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Managing Volatility: Fiscal Policy, Debt Management and Oil Revenues in The Republic of Congo

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Abstract

Assessing fiscal sustainability – i.e. considering whether or not a country can maintain its current fiscal policies without running into solvency pro3blems 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. The paper applies a framework for fiscal sustainability and managing uncertainty to Congo. Congo is rapidly building up its production and export capacity and can expect to be a substantial energy producer for several decades to come. Its major challenge is how to manage the hump shaped nature of its oil windfall and how to ensure fiscal sustainability when the oil windfall is gone. The paper analyzes explicitly the effects of uncertainty through stochastic analysis allowing for Value-at-Risk assessments. Furthermore, using an active debt feedback rule, the paper provides an example of how fiscal policy can be used to actively manage debt, in this particular case to reduce its volatility. Such a fiscal policy rule, leading to tightening fiscal policy whenever negative debt shocks occur, can greatly reduce the variance of future debt outcomes and thereby lower the riskiness of the economic environment in Congo without on average increasing the expected burden of fiscal policy.

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I. Introduction

Resource-rich countries have witnessed stagnating growth, de-industrialization, low savings, lagging human and physical capital accumulation, and stagnating or declining productivity. Recent turmoil in commodity markets has highlighted an important factor behind this performance problem: the volatility of what for most resource-rich countries is the dominant source of export earnings. Managing volatility may well be the prime challenge facing resource-rich countries, superseding traditional concerns about competitiveness of non-resource sectors. In addition, corruption, rent-seeking and vested interests—the "political economy of oil"—are barriers that need to be overcome to inject transparency into the accounting for the accrual and use of oil revenues. This is of course a precondition for using oil revenues effectively.

"Debt overhang" (when arrears on old debt deter new lenders, thereby blocking the country's new access to capital markets) has been cited in the literature as a potential explanation for the negative macroeconomic experiences of many resource-rich countries – in Nigeria, for instance, debt overhang problems have magnified expenditure volatility, contributing to a hostile climate for private sector development.

A large number of resource-rich countries remain classified by the World Bank as severely indebted, with high levels of external debt making them vulnerable to resource-wealth volatility. Several commodity exporters have gone through external debt crises and long periods of depression (Mexico and Nigeria are well known examples). Public indebtedness also tends to be high in oil-exporting countries, and a substantial number of them have run into debt problems (for example, Angola, Chad, Republic of Congo, Ecuador, Iraq, Mexico, Nigeria, the Russian Federation, Sudan, the Republic of Yemen, and República Bolivariana de Venezuela), mostly when oil prices were in decline but some even in boom periods. This evidence suggests that the design of fiscal policy should pay special attention to downside risk in international capital markets: debt overhang problems imply that world capital markets become inaccessible at precisely the moment they are needed most.

This paper focuses on the role of fiscal and debt management policies in managing resource-wealth volatility and its implications for debt and development. The case study

selected for our assessment is the oil-rich country of Congo (but other natural resources, like copper, would present similar problems). The paper presents a new framework for assessing fiscal sustainability and vulnerability to debt overhang problems applicable to special features of oil-rich countries and applies it to debt-overhang problems in Congo. Congo is rapidly building up its production and export capacity, and can expect to be a substantial energy producer for several decades to come. But Congo's oil reserves are smaller than those of countries that, for all practical purposes, have oil for the foreseeable future: the post-oil economy is nearer for Congo. The country's major challenge, if its oil wealth is to prove a resource blessing rather than a resource curse, is how to manage an oil windfall that will be short-lived, and how to ensure fiscal sustainability when that windfall is gone.

The paper analyzes explicitly the effects of uncertainty through stochastic analysis allowing for Value-at-Risk assessments. Furthermore, the paper provides an example of how fiscal policy can be used to actively manage debt, in this particular case to reduce its volatility. Implementing a fiscal policy rule, which implies tightening fiscal policy whenever negative debt shocks occur, can greatly reduce the variance of future debt outcomes and thereby lower the riskiness of the economic environment in Congo without on average increasing the expected burden of fiscal policy.

II. Background

II.1 Oil Wealth and the Poor Growth Record

Congo began exploiting its petroleum reserves in late 1950s and today petroleum extraction is the dominant sector of the economy. In 2005, Congo was the sixth largest oil producer in sub-Saharan Africa, following Nigeria, Angola, Sudan, Equatorial Guinea, and Gabon. Using 1970 as a benchmark, Congo gained an extra $57 billion in oil exports over the period 1970-2007, or 7.4 times 2007 GDP, expressed in constant 2007 dollars. The sizeable oil windfall of course does present net wealth and thus additional spending room, but it has also complicated macroeconomic management and led to an extreme dependency on oil, a highly volatile source of income. The share of mining in total GDP increased

substantially, representing about 60 percent of GDP in 2007. Oil also accounted for more than 90 percent of exports and 80 percent of government revenues (see Figure 1a).

Figure 1a: Indicators of Oil Dependence.

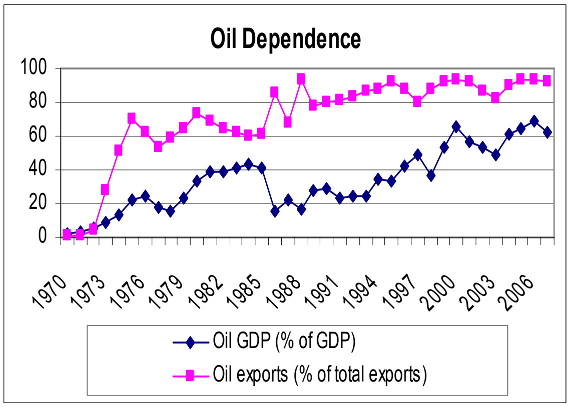
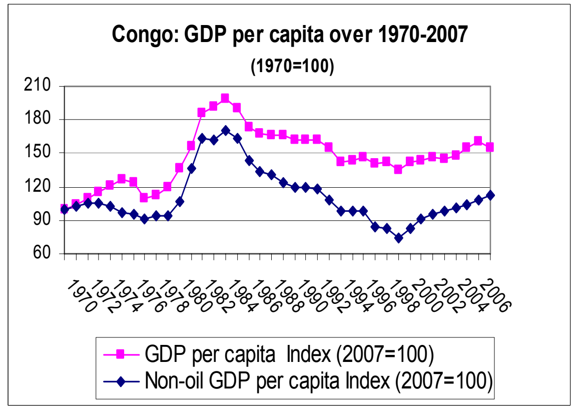


Figure 1b: Per Capita Income in Congo



Yet the many years with oil money have not brought the population an end to poverty nor, at least not until recently, allowed the economy to break out of what seems like perennial stagnation in the non-oil economy (see Fig. 1b). Congo was formerly ranked as a lower middle-income country. As shown in Fig. 1b, during the 1970s and 1980s, the GDP per capita has closely tracked the oil sector developments – it increased substantially during the first and the second oil price shock, but declined steadily in late 1980s, when oil prices collapsed. The decline in GDP per capita continued through 1990s when on top of the low oil prices the situation was exacerbated by the effects of the war that ravaged the country. Military conflicts have exacted a heavy toll on the country's infrastructure. In addition, the poverty rate is still very high (close to 50 percent in 2005), after peaking at close to 70 percent in the period immediately following the conflicts. Unemployment among the active population is estimated at close to 50 percent.

Despite its long history of poor economic performance and series of military conflicts, real GDP per capita seems to be on an increasing trend since 2000. The adoption of a new constitution and a peace agreement between the government and all remaining rebel groups in 2003 have further boosted economic activity and contributed to macroeconomic stability. The non-oil sector growth remained robust and registered an annual average growth of about 8 percent during 2000-2007. Oil sector performance for

the same period, however, was much weaker, mostly on the account of a huge production decline, caused by an accident in May 2007. Going forward, oil production is again on a rising trend as new fields are coming on stream. Congo's oil reserves are estimated at 1.6 billion barrels (see IMF (2007)), which is much smaller than those of countries that, for all practical purposes, have oil for the foreseeable future: the post-oil economy is nearer for Congo. As oil output is expected to peak by 2010 and then decline over the next 20 years as fields mature, the oil windfall will be short-lived. How to manage such a windfall is a major challenge to the country.

Are there any lessons Congo should learn from its poor record in the past that could help insure that current favorable developments become structural and, last beyond the end of the current windfall gains?

II.2 The Challenge of Managing Oil Revenue Volatility

Oil income is highly volatile even when quantities are relatively easy to predict, because oil *price volatility* is high (See Figure 2a). High spending out of oil income, therefore, translates income volatility into highly volatile expenditure, with serious negative macroeconomic consequences. Volatility can be seen as a tax on investment. Investment requires irreversible decisions because capital, once installed, cannot be moved to other sectors. Highly volatile relative prices discourage the irreversible commitments to specific sectors that capital investment implies (van Wijnbergen (1985)). Aghion et al. (2006) have shown empirically that high volatility slows down productivity growth by a substantial margin in countries with a relatively underdeveloped financial sector, like Congo. In their sample, a 50 percent increase in volatility slows down productivity growth by 33 percent, on average.

Figure 2. a) Oil Price Volatility and b) Fiscal Policy and Output Volatility

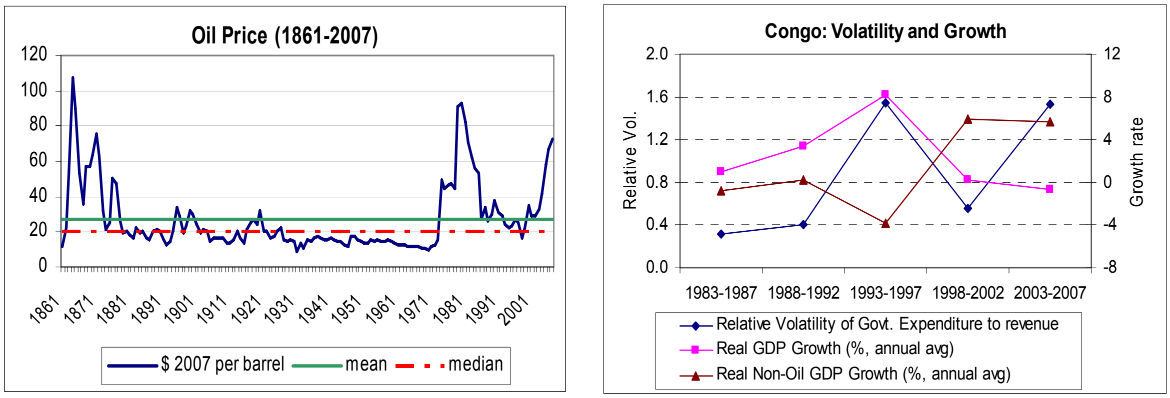


Figure (2b) demonstrates moreover that fiscal policy has pushed volatility beyond the volatility stemming from variable oil prices; the Government itself has become a source of macroeconomic volatility. This has happened in Congo recently.

And there is another problem in Congo and in many ORCs – the problem of too close a link between public expenditure and volatile current oil income. When oil prices go down unexpectedly, it is often difficult and costly to adjust expenditure downwards, while the need to do so may in fact be larger than the actual decline in income triggering the need for adjustment to begin with. This is because ORCs, and Congo very much so, have a peculiar problem concerning capital market access. Obviously, their need to borrow is lowest when oil prices are high, and is high when prices are low. However, their borrowing capacity is inversely related to their borrowing need, because the value of their de facto collateral, oil wealth, also peaks when prices are high and drops when they are low. This perverse link between income shortfalls, declining collateral values and reduced resource inflows are an obvious recipe for debt overhang problems: new lenders will fear too much of their money will be diverted to service old debt, thereby reducing the value of their claims even if projects financed by the new moneys have a sufficiently high rate of return to service new debt in the absence of old claims outstanding. Manzano and Rigobon (2001) have suggested a link between debt problems and slow growth in resource-rich countries. Budina and van Wijnbergen provide empirical evidence of this problem for Nigeria (Budina and van Wijnbergen (2007)).

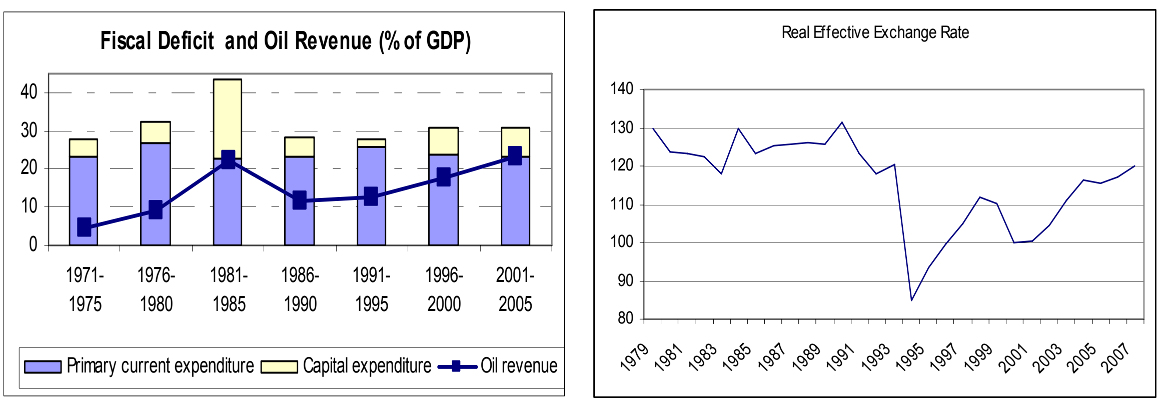
It is important to note that debt overhang problems can arise in countries with relatively little debt; what matters is short term cash flow needs. So a modest debt but all

coming due in the near future is more damaging than a much higher debt with amortization smoothly stretched out. And the worse the debt service record, the more likely there will be a debt overhang problem. Debt overhang exists when debt has strong equity characteristics (i.e. is only serviced in good times) and accordingly trades at a large discount.

II.3 The Origin of the Debt Problem

Following the oil boom of the 1970s, Congo pursued highly pro-cyclical fiscal policies in the 1980s which, together with civil war, resulted in growing deficits and a rapid rise of the public sector during the oil boom years of the early 1980s. The late 1980s and early 1990s were characterized by large macroeconomic imbalances. The decline in oil prices of the late '80s resulted in significant decline in oil revenues, cuts in government investment spending and limited structural reforms.

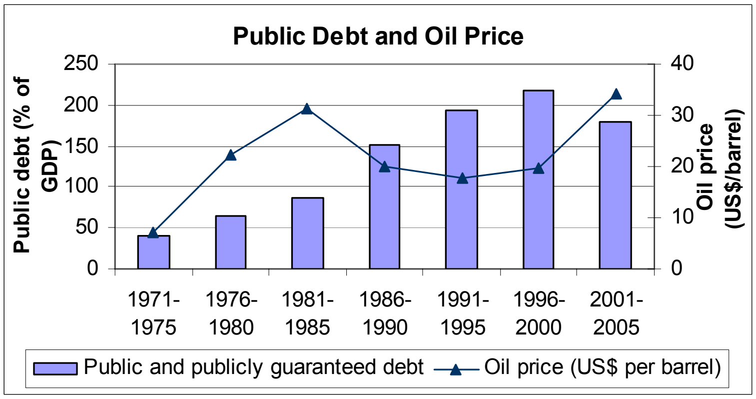
Figure 3. a) Oil Revenue and Public Spending and b) Real Effective Exchange Rate (up is appreciation)



In addition, 1994 saw a 50 percent devaluation of the CFA franc—decided at the CFA franc zone level—to restore competitiveness and boost exports. These factors, together with the civil war, brought external public debt and the debt service burden to unsustainable levels. Successive economic programs supported by the IMF went off track, because of political instability, weak fiscal discipline and insufficient resolve to implement structural reforms, especially in the oil sector. As a result, the economy stagnated, fiscal and external imbalances widened markedly, and the external public debt and debt-service

burdens grew to unsustainable levels. In addition, large domestic and external payment arrears accumulated.

Figure 4. External Public and Publicly Guaranteed Debt and the Price of Oil



High public indebtedness in many other oil-exporting countries, in spite of their oil wealth, means that fiscal policy design should pay special attention to downside risk in international capital markets: debt overhang problems imply that world capital markets become inaccessible at precisely the moment they are needed most.

III. Fiscal Sustainability and Managing Oil Price Uncertainty

Assessing fiscal sustainability and vulnerability to debt overhang problems for oil-rich countries requires distinguishing between oil and non-oil primary deficits.[2] Such a distinction is warranted because of the different nature of the oil-related fiscal revenue. Oil is an exhaustible asset which means that fiscal revenues from oil extraction result from (natural) asset decumulation; so oil revenue is more a financing item instead of current revenue. Faster oil depletion today means less for future generations unless (part of) the oil revenue is reinvested in other forms of assets/capital.

[2] See PREM note (2006) and Davis at al (2004).

III.1 A Framework for Fiscal Sustainability and Managing Uncertainty

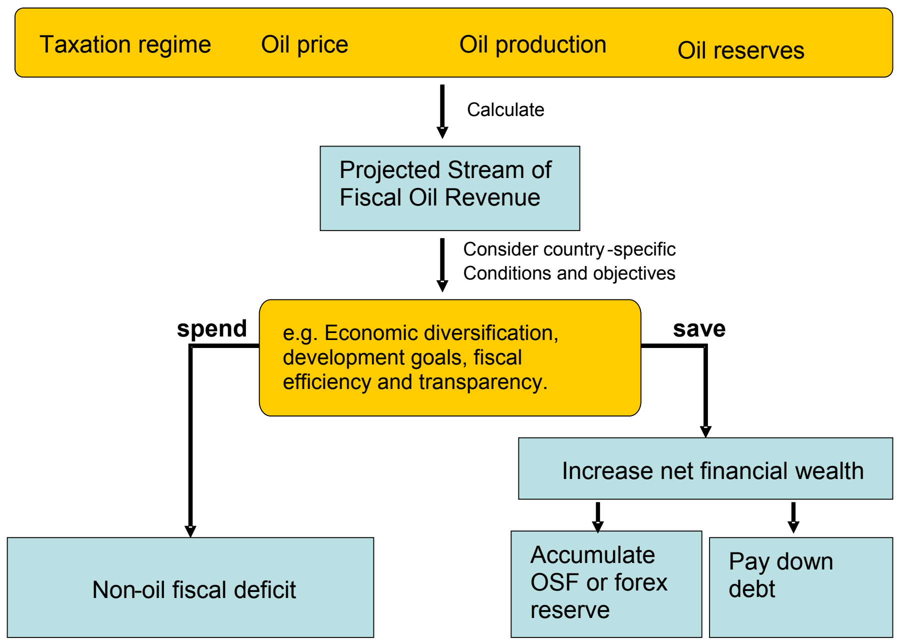
We use a model based on simulation methods to forecast the distribution and evolution of net public debt/assets, accounting for various rules governing oil fund allocations, the non-oil primary deficit and foreign debt accumulation. It consolidates the government's fiscal accounts with the Oil Stabilization Fund (like for example Norway's Oil Fund)[3] 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 money 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

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 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 equivalent* of oil wealth.

Such a rule has several 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 effects.

[3] Although we refer to oil, any other natural resource can be substituted, like Chile's Copper Stabilization Fund.

Figure 5. Fiscal Sustainability Framework for Oil-Rich Countries

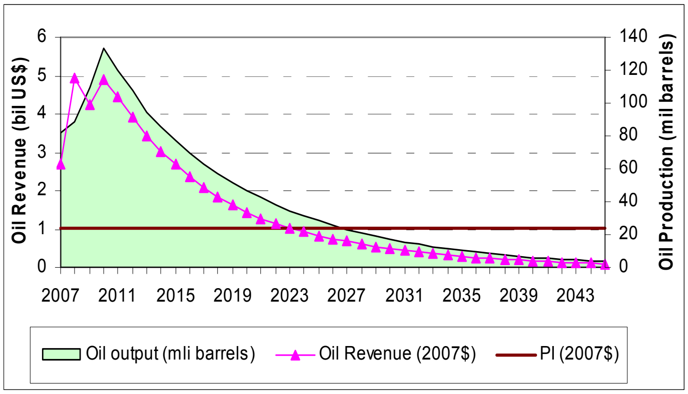


III.2 The Value of Congo's Oil Wealth and Sustainable Spending

Three strategic questions frame the challenge that Congo faces in managing its oil windfall: (1) How to manage an oil windfall that is likely to be short-lived? (2) How much oil revenue should be saved and spent every year, or how to set meaningful fiscal rules to ensure fiscal sustainability when that windfall is gone? And (3) How to assess the impact of uncertainty and how to manage oil revenue volatility?

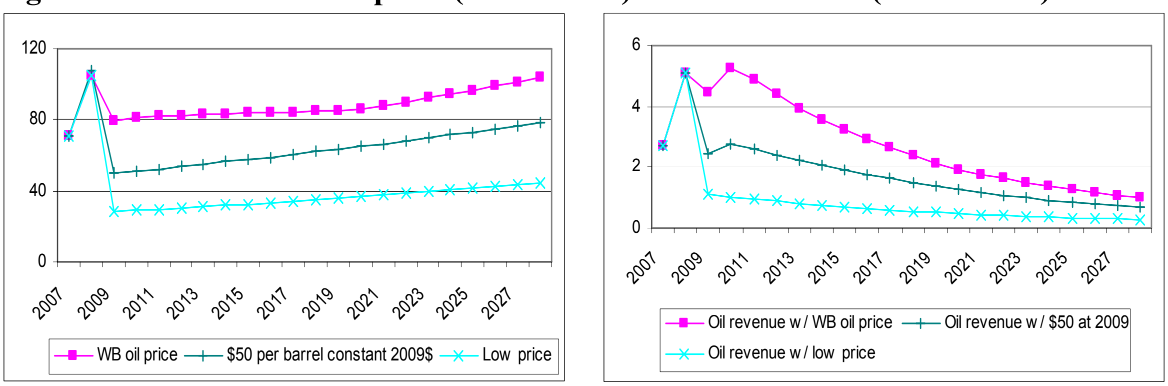
Below we sketch answers to these questions. All calculations should be considered preliminary as they will be updated on the basis on new information and some fine-tuning of key parameters in the framework.

Figure 6. Projected Extraction Profiles in Congo



The first set of inputs concerns the oil sector. Congo's oil reserves are estimated at 1.6 billion barrels (see IMF (2007)). Oil production has been going up steadily and is expected to rise substantially up to 2010 as new offshore fields come on stream and as new extraction technologies are applied to extract more oil from maturing fields (See Figure 6 and IMF (2007)). The government oil model assumes that after 2010, barring new oil discoveries, oil production may be on a declining trend and growth will depend increasingly on the non-oil sector.

Figure 7 a. Oil Price Assumption (USD/barrel) b. Oil Revenues (billion USD)

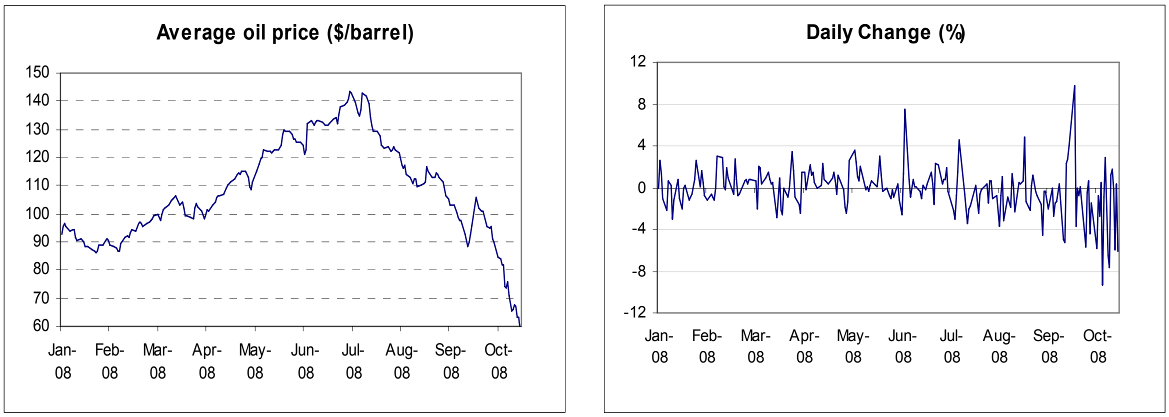


The second critical input concerns the oil price assumptions/projections (cf Figure 7a and Annex A). Average oil prices were on a free fall since their peak in Jul 2008 and reached nearly $60 per bbl on October 24, 2008 (See Figure 8a). Furthermore, oil price volatility was high and increasing throughout 2008 (Figure 8b).

In view of the high uncertainty surrounding long term oil prices, several assumptions about the long term oil prices have been used to check the sensitivity of the results (See Fig. 7a): (i) official World Bank's oil price forecast as of Oct. 7, 2008; (ii) an assumption of a constant $50 per bbl in and after 2009; and (iii) a low oil price scenario

where prices return to their long term (since 1861) mean in 2009 (estimated at about $28 per bbl expressed in 2009 dollars), and remain at this level thereafter.[4]

Figure 8 a. Average Daily Oil Price in 2008 (USD/barrel) b. Daily Volatility (%)



The revenue projections are derived from a framework that includes production forecasts of different fields and accounts for profit sharing and government charge schemes. By changing price assumptions, this framework produces the corresponding revenue profile. The revenues at these three different price schemes are presented in Figure 7b given the above production profile (Figure 6). Under official World Bank's oil price assumptions, Congo will experience a very steep increase in oil fiscal revenues during 2008-2011. However, without any new oil discoveries, oil revenues are projected to decline quickly, returning to their 2007 level by 2016 and further dropping to about a third of their 2007 level by 2028 and disappearing by 2045.

In Table 1 we build up the NPV of the stream of oil-related fiscal revenues that Congo can expect. We discount the future income back to 2007 in a Net Present Value calculation, assuming a safe real rate of interest of 3 percent. This is added to a long term US inflation projection of 2.4 percent to arrive at a safe nominal rate of 5.4 percent. But the income stream being discounted is a highly uncertain stream; to account for the riskiness, we have to add a risk premium. We assume 3%, the current academic consensus on the equity premium, on the assumption that oil shocks are mostly demand driven nowadays and thus highly and positively correlated with stock markets. Under the World Bank oil price projections, oil wealth then equals about 4 times 2007 GDP and no less than 11 times

[4] See BP Statistical Review.

2007 non-oil GDP. Under a by now more realistic scenario ($50 real), oil wealth falls by about one third, and another third if oil prices collapse to their historical average.

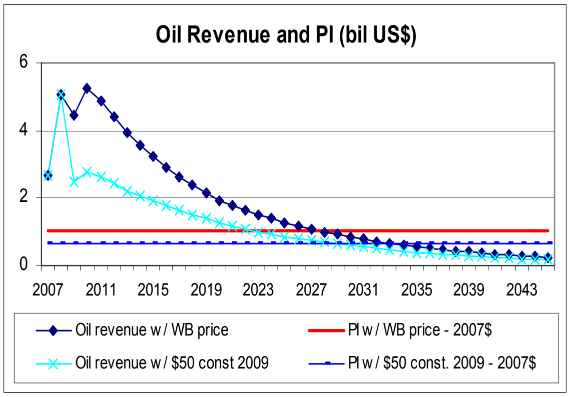
Table 1. Permanent Income Approach to Oil Wealth (in 2007 $)

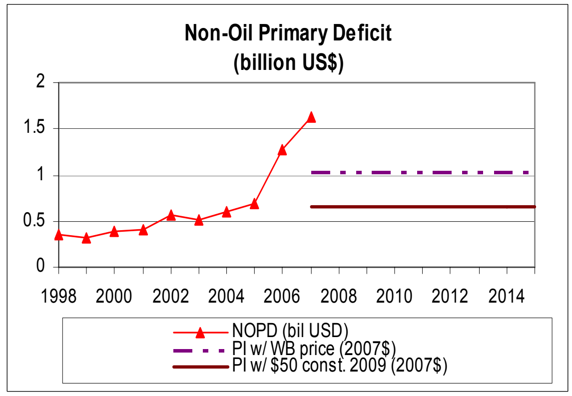
Oil Price Assumption	Net Wealth bil US$	Net Oil Wealth to 2007 GDP (%)	Net Oil Wealth to 2007 non-oil GDP (%)	Annuity billion 2007$	PI as % of NOGDP (2007)
	Real Safe Rate of Interest = 3%, Risk Premium =3%, Foreign Inflation				
WB Oil Price (Oct 7, 2008)	34.08	445.03	1171.70	1.02	35.15
$50 at const 2009 $	21.70	283.37	746.08	0.65	22.38
Low oil price scenario (historical average)	11.10	145.03	381.83	0.33	11.45

Table 1 also shows the permanent income (PI) equivalent of that NPV measure of oil wealth: this is by construction the amount that can safely be spent on an annual basis indefinitely. Under such a rule each generation receives equal amounts in real terms. The corresponding PI equivalent is estimated at 35, 22 and 11 percent of 2007 non-oil GDP under the World Bank, constant oil prices of $50 per bbl, and low oil price scenario, respectively. As shown in Table 1, the PI out of the oil windfall for three different oil price projections varies from $1.02 to $0.65 to $0.33 billion in constant 2007 dollars. Note that such a schedule is less back loaded than a constant share of GDP rule. The latter would transfer substantially more to future generations in spite of their greater non-oil wealth. We consider this feature of a constant-as-share-of-GDP rule unattractive.

These PI estimations 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. The permanent income levels shown in Figure 9a indicate that Congo, on this rule, should save substantial amounts of its oil revenues over the next 20 years, and that current levels of expenditure, which are also increasing rapidly, have already been well above the PI equivalent level in 2007 even under more optimistic oil price assumptions.

Figure 9. a. PI in Constant 2007 dollars and b. Comparison with the actual NOPD





Next, these PI estimates have been used together with other macro assumptions to obtain illustrative simulations for the likely trajectory of the net debt to GDP ratio. A PI-based fiscal 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. These are constant in real terms, so they will decline as a share of GDP. This is a reasonable sharing rule since overall GDP growth is projected to be based not on population growth but on capital accumulation and productivity growth.

In addition, the paper also assesses the impact of three illustrative fiscal strategies on fiscal sustainability (Figure.10a): (i) a drastic adjustment of the NOPD to its PI-equivalent at the beginning of projection period;[5] (ii) gradual fiscal adjustment to PI; and (iii) the NOPD stays at its 10-year historical average (15.3 percent of GDP).

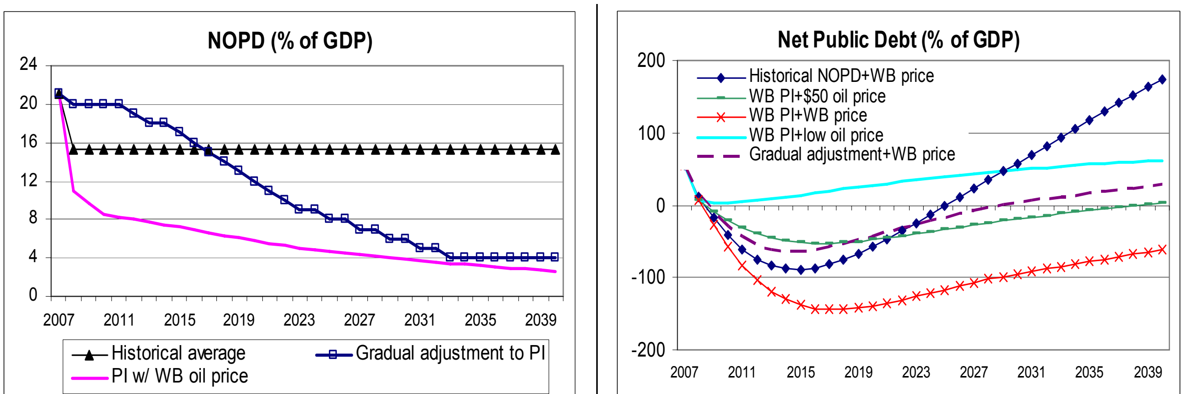
Assessing the impact of various fiscal strategies on fiscal sustainability involves forward-looking simulations of the net debt to GDP ratio over a longer time horizon. We choose until 2040 so as to check sustainability and robustness of various fiscal strategies also for the years when the oil windfall will be gone.[6] Furthermore, various oil price assumptions have been used to check the sensitivity of these simulations to different oil price assumptions (Figure 10b).

[5] For the derivation of such a strategy of a gradual adjustment to permanent income equivalent see IMF (2007).

[6] For more information and details on the methodology see Budina, van Wijnbegren and Bandiaera (2008), "How to" of Fiscal Sustainability in Oil-Rich Countries: The Case of Azerbaijan, forthcoming in the proceedings of the Workshop on Fiscal Sustainability, organized by the Bank of Italy.

Under the PI scenario sustainability is of course not under threat because it is explicitly designed as a sustainable strategy; the net asset position remains strong and basically unchanged over the projection horizon. Because of the hump-shaped profile of the oil extraction, initial net savings are positive as oil revenues exceed the PI transfer and the NOPD is limited to the value of the PI transfer; later on net savings stop but the overall net asset position remains essentially stable. Given that the 2007 NOPD is already substantially above the PI equivalent spending out of the oil wealth, such a strategy implies drastic fiscal adjustment during the next few years. PI is not entirely risk free as there is still a chance that net asset position will evaporate by 2040 if oil price turns out to be lower than the World Bank projections (for example under the assumption of a constant $50 in 2009 prices).

Figure 10.a. Illustrative Fiscal Strategies and b. Impact on the path of the Net Debt/GDP ratio



However, there maybe legitimate reasons for higher spending levels during the initial years than implied by the PI approach. In particular, the need to improve both quantity and quality of the country's infrastructure may require more financing than possible under the PI approach. This will add to upward pressure on the exchange rate and thus reduce competitiveness now, but it may improve future competitiveness and therefore growth.[7] Such a scenario is purely illustrative and assumes that the NOPD for the next 3

[7]This maybe important particularly in countries with large infrastructure gaps, as investing in (public) infrastructure may yield higher returns and fit in better with development objectives. But caution is advisable when financing domestic infrastructure: sudden oil wealth may easily lead to wasteful spending, corruption and binding absorptive capacity constraints. If oil money is used for public investment, care should be taken not to let

years will remain close to its 2007 level and then decline but much more gradually than the NOPD levels implied by the previous two scenarios. Once again, during the next 5-6 years Congo is likely to accumulate sizeable albeit smaller assets compared with those under the PI scenario, because the NOPD would still be lower than projected oil fiscal revenues (as production levels will increase about 63 percent at their peak at 364,800 barrels per day). Beyond the next 5-6 years, gaps will start to emerge because oil production will decline rapidly in the absence of new oil discoveries, while the fiscal adjustment would be much more gradual. As a result, Congo will deplete its financial assets by 2030 and beyond that the country will accumulate nearly 30 percent public debt to GDP ratio. While such a scenario maybe most desirable given the massive infrastructure needs of the country it is important to keep in mind that unlike the PI scenario, this gradual adjustment scenario is not robust to negative oil price shocks. For example, an oil price drop to $50 a bbl in 2009 and constant in real terms thereafter implies that Congo will reestablish itself as a major debt – the net debt position deteriorates throughout the period, reaching more than 90 percent of GDP in 2040.

Finally, it is also important to assess consequences of a hypothetical historical scenario, whereby the non-oil primary deficit is kept constant at its past 10 years average level (15.3 percent of GDP), to check the implications of an unchanged fiscal strategy on fiscal sustainability. Given the steep increase in oil revenue during the next five years, such a strategy would still imply net assets accumulation by 2015. Beyond 2015, the runs reflect an outcome whereby the net asset position evaporates as time goes by; in about 30 years, the non-oil primary deficit financing would result in net assets decline and full depletion by 2024. Beyond that, massive gaps will appear and will re-establish Congo as a major debtor once again.

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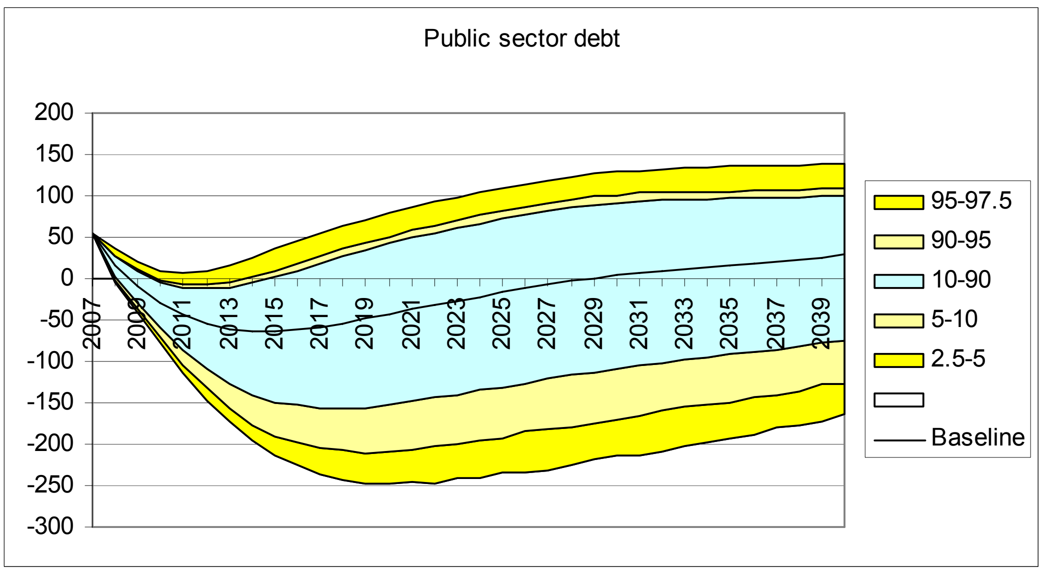
expenditure rise too rapidly to avoid waste due to absorptive capacity constraints. And institutional investments in anticorruption measures and project evaluation capacity deserve high priority.

III.3 Fiscal Sustainability Under Uncertainty: Monte Carlo (MC) Simulations

Fiscal revenues from oil account for some 80 percent of total revenues of Congo in 2007. Oil price volatility thus implies high risks for the fiscal status of Congo. To assess those risks we perform a Monte Carlo analysis. We use stochastic simulations of four key variables: changes in the real exchange rate, real interest rate, real growth rate and the price of oil. The FSA tool runs full scale Monte Carlo simulations, using historical variances of these exogenous variables, and in this way derives the full probability distribution of future debt/output ratios. The results are presented using a so called "fan chart" for the debt-to-GDP ratio.

Figure 11. Distribution of Future Debt Stocks under Gradual Adjustment to PI

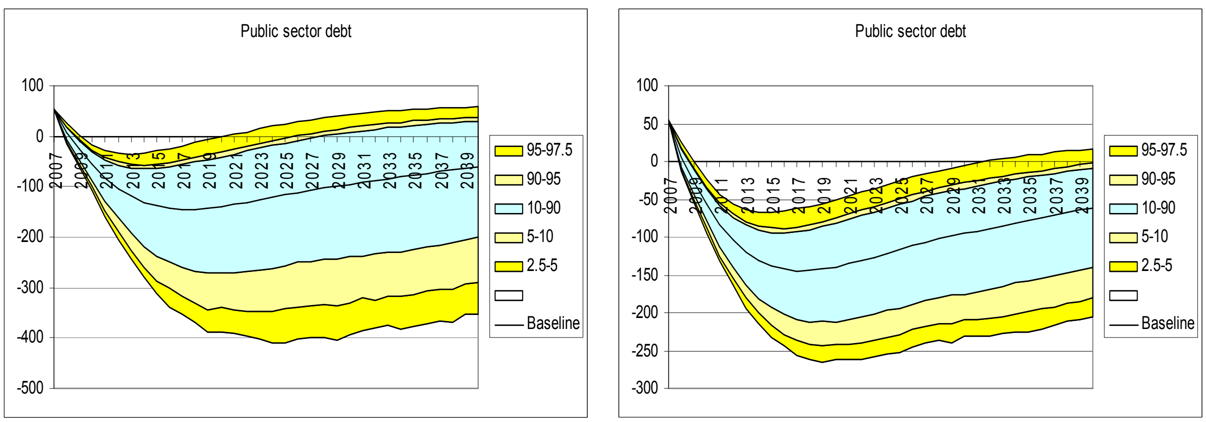


First, we assess the riskiness of a hypothetical scenario of a gradual fiscal adjustment to PI (fiscal strategy ii in section III.2). Under this strategy the net asset position evaporates as time goes by; in about 30 years, Congo is expected to become a net debtor once again under this scenario – net debt to GDP ratio in 2040 is nearly 30 percent of GDP. Such a rule, however, introduces considerable uncertainty in the sense that the resulting distributions become very wide.- there is a 50% chance that the net debt will be higher than 30 percent of GDP and a non-negligible 10% chance that net debt will be

higher than 100 percent of GDP by 2040. Therefore, 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. This indicates that the risk of major debt problems is very real under this strategy (cf Figure 11).

Next, we assess the riskiness of the PI-based fiscal strategy. We run two variants: one using historical variances for all the variables being simulated (Figure 12a), and one where the variance of the real exchange rate is reduced by 50 percent, reflecting the fact that this run has a more stable expenditure policy (Figure 12b). The simulations summarized in Figure 11a and b show that reduced real exchange rate variance helps: the maximum probable loss at 2.5 percent range now falls from about 60 to 20 percent of GDP. In the Figure 12b scenario, Congo will stay out of debt with about 95 percent certainty during the entire horizon. Thus we can safely conclude that the PI scenario provides Congo much safer environment.

Figure 12. Distribution of Future Debt Stocks under PI evaluated at
a. Historical variances **b. 50% of RER historical variance**



III.4 Using Fiscal Policy for Debt Management

All simulations presented so far assume a fixed NOPD 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 (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 future crises.

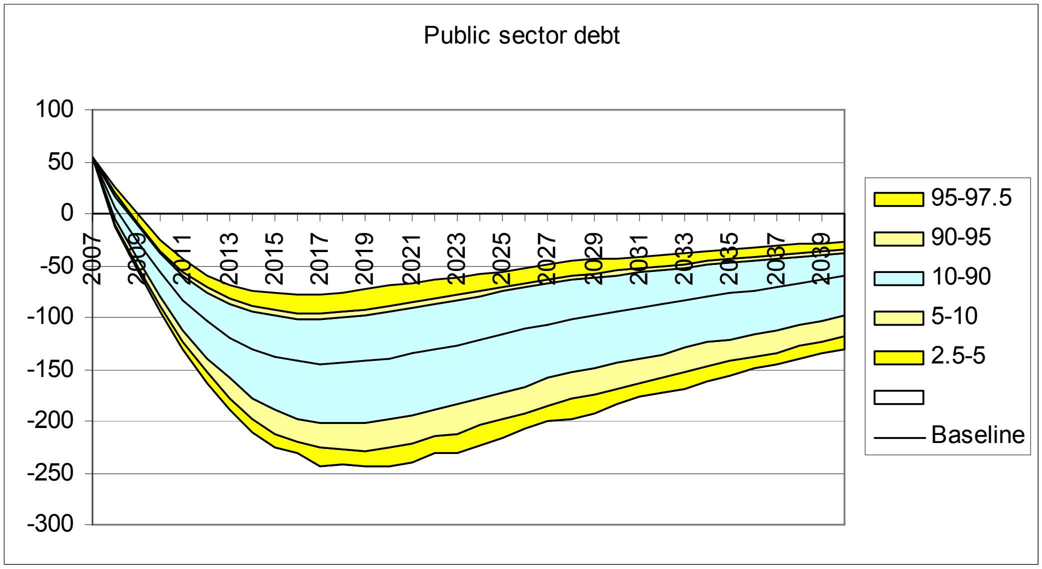
In this section the paper illustrates how using an active debt feedback rule - tightening fiscal policy whenever negative debt shocks occur - can greatly reduce the variance of future debt outcomes. This will lower the riskiness of the economic environment in Congo, without on average increasing the expected burden of fiscal policy. Such a debt feedback rule is an example of how fiscal policy can be used to actively manage debt, in this particular case to reduce its volatility.

In what follows, we apply this rule to a PI-based scenario to lower volatility of future net debt. Figure 12b above 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 percent. Although Congo can be said with 95 percent 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 a fixed percent 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 percent of any debt surprise corrected the following year by tightening fiscal policy, while Celasun, Debrun and Ostry find a lower coefficient of 4.3 percent for a sample of emerging market countries. If we add such a feedback rule (assuming a coefficient of 5%) to the simulations of Figure 12b, we obtain the results summarized in Figure 13.

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 substantially. The 95 percent worst outcome line now stays at a positive net assets position of 40 percent of GDP, instead of touching zero; and the range between the 95 percent worst outcome and 95 percent best outcome narrows down to about 100 percentage points in 2040, down from a high 220 percent of GDP.

Figure 13. 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 = 0.05



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 5 percent 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.

IV. Conclusions

Congo faces a major challenge managing its high but temporary and highly volatile oil wealth. Because of the temporary nature, intergenerational fairness is a major issue, as are concerns about post oil economic performance. But the highly volatile nature of oil revenues is the major policy challenge now. If income volatility would translate into

volatile spending levels and thus increased 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 is advisable. The illustrative simulations, where the NOPD is initially at close to its 2007 level for the next several years but then gradually declines with lower levels of expenditure, shows the re-emergence of Congo 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 their 10 year historical average, which will result in unsustainable levels of net debt once the oil windfall is gone.

But limiting the net claim on resources by the public sector (the non-oil primary deficit) to the Permanent Income Equivalent of Congo's oil wealth will result in sustainable spending programs. Under this scenario Congo 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, real growth rate and real interest rates. What jumps out is that 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. Under the gradual fiscal adjustment to PI (scenario ii), in a variant on the Value at Risk approach, the maximum debt level that can be expected with 90% confidence reach as high as 100%. The scenario iii (NOPD at 10 year historical average), is clearly unsustainable given the declining production profile. Thus these scenarios expose Congo 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 response to more stable expenditure patterns, we can say with 95% certainty that Congo will remain out of debt for the entire simulation horizon, thereby substantially reducing crisis probabilities.

Finally, the paper illustrates how fiscal policy can be used to actively manage debt. In this particular case, the use an active debt feedback rule - tightening fiscal policy whenever negative debt shocks occur - greatly reduces the variance of future debt outcome. 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, 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. With a correction coefficient of 5 percent, we show that such a feedback policy leads to a dramatic narrowing of the range that future debt stocks will stay in. In particular debt level actually stays widely negative under the PI scenario: with 95% certainty net assets will stay at 20% of GDP or higher. Such a debt feedback rule will not raise the average burden of fiscal policy but will greatly reduce estimated crisis probabilities by reducing variance in the economy.

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Annex A: Oil Price and Revenue Projections

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
WB oil price	71	105	79	81	82	82	83	83	84	84	85
Constant $50 at 2009$	71	107	50	51	52	54	55	56	58	59	60
Low oil price (long-term avg.)	71	105	28	29	30	30	31	32	32	33	34
WB oil revenue (bil CFAF)	1284	2189	1953	2289	2114	1895	1692	1531	1386	1253	1131
Oil revenue w / const. $50	1284	2189	1077	1195	1133	1041	951	881	816	755	699
Oil revenue w / low price	1284	2189	483	436	416	381	345	316	289	267	249

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
WB oil price	71	105	79	81	82	82	83	83	84	84	85
Constant $50 at 2009$	62	63	65	66	68	70	71	73	75	77	78
Low oil price (long-term avg.)	35	36	37	37	38	39	40	41	42	43	44
WB oil revenue (bil CFAF)	1021	920	828	762	702	647	595	547	501	464	430
Oil revenue w / const. $50	645	595	548	505	464	428	398	370	344	319	296
Oil revenue w / low price	232	217	203	191	179	167	156	146	136	126	117

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:[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 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 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).

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.

8 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).

Similarly, isolating oil revenue also allows us to assess the impact of oil shocks on the overall net debt/net asset position.

$$pd = f - Roil \tag{2}$$

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

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

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, R*oil*- $Roil_{sb}$. 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:

$$\dot{d} = \left(f - Roil_{sb} - \sigma\right) + \left(r \text{ - } g\right)b + \left(r^* + \hat{e} - g\right)\left(b^* - nfa^*\right)e - \left(r^* + \hat{e} - g\right)oa^*e \quad \left(Roil - Roil_{sb}\right) + OF$$
(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:

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

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.

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

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.