Investing Volatile Oil Revenues in Capital-Scarce Economies: An Application to Angola

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Past expansionary monetary and fiscal policies left Angola vulnerable at the onset of the global financial crisis

2009 was a difficult year for Angola: International reserves down by 1/3, accumulation of sizeable arrears, sharp exchange rate depreciation

Today Angola’s macroeconomy is in a better position, however significant challenges remain

Pressing challenge is to put in place a fiscal framework to protect investment before the next crisis hits
Resource revenue management faces challenges from exhaustibility, price volatility, and uncertainty. Angola is exposed to greater volatility due to price, production, and institutional uncertainties. Angola (02-13): 33.1 percent of GDP (6.1 stdev). Other oil producers (02-12): 19.4 percent of GDP (5.2 stdev).
A small open, real DSGE model, adapted from Berg et al. (2013), suitable for resource-rich developing countries to analyze different fiscal approaches to managing resource revenue.

- Three production sectors: non-traded goods, (non-oil) traded goods, oil.
- Closed private capital account for simplicity.
- Traded good production features learning-by-doing externality to capture Dutch disease.
- Public investment features inefficiency, subject to absorptive capacity constraints.
- A resource fund is included to save additional resource revenue and act as a fiscal buffer.
Public investment is subject to inefficiency, and the depreciation rate of public capital can increase with insufficient investment to cover maintenance costs:

\[
K_t^G = (1 - \delta^G_t)K_{t-1}^G + \varepsilon_t \left( G_t^I \right) \times G_t^I \\
\equiv \tilde{G}_t^I, \text{ effective investment}
\]

\[
\varepsilon_t \left( G_t^I \right) = \begin{cases} 
\varepsilon, & \text{when } G_t^I < \tilde{G}_t^I \\
\frac{\varepsilon}{\tilde{\varepsilon}}, & \text{when } G_t^I \geq \tilde{G}_t^I
\end{cases}
\]

\[
\delta^G_t = \begin{cases} 
\delta^G \times \frac{\delta^G K_G^G_{t-1}}{\tilde{G}_t^I}, & \text{when } \tilde{G}_t^I < \delta^G K_G^G_{t-1} \\
\delta^G, & \text{when } \tilde{G}_t^I \geq \delta^G K_G^G_{t-1}
\end{cases}
\]
Public capital increases productivity of private production factors:

\[ y_t^N = z^N (k_{t-1}^N)^{1-\alpha^N} (l_t^N)^{\alpha^N} (K_{t-1}^G)^{\alpha^G} \]

\[ y_t^T = z_t^T (k_{t-1}^T)^{1-\alpha^T} (l_t^T)^{\alpha^T} (K_{t-1}^G)^{\alpha_G} \]

\[ \ln z_t^T = \rho z_T \ln z_{t-1}^T + d \ln y_{t-1}^T \]
Two fiscal approaches are considered

- **Spend-as-you-go**: All oil windfall each period is spent on public investment and government consumption.

\[
p_t^g G_t^I - p^g G^I = \gamma (T_t^O - T^O)
\]
\[
p_t^g G_t^C - p^g G^C = (1 - \gamma) (T_t^O - T^O)
\]

- **Gradual scaling-up**: It gradually increases public investment, with excess revenues saved to be drawn on when there is a revenue shortfall.

\[
F_t^* = F_{t-1}^* + ES_t^*
\]
\[
ES_t = T_t^O + T_t^{NO} + s_t r^* F_{t-1}^* - p_t^g G_t - Z_t - (R_t - 1) B
\]
Model: the Oil Sector

- Oil price \( (p_t^O) \): exogenously determined, following a unit-root process.
- Oil production \( (y_t^O) \): production shocks are backed out to target projected quantities.
- Oil royalty tax rates capture the price-dependent schedule as practiced in Angola.

\[
\begin{align*}
\tau_t^O &= 0.56, \text{ if } p_t^O < 75; \\
\tau_t^O &= 0.58, \text{ if } 75 \leq p_t^O < 100; \\
\tau_t^O &= 0.60, \text{ if } 100 \leq p_t^O < 125; \\
\tau_t^O &= 0.65, \text{ if } p_t^O \geq 125.
\end{align*}
\]

- Oil revenue is \( T_t^O = \tau_t^O s_t p_t^O y_t^O \)
Simulation Exercises

Exercise I: Study two fiscal approaches (spend-as-you vs. gradual scaling-up) under two resource revenue scenarios.

- **Baseline**: Take WEO assumptions until 2017, subject to small oil price shocks afterwards
- **Alternative**: Subject oil prices to large negative shocks from 2015 to 2017.

Exercise II: Use the framework to inform allocation decisions between capital spending and external saving, accounting for historical oil price volatility.
Baseline scenario: Less volatile oil prices

**Angola: Oil Production and Prices, 2012-2030**

**Angola: Oil revenue excl. interest from saving, 2012-2030**

(Percent of GDP)

Sources: IMF staff estimates (based on WEO Spring 2012).

Source: IMF staff estimates.
Baseline scenario: The economy accumulates external savings with gradual scaling-up

**Baseline: Stabilization fund, 2012-2030**
(Percent of GDP)

- **Spend-as-you-go**
- **Gradual scaling-up**

Source: IMF staff estimates.

**Baseline: Public investment, 2012-2030**
(Percent of GDP)

- **Spend-as-you-go**
- **Gradual scaling-up**

Source: IMF staff estimates.
Baseline scenario: Higher initial investment with spend-as-you-go leads to more capital initially.

Angola: Public Capital, 2012-2030
(level)

Spend-as-you-go
Gradual scaling-up

Source: IMF staff estimates.

Angola: Public Capital, 2012-2030
(percent deviation from steady state)

Spend-as-you-go
Gradual scaling-up

Source: IMF staff estimates.
Baseline scenario: Under a non-volatile resource price path, non-oil GDP may perform better in the short run with spend-as-you-go.

Non-oil GDP, 2012-2030
(percent deviation from steady state)

Non-oil private investment, 2012-2030
(percent deviation from steady state)

Source: IMF staff estimates.
Alternative scenario: Oil price shock of same magnitude as 2008-10 global crisis

Angola: Oil Production and Prices, 2012-2013

Source: IMF staff estimates.

Angola: Oil revenue excl. interest from saving, 2012-2030 (percent deviation from steady state)

Source: IMF staff estimates.
Alternative scenario: With gradual-scaling up, public investment can be higher and somewhat smoother (particularly at the outset).

Alternative: Stabilization fund, 2012 - 2030 (Percent of GDP)

Spend-as-you-go  Gradual scaling-up

Source: IMF staff estimates.

Alternative: Public investment, 2012 - 2030 (Percent of GDP)

Spend-as-you-go  Gradual scaling-up

Source: IMF staff estimates.
Alternative scenario: Volatile investment path with spend-as-you-go drives up depreciation rate and lower public capital

Angola: Public Capital, 2012-2030
(level)

Angola: Public Capital, 2012-2030
(percent deviation from steady state)

Source: IMF staff estimates.
Alternative scenario: The effects of the shock on non-oil GDP and the REER are mitigated under a gradual-scaling up approach.

**Non-oil GDP, 2012-2030**
(percent deviation from steady state)

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**Non-oil private investment, 2012-2030**
(percent deviation from steady state)

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Source: IMF staff estimates.
Earlier simulations show that between the two investing approaches, gradual scaling-up can better manage oil revenue volatility and are likely to deliver better growth outcomes in medium and long runs.

When following gradual scaling-up, one question is how to determine the scaling-up magnitude and a sustainable investment spending level.

More aggressive scaling-up may yield more economic growth, but an economy without a fiscal buffer is prone to fluctuating spending paths driven by volatile oil revenues.
Simulations Accounting for Uncertain Oil Prices
Simulations Accounting for Uncertain Oil Prices
Under a spend-as-you-go approach, Angola is vulnerable to a sudden decline in oil revenue

- If a 2008/09 size price shock were to hit within the next 3-5 years, current low levels of fiscal buffers would be quickly depleted
- Capital spending disrupted for at least 5 years after onset of shock

Gradual scaling-up calls for better prioritization of investment, but allows time to build capacity

- Under this scenario Angola would be able to withstand a 2008/09 size price shock
- Investment would be smoother and higher if resources set aside used

Urgency to move towards a medium-term planning horizon for fiscal policy

- Allow time to build fiscal buffers and acquire additional capacity, to withstand revenue volatility
What is Angola doing now to protect itself from volatility of oil revenues? Institutions in flux.

How does the path for scaling up investment (to 12 percent of GDP by 2017) fit with Angola’s public investment program and priorities?

Is the concept of a stabilization fund compatible with Angola’s objectives or are alternative fiscal mechanisms preferable? Is a SWF the way to go?