabilizing fiscal revenue from the volatility of oil prices. However, fiscal rules are necessary to prevent the accumulation of unsustainable public debt, consistent with the rules for the accumulation and use of oil reserves. The FSA tool includes 4 rules for NOPD. Each rule would interact with oil assets accrual rules defined above.

A second component, which is equally important for setting up meaningful fiscal rules for oil-rich countries, consist of supplementing the Oil Fund Accumulation rules by limits on the non-oil primary deficits. For example, an implementation of a PI rule requires not only limiting the oil transfer to the budget to the permanent income equivalent of the oil wealth, but equally, important, it also require limiting the non-oil primary deficit to the size of this oil transfer to the budget. Putting money aside with one hand but borrowing on the side with the other obviously would make any Oil Fund Accumulation Rule ineffective.

2.2 *Incorporation of uncertainty*

The second extension to regular FSA is the incorporation of uncertainty. So far we have assumed deterministic paths for the variables underlying the debt dynamics, as spelled out in equations (12.1) and (12.3). Given that there is uncertainty attached to projections of variables such as interest and growth rates, exchange rate developments, and so on, how sensitive are the results to a given shock in any of the variables used as input in the exercise? One way to address these uncertainties is to introduce *stress tests* to deal with specific risks. In a stress test, a set of sensitivity tests to the baseline scenario is conducted, assuming that the underlying variables swing away from their means by one or two standard deviations. Stress tests are a useful sensitivity check, but they have their limitations. In particular, they are incomplete because they ignore the endogenous interactions between input variables, and so are not a substitute for a full macroeconomic model-based analysis. But their merit is that they significantly reduce computational complexity and data requirements, and still give meaningful insights about the sensitivity of the model results to exogenous shocks. The most important sensitivity analyses include stress tests with respect to oil prices, real interest rates on domestic and foreign public debt, real output growth, primary balance, and (changes in) the real exchange rate.[6] The purposes of the various alternative scenarios are to facilitate a discussion of key vulnerabilities of the economy and to ensure more realistic fiscal sustainability assessments. In addition, the framework used allows for a fully specified crisis scenario, whereby the fiscal rule is compromised and a country is hit by a severe negative oil price shock.

Furthermore, the FSA tool also introduces the possibility to use a full scale Monte Carlo (MC) simulation of a using the stochastic properties of key variables driving the debt dynamics

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6 For a more detailed description of all the stress tests, see Bandiera *et al.* (2007).

process (see IMF, 2003 and Celasun, Debrun and Ostry, 2005). The input variables for stochastic simulations include oil prices, growth, real interest rates, real exchange rate and inflation. Using estimated parameters of the joint distribution of all input variables, the distribution of these variables can be simulated jointly using MC methods (see Bandiera *et al.*, 2007, for a technical description of the stochastic simulations). This implies that for n input variables and a horizon of T years, nxT random numbers are generated repeatedly until the generated and empirical distribution are sufficiently close. For each run, the model is applied to derive the full path of debt stocks. In this way the full probability distribution of debt/output ratios at each future point in time is derived. The probability density of the outcomes of debt ratio can be plotted from the stochastic simulations, generating a so called "fan chart" for the debt-to-GDP ratios over the projection period.

One way of obtaining the relevant variance-covariance information is to run a VAR on historical variables and transform the generated random numbers from the MC simulation in such a way that the resulting joint distribution of shocks conforms to the moments of the distribution of residuals estimated through the VAR. In the case of a multi-variate normal, a transformation using the Cholesky decomposition of the empirical covariance matrix can be used to transform iid generated random variables into variables corresponding to the empirical distribution.

Finally, as discussed below, MC simulations may overestimate the impact of exogenous shocks, since the government may take deliberate corrective actions as its debt stock rises. Therefore the FSA tool includes the possibility to combine stochastic simulations with an endogenous fiscal policy reaction function, which introduces a linear feedback effect from deviations from base level debt stocks to deviations from base level primary surpluses. Bohn (1998) shows that, if all other determinants of fiscal policy are stationary, a positive correlation between the primary surplus and the past level of the public debt-to-GDP ratio is sufficient to guarantee fiscal sustainability.

3 Fiscal sustainability and managing oil wealth in Azerbaijan

3.1 The value of Azerbaijan's oil wealth and sustainable spending

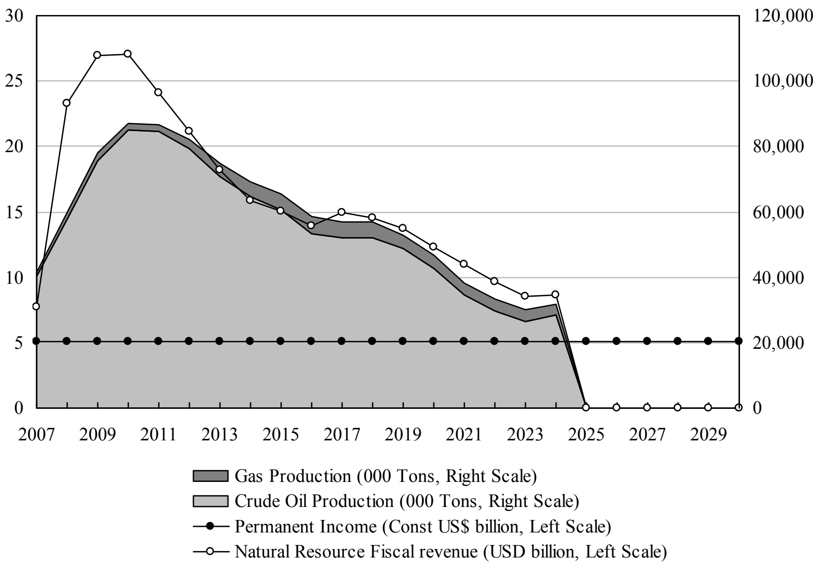
Three strategic questions frame the challenge that Azerbaijan faces in managing its oil windfall: (1) How much oil revenue should be saved and spent every year, or how to set meaningful oil fund/non-oil deficit rules? What is the link between oil fund rule and non-oil deficits and what are their implications for fiscal sustainability? (2) How to deal with uncertainty and manage oil revenue volatility? And (3) What other key (macro or capacity-related) factors constrain overall level of fiscal spending?

Below we sketch answers to these three questions. Simulations use a tool for fiscal sustainability analysis developed to introduce uncertainty on the effect of fiscal policy decisions in resource rich countries. The framework is described in Section 2 above.

The first set of inputs concerns the oil sector. We have used the latest available World Bank long term oil prices forecasts (see Annex A). However, just for comparison purposes we have compared them with the long term oil price forecast as of Nov. 07 (referred as old oil price forecasts). We also used available forecasts of oil and gas extraction rates and rich data on the costs in each individual oil field. After accounting for the tax structure, royalties, and production sharing schemes, the study was able to specify the relationship between oil revenues and various oil price scenarios. Under baseline oil price assumptions, Azerbaijan will experience a very steep increase in oil fiscal revenues during the next five years (2007-2012). However, without any new oil/gas

Figure 2

An Application of the PI Approach to Oil Wealth in Azerbaijan



discoveries, oil revenues are projected to decline quickly, returning to their current levels by 2015 and disappearing by 2025.

Below we calculate the PI equivalent for Azerbaijan before and after recent adjustments in price expectations to demonstrate this point. The graph lists oil price projections before and after a recent modification (February 2008), and the associated projected fiscal revenues from oil and gas production for the Azeri Government.

In Table 1 below we build up the NPV and PI calculation for Azerbaijan. We discount the future income back to 2007 in a Net Present Value calculation, assuming a safe real rate of interest of about 3 per cent (equal to the US long term real rate plus a hundred basis points Azerbaijan country risk). This is added to a long term US inflation projection of 2.4 per cent to arrive at a safe nominal rate of 5.5 per cent. But the income stream being discounted is not a safe stream; it is shrouded in substantial uncertainty. To account for the riskiness, we add a 3 per cent risk premium to the basic safe real rate.

Under the new oil price assumptions, the NPV of the oil and gas wealth is of course higher: an estimated US$165 billion, or a massive 594 per cent of 2007 GDP, and no less than

Table 1

Permanent Income Approach to Oil Wealth
(constant 2007 US$)

Oil Price Assumptions	**Net Wealth** *(US$ billion)*	**Net Oil Wealth to 2007 GDP** *(percent)*	**Net Oil Wealth to 2007 Non-oil GDP** *(percent)*	**Annuity**[1] *(US$ 2007 million)*
Real Safe rate of interest=3%, Risk premium=3%, Foreign inflation=2.4%				
Old Oil Price Assumptions	143	515	1274	4.4
New Oil Price Assumptions (February 2008)	165	594	1470	5.1

Note: In addition to the assumptions on oil prices and exploitable oil reserves, the results depend on the profile of the extraction, the pace of investments, and financial and operational decisions of the operators that may change the path of revenue that the government receives from oil operations.

[1] This annuity can be interpreted as the sustainable level of annual spending.

1470 per cent of 2007 non-oil GDP. The permanent income equivalent corresponding to this higher level of wealth, and again using the safe real rate to discount a flow of income/expenditure that is constant in real terms, is about US$5 billion in 2007 dollars, or slightly over 18 per cent of 2007 GDP and a whopping 45 per cent of 2007 non-oil GDP. The PI amount is what can be safely spent on an annual basis indefinitely, thus allowing future generations to share in equal absolute annual amounts in real terms (not per capita or as share of their income).

Furthermore, Table 1 shows the different PI calculations compared to the two revenue forecasts. An increase of more than US$20 billion in oil wealth (measured in NPV terms) results in an increase of less than $700 million of the annual spending limit because the windfall gain is spread out over the entire future. Of course the increase in the spending limit is linked to world inflation. Hence, under the assumption of the old (lower) long term oil price forecast, the NPV of the oil wealth is brought down to $143 billion, or only 12.7 per cent of non-oil GDP, while the corresponding permanent income equivalent is now estimated at $4.4 billion.

3.2 Deficit Rules, Oil Income and Fiscal Sustainability

As shown in Table 1, the PI out of the oil windfall for two different oil price projections varies between US$4.4 billion and US$5.1 billion in constant 2007 dollars. The permanent income levels shown in Figure 1 indicate that Azerbaijan, on this rule, should save substantial amounts of its oil revenues over the next 20 years, and that current levels of expenditure may be somewhat high, but are not very far out of line with what the PI approach would dictate (see Figure 3b) based on current wisdom in terms of oil price projections (see Annex A).

The measures of PI should be compared to the NOPD, as it represents the net claim on non-oil resources, to be covered by the PI amount transferred from the Oil Fund. Azerbaijan has wisely chosen to reduce spending volatility below the levels of oil revenue volatility by diverting a stable flow of resources from oil revenues to the budget, and allocating the remainder to a stabilization fund. To be effective, such an allocation rule needs to be complemented by a rule on the non-oil deficit; there is little point to adding money to a fund with the one hand, and borrowing against future oil revenues with the other. The Fiscal Sustainability Analysis tool (FSA) presented in Section 2 and in Annex B is designed to analyze the interaction between these two rules (oil fund allocation rule and non-oil primary deficit rule).

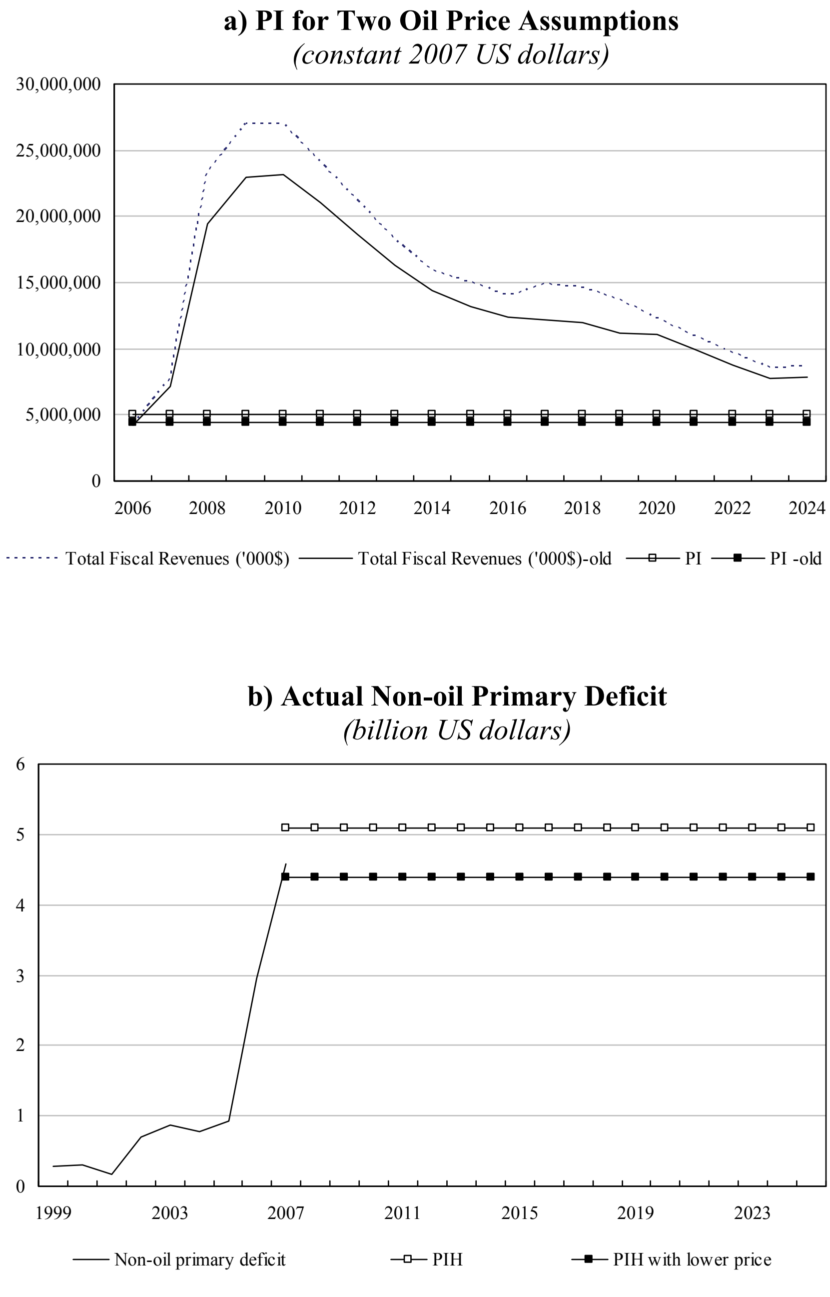
Some concern remains however about the *pace* of the increase in spending, even as it current *level* does not seem very far out of line with what the PI approach coupled with current non-oil public revenues allow. Public expenditure increased by 80 per cent in 2006 alone and tripled over the past three years. Managing such rapid expenditure increases is a challenge under the best of circumstances; the fact that Azerbaijan's public institutions are still in a build up phase adds further complications. There is for example not yet a public investment evaluation capacity in any of the existing ministries.

Given the challenge to manage future expenditure increases, we present three illustrative fiscal strategies for the non-oil deficit to GDP ratio: the first strategy assumes that the non-oil deficits in the next five years and beyond are bounded by the flow of oil revenue to the budget, which in turn is based on the deficit will be declining as a ratio of GDP. This is a reasonable sharing rule since over-all GDP growth is projected to be based not on population growth but on capital accumulation and productivity growth. Constant real amounts with a constant population imply equal amounts (in real terms) for current and future generations on a per person basis.

Furthermore, a base case strategy, guided by the medium term fiscal framework (MTEF) for the next three years, envisages non-oil primary deficits in excess of its “permanent income” equivalent in order to accommodate high infrastructure requirements strategy (see Figure 8a). Thereafter, it is assumed that the non-oil primary deficit gradually declines from about 20 per cent of GDP to 12 per cent by 2015 (its 2007 level), reaching 4.3 per cent of GDP by the end of the projection period.

Finally, a “high spending” strategy, whereby public spending increases according to the MTEF for the next three years, but as oppose to envisaged decline, public spending remains at its 2010 level (30 per cent of GDP). Provided that the non-oil revenue remains the same as in the base case, this implies a constant NOPD of 12 per cent of GDP from 2015 onwards.

Figure 3



With the different fiscal strategies specified (see Figure 4a), we run the fiscal sustainability tool to derive baseline projections for net public debt throughout the projection period. Note that as explained in Section 2, this framework also incorporates the dynamics of the oil fund assets and consequently, an oil fund rule to deal with the large but volatile oil revenue in Azerbaijan.

Under the PI scenario sustainability is of course not under threat because it is explicitly designed as a sustainable strategy; the net debt position remains basically unchanged over the planning horizon. Initial net saving are positive as oil revenues exceed the PI transfer and a NOPD that exactly matches the PI transfer; later on net savings stop but the overall net debt position remains essentially stable.

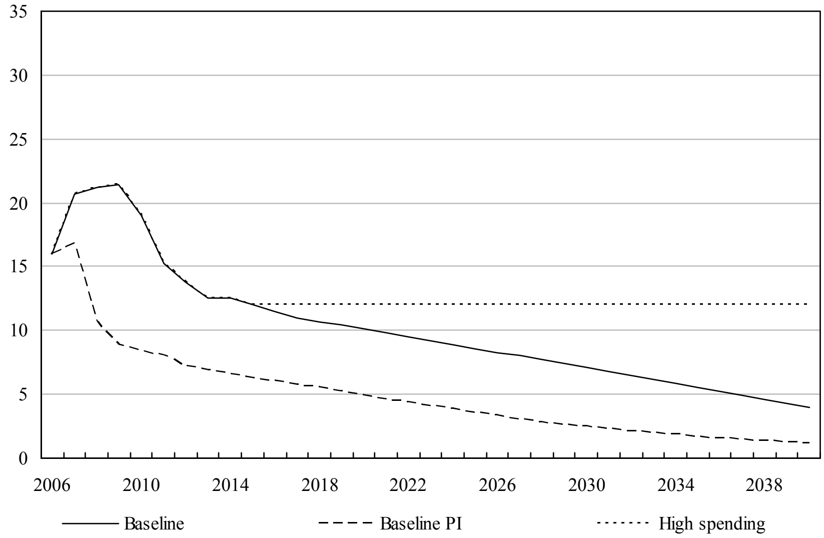
Under the high spending scenario, the government will maintain primary spending at 30 per cent of GDP, and corresponding NOPDs at 12 per cent of GDP. The net asset position deteriorates and reaches zero in 2030. Thereafter, Azerbaijan will become a net debtor again, to reach a net debt of 90 per cent by 2040, a deterioration of no less than 80 per centage points of GDP.

Finally, we also perform a stress test to the high spending scenario (HSP), to check the sensitivity of this strategy to a negative oil price shock. This stress test assesses the impact of a permanent oil price drop back to its long term historical average (see Figure 1b above) of about US$35 ppb in real terms while maintaining the high spending levels of the HSP scenario. The stress test indicates that this "high spending" scenario once again establishes Azerbaijan as a major debtor.

Figure 4

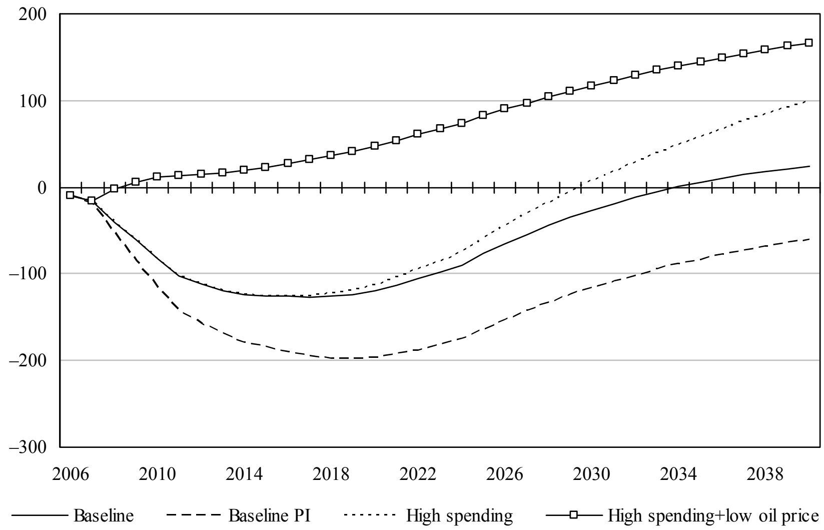
a) Illustrative Fiscal Strategies for Net Debt-to-GDP Ratio

(percent)



b) Stress tests for Net Debt-to-GDP Ratio

(percent)



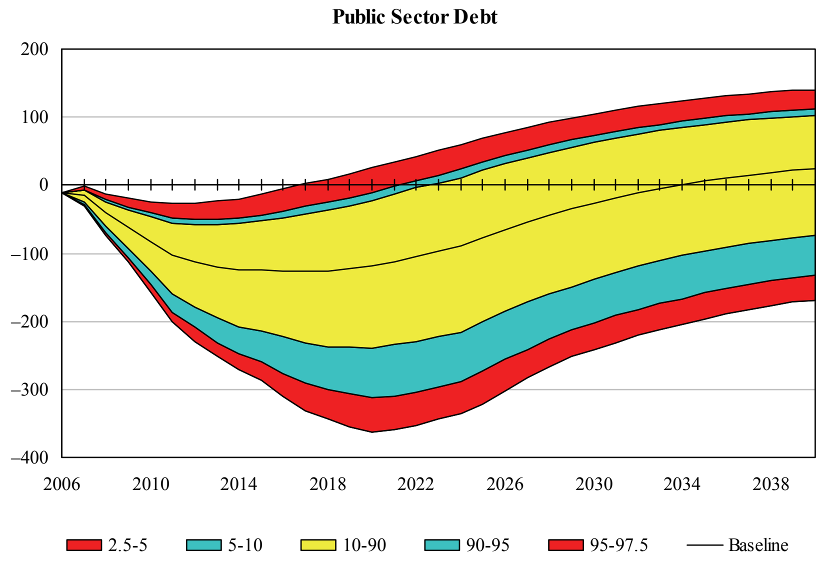
3.3 Fiscal sustainability under uncertainty: Monte Carlo (MC) simulations

The dominant feature of the Azeri economy is the high volatility of its main source of income, oil and gas. Thus a Monte Carlo analysis around base line predictions is useful: because of the high volatility, scenarios that seem reasonable in expected value terms may nevertheless mask substantial risks. V@R approach to public debt is implemented using stochastic simulations of two key variables: changes in the real exchange rate and the price of oil. The FSA tool runs full scale Monte Carlo simulations, using historical variances of two variables being simulated, simulates the full probability distribution of future debt/output ratios and plots distributions resulting from stochastic simulations in a so called "fan chart" for the debt-to-GDP ratio.

The runs reflect the baseline outcome, a net asset position that evaporates as time goes by; in about 30 years, Azerbaijan is expected to become a net debtor once again under this scenario. Such a rule introduces considerable uncertainty in the sense that the resulting distributions become very wide (*i.e.* the long term risks are large). Moreover, based on historical variances and the complete lack of any feedback of rising debt levels on fiscal policy, the net debt position can become very large over the next three decades. With 95 per cent certainty we can only say that the net debt will not become larger than 100 per cent of GDP, indicating that the risk of major debt problems is very real under this strategy (see Figure 5). One response would be to introduce feedback strategies: if net debt raises faster than planned a larger non-oil surplus is implemented.

Figure 5

Distribution of Future Debt Stocks under the Base Line Scenario



But first we will show what happens under the PI strategy. We run two variants: one using historical variances for both variables being simulated (Figure 6a), and one where the variance of the real exchange rate is reduced by 50 per cent, reflecting the fact that this run has a more stable expenditure policy (Figure 6b). The simulations summarized in Figure 6a and b show that reduced real exchange rate variance helps: the 95 per cent range now falls from net debt of about 30 per cent of GDP to net assets of about 10 per cent of GDP. In the Figure 6b scenario, Azerbaijan will stay out of debt with more than 95 per cent certainty during the entire horizon. Thus we can safely conclude that the PI scenario provides Azerbaijan with a reasonably safe environment.

However, there are legitimate reasons why spending levels during the initial years maybe higher than the one based on the PI approach. In particular, the need to improve both quantity and quality of the country's infrastructure may well require more financing than possible under the strict PI approach. This will add to exchange rate pressure, but may improve future competitiveness and therefore growth.

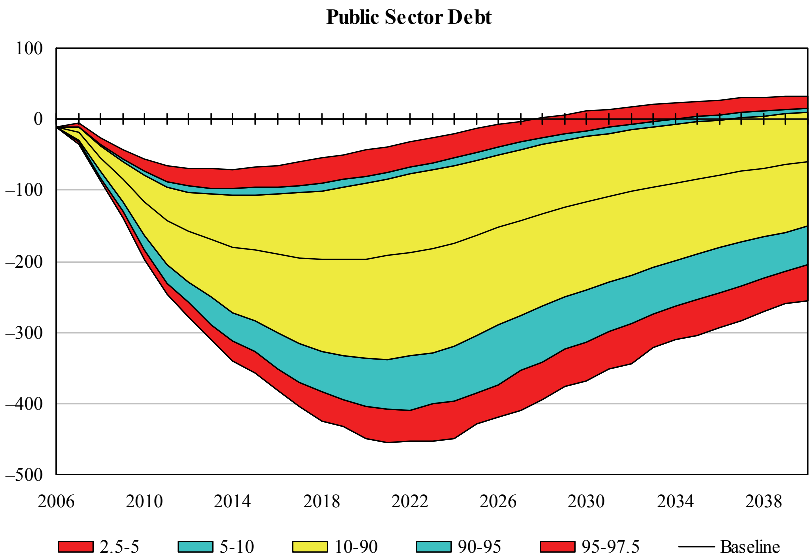
3.4 Fiscal sustainability under uncertainty: debt feedback rules

All simulations presented so far assume a fixed fiscal rule, for example a NOPD equal to the *ex ante* calculated PI level of oil revenues. The lack of any *ex post* response to adverse shocks then leads to a great deal of uncertainty about future debt stocks; even the use of a fixed PI rule turns out not to be enough to get manageable levels of debt variance. This matters a great deal: default risk premia will depend on the likelihood that debt levels are larger than a threshold level beyond which political problems will block debt service (see Schabert and van Wijnbergen, 2008). Although we do not know those thresholds, for any given value of such a threshold, greater uncertainty about future debt levels implies a greater probability of future crises.

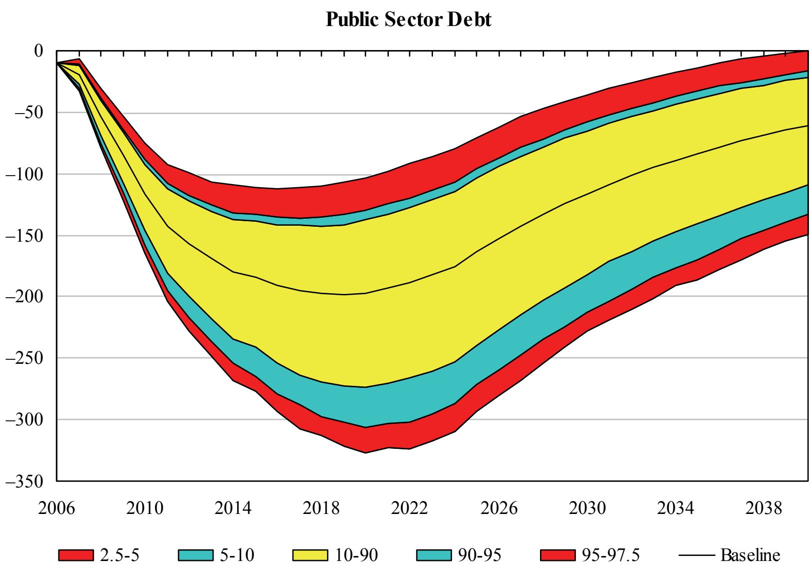
Figure 7 shows how a feedback of unanticipated higher debt levels to larger (smaller) primary surpluses (deficits) leads to much less uncertainty about future debt stocks, and therefore to much lower crisis expectations. Figure 6b assumed that the non-oil primary deficit equals the permanent income value (as currently estimated) of oil revenues, and that the increased stability of spending would reduce the variance of the real exchange rate by 50 per cent. Although Azerbaijan can be said with 95 per cent certainty to stay out of net debt, there is a very wide range of expectations about future debt stocks.

Figure 6

a) PI at Historical Variances



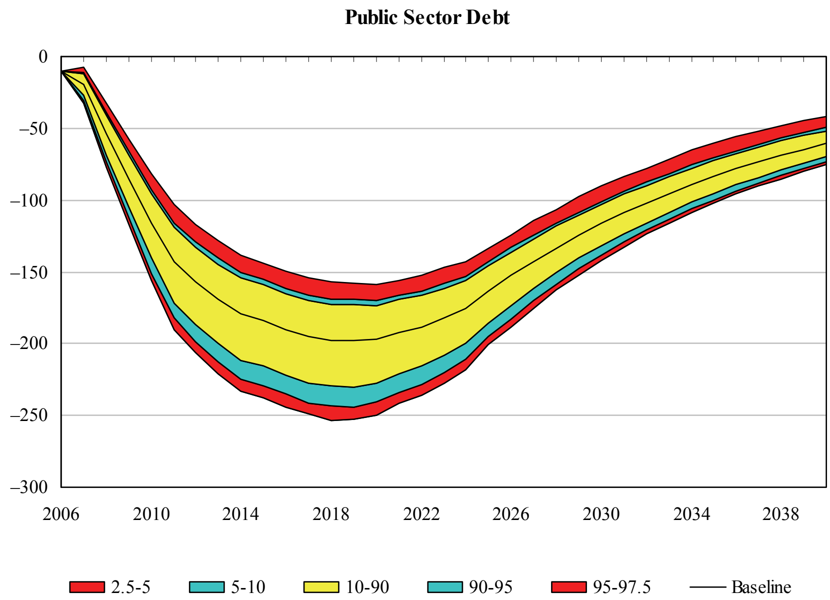
b) PI at Historical Variance for Oil Prices and at 50 percent of Historical Variance for RER



Next we assume a feedback rule from higher than anticipated debt stocks to a stricter fiscal policy. In particular, we assume a simple linear feedback rule where a fixed per cent of last year's excess debt (higher than projected in the base run for given NOPD assumptions) is offset by a lower NOPD. Budina and van Wijnbergen (2007) show that Turkey throughout the Nineties used a strong feedback rule, with 20 per cent of any debt surprise corrected the following year by tightening fiscal policy. If we add such a feedback rule to the simulations of Figure 6b, we obtain the results summarized in Figure 7.

Figure7

PI Spending, at Historical Variance for Oil Prices and at 50% of Historical Variance for RER; Feedback from Debt Surprises to Primary Surplus Correction, ALPHA=0.2



The simulations show a dramatically improved outlook. While the expected value of future debt stocks (the black line in the middle) is not affected, the distribution around that line narrows dramatically. The 95 per cent worst outcome line now stays at a positive net assets position of 40 per cent of GDP, instead of touching zero; and the range between the 95 per cent worst outcome and 95 per cent best outcome narrows down to about 30 percentage points in 2040, down from a high 140 per cent of GDP.

The conclusion should be obvious. It is advisable to complement the fiscal deficit strategy (non-oil deficits equal to the permanent income level of future oil revenues) by a target level for net debt, with a rule that any excess over that target level will result in a smaller NOPD by for example 20 per cent of that excess. This should have a strong impact on confidence; while it does not affect the average spending level of the Government, it will greatly reduce the variance of debt outcomes and thereby lower crisis expectations. A fiscal policy reaction should translate in lower costs of debt servicing and less volatility in the capital account.

4 Conclusions

Azerbaijan faces a major challenge managing its sudden high but temporary oil wealth. Because of the temporary nature of Azerbaijan's likely oil and gas revenues, intergenerational fairness is a major issue, as are concerns about post oil economic performance. Finally the highly volatile nature of oil revenues add further policy challenges; if it would translate in highly volatile spending levels and associated volatility of the real exchange rate, an effective tax on private investment would result with negative consequences for economic growth.

In this paper we argue that explicitly adopting a permanent income approach to the decision on how much to spend out of oil revenues provides an adequate response to all three questions. We use a fiscal sustainability analysis tool to evaluate the outcomes of different scenarios. The baseline simulations, where non-oil deficits are initially at currently budgeted levels but eventually return to 12 per cent of GDP with lower levels of expenditure, shows the re-emergence of Azerbaijan as a net debtor in the future once oil revenues start declining. This is even more so if spending levels do not decline and remain at the high levels currently foreseen under the medium term framework. The worst scenario of all, high spending but low oil prices, where oil prices would collapse to their historical average of about $35 dollars in 2007 ppb will see clearly unsustainable levels of net debt.

But limiting the net claim on resources by the public sector (the non-oil primary deficit) to the Permanent Income equivalent of Azerbaijan's oil wealth will result in sustainable spending programs. Under this scenario Azerbaijan is not expected to run into a net debt position at any time during the projection period.

Of course such simulations do not reflect the uncertainty that dominates any claim on future outcomes. Therefore we ran stochastic simulations deriving the entire distribution of future debt stocks based on historical variances of the simulated driving variables. In particular we looked at shocks in oil prices and to the real exchange rate. Future debt levels are characterized by a very wide distribution as uncertainty accumulates. This matters a great deal: projections of crises will depend on the likelihood that critical debt levels will be exceeded, so the wider the distribution of future debt stocks around a given baseline, the greater the associated estimates of crisis probabilities, even if the baseline itself would stay below any crisis trigger level. We show that under all but the PI scenarios, in a variant on the Value at Risk approach used by commercial banks, the maximum net debt levels that can be expected with 95 per cent confidence reach as high as 100 per cent of GDP under the baseline scenario. Thus this scenario exposes Azerbaijan to considerable risk. The PI approach considerably reduces that risk. If we also assume a reduced variance of the real exchange rate in response to more stable expenditure patterns, we can say with 95 per cent confidence that Azerbaijan will remain out of debt for the entire simulation horizon, thereby essentially reducing crisis probabilities to zero.

Finally, the assumption made in the stochastic simulations, that there would be no feedback from higher than expected debt stocks to the non-oil primary deficit, was replaced in the final section by an active feedback loop: under this extension to fiscal policy reminiscent of the European stability pact, targets for deficits are extended by targets for debt; and any excess of debt over that target path results in a deficit reduction equal to a given percentage of the excess debt stock of the previous year. We have simulated the impact of a feedback loop with a high correction percentage of 20 per cent, equal to empirical estimates obtained for Turkey, simply as an example. Such a feedback policy leads to a dramatic narrowing of the range that future debt stocks will stay in, according to simulations. In particular the 95 per cent certainty maximum debt level actually stays widely negative under the PI scenario: with 95 per cent certainty net assets will stay at 40 per cent of GDP or higher. Such a feedback policy will not raise the average burden of fiscal policy but will greatly reduce estimated crisis probabilities by further reducing variance in the economy.

ANNEX A
WB OIL PRICE FORECASTS

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
WB Oil Price Projections:										
International Oil Price $/Bbl - New	64.3	71.1	84.1	78.4	73.1	68.0	63.2	58.8	54.7	52.7
International Oil Price $/Bbl - old	64.3	67.9	72.4	68.2	64.2	60.3	56.7	53.2	50.0	48.5
Total Projected Fiscal Revenues from oil ('000$)	4,231,284.7	7,775,139.8	23,314,562.5	26,945,654.7	27,015,457.3	24,084,305.2	21,122,418.3	18,242,664.3	15,913,804.3	15,038,386.7
Total Fiscal Revenues ('000$)-old oil prices	4,231,284.7	7,154,242.9	19,450,961.6	22,945,221.4	23,114,485.6	21,018,269.3	18,639,343.0	16,280,122.0	14,351,972.8	13,186,209.8
PI - new Oil prices	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1
PI - old Oil Prices	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
WB Oil Price Projections:										
International Oil Price $/Bbl - New	52.9	53.2	53.5	53.7	54.0	54.3	54.5	54.8	55.1	
International Oil Price $/Bbl - old	48.7	48.9	49.2	49.4	49.7	49.9	50.2	50.4	50.7	
Total Projected Fiscal Revenues from oil ('000$)	1,395,0719.9	14,906,494.5	14,565,839.7	13,730,952.6	12,270,220.1	10,943,518.2	9,684,165.7	8,591,444.3	8,669,189.7	
Total Fiscal Revenues ('000$)-old oil prices	12,348,286.4	12,226,900.6	11,932,629.9	11,178,946.7	11,121,534.3	9,920,191.5	8,776,848.9	7,786,636.4	7,861,064.2	
PI - new Oil prices	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	4,251,601.1	
PI - old Oil Prices	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	4,388,561.9	

ANNEX B
PUBLIC DEBT DYNAMICS

Increases in net public debt (that is, measured net of the net foreign assets, public debt holdings of the central bank, and oil fund assets) can be decomposed in various contributing factors, which, in turn, can be linked to the macroeconomic projections available. By switching to ratios to GDP, public debt dynamics can be broken down into several components: (1) the primary fiscal deficit net of seigniorage revenues; (2) growth adjusted real interest rate payments on domestic debt; (3) the real cost of external borrowing, including capital gains and losses on net external debt due to changes in the real exchange rate; and (4) other factors. This can be expressed in the following formulas:[7]

$$\dot{d} = (pd - \sigma) + (r - g)\, b + \left(r^* + \hat{e} - g\right)\left(b^* - nfa^*\right) e + OF \qquad (1)$$

where d is the net public debt-to-GDP ratio (that is, measured net of the net foreign assets, public debt holdings of the central bank, and oil fund assets); pd is the overall primary deficit as a share of GDP; g is the real GDP growth rate; r is the real interest rate on domestic debt, r^* is the real interest rate on external debt; e is the real exchange rate EP^*/P, with obvious definitions of variables; and *OF* refers to other factors. *OF* collects residuals due to cross product terms arising because of the use of discrete time data (see Bandiera *et al.*, 2007, for explicit discrete time formulas) and the impact of debt increasing factors that in a perfect accounting world would be included in deficit measures, but in the real world are not. Examples are contingent liabilities that actually materialize, such as the fiscal consequences of a bank bail out, one-off privatization revenues, and so on. Of course, if countries borrow in more than one foreign currency (for example, dollars and euros or yen), more than one foreign debt stock should be kept track of in an analogous manner. Note that in this single equation exercise, debt levels are generated, but all other variables are considered exogenous (*i.e.* feed backs from shocks to debt levels are not incorporated).

Given the special features of oil revenue, in particular, its exhaustibility and volatility, the next step requires the incorporation of various non-oil deficit rules in the public debt dynamics equation. To do that, we break the overall primary balance to two components: the non-oil primary balance f, which measures the true fiscal effort in an oil-producing country, and the projected oil fiscal revenues *Roil*, (revenue projected using World Economic Outlook [WEO]/Development Prospects Group oil prices), which reflects the fact that oil windfall due to high prices or faster oil extraction would result in much lower primary deficit. Similarly, isolating oil revenue also allows us to assess the impact of oil shocks on the overall net debt/net asset position.

$$pd = f - Roil \qquad (2)$$

After expressing pd in equation (1) in terms of non-oil primary deficit, f, we obtain:

$$\dot{d} = (f - \sigma) + (r - g)\, b + \left(r^* + \hat{e} - g\right)\left(b^* - nfa^*\right) e - Roil + OF \qquad (3)$$

Hence, public debt dynamics equation (equation 3) now renders transparent the fact that net public debt could increase because of higher non-oil primary deficit, and decrease because of higher oil revenues due to high prices or faster oil extraction. Isolating oil revenue also allows us to assess the impact of oil shocks on the overall net debt/net asset position.

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7 Note that, to simplify the exposition, we present a continuous time formula. See Bandiera *et al.* (2007) for a discrete derivation of formulas for public debt dynamics. A similar debt decomposition formula also has been used in World Bank (2005).

Furthermore, given the oil price uncertainty and the possibility of volatility clustering, many oil-rich countries have introduced fiscal/oil fund rules that aim at stabilizing the oil revenue flow to the budget. Some countries aimed at stabilizing the oil revenue flow to the budget using a conservatively chosen budget reference price of oil. In what follows, we are referring to a so-called reference price rule, whereby all revenues due to actual prices in excess of this reference price are diverted to an oil fund. Commensurately, revenue shortfalls due to prices falling short of the reference price can be met from the oil fund. The implementation of such a price stabilization rule is especially relevant for mature oil producers with relatively constant extraction profile, so it is oil price volatility that matters most.

Such an oil fund rule, however, needs to be modified for countries with new oil discoveries (such as Azerbaijan), which might find that they can suddenly and substantially raise the non-oil deficit. Whereas the same considerations – such as absorptive capacity, impact on real exchange rate and non-oil economy, and intergenerational equity – apply, the relative emphasis would be different, with absorptive capacity becoming much more important. For countries where oil is running out (such as Yemen), the emphasis on the non-oil economy and diversification should receive more prominence.

Finally, it is also important to stress that, to be meaningful at all, any oil fund accumulation rule should be complemented with targets for the non-oil deficit. Putting money aside with one hand but borrowing on the side with the other obviously would make the oil fund rule ineffective.

Hence, to be able to assess fiscal sustainability implications of oil fund/non-oil deficit rules, we break down further the oil fiscal revenues, *Roil*, in two parts: (i) oil revenue flow to the budget $Roil_{sb}$, and (ii) net inflow in the oil fund, or the difference between total oil revenue and the oil revenue flow to the budget, $Roil–Roil_{sb}$. Furthermore, by subtracting and adding the oil revenue flow to the budget, $Roil_{sb}$, in the RHS of equation 3, we also express the public debt dynamics equation in terms of these two components of the total oil fiscal revenue:

$$\dot{d} = (f - Roil_{sb} - \sigma) + (r - g)\,b + (r^* + \hat{e} - g)(b^* - nfa^*)\,e - (r^* + \hat{e} - g)\,oa^* e \quad (Roil - Roil_{sb}) + OF \qquad (4)$$

We also assume that the excess oil revenue above the oil revenue flow to the budget and interest earned on the stock of oil fund assets are saved in a ring-fenced oil fund:

$$\dot{o}a^* = (r^* + \hat{e} - g)\,oa^* e \quad (Roil - Roil_{sb}) \qquad (5)$$

Hence the change in the net public debt ot GDP ratio now also accounts for the accumulation of assets in a ring-fenced oil fund, oa^**–dot*.

$$d = (f - Roil_{sb} - \sigma) + (r - g)\,b + (r^* + \hat{e} - g)(b^* - nfa^*)\,e - \dot{o}a^* e + OF \qquad (6)$$

The modified public debt dynamics equation (6) also isolates the impact of oil on public finances. In particular, it reflects the following major changes. First, it renders transparent the fact that a substantial share of fiscal revenues is derived from oil; the primary fiscal deficit (noninterest spending minus revenues) is replaced with the non-oil primary deficit, isolating net oil revenues evaluated at reference price as a financing flow, $Roil_{sb}$. Second, the change in net debt-to-GDP ratio now also accounts for fiscal savings out of oil, accumulated in a ring-fenced oil fund, oa^**–dot*.[8] Third, given the higher volatility of the oil fiscal revenue, the uncertainty about the net debt trajectory for oil-rich countries is likely to be much higher; hence, fiscal sustainability assessment should pay much more attention to the issues of uncertainty and risk.

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[8] Ring-fenced oil funds can be successful only if complemented with a rule that limits the non-oil deficit or public debt. Otherwise, the government will accumulate assets in the oil fund while borrowing, so the net asset position may even deteriorate because the cost of borrowing is typically higher than the interest earned on oil fund assets.

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