Fiscal sustainability and oil wealth: Managing oil and gas volatility in Azerbaijan

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Fiscal Sustainability and Oil Wealth: Managing oil and gas volatility in Azerbaijan

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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.

I *Introduction*

Macroeconomics in Azerbaijan is about oil and its consequences for the economy. Azerbaijan is rapidly building up its production and export capacity and can expect to be a substantial energy producer for several decades to come. Its situation is different from major oil exporters like Russia or Kazakhstan, however, in that oil and gas production is expected to peak in the coming 5 to 10 years. Russia and Kazakhstan expect to remain major oil producers at least until the next century. At currently known reserve levels and production plans, revenues from oil will essentially run out in twenty years in Azerbaijan, and from natural gas within about twenty years. The temporary nature of oil and gas income in Azerbaijan gives rise to special concerns: the post-oil economy is less far off than in countries that for all practical purposes have oil for the foreseeable future. Its major challenge is managing the hump shaped nature of its oil windfall.

One approach to this problem is to limit expenditure out of oil revenue to levels that can be sustained indefinitively, the so called Permanent Income Equivalent. This can be implemented by saving in high revenue years through allocation to a dedicated Oil Fund (OF), and dissaving out of that OF in low income years[1]. Allocating all O&G revenues to the OF, and allocating the PI equivalent from the OF to the budget would give the OF an extra function, i.e. that of smoothing out any unexpected change in income due to temporary and unanticipated price changes. Importantly, such an allocation should be accompanied by a limit on the non-oil primary deficit, otherwise what is saved on the one hand is dissaved on the other, thereby making the allocation to the OF ineffective. Settting the nopd equal to the amounts allocated from the oil fund to the budget means that any additions to the OPF are truly net savings.

In this paper we calculate the PI level at which non-oil defciits can be sustained forever under such an oil fund strategy, building on the results of a companion paper (van Wijnbergen (2008)). We then simulate likely debt stocks in the future under various policy scenarios for the non-oil deficits. Under one scenario, the nopd is limited to the calculated valuer of the Permanent Income Equivalent of all current and future oil revenues. The consequences of high spending and low oil prices are explored. We then show the impact of uncertainty by deriving not just the expected value of future

[1] Accrued interest is added to the OF.

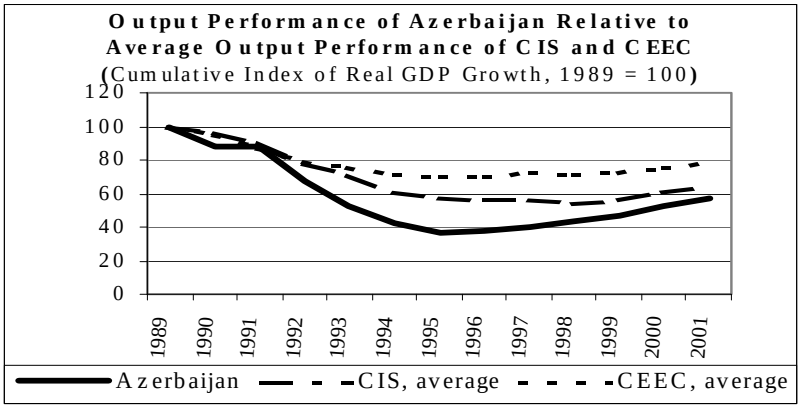
net debt stocks, but their entire distribution if historical variances in oil prices and real exchange rates persist. The results reflect the high volatility of the Azeri economy: without active fiscal management of uncertainty, the likelihood of very high levels of net debt cannot be excluded unless the permanent income approach is followed. We also show that a policy whereby debt shocks lead to lower deficits, while not increasing the expected burden of fiscal policy, can greatly reduce the variance of future outcomes and thereby lower the riskyness of the economic environment in Azerbaijan.

II. Background

A. From Chaos to Oil Boom

Following independence in 1991, Azerbaijan experienced massive terms of trade shocks, a disintegration of marketing and trading systems, and an end to Soviet era fiscal transfers and subsidies. The economy was riddled with distorted relative prices, multiple exchange rates and black market for foreign exchange, and widespread supply shortages. The armed conflict with Armenia and the associated influx of about one million Azeri refugees have further aggravated the economic problems. As a result, Azerbaijan suffered an output collapse and entered the post-independence transition period considerably poorer than many other former Soviet republics - Azerbaijan's GDP dropped by 63 percent between 1989 and 1995, compared with an average of 42 percent in the CIS over the same period (See Fig. 1a).

Figure 1: Real GDP growth.



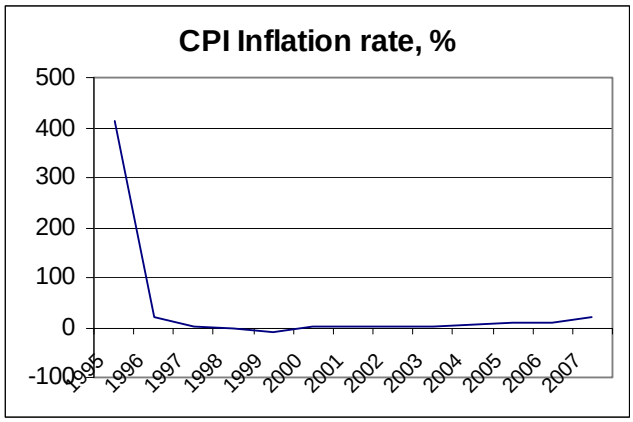
CIS- Countries of Independent States

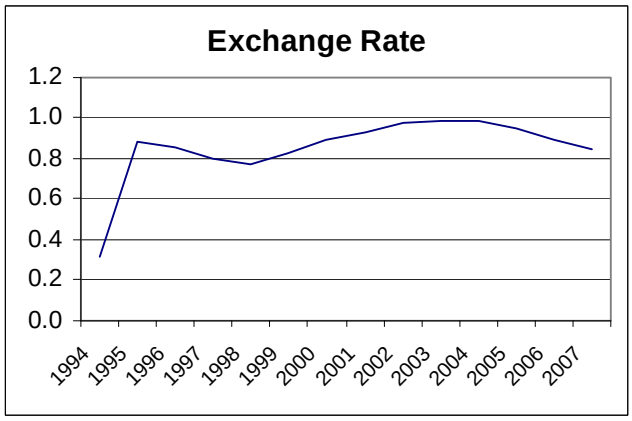
CEEC- Central and Eastern European Countries

Source: EBRD Transition report 2000, 2001 and authors' calculations

Azerbaijan started its transition to a market economy in early 1992, when most prices were liberalized, a new currency (manat) was introduced, a foreign direct investment law was adopted, and a central bank law was enacted. This insulated the economy from FSU-wide economic instability and facilitated leaving the ruble zone and the introduction of an exchange rate policy that would ease the adjustment of domestic prices to world levels. After price liberalization in January 1992, inflation soared to triple digits (See fig. 2a). Similarly, massive exchange rate depreciation was required to eliminate the black market for foreign currency and multiple exchange rates (See fig. 2b).

Figure 2: a. Inflation rate and **b. Exchange rate**

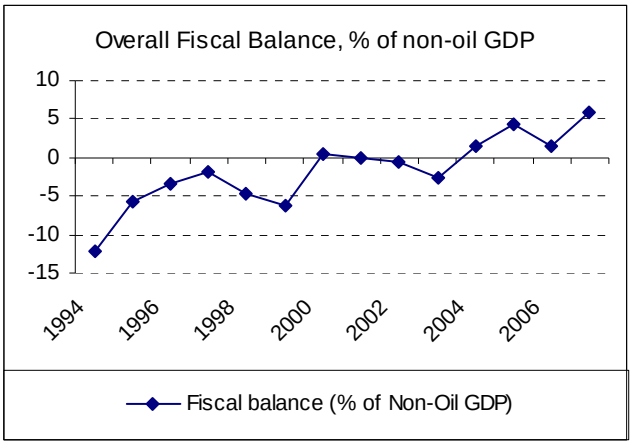


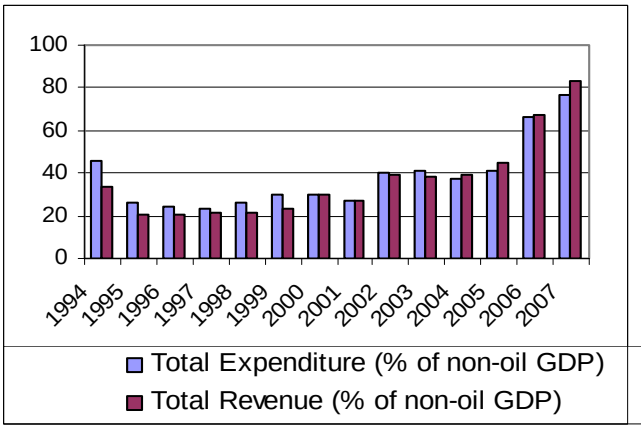


Azerbaijan was running large fiscal deficits right after the break up of the Soviet Union ((See fig. 3a below). Large revenue shortfalls after the elimination of fiscal transfers from Russia after independence, could not be compensated overnight and required massive expenditure cuts (See Fig. 3b). Coupled with less than efficient budgetary and quasi-fiscal expenditure allocations, as well as a major need to strengthen management and implementation capacity, the cuts have led to decline in social outcomes and quality of public services.

Since 1995 the Government embarked on a comprehensive stabilization and structural reform program supported by the International Monetary Fund (IMF) and the International Development Association (IDA). The key component of this stabilization effort was stringent fiscal control, supported by restrictive monetary policies. These efforts were complemented by a wide array of structural reforms designed to accelerate the transition to a market economy and to improve the environment for both foreign and domestic investment.

Figure 3: a. Fiscal deficits and b. Expenditure and revenue (% of non-oil GDP)





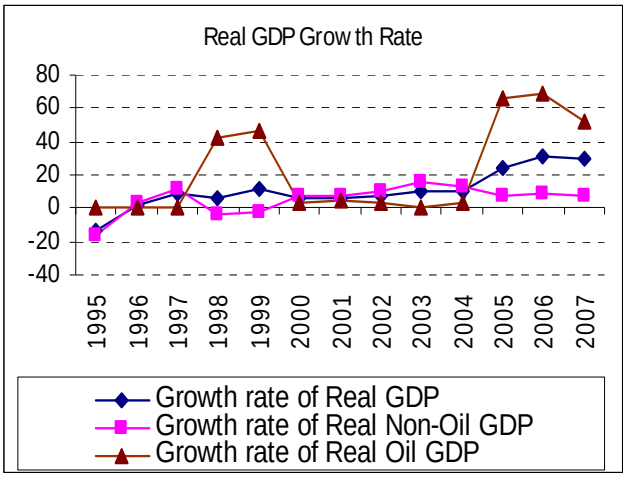
This reform program has been remarkably succesful: macroeconomic and financial stability have been restored and maintained throughout severe external shocks, such as the Russian financial crisis in 1998 and the large drops in oil prices in 1998 and 1999. Growth has recovered, to more than 11 percent per year over the period 1996-2006. While this growth was aided by rapid oil and gas exploration (the sector grew at 22 percent per year on average), the non-oil sector also grew at more than 7 percent per year over the same period. The succes in bringing down inflation was also impressive – the inflation rate was reduced from triple digits in the early 1990s to single digit levels in the late 1990s. The overall fiscal deficit was reduced from 12 to less than 2 percent of non-oil GDP during 94 -97. The budget even registered a small surplus for the first time in 2000, largely on account of high oil prices.

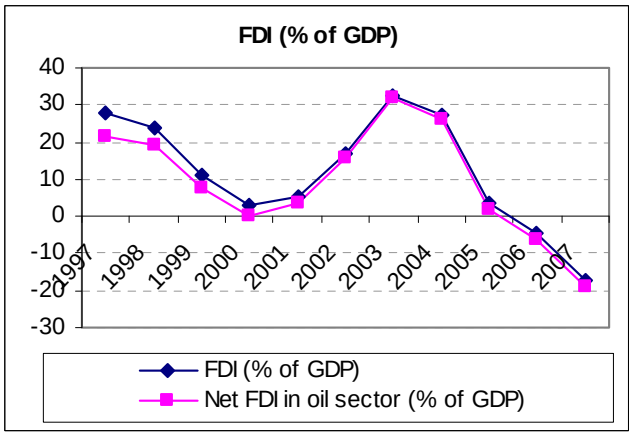
B. The challenge of managing the oil bonanza

Prospects for growth improved significantly with the beginning of the oil bonanza. The boom in the oil sector started with the signing of a number of Production Sharing Agreements (PSAs) between the Azeri State Oil Company (SOCAR) and foreign oil companies in the mid-1990s, regulating both exploration and oil production. These have opened the way for investment in two major pipelines - the Baku-Tbilisi-Ceyhan (BTC) pipeline which transports oil primarily from the Azeri, Chirag and Gunashli (ACG) oil fields in Azerbaijan to the Turkish port of Ceyhan on the

Mediterranean Sea through Georgia, and the Shah-Deniz pipeline which will transport gas to Turkey, also through Georgia.

Figure 4: a. Real non-oil and oil GDP growth and b. Oil as a share of GDP





Note: FDI is presented net of capital repatriation

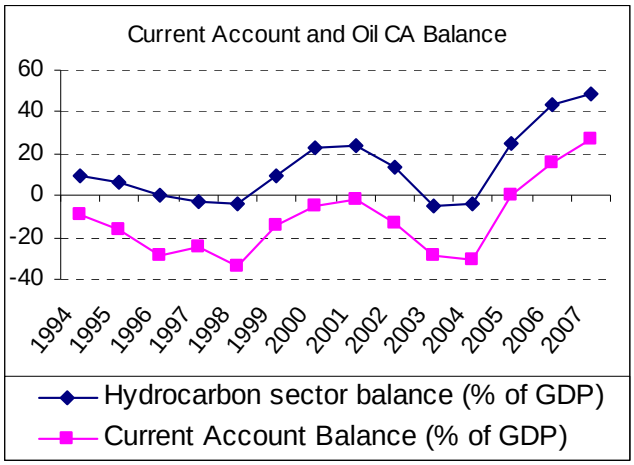
The Azeri economy grew by 11 percent per year on average during 1996-2006. This growth was of course largely driven by the rapid development of the oil and gas sector. After signing of the PSAs, Azerbaijan experienced massive foreign investments in several mega-projects in thosse ssectors. As a result, the oil and gas sector registered extraordinary growth rates of 42 and 47 percent in 1998 and in 1999.

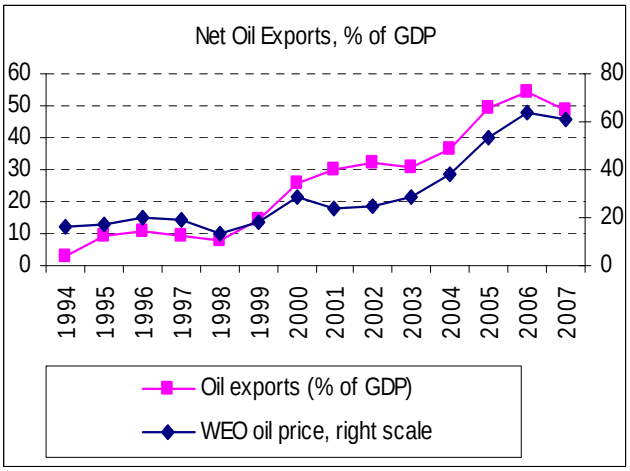
In 2005 and 2006, GDP growth ciontinued at very high rates (24 and 31 percent respectively). But these were now driven primarily by new oil production coming on stream, and the much higher export volumes that made possible. Oil GDP, which includes oil and gas extraction and oil processing (but excludes oil and gas transportation such as pipelines and oil and gas related construction) grew by 67 and 69 percent respectively in 2005 and 2006 (See Fig. 4a). As a result, the share of oil and gas sector in the economy expanded from about 15 percent of GDP in1995 to about half in 2006 (Fig. 4b).

Thus in a change since the late 1990s the contribution of the oil and gas sector to growth has come not anymore through massive foreign investments, but since 2005, through large increases in net oil and gas exports, a process that was accerelerated by the simultaneous rise in oil prices. Oil-related imports fell in line with lower foreign investments in the sector. This development has been

reflected in a positive current account balance of the oil sector, which also includes profit repatriation of the foreign oil company. Despite profit and capital repatriation, the current account surplus progressively improved and reached 12 percent of GDP in 2006.

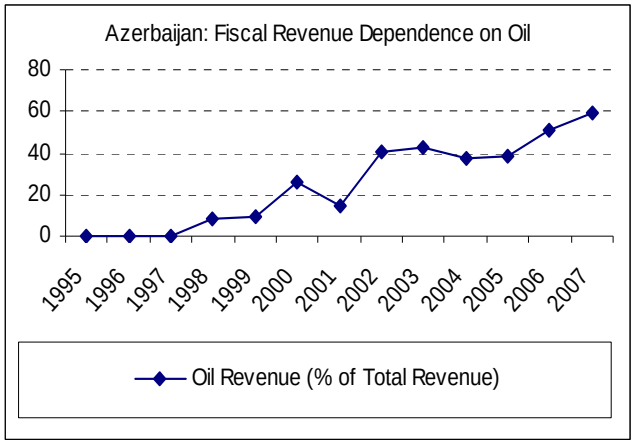
Figure 5: a. Current account balance and NFA and b. FDI inflows

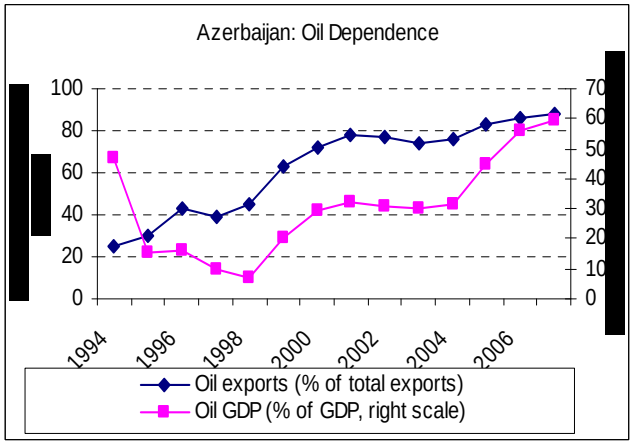




The economic dependence on oil and gas increased substantially as a result of the rapid oil sector development. The share of oil and gas exports in total exports has grown from about 30 to 86 percent in 2006 (See Fig. 6.b). As a result, fiscal revenues from oil and gas exploration have become increasingly important source of revenue – they increased from meager 8 percent of total revenue in 1998 to more than half of total revenue in 2006 (See Fig. 6.a).

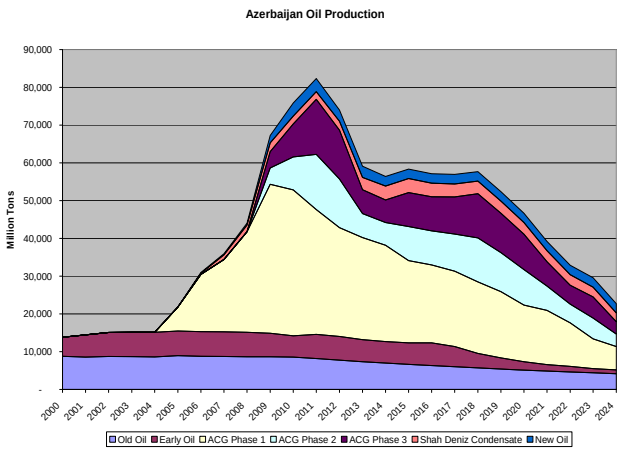
Figure 6: Increased oil dependence of a. the budget and b. export revenues.

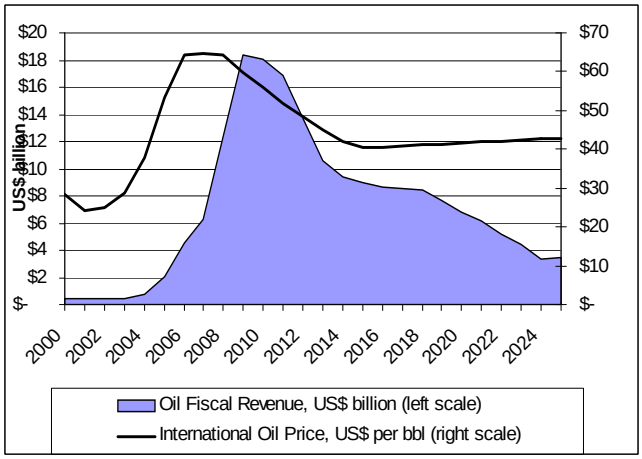




In the future, the contribution of the oil and gas sector to the economy is likely to increase further as Azerbaijan is rapidly building up its production and export capacity and can expect to be a substantial energy producer for several decades to come. Azerbaijan's proven oil reserves are conservatively estimated at 900 million tons. But absent any major new oil discovery, production should peak at about 65 million tons in 2011, followed by a relatively short plateau and thereafter will decline rapidly to less than half its peak level by 2018 and then to about a quarter of the peak level in 2024 (see fig. XX). This hump-shaped production profile will cause a similar pattern of rising and then decreasing oil revenues (Fig 7a).

Figure 7a. Oil production profile and b. projected fiscal revenues.





Under the PSA, revenues from oil and gas extraction are divided between the oil companies and other contractors, as compensation for operating costs and for profit and capital repatriation, and the Govenrment as oil- related fiscal revenues. The latter consist of Oil Fund revenues and oil-related collections through the state budget, such as oil-related profit taxes. The structure of the the PSAs are thus among the key assumptions required for projections of oil and gas related fiscal revenues, in addition to projections of production volumes and oil and gas prices throughout the duration of the oil windfall (See fig. 6a and b above).

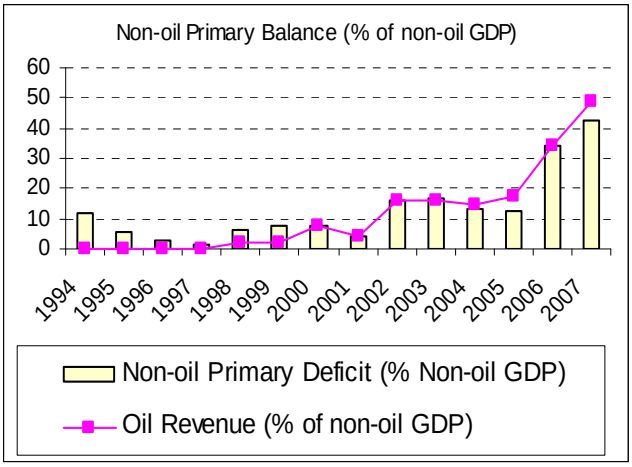
Based on World Bank projections, Azerbaijan will experience very sharp but temporary increases in oil fiscal revenues during the next five years (2007-1012). However, without any new oil/gas discoveries, oil revenues are projected to decline quickly, returning to their current levels by 2015 and disappearing altogether by 2025. Assuming that oil prices will remain above $40-45 per bbl during the next 20 years, oil and gas amounts to $130 billion, or about 15 times the 2006 non-oil GDP in constant US dollars (of xcourse this calculation ignores the time element, to which we will return below).

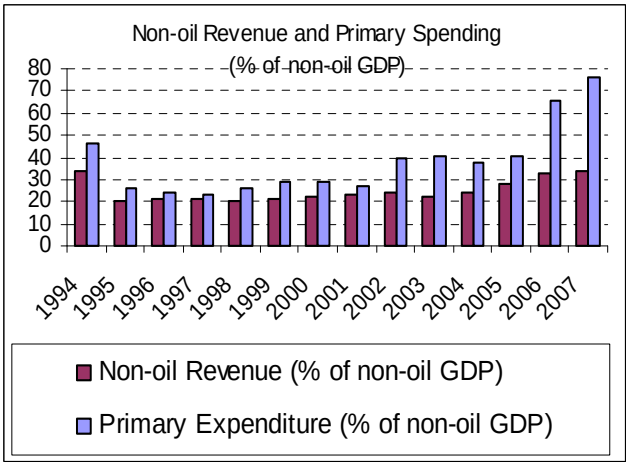
The humpshape of oil revenues gives rise to a series of questions, both on intergenerational equity (how can generations that will come after the hump share in the oil wealth), and on how Azerbaijan can adjust to a post-oil era. The creation of the Oil Fund and the cautious approach that has been adopted for its use is a positive step in the light of these questions. It shifts some of the benefits to future generations and smoothes out oil financed expenditure, thereby shifting into the future and reducing any post-oil adjustment problems. Moreover, an important advantage of the Oil Fund is that it separates the commercial decisions associated with oil extraction from public spending decisions and provides an effective and convenient way to insulate the economy from the adverse effects of excessive and volatile oil revenues.[2]

However, the fiscal stance is becoming progressively relaxed in 2006 as the non-oil primary deficit has more than doubled and even tripled in 2007 (See Fig. 7a). Much higher oil and gas related revenue seem to go hand in hand with additional fiscal relaxation, which is explained by the substantial increase in public expenditure from 40 to close to 70 percent of non-oil GDP (See Fig. 7b) over 2006 and 2007.

[2] The Oil Fund inflows consist of oil signature bonuses, the Government's share of profit oil, acreage fees, transit fees, rental fees and interest accruing to the Oil Fund's assets.

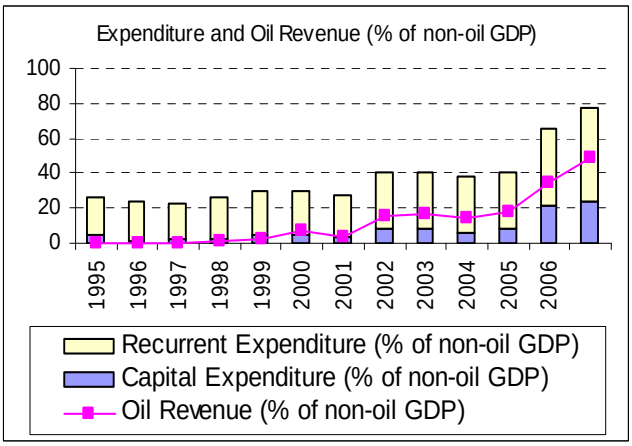
Figure 8a. Non-oil deficit, oil revenue and b. non-oil revenue and primary spending .

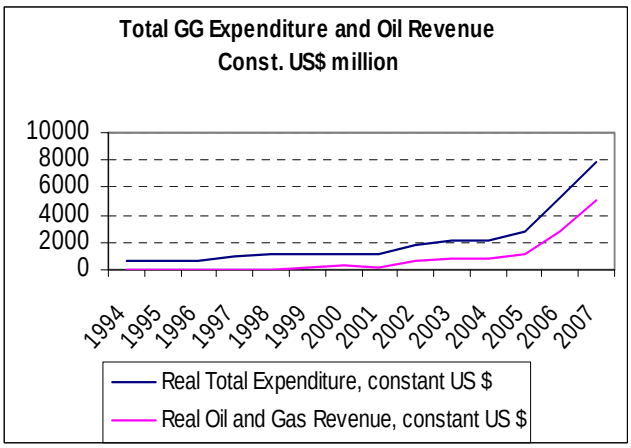




Indeed, during1998 till about 2002 real public expenditure was almost flat, signaling very conservative fiscal policy despite the anticipated large windfall of oil revenue. However, since 2003 real public spending started to increase in line with higher oil revenues and by 2006 real public spending almost tripled as compared to its level during 1998-2002.

Fig. 8c Composition of Government Esxpenditure; d: Total Government expenditure, oil revenues





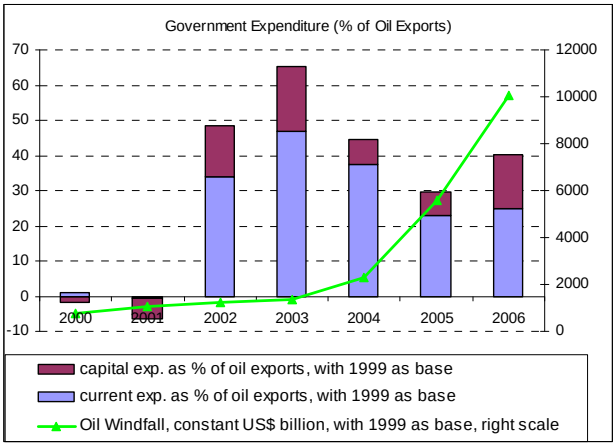
C. Oil Income Volatility

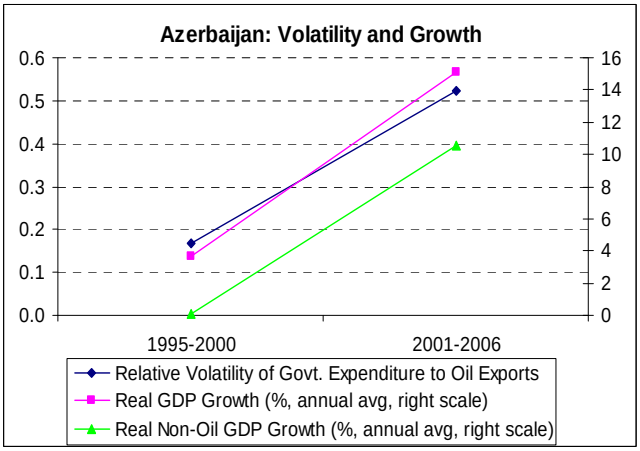
Higher oil revenues allow for additional spending, but they lead to an increased dependence on a highly volatile source of income, which in turn complicates macroeconomic management. Two problems stand out: first the issue of volatility; and two the exchange rate consequences of spending out of oil revenues. Oil revenues are highly volatile, even when quantities are relatively easy to predict: price volatility is high, making oil revenue a highly uncertain source of income even when production levels are relatively stable. In Azerbaijan the situation is even more challenging is managing given the hump shaped nature of the oil windfall.

High spending out of oil income translates income volatility into highly volatile expenditure, with potentially serious negative macroeconomic consequences. Azerbaijan has been relatively conservative in spending out of its oil income until recently –except in 2002 and 2003, marginal spending out of oil windfall has always been less then 50 percent, a wise decision considering the temporary nature of the oil windfall (See Fig. 8a). However, despite the government's intentions to invest in infrastructure, it seems that the bulk of spending out of the windfall went into current expenditure so far although public investment has been rising (cf Fig. 8c).

Volatility can be seen as a tax on investment. Experience has shown that high volatility slows down productivity growth by a substantial margin, in particular in countries with a relatively underdeveloped financial sector. While the volatility of public spending relative to oil income volatility during 2995 – 2000 was quite low (below 20 percent), it increased sharply to about 50 percent during 2001-2006, the beginning of the oil bonanza period (See Fig. 8b). This ratio is still low compared to what can be observed in many other oil exporters; Nigeria is an extreme example, where the ratio has mostly been above 1 for most of Nigeria's oil years. This suggests that the current fiscal framework has insulated public expenditure from oil income volatility; but the direction and the rate of change of this measure deserves attention when discussing a medium term fiscal strategy with the GoA.

Figure 9a. Spending out of oil windfall and b. Volatility of public spending relative to oil income volatility.





Uncertainty of a major revenue source calls for conservatism in deciding what level of expenditure out of oil revenues is sustainable: guessing high while low is appropriate causes major macroeconomic adjustment problems, while guessing low while high was possible just means benefits are somewhat delayed. Azerbaijan has wisely chosen to reduce spending volatility below the levels of oil revenue volatility by only diverting a stable flow of resources from oil revenues to the budget, and allocating the remainder to a stabilization fund.

Rapid increases in expenditure, justified as they may be, pose their own challenge in terms of maintaining efficiency and avoiding waste. Paying attention to the entire investment cycle, from evaluating and selecting projects, monitoring ongoing projects and budgeting for recurrent costs once the projects are completed, takes on special importance after such rapid increases put pressure on the existing institutional infrastructure. Finally the authorities should be aware that projects, once started, are difficult or very expensive to temporise or stop; that implies that the flexibility of government expenditure is reduced and thereby its ability to respond to adverse circumstances.

D. "Dutch Disease" issues

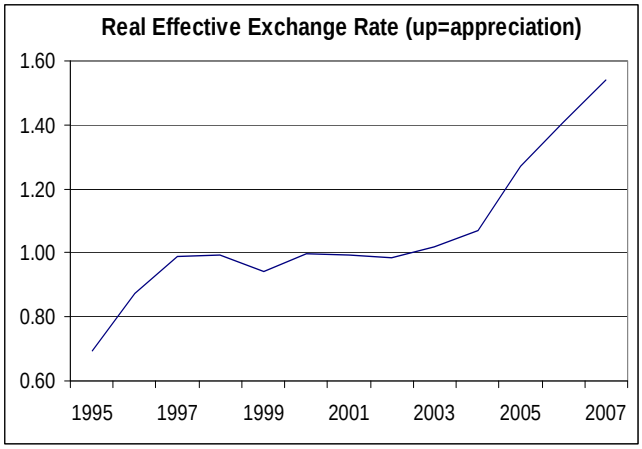
High spending out of oil revenues creates another problem with managing oil wealth, its effect on the exchange rate. First of all, increases in expenditure unavoidably fall to a large extent on

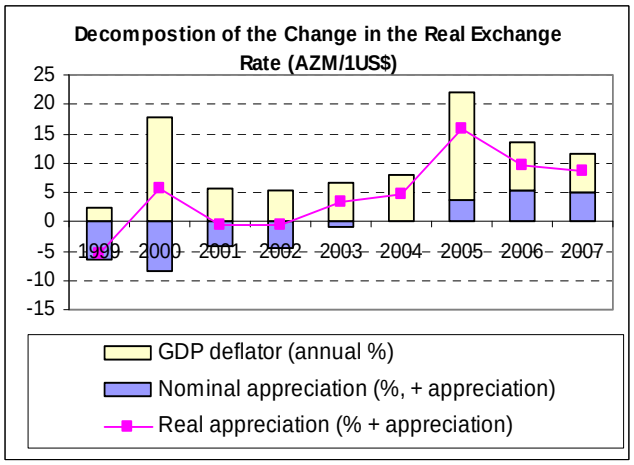
goods and services where international trade offers only an imperfect substitute or none at all, such as construction. This in turn implies that high spending unavoidably puts upward pressure on the prices of those goods and services, with a real appreciation as a result. For given expenditure levels, the authorities have no choice on the real exchange rate consequences, only on how they come about.

One option to effect a real appreciation is a gradual revaluation of the nominal exchange rate, so as to bring about the real appreciation necessary. Is that option not chosen, domestic goods end up under priced given the state of demand for them, and high inflation will result, the other way of effecting a real appreciation. It is important to realize that such inflationary pressures are essentially fiscal in nature, related as they are to expansionary fiscal policy; monetary tightening will mostly not be an appropriate response. Which approach of the two (or which combination of the two) is chosen is a policy choice the Government of Azerbaijan needs to make; but that a real appreciation will follow the large increase in expenditure is certain.

The real bilateral exchange rate to the dollar was stable since 1997 (see Fig. 10 below), when macroeconomic and financial stability has been restored, until about 2002. Since 2003, however, the real exchange rate started to appreciate and by 2006 it appreciated by 28 percent. Of course some of this reflects the slide of the dollar against major currencies, but it is likely that the spending increases of recent years had their impact too. The second graph (11.b) shows that a substantial part of the real appreciation has been brought about by high domestic inflation rather than nominal appreciation.

Figure 10a. Real Exchange Rate and **b. Nominal Exchange rate and Inflation**





Real appreciation, unavoidable or not, always raises the issue of competitiveness and the survival of traditional manufacturing industries. Key is to point out that such diversification concerns are appropriate only when the appreciation is expected to be temporary. If expenditure is anticipated to decline in line with falling oil revenues in the near future, real exchange rate pressure will again subside. A case can be made that letting the T-sector go to waste in the mean time will lead to unnecessary adjustment problems now and lost opportunities later, in particular in countries with weak financial intermediaries.

These issues are clearly relevant in the Azeri context. The non-oil economy grew at a healthy 7 percent per year on average since 1997. This overall good performance is not across the board however. The growth rate of non-tradable sectors increased from an average of 6 percent per year in 2002-2003 to 10 percent in 2006 and to 11.2 percent for the first three quarters of 2007. The growth of the non-oil tradable sectors on the other hand is continuing the downward trend initiated in 2006, drawn down by non-oil industry, although agriculture is recovering. [3]

Azerbaijan has already taken a major step to counter any post-oil problems that might arise from the relative decline in the Traded Goods sector, by opting for the Permanent Income (PI) approach discussed below. With this approach, spending out of oil revenues is set at levels that can be maintained once the oil runs out by saving in high income years. Thus expenditure does not need to decline once oil revenues run out and there will be no need for a future real depreciation at that time. That in turn means that keeping the T-sector alive through subsidies ("diversification policies") until the time the real appreciation will be reversed is uncalled for since there will be no such reversal.

A complication of this debate is caused by the question of whether temporary increases in expenditure above PI levels can be defended, for example to improve infrastructure, an accummulation of public capital that actually helps the Traded sectors once completed. The investment may be necessary for future competitiveness but will come at the expense of current competitiveness as high expenditure today adds to real exchange rate pressure.

[3] See Table 2 in World Bank (2008), Azerbaijan Economic Monitoring Note, Quarterly Monitoring Report, Jan. 2008.

III. Fiscal Sustainability and Managing Oil Price Uncertainty

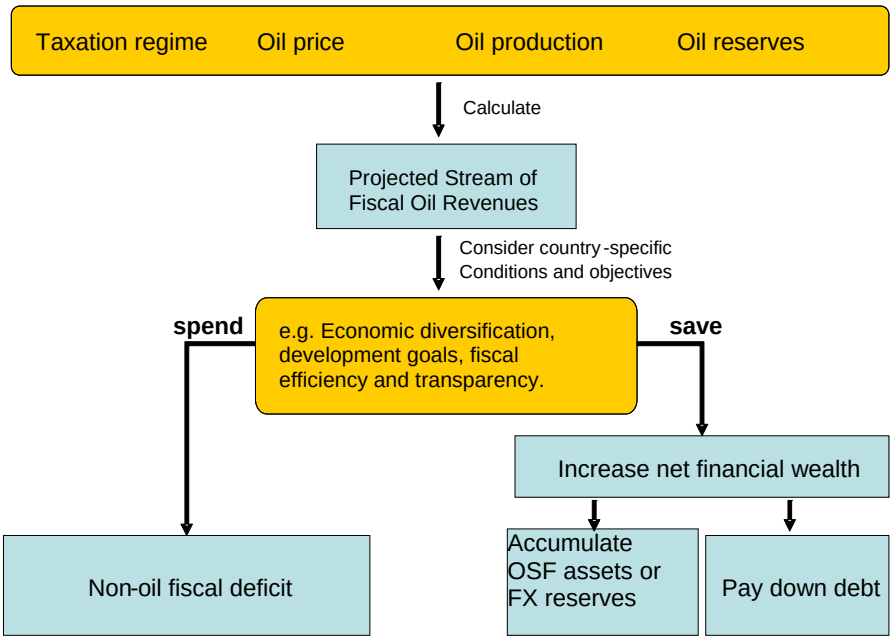
Assessing fiscal sustainability for oil-rich countries requires distinguishing between the oil and non-oil fiscal position. [4] Such a distinction is warranted because of the different nature of the oil-related fiscal revenue. First, oil is an exhaustible asset which means that fiscal revenues from oil extraction result from (natural) asset decumulation; this calls for treating oil revenue as a financing item, rather than current fiscal revenue. Second, faster oil reserves depletion today means that future generations would be worse off as oil will not last forever; to avoid leaving future generations worse-off, part of the oil revenue needs to be reinvested in other forms of assets/capital. Finally, oil revenue and implicitly the size of the oil wealth are volatile, mainly because of oil price volatility; this complicates fiscal management and underscores the importance of accounting for oil price volatility when assessing fiscal sustainability.

A. A Framework for Fiscal Sustainability and Managing Uncertainty

The model utilizes simulation methods to forecast the distribution and evolution of net public debt/assets, accounting for various rules governing oil fund allocations, the non-oil primary deficit and foreign debt accumulation. It consolidates the government's fiscal accounts with the Oil Stabilization Fund (like for example Norway's Oil Fund)[5] and the central bank's foreign-currency reserves. 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 from the OSF to the budget. Fiscal sustainability analysis then means examining 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. Moreover, it allows for explicit analysis of the effects of uncertainty not just through scenario analysis but also through full stochastic analysis allowing Value-at-Risk assessments. A schematic of the proposed framework is shown in Figure A1.

[4] See PREM note (2005) and Davis at al (2004).
[5] Although we refer to oil, any other natural resource can be substituted, like Chile's Copper Stabilization Fund.

Figure A1.Fiscal Sustainability Framework for Oil-Rich Countries



The country's oil revenue profile crucially influences the decision about how much to spend out of current oil income. 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.

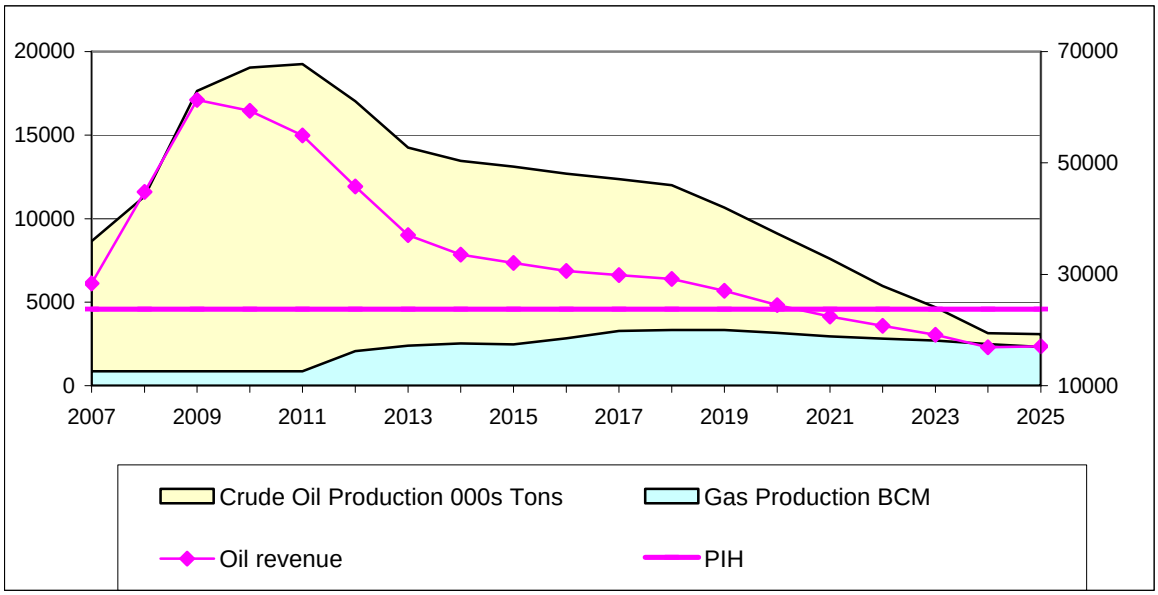
For countries with large proven oil and gas reserves, like Russia, limiting budget transfers out of oil income to revenues calculated at a long term average (reference) price rather than the current high price has similar effects to the PI approach. Oil stabilization funds (OSFs) maybe set up to save 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. Russia has been successful in reducing expenditure volatility by using such a rule and by accumulating assets in an OSF.

B. 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. All calculations should be considered preliminary as they will be updated on the basis on new information and some fine-tuning of key parameters in the framework.

Figure 11. Projected Extraction Profiles in Azerbaijan



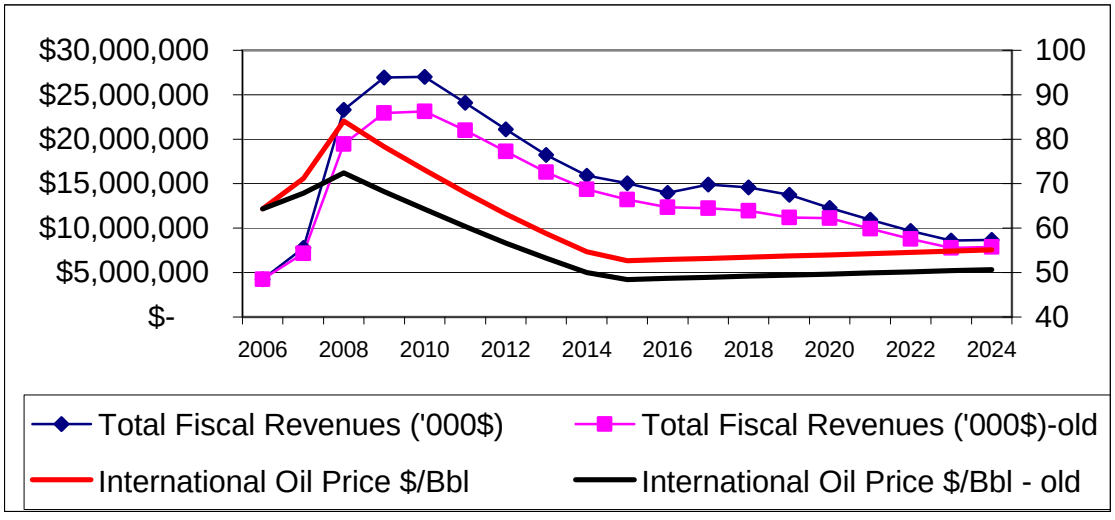
The first set of inputs concerns the oil sector. We have used the latest available World Bank long term oil prices forecasts (cf Annex A). However, just for comparison purposes we have compared them with the long term oil price forecast as of Nov. 07 (referred as old oil price forecasts).We also used available forecasts of oil and gas extraction rates, 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 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 & Gas production for the Azeri Government. The revenues have been generated using a detailed model incorporating the contract structure under which Azeri oil & Gas are extracted and sold abroad (or, of course, at home). This explains some of the obvious non-linearities in the impact of higher oil prices (See Table 1 and Fig 12 below).

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% (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% to arrive at a safe nominal rate of 5.5%. 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% risk premium to the basic safe real rate.

Figure 12. Azeri revenues from oil at old and new price projections (February 2008)



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% of GDP, and no less than 1470% 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 5 billion 2007 dollars, or slightly over 18% of 2007 GDP and a whopping 45% of 2007 non-oil GDP. The Permanent Income (PI) amount is what can be safely spent on an annual basis indefinitively, thus allowing future generations to share in equal absolute annual amounts (not per capita or as share of their income).

Table 1. Permanent Income Approach to Oil wealth (in const (2007) US$)

Oil Price Assumptions	Net wealth US$ billion	Net oil wealth to 2007 GDP (%)	Net oil wealth to 2007 non-oil GDP, %	Annuity 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 (Febr 2008)	165	594	1470	5.0

Note: All simulations are illustrative at this point. 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 receipts from oil operations.

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

Furthermore, table 1 shows the different PI calculations compared to the two revenue forecasts. An increase of more than 20 bUS$ in oil wealth (NPV) results in an increase of less than $ 700 million of the 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 percent of non-oil GDP, while the corresponding permanent income equivalent is now estimated at $4.4 billion.

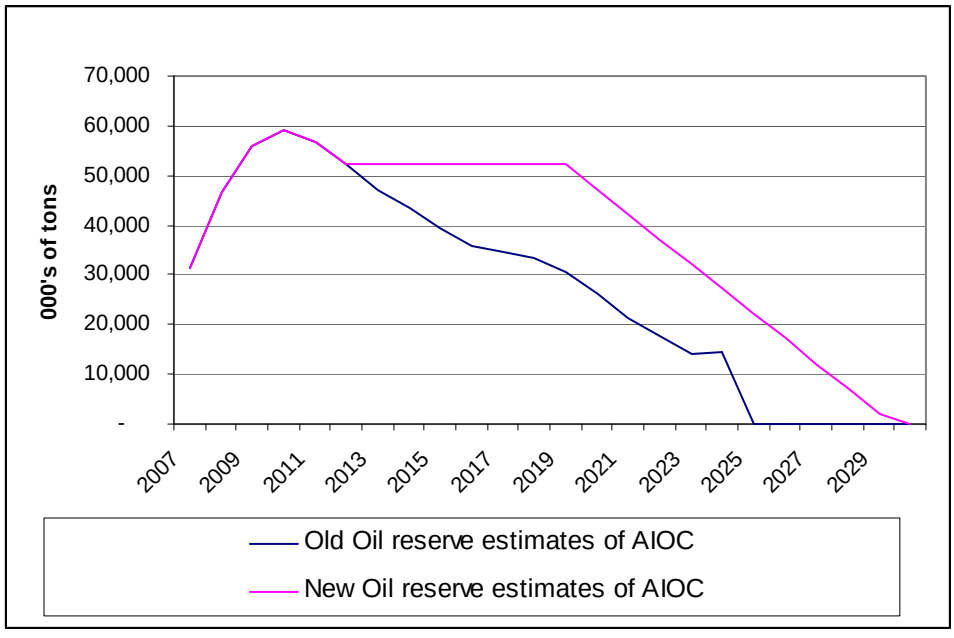
Consider next the impact of changes in the various components of the discount rates. In the first row we list the NPV and the spending level (constant in real terms over time) that yields the same NPV (the permanent income equivalent) for a basic safe rate of 3% and a risk premium also of 3%, equal to the consensus view on the equity premium (all in 2008 prices). Lowering the risk

premium has a substantial impact on the valuation of the uncertain income stream: in the extreme case of a zero risk premium, the NPV jumps from 165 billion US$ to almost 195 bUS$, and the PI equivalent goes up from about 5 billion to 6 billion US$.

Lowering the discount rate itself has a different impact. Going to a safe rate of 2%, again at zero risk premium, increases the NPV to 208 billion US$. However, because the permanent income equivalent is more stretched out towards the future, the impact of lower rates is more pronounced than on the more frontloaded profile of actual revenues. The net impact of lower real rates is thus to decrease rather than increase the PI equivalent.

Finally, consider the impact of new oil reserve discoveries on the PI calculation. Fig. 13 plots the impact of new oil reserves discoveries on the production profile of the AIOC, the oil consortia consisting of BP and the National oil company, which is exploring the major new oil field in Azerbaijan. It is estimated that the new oil discoveries are to increase the size of Azerbaijan's oil reserves by about 254 million ton, or by slightly less than 2 billion bbl of oil.[6] As a result, Azerbaijan's oil wealth is projected to last a bit longer – until 2029 as opposed to 2024, with somewhat longer plateau until 2021.

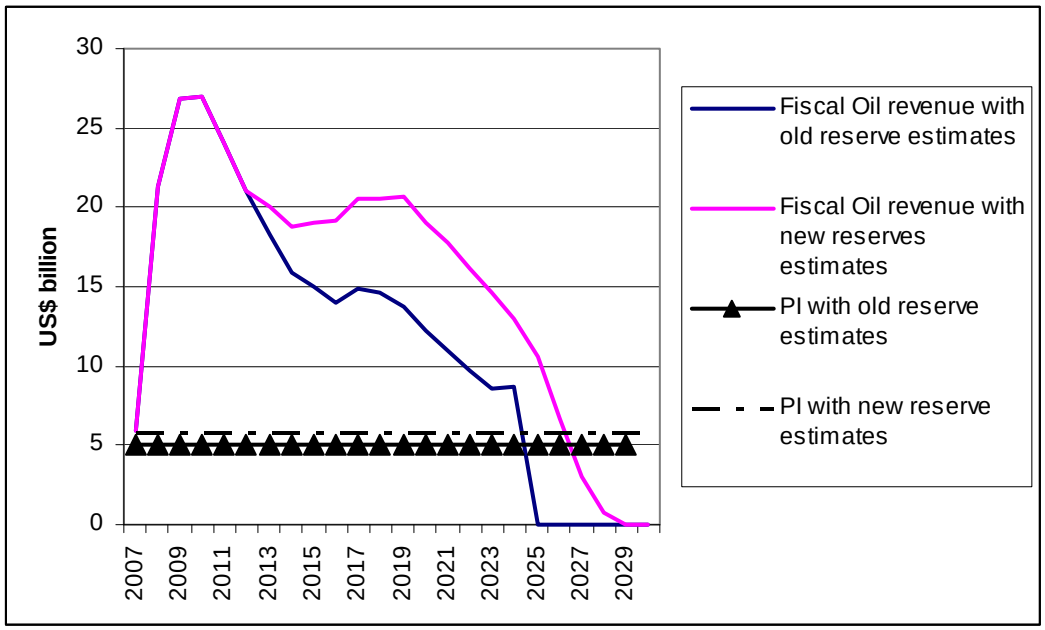
Fig. 13. AIOC Production profile: The impact of mew oil reserve discoveries



[6] Source BP and World Bank Staff Estimates.

The value of the oil wealth will increase ass a result of these new oil discoveries if everything else remains the same (projected oil prices as well as the risk premium on the discount rate). However, because these new reserves will be extracted far away in the future (starting 2013 and continuing until 2029), their impact on the net present value of the oil wealth will be much smaller – indeed the NPV of oil wealth increases by about US$ 27 billion, from 165 to 192 billion dollars. The increase of the permanent income derived from this wealth would be even smaller, simply because we only consume the real return on this wealth). As a result, the permanent income increases from about 5 to about 5.9 constant 2007 US$ billion (see fig. 14)

Fig. 14. Permanent Income Derived from Oil Wealth: The Impact of new oil reserve discoveries

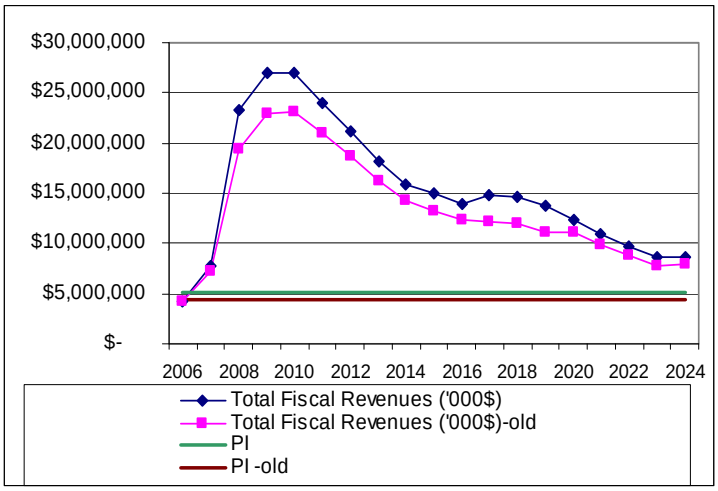


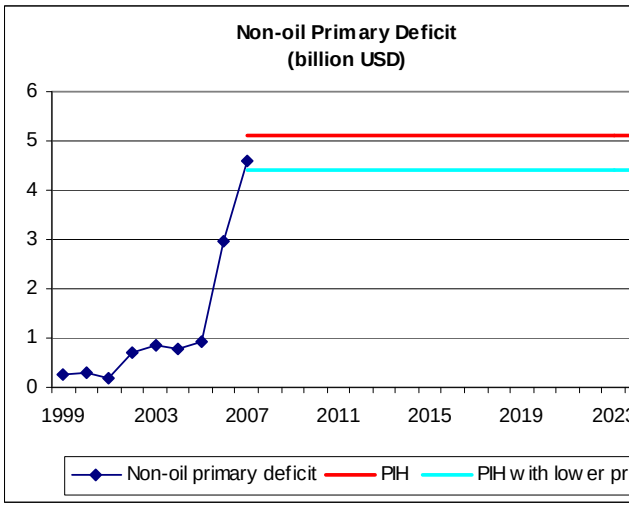
B. Deficit Rules, Oil Income and Fiscal Sustainability

A "Permanent Income" approach to stabilize the oil inflow to the budget ($Roil_{sb}$) will restrain expenditure out of oil income to levels that can literally be sustained indefinitely, beyond exhaustion date, through the use of the moneys saved during the high income years. This approach involves estimating the income flow which can be spent without depleting the real stock of oil wealth. Initial results from the Permanent Income calculations are presented in figure 13. As shown in figure 13a, the permanent income out of the oil windfall, calculated for projected oil prices and as a low case

estimate for historical average oil price of the past 20-year ($25.5 per bbl in const 2007 dollars) is between $3.8 billion and $5.3 billion in constant 2007 dollars. The permanent income levels shown in Fig. 13 indicate that Azerbaijan, on this rule, should save substantial amounts of its oil revenues for the entire duration of the first half of this century, 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 (cf fig. 13b) based on current wisdom in terms of oil price projections, i.e. the current World Bank oil price projections (see Annex I).

Figure 13. a. Permanent Income for two oil price assumptions in const 2007 $ and b. actual nopd





The measures of permanent income (PI) should be compared to the non-oil primary deficit (*nopd*), as the nopd represents the net claim on non-oil resources, to be covered by the PI amount transferred from the Oil Fund. Current spending plans are thus close to the PI estimates, but consistently above it, so some degree of caution is called for in particular if further increases in non-oil deficits were to follow the large increases in 2006 and 2007.

C. A Framework for Fiscal Sustainability: Managing Uncertainty in Azerbaijan

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

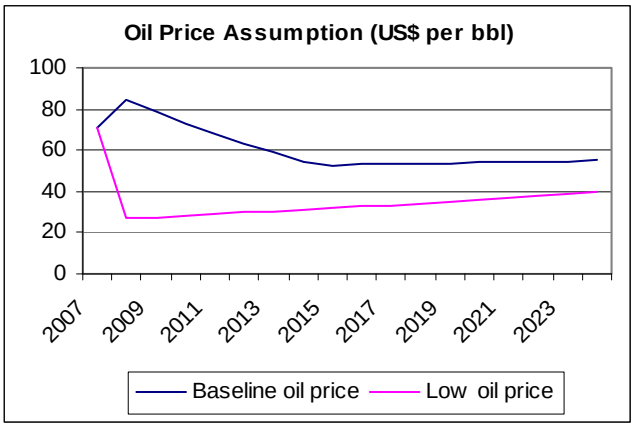
by a rule on the non-oil deficit; there is little point to adding money to a fund with the one hand, and borrowing against future oil revenues with the other. The Fiscal Sustainability Analysis tool (FSA) presented in the annex is designed to analyze the interaction between these two rules (oil fund allocation rule and non-oil primary deficit rule).

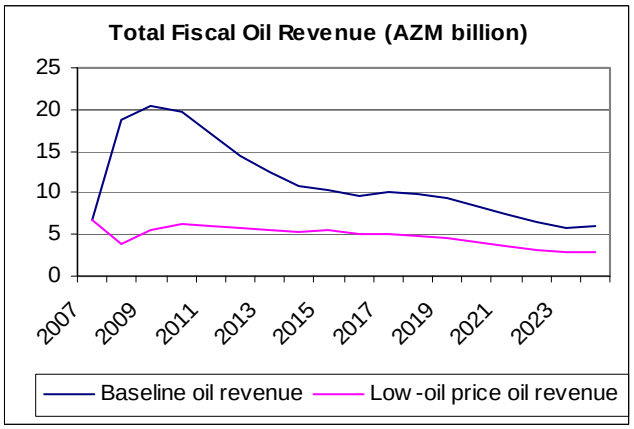
Some concern remains however about the *pace* of the increase in spending, even as it current *level* does not seem very far out of line with what the PI approach coupled with current non-oil public revenues allow. Public expenditure increased by 80 percent in 2006 alone and tripled over the past three 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 two 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 "permanent income" rule. One implication of this rule is that because the economy is growing, non-oil 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.

We also specify an alternative "high spending" fiscal strategy, whereby public spending continues to increase during 2007-2009, to accommodate high infrastructure requirements and as a result it exceeds the permanent income equivalent. However, given the short time horizon of the windfall, we assume that the non-oil deficit to GDP ratio will decline beyond 2008, and it will reach its 10 year historical average of about 13 percent of GDP by the end of the windfall, 2025 (see figure 15 below).

Figure 14. a. Long term Oil Prices and b. Projected Oil Fiscal Revenues





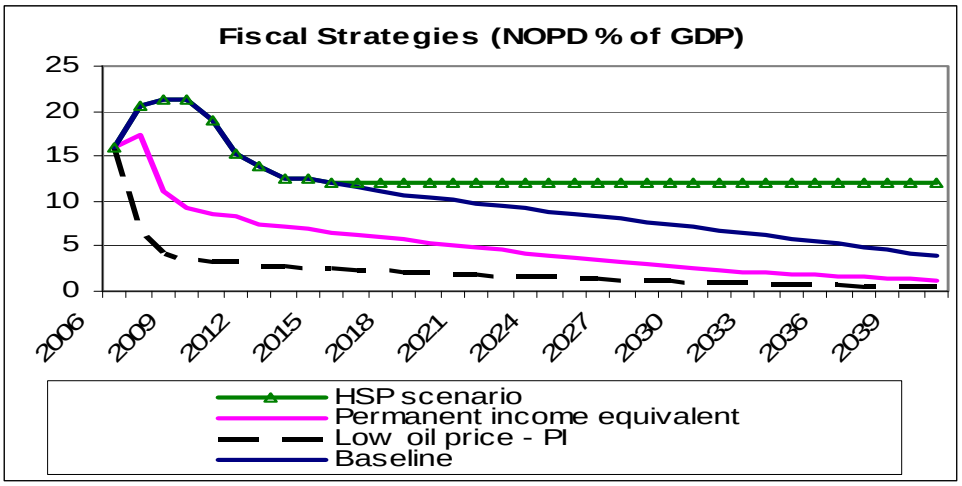
To derive PI spending limits, we need the NPV (Net Present Value) of oil revenues. We have used World Bank long term oil price forecasts (Annex I), projections of oil and gas extraction rates, and assumptions on the costs and benefits in each individual oil field. Accounting for the tax structure, royalties, and production sharing schemes then allows derivation of the relationship between oil revenues and various oil price scenarios.

Given the authorities' plans we present three illustrative fiscal strategies for the non-oil deficit to GDP ratio nopd (See Fig. 15):

1. a base case scenario, which is guided by the medium term fiscal framework for the next three years, envisaging non-oil primary deficits in excess of its "permanent income" equivalent in order to accommodate high infrastructure requirements. Thereafter, we assume that public spending will decline slightly and remain at about 30 percent of GDP during 2011-2015, decline further afterwards and will reach 22 percent of the non-oil GDP by the end of the projection period. Non-oil revenues to GDP ratio are projected to increase gradually from current 11.2 percent in 2007, reaching 18 percent of GDP by 2015 and to remain at about 18 percent of GDP thereafter. The resulting non-oil primary deficit increases initially, reaching nearly 21 percent of GDP during the next three years, but then declines and reaches 12 percent by 2015, and after some additional adjustment, reaches about 4 percent of GDP by the end of the projection period.
2. a PI strategy, which assumes that the non-oil deficits in the next five years and beyond are bounded by the "permanent income" rule and the associated flow of oil revenue to the budget. One implication of this rule is that because the economy will be growing, non-oil deficit to GDP ratios will decline in the future.

3. Finally, we also specify a "high spending" scenario, 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% of GDP). Provided that the non-oil revenue remains the same as in the base case, this implies a constant non-oil deficit of 12 percent of GDP from 2015 onwards (see figure 15 below).

Figure 15. Illustrative fiscal strategies for managing oil windfall: NOPD and Primary Spending

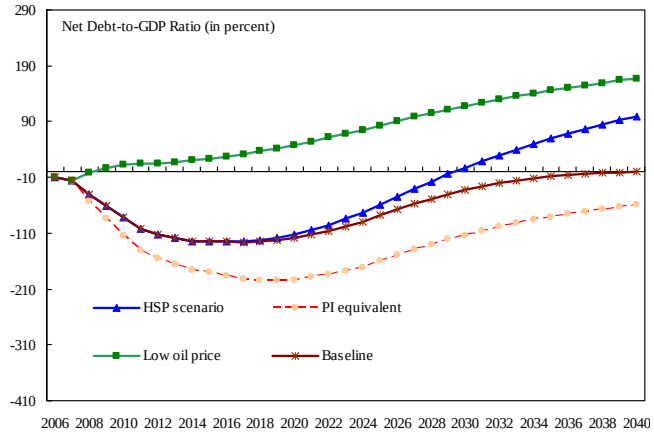


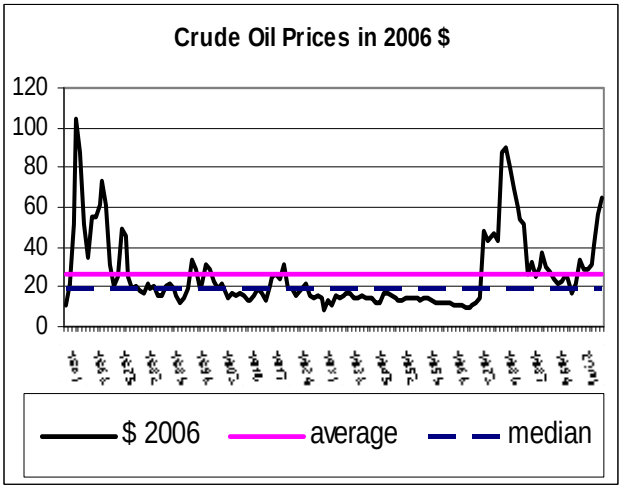
With the different fiscal strategies specified, we run the fiscal sustainability tool to derive baseline projections for net public debt throughout the projection period. Note that as explained in the annex, this framework also incorporates the dynamics of the oil fund assets and consequently, an oil fund rule to deal with the large but volatile oil revenue in Azerbaijan. Fig.16 below summarizes the results.

In Fig.16a we present FSA results for the four fiscal strategies: base case, PI and high spending. The diagram shows the net debt to GDP ratio, including the OSF as a negative item, under the various spending programs. The starting point is a negative number: the Oil Fund and other FX assets exceed the gross public debt by a substantial margin end 2007, for a net debt position of -10%

of GDP. Given the hump-shaped profile of the oil revenues within the next 20 years, and assuming the baseline fiscal strategy (the thick blue line in Fig. 15), Azerbaijan is to accumulate sizeable net financial assets by 2015 (negative net debt implies a positive net asset position) – fig. 16a. Once the oil windfall starts to dissipate, the baseline fiscal strategy would imply running down of the net assets. At the end of the planning horizon, Azerbaijan has eaten up its OSF and other FX assets it started out with, and reaches a zero net debt position. Of course after that Azerbaijan will get into debt again as gross debt will continue to increase while the OSF will start to shrink since the budget transfers by that time exceed oil revenues.

Figure 16.a. Stress tests for Net Debt/GDP ratio and b. Av. oil price in 2006$





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 an *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 percent of GDP, and corresponding non-oil primary deficits at 13 percent 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 percent by 2040, a deterioration of no less than 80 percentage points of GDP.

Finally, we also perform a stress test to the high spending scenario, 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 fig. 16b above) of about 35$ 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 (fig. 16a).

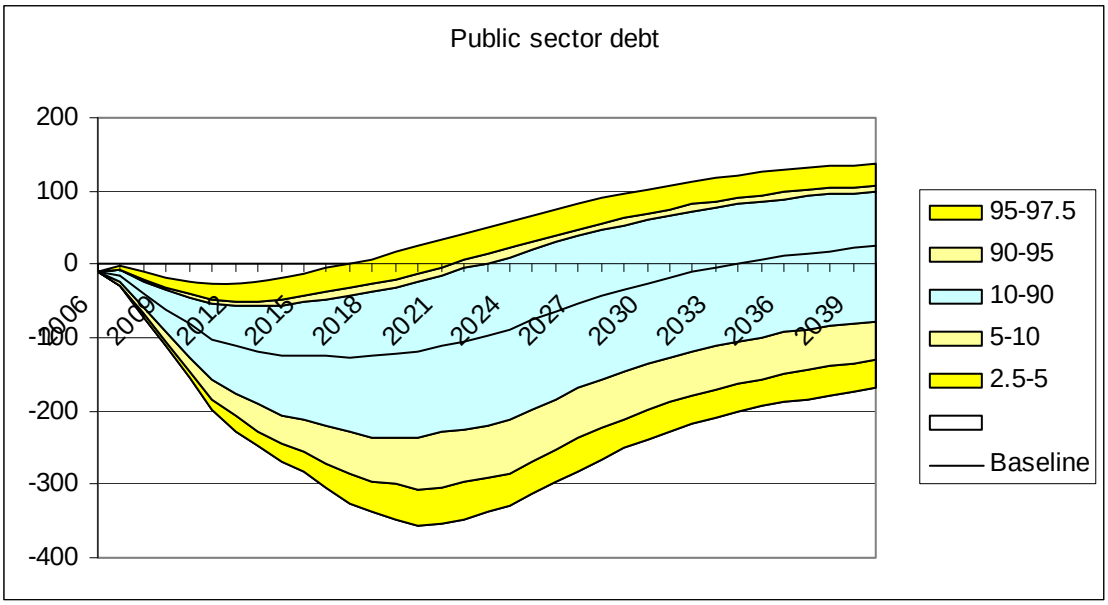
D. **The Impact of Uncertainty: Monte Carlo (MC) Simulations**

D.1 *MC simulations around the four scenarios with fixed fiscal rules*

The dominant feature of the Azeri economy is the high volatilityof its main source of income, oil & 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. We therefore implement a V@R approach to public debt. As explained in Annex II, we do that by running full scale Monte Carlo simulations, using historical variances of the variables being simulated and simulating the full probability distribution of future debt/output ratios. We then plot the distributions resulting from the stochastic simulation in a so called "fan chart" for the debt-to-GDP ratio. We concentrate on two key variables, changes in the real exchange rate and the price of oil. In the first section (E.1) we use fiscal rules (PI rules or otherwise) that do not respond to the simulation outcomes. It will become clear that such a rule introduces considerable uncertainty in the sense that the resulting distributions become very wide (i.e. the long term risks large). In Section E.2 we show that even modest feedback from higher debt levels to higher surpluses reduce that uncertainty to a considerable extent.

In the first graph we show base case 1, high initial *nopd*s followed by a long string of nopds set at 12% of GDP (see fig. 16a, High Spending Scenario). The results show widely dispersed distributions, as a reflection of the very high variance that obtained in the past (cf fig.17).

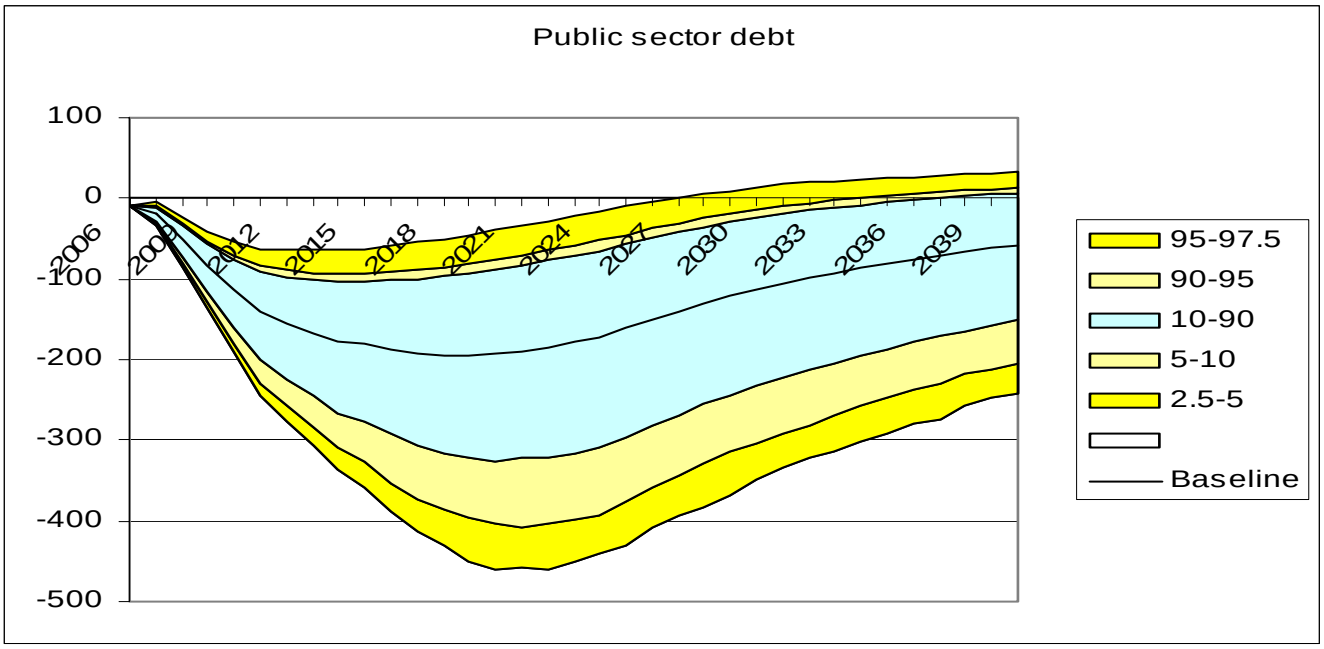
Fig.17: Distribution Future Debt Stocks under the Base Line Scenario



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 nscenario. Moreover based on historical variances and the complete lack of any feedback of rising debtlevels on fiscal policy, the net debt position can become very large over the next three decades. With 95% certainty we can only say that the net debt will not become larger than 100% of GDP, indicating that the risk of major debt problems is very real under this strategy. One response would be to introduce feedback strategies: if net debt rises fasrter than planned a larger non-oil surplus is implemented; we will explore such strategies in the next section. But first we will show what happens under the PI strategy.

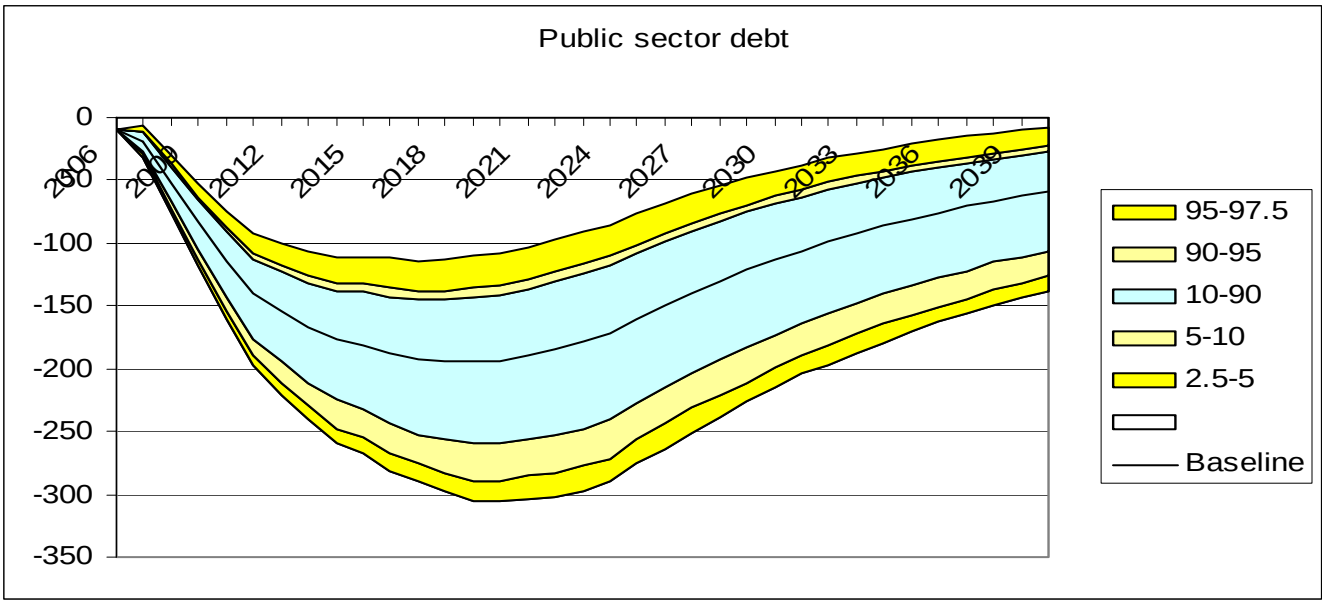
We run two variants: one using historical variances for both variables being simulated (fig.18a), and one where the variance of the real exchange rate isd reduced by 50%, reflecting the fact that this run has a more stable expenditure policy (fig.18b).

Fig.18a PI at historical variances



The simulations summarized in fig.18b show that reduced real exchange rate variance helps: the 95% range now falls from 250% of GDP down to about 140%, with further gains likely once a debt feedback rule would be adopted. In the fig.18b scenario, Azerbaijan will stay out of debt with more than 95% certainty during the entire horizon. Thus we can safely conclude that the PI scenario provides Azerbaijan with a reasonably safe environment.

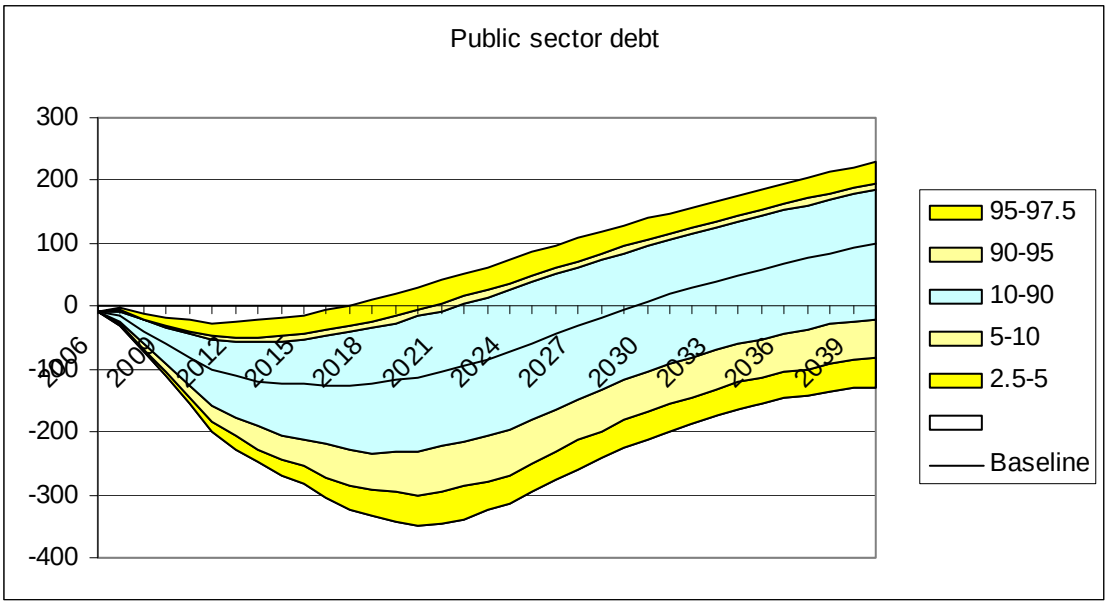
Fig.17b PI at historical variance for oil prices and at 50% of historical variance for rer



However, there are legitimate reasons why spending levels during the initial years maybe higher than the one based on the permanent income 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 (this will be the subject of a follow up study).

Under this high spending scenario on top of the already expansionary base line, the debt situation seriously gets out of hand. The expected value (black middle base line) shows that debt levels are likley to reach some 100% of GDP, while the stochastic simulation shows that it could well run up to double that amount. All we can say is that with 95% certainty the net debt level will stay below 200% of GDP, clearly an unacceptable level of debt once oil has run out. Of course this assumes that the high spending will be assumed throughout the simulation period, and without any feedback from high debt to fiscal policy. We will relax this assumption in the enxt section, but the simulation makes a basic point: the high spending scenario on top of an already expansionary base case exposes Azerbaijan to major risks.

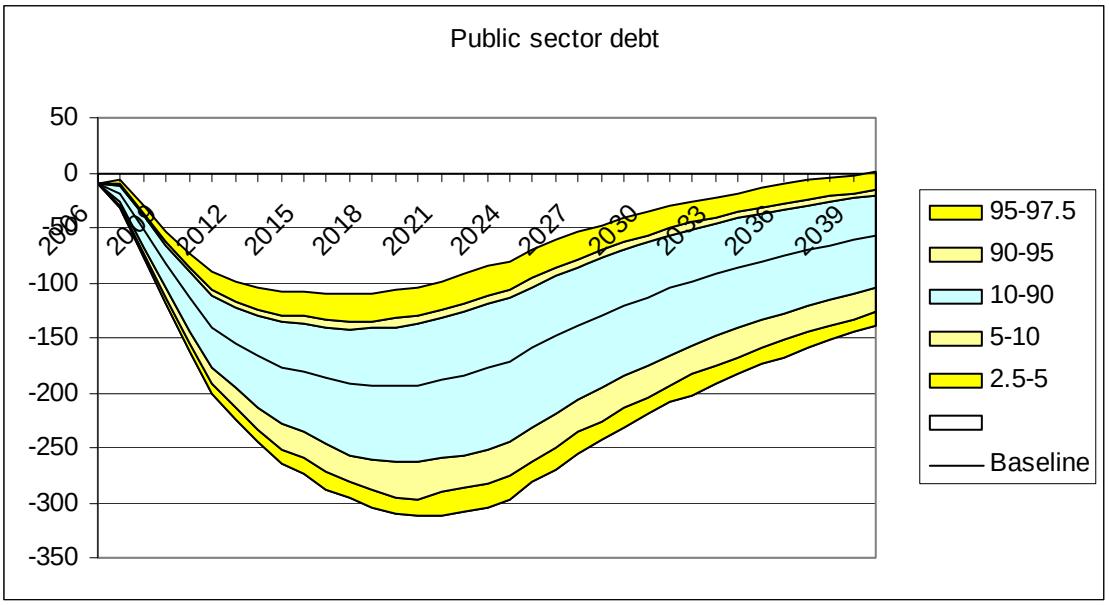
Figure 19. "Fan-chart" Public Sector Debt for High Spending Scenario



D.2 Monte Carlo analysis with feedback from higher debt levels back to higher surpluses: uncertainty will be much reduced with modest feedbacks

All simulations presented sofar assume a fixed fiscal rule, for example a primary non-oil deficit equal to the ex ante calculated Permanent Income level of oil revenues. The lack of any *ex post* response to adverse shocks then leads to a greaty deal of uncertainty about future debt stocks; even the use of a fixed PI rule turns out not te be enough to get manageable levels of 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 (cf 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 a future crises.

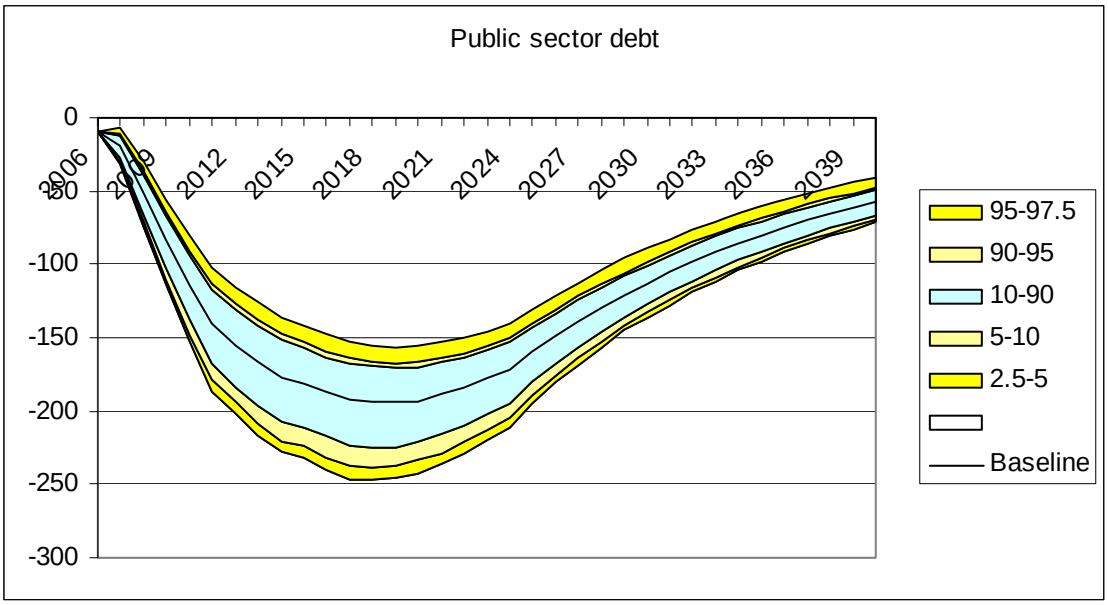
Fig. 19a: PI spending, historical variance for oil prices, 50% of historical variance for rer



Figures 19a and 19b show how a feedback of unanticipated higher debt levels to larger (smaller) primary supluses (deficits) leads toa much less uncertainty about future debt stocks, and therefore likely to much lower crisis expecations. Figure 19a above simply reproduces the simulation results already reported in Fig. 17b. There we 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%. Although Azerbaijan can be said with 95% certainty to stay out of net debt, there is a very wide range of expectations about future debt stocks.

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 alpha % of last year's excess debt (higher than projected in the base run for given nopd assumptions) is offset by a lower non-oil primary deficit. Budina and van Wijnbergen (2007) show that Turkey throughout the nineties used a strong feedback rule, with a coefficient alpha equal to 0.20 (i.e. 20% of any debt surprize is corrected the following year by tightening fiscal policy). If we add such a feedback erule to the simulations of 19a, we get the results summarized in fig. 19b.

Fig. 19b: PI spending, at historical variance for oil prices and at 50% of historical variance for rer; Feedback from debt surprizes 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% worst outcome line now stays at a positive net assets position of 40% of GDP, instead of touching zero; and the range between the 95% worst outcome and 95% best outcome narrows down to about 30 percentage points of in 2040, down from a high 140% of GDP.

The conclusion should be obvious. It is very 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 non-oil deficit by for exqample 20% 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. This should translate in lower costs of debt servicing and less volatility in the capital account.

III. 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 consequwences 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. The baseline simulations, where non-oil deficits are initially at currently budgeted levels but eventually return to 12% 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 prices 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. What jumps out is that future debt levels are characterized by a very wide distribution as uncertianty 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 dsitribution of future debt stocks around a givern 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% confidence reach as high as 100% of GDP under the baseline scenario. Under the high spoending scenario, the 95% certainty maximum debt level evven exceeds 200% of GDP, a clearly unsustainable level. Thus these scenarios expose Azerbaijan to considerable risk. The PI approach reduces that risk a great

deal. If we also assume a reduced variance of the real exchange rate in resposne to more stable expenditure patterns, we can say with 95% certainty 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%, 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. In particular the 95% certainty maximum debt level actually stays widely negative unde rthe PI scenario: with 95% certainty net assets wil stay at 20% of GDP or higher. Such a feedback policy will not raise the average burden of fiscal policy but will greatly reduce estimated crisis pobabilities by reducing variance in the economy.

References:

Aghion, Ph., Ph. Bacchetta and R. Ranciere (2006), Exchange Rate Volatility and Productivity Growth: the Role of Financial Development", NBER WP 12117

Anand, R., and S. van Wijnbergen. 1988. “Inflation, External Debt and Financial Sector Reform: A Quantitative Approach to Consistent Fiscal Policy with an Application to Turkey.” Working Paper 2731, National Bureau of Economic Research, Cambridge, MA.

------. 1989. “Inflation and the Financing of Government Expenditure: An Introductory Analysis with an Application to Turkey.” *World Bank Economic Review* 3 (1): 17–38.

Bandiera, L, N. Budina, M. Klijn, and S. van Wijnbergen. 2007. “The ‘How to’ of Fiscal Sustainability: A Technical Manual for Using the Fiscal Sustainability Tool.” Policy Research Working Paper 4170, World Bank, Washington, DC.

Baunsgaard, T. 2003. “Fiscal Policy in Nigeria: Any Role for Rules?” Working Paper 03/155, International Monetary Fund, Washington, DC.

Budina, N. and S. van Wijnbergen (2007), “Quantitative Approaches to Fiscal Sustainability Analysis: A New World Bank Tool Applied to Turkey”, Policy Research Working Paper No. 4169, World Bank, Washington DC.

Budina, N. and S. van Wijnbergen (2007): “Debt, Deficits and Inflation in Turkey: is there a Fiscal Dominance Problem?”, mimeo, University of Amsterdam.

Budina, N., G. Pang, and S. van Wijnbergen (2007), “Nigeria’s Growth Record: Dutch Disease or Debt Overhang?”, Policy Research Working Paper 4256, World Bank, Washington, DC.

Burnside, C. 2005. <I>*Fiscal Sustainability in Theory and Practice: A Handbook.*<I> Washington, DC: World Bank.

Celasun, O., X. Debrun and J. Ostry (2005), “Primary Surplus Behaviour and Risks to Fiscal Sustainability in Emerging Markets: a Fan-Chart Approach”, IMF, Washington DC

Corden, M. and J. P.Neary (1984), "Booming Sector and Deindustrialization in a Small Open Economy", Economic Journal, vol.92

Davis, J. M., R. Ossowski, and A. Fedelino, eds. 2003. <I>*Fiscal Policy Formulation and Implementation in Oil-Producing Countries.<I>* Washington, DC: International Monetary Fund.

Devlin, J., and M. Lewin. 2005. “Managing Oil Booms and Busts in Developing Countries.” In <I>*Managing Economic Volatility and Crises: A Practitioner’s Guide,<I>* ed. J. Aizenman and B. Pinto, 186–209. Cambridge, UK: Cambridge University Press.

Hausman, R., and R. Rigobon. 2002. “An Alternative Interpretation of the Resource Curse: Theory and Policy Implications.” Working Paper 9424, National Bureau of Economic Research, Cambridge, MA.

Lane, P. R., and A. Tornell. 1996. “Power, Growth and the Voracity Effect.” <I>*Journal of Economic Growth*<I> 1 (2): 213–41.

World Bank (2005), “Nigeria’s Opportunity of a Generation: Meeting the MDGs, Reducing Indebtedness.” Anchor Report prepared for Poverty Reduction and Economic Management, Africa Region, World Bank, Washington, DC.

World Bank (2006), “Debt Sustainability Analysis in Oil-Rich Countries.” PRMED Note, World Bank, Washington DC.

Van Wijnbergen, Sweder van (2008), “The Permanent Income Approach in Practice: a Policy guide to Sustainable Fiscal Policy in Azerbaijan”, mimeo, University of Amsterdam

Annex 1: WB Oil Price Forecasts

Annex Table

	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	
International Oil Price $/Bbl - old	64.3	67.9	72.4	68.2	64.2	60.3	56.7	53.2	50.0	
Total Projected Fiscal Revenues from oil ('000$)	4231284.7	7775139.8	23314562.5	26945654.7	27015457.3	24084305.2	21122418.3	18242664.3	15913804.3	15
Total Fiscal Revenues ('000$)-old oil prices	4231284.7	7154242.9	19450961.6	22945221.4	23114485.6	21018269.3	18639343.0	16280122.0	14351972.8	13
PI - new Oil prices	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4
PI - old Oil Prices	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4

	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 $/Bbl - old	48.7	48.9	49.2	49.4	49.7	49.9	50.2	50.4	50.7
Total Projected Fiscal Revenues from oil ('000$)	13950719.9	14906494.5	14565839.7	13730952.6	12270220.1	10943518.2	9684165.7	8591444.3	8669189.7
Total Fiscal Revenues ('000$)-old oil prices	12348286.4	12226900.6	11932629.9	11178946.7	11121534.3	9920191.5	8776848.9	7786636.4	7861064.2
PI - new Oil prices	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1	4251601.1
PI - old Oil Prices	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9	4388561.9

Annex II: The Fiscal Sustainability Tool

The traditional approach to fiscal sustainability asks whether current or planned primary fiscal balances (public revenues minus non-interest expenditure and) are compatible with stable debt-to-GDP ratios given interest rates, growth rates and real exchange rate developments. Given the special features of oil-rich countries noted above, managing volatility during oil price booms makes it advisable to 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.

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. As mentioned above, customizing the forward looking approach to oil-rich countries 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.

Once the baseline scenario is created, the next step requires checking the vulnerability of the net debt/net asset dynamics to key debt determinants and, most important, to sudden drops in oil prices. The sensitivity checks to low oil prices are especially important, given the large uncertainty surrounding future oil prices, high oil price volatility, and possible volatility clustering.

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, 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.[7] 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, 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, 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: [8]

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

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

[7] For debt decomposition derivation in discrete time, see the annex to this chapter.

[8] Note that, to simplify the exposition, we present a continuous time formula. As shown in the chapter annex, however, in the fiscal sustainability analysis we use discrete time formulas for deriving public debt dynamics. A similar debt decomposition formula also has been used in World Bank (2005).

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, $\frac{EP^*}{P}$ 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 e.a. (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).

2.3 Modifying public debt dynamics to isolate the impact of oil on public finances

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 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 eq.(1) in terms of non-oil primary deficit, we get:

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

Hence, public debt dynamics equation (eq.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.

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 eq. 3, we also express the public debt dynamics equation in terms of these two components of the total oil fiscal revenue:

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

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:

$$\dot{oa}^* = (r^* + \hat{e} - g)oa^* e + [Roil - Roil_{sb}] \qquad (5)$$

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.

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

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*.[9] 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.

[9] 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.