

International Monetary Fund

Joint SPR-RES Conference



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

January 30, 2014

Christine Richmond (University of Illinois),  
Irene Yackovlev (IMF) and Susan Yang (IMF)



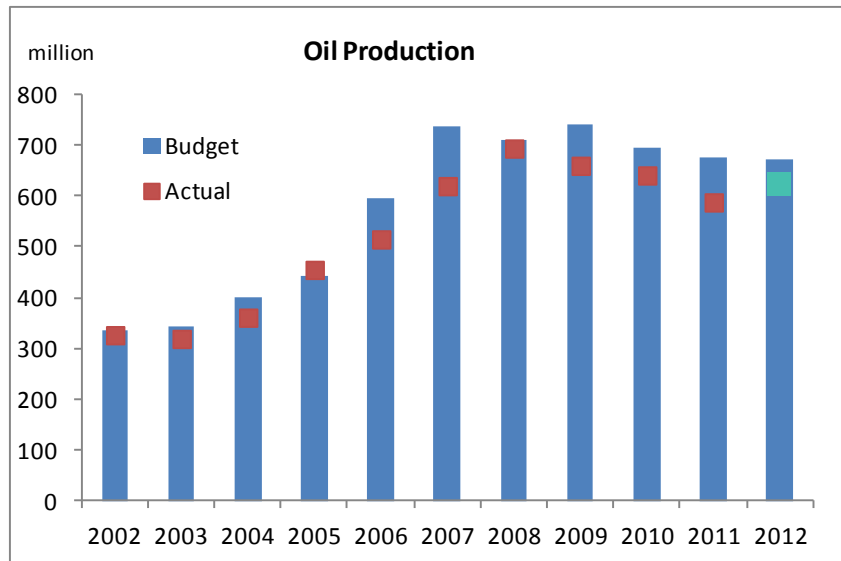
# Introduction

- ❑ 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**

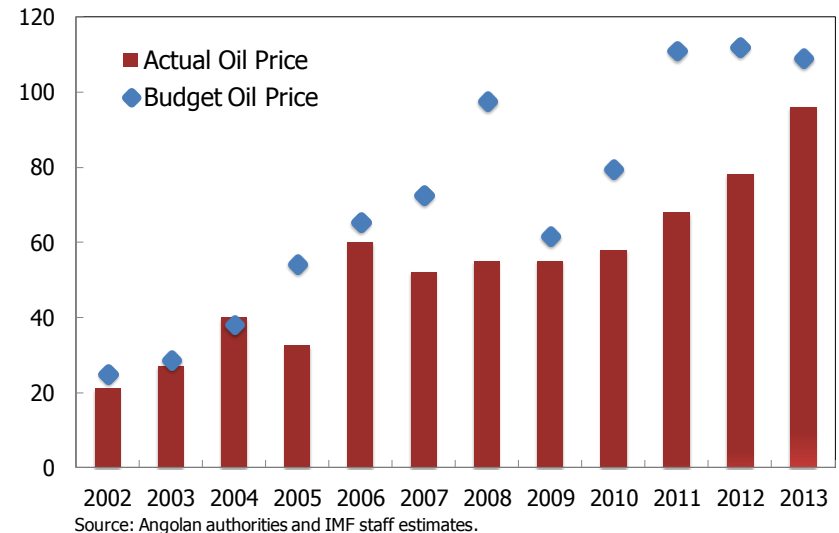


# Challenges to managing resource revenue

- ❑ 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)



**Angola: Oil Prices, 2002-2013**  
(U.S. dollars per barrel)





# Model

**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.



# Model: Public Investment process

**Public investment is subject to inefficiency, and the depreciation rate of public capital can increase with insufficient investment to cover maintenance costs:**

$$K_t^G = (1 - \delta_t^G)K_{t-1}^G + \underbrace{\epsilon_t(G_t^I) \times G_t^I}_{\equiv \tilde{G}_t^I, \text{ effective investment}}$$

$$\epsilon_t(G_t^I) = \begin{cases} \epsilon, & \text{when } G_t^I < \bar{G}^I \\ \bar{\epsilon}, & \text{when } G_t^I \geq \bar{G}^I \end{cases}$$

$$\delta_t^G = \begin{cases} \delta^G \times \frac{\delta^G K_{t-1}^G}{\tilde{G}_t^I}, & \text{when } \tilde{G}_t^I < \delta^G K_{t-1}^G \\ \delta^G, & \text{when } \tilde{G}_t^I \geq \delta^G K_{t-1}^G \end{cases}$$



# Model: Public Investment-Growth Linkage

**Public capital increases productivity of private production factors:**

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

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

$$\ln z_t^T = \rho_{zT} \ln z_{t-1}^T + d \ln y_{t-1}^T$$



# Model: Fiscal Policy Specification

## 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.**
  - $\tau_t^O = 0.56$ , if  $p_t^{O*} < \$75$ ;
  - $\tau_t^O = 0.58$ , if  $\$75 \leq p_t^{O*} < \$100$ ;
  - $\tau_t^O = 0.60$ , if  $\$100 \leq p_t^{O*} < \$125$ ;
  - $\tau_t^O = 0.65$ , if  $p_t^{O*} \geq \$125$ .
- ❑ **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.**

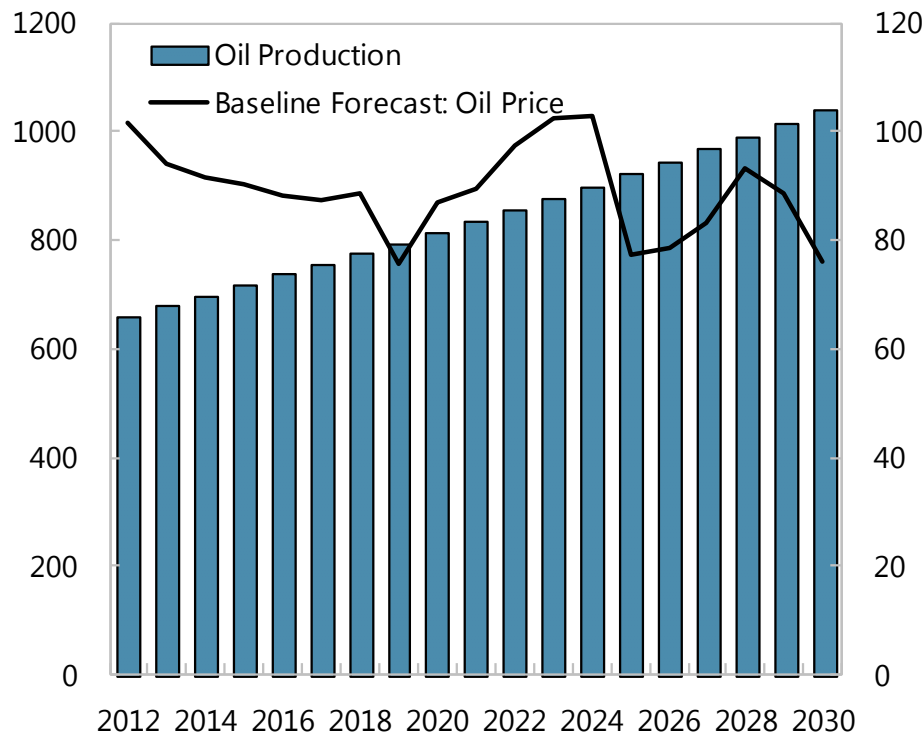
- ✓ Baseline: Take WEO assumptions until 2017, subject to small oil price shocks afterwards
- ✓ Alternative : Subject oil prices to large negative shocks from 2015 to 2017.

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



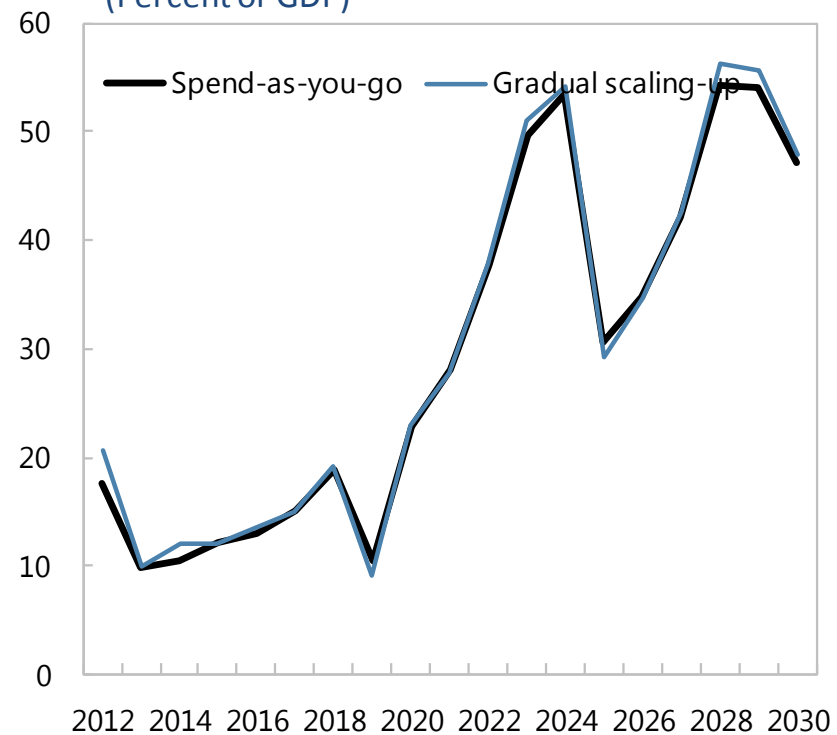
# Baseline scenario: Less volatile oil prices

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



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

**Angola: Oil revenue excl. interest from saving, 2012-2030 (Percent of GDP)**

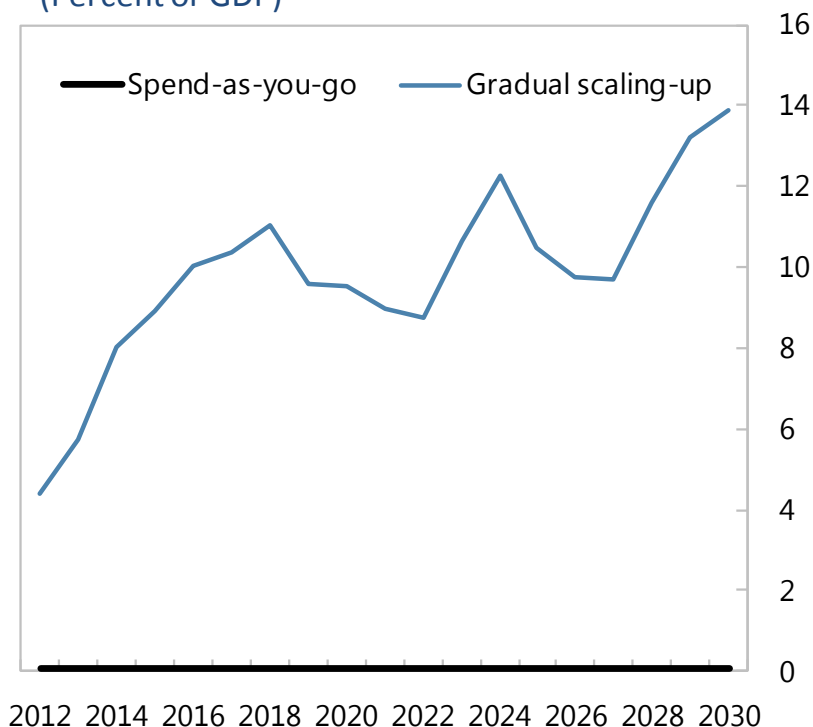


Source: IMF staff estimates.



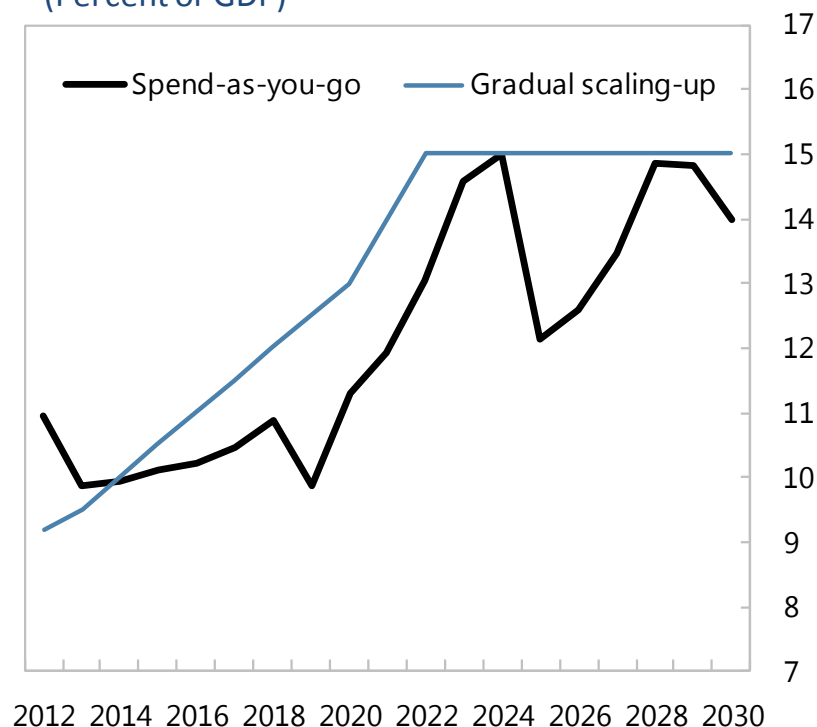
# Baseline scenario: The economy accumulates external savings with gradual scaling-up

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



Source: IMF staff estimates.

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



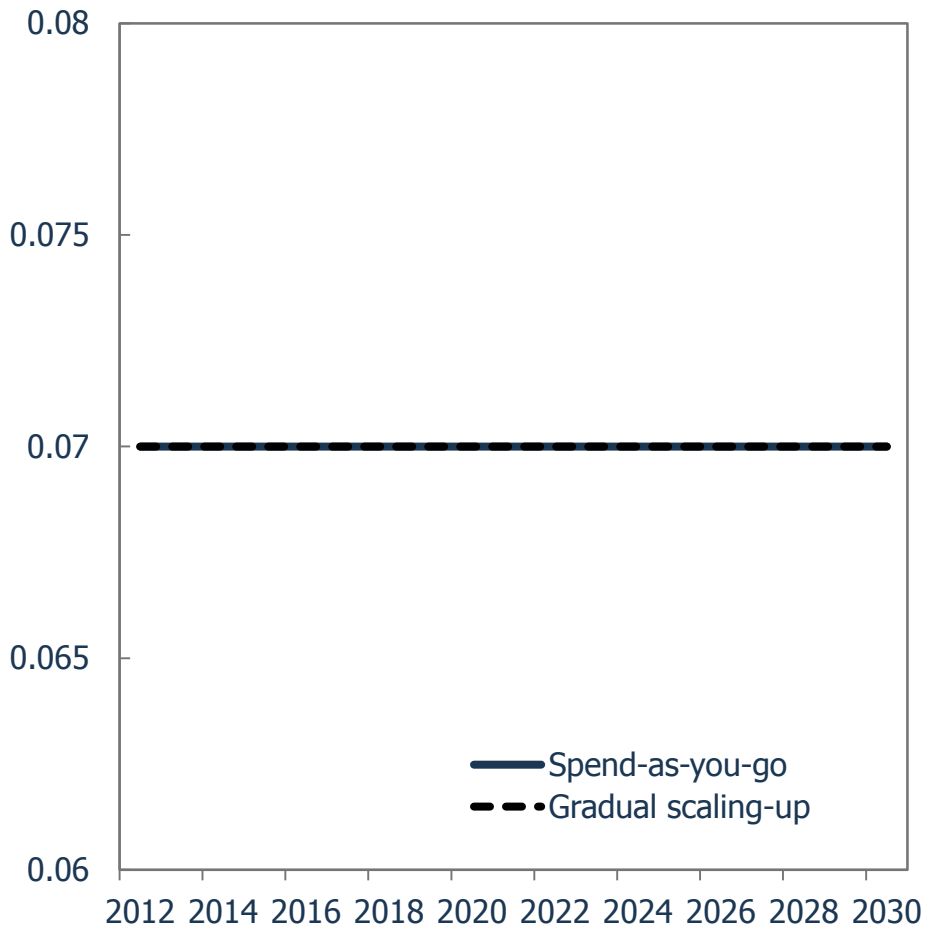
Source: IMF staff estimates.



# Baseline scenario: Higher initial investment with spend-as-you-go leads to more capital initially

### Angola: Public Capital, 2012-2030

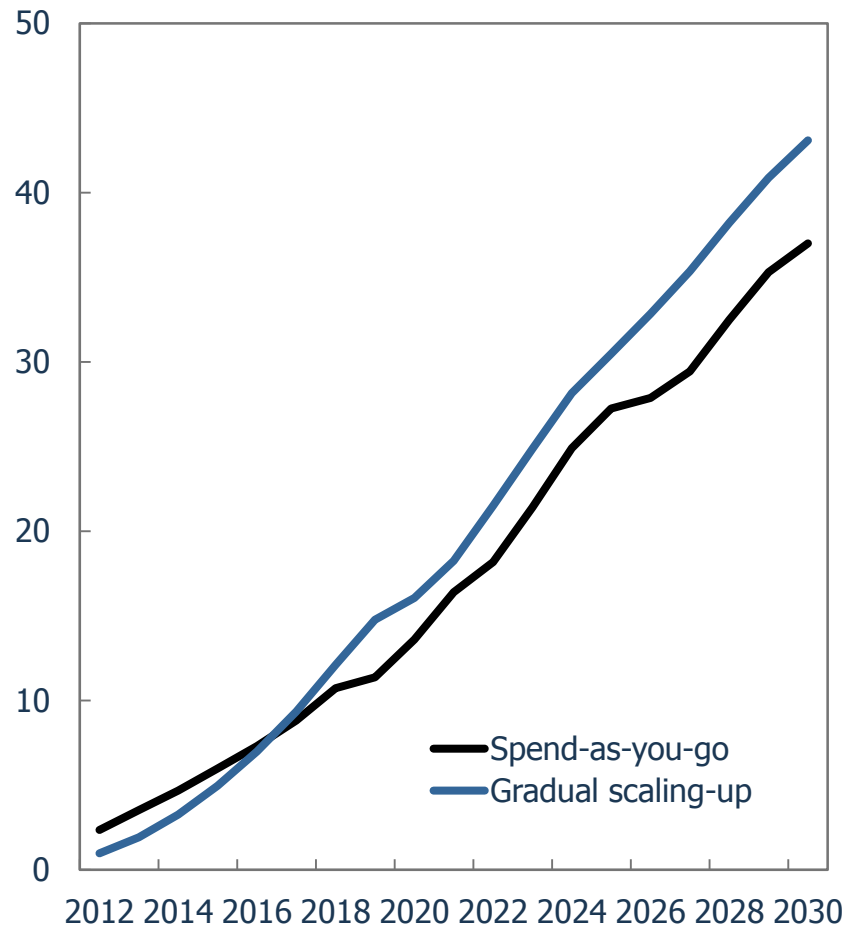
(level)



Source: IMF staff estimates.

### Angola: Public Capital, 2012-2030

(percent deviation from steady state)



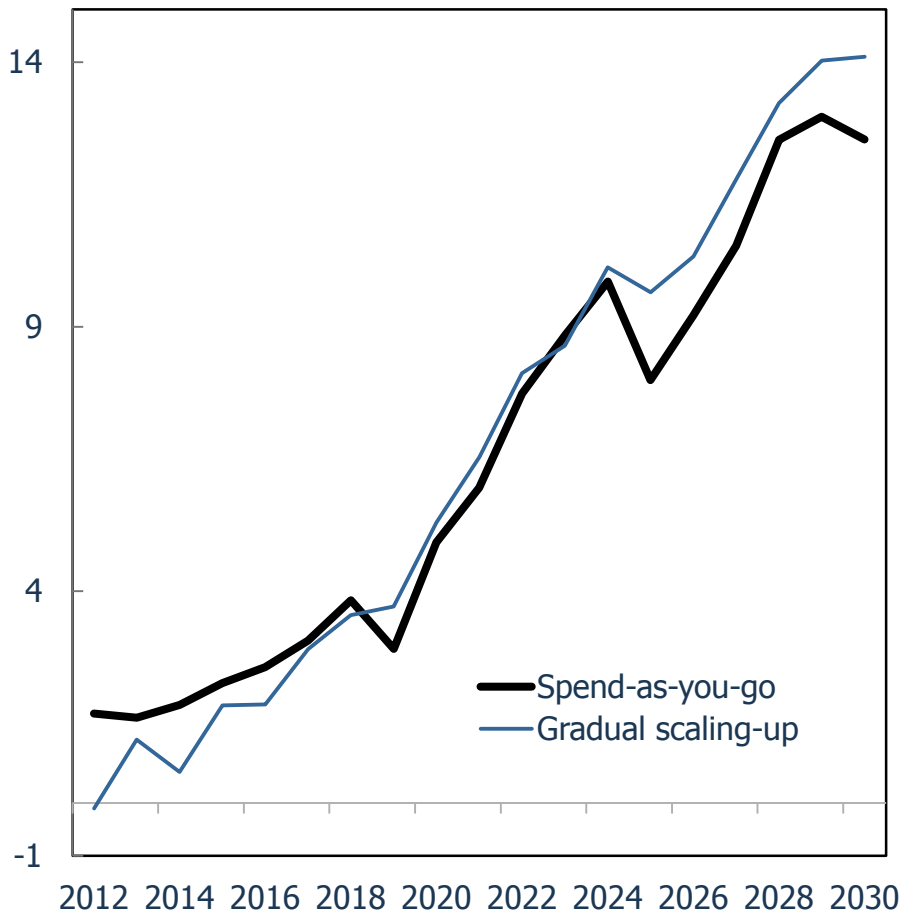
Source: IMF staff estimates.



# 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

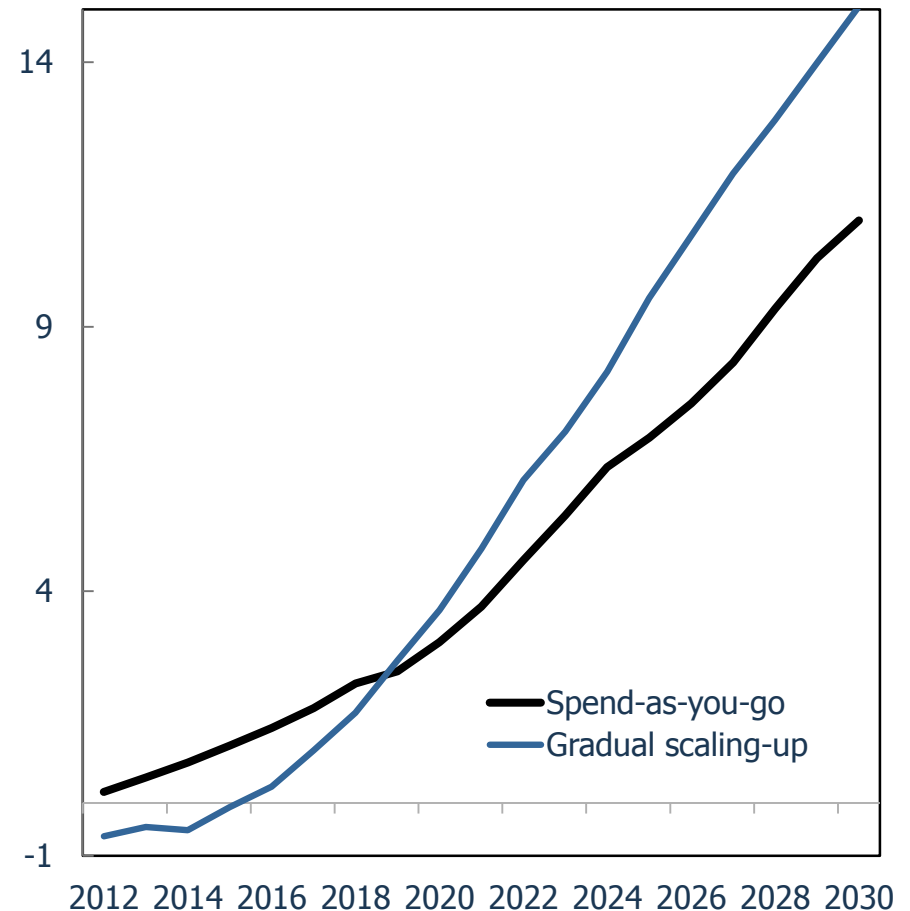
(percent deviation from steady state)



Source: IMF staff estimates.

## Non-oil private investment, 2012-2030

(percent deviation from steady state)

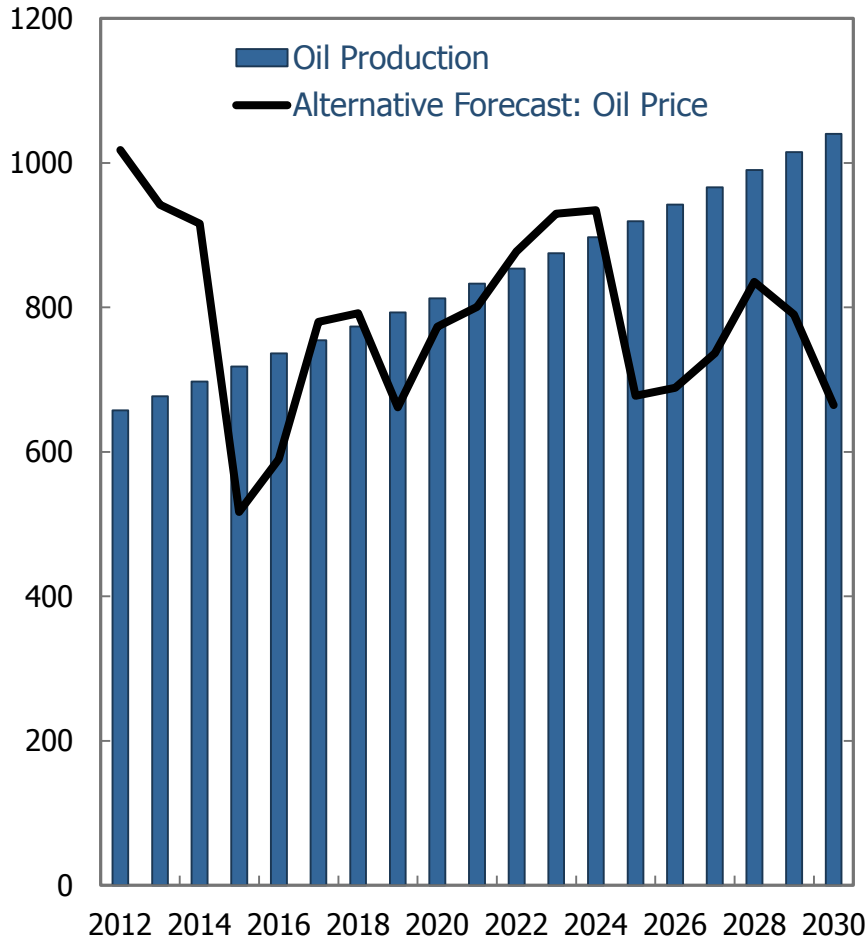


Source: IMF staff estimates.



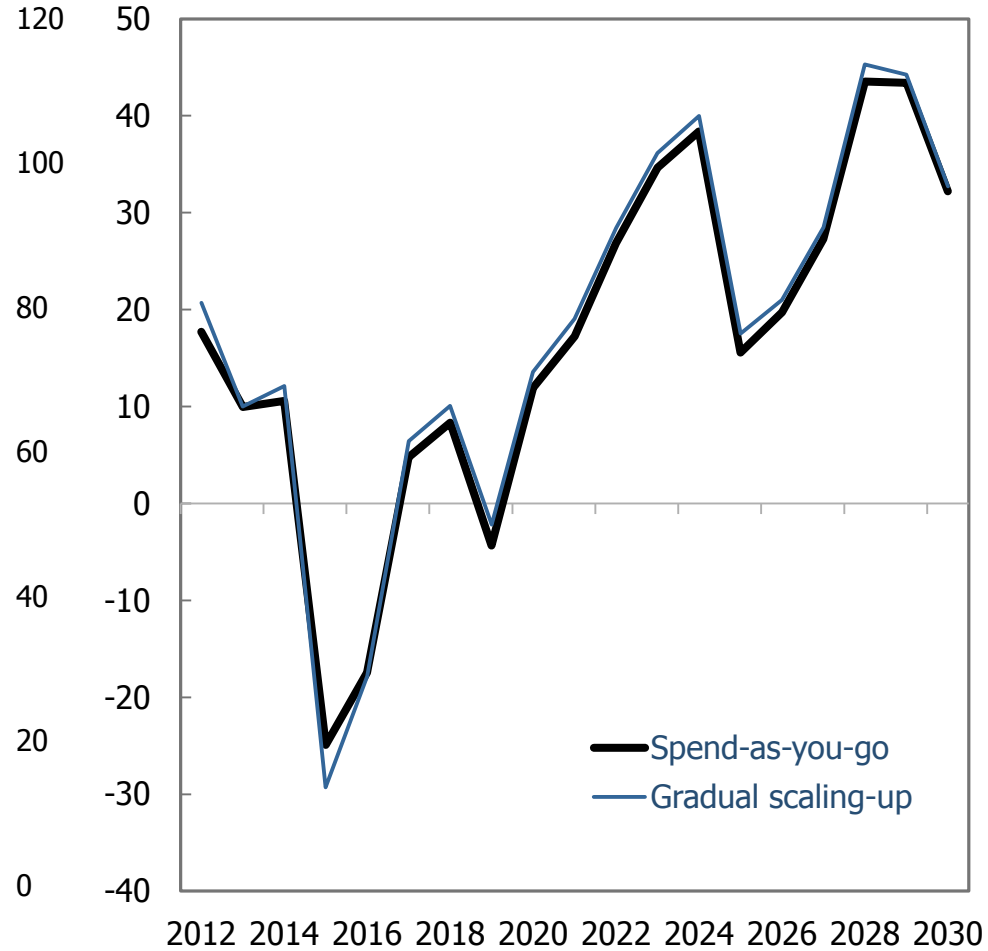
# Alternative scenario: Oil price shock of same magnitude as 2008-10 global crisis

**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)

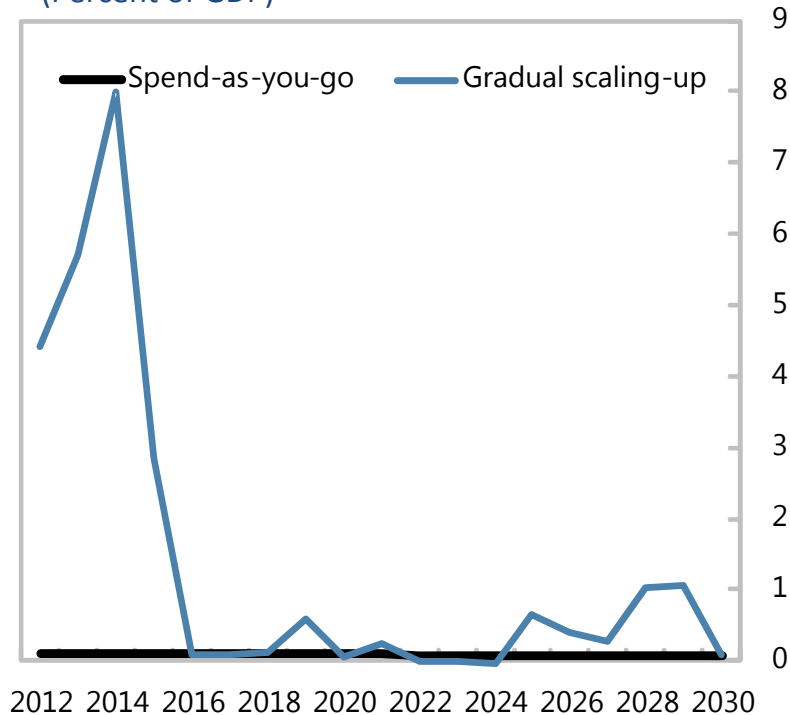


Source: IMF staff estimates.



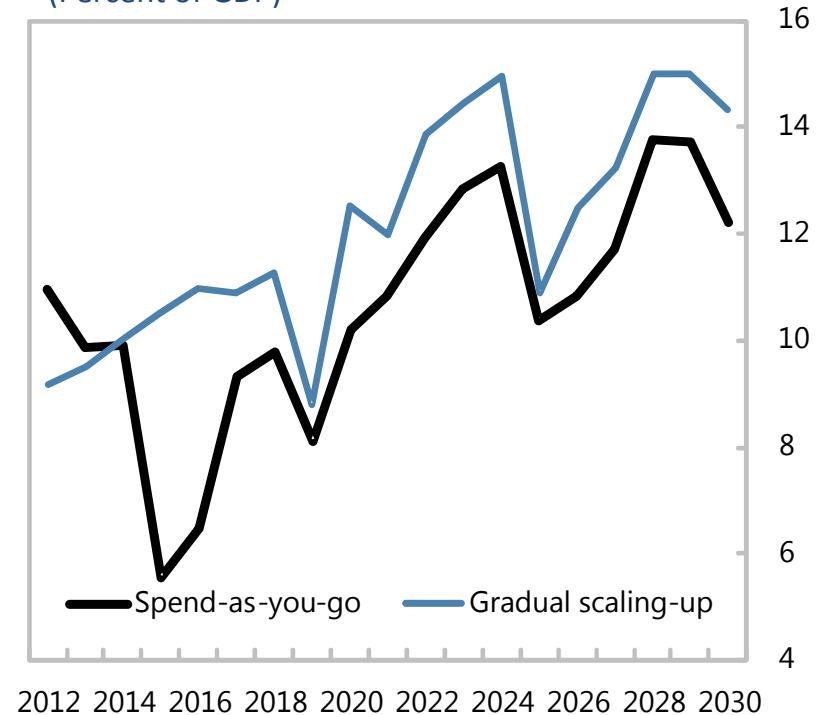
# Alternative scenario: With gradual-scaling up, public investment can be higher and somewhat smoother (particularly at the outset)

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



Source: IMF staff estimates.

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

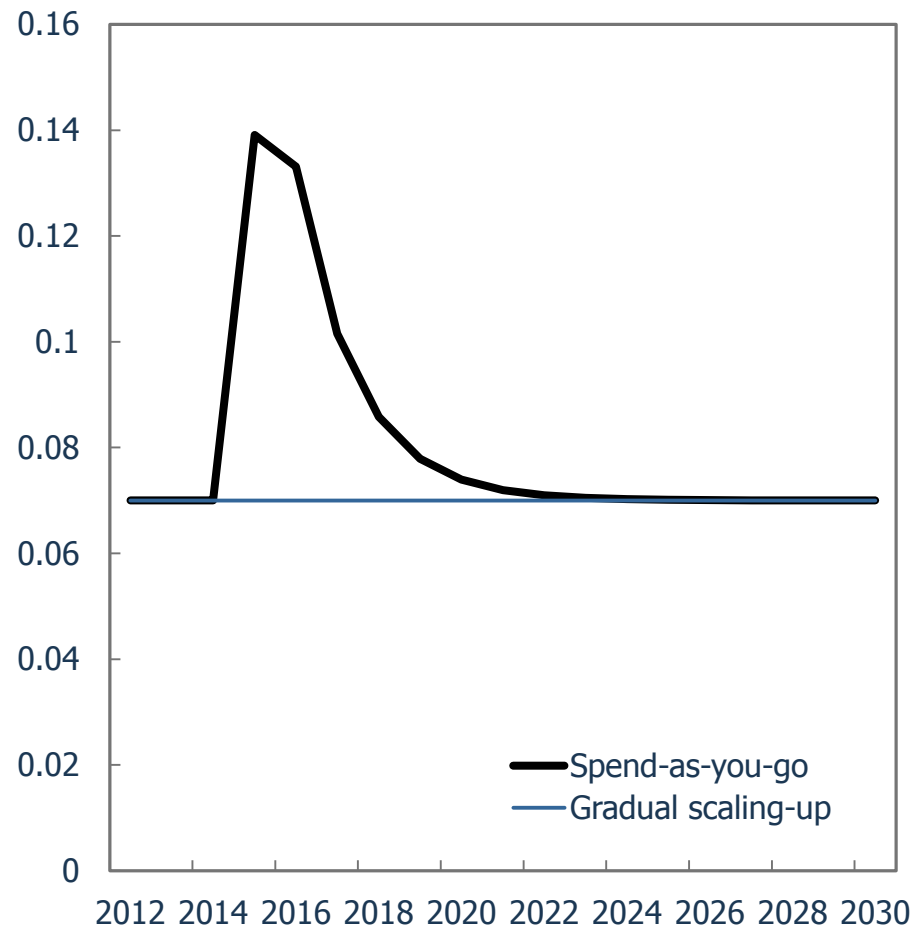


Source: IMF staff estimates.



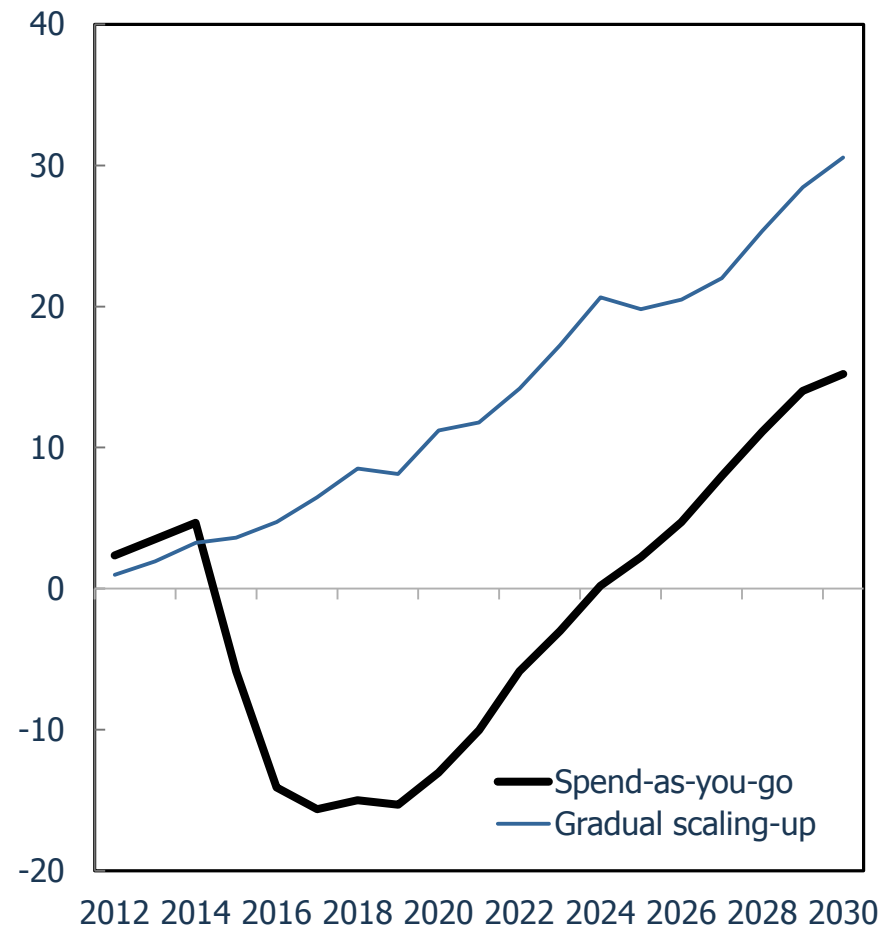
# Alternative scenario: Volatile investment path with spend-as-you-go drives up depreciation rate and lower public capital

**Angola: Public Capital, 2012-2030**  
(level)



Source: IMF staff estimates.

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



Source: IMF staff estimates.

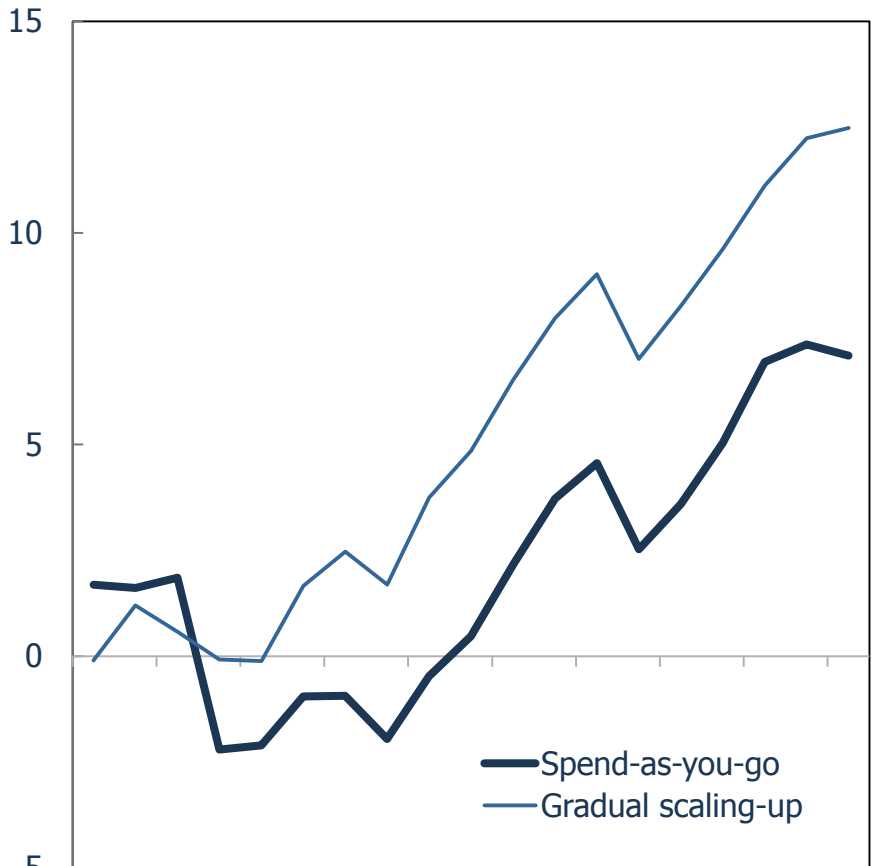




# Alternative scenario: The effects of the shock on non-oil GDP and the REER are mitigated under a gradual-scaling up approach

## Non-oil GDP, 2012-2030

(percent deviation from steady state)

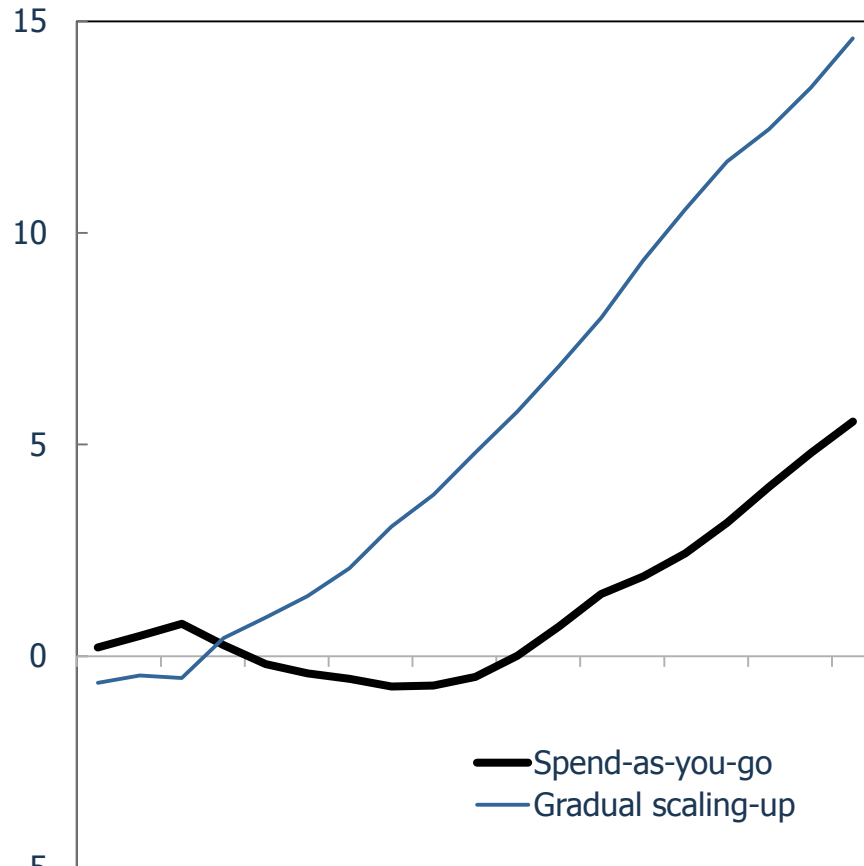


2012 2014 2016 2018 2020 2022 2024 2026 2028 2030

Source: IMF staff estimates.

## Non-oil private investment, 2012-2030

(percent deviation from steady state)



2012 2014 2016 2018 2020 2022 2024 2026 2028 2030

Source: IMF staff estimates.

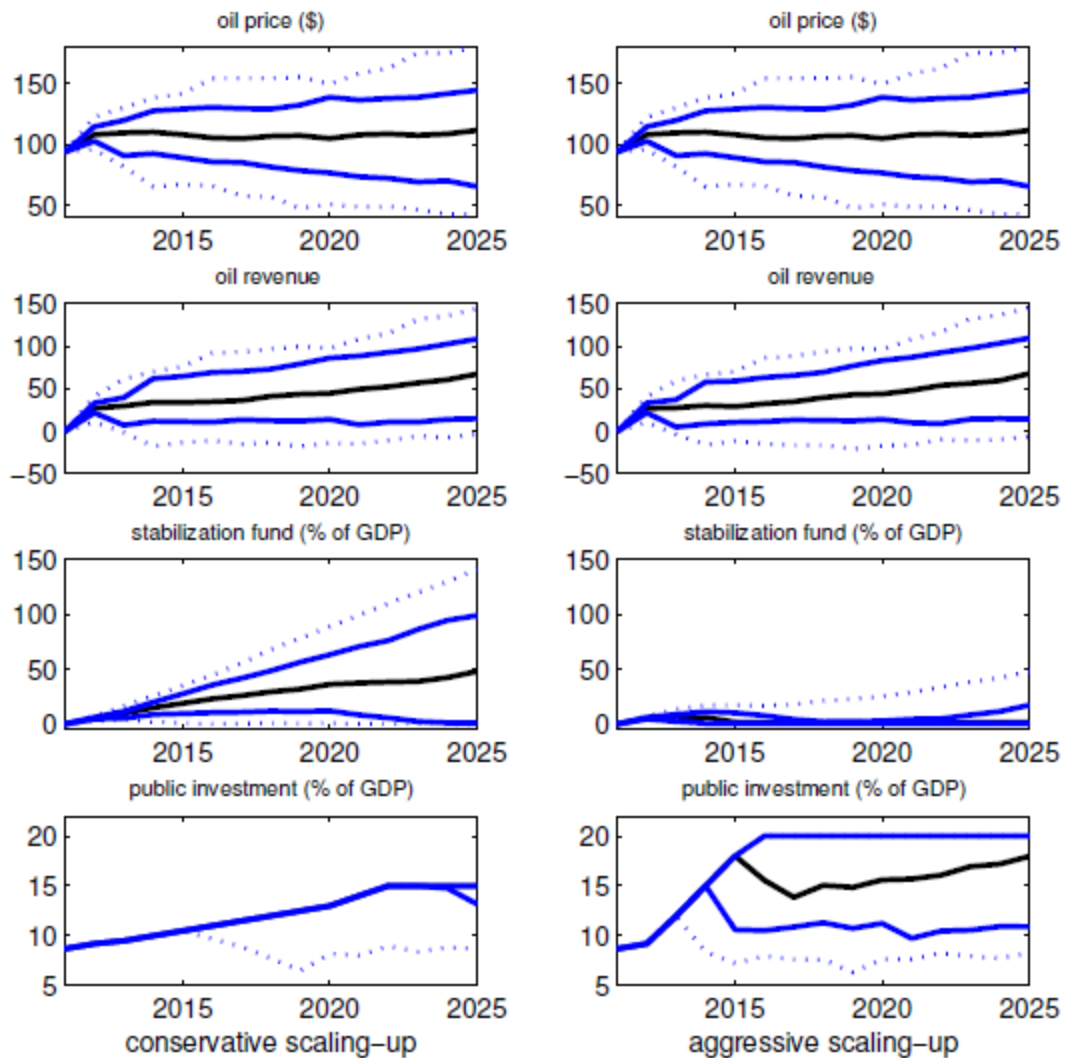


# Determining a Sustainable Investing Path

- ❑ 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.**

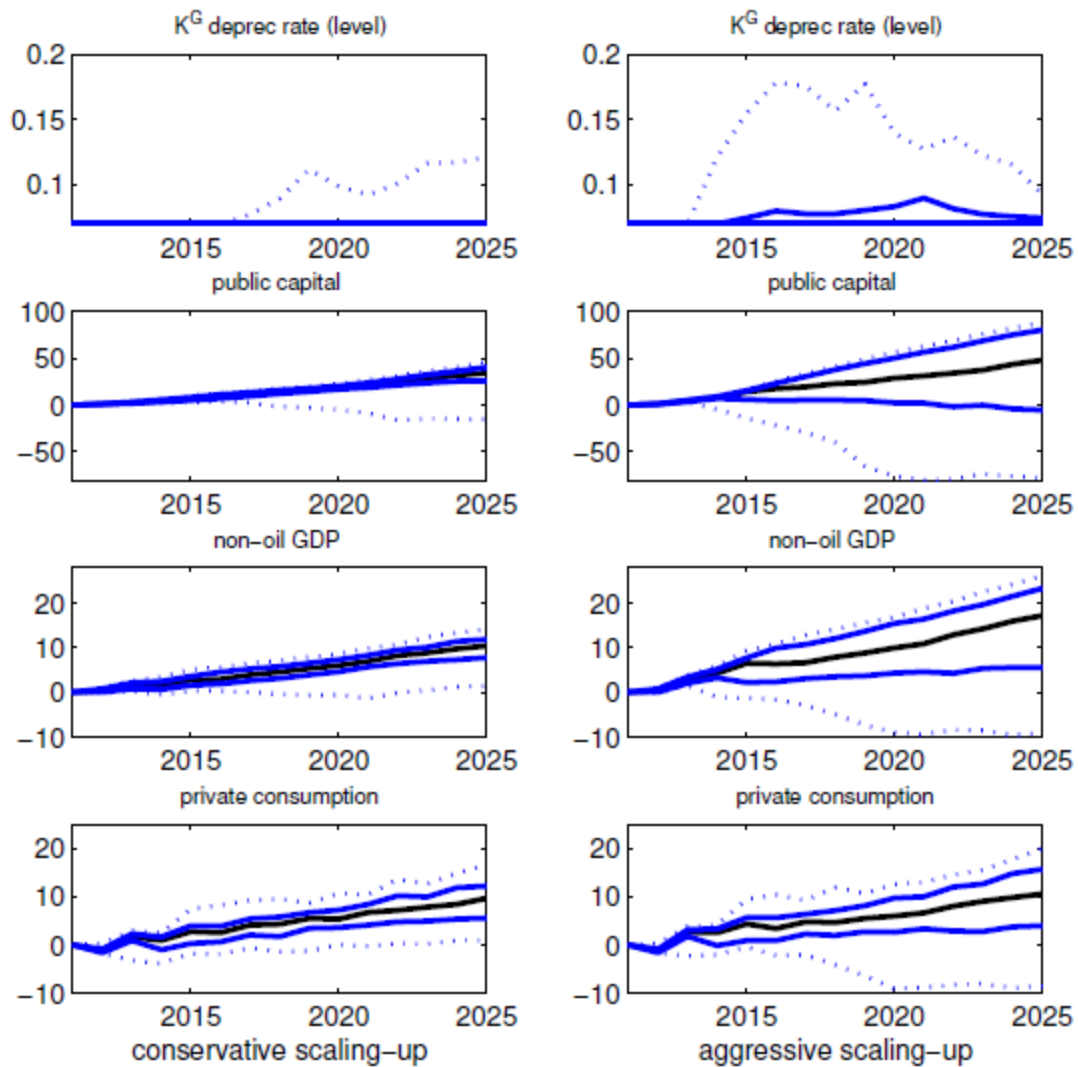


# Simulations Accounting for Uncertain Oil Prices





# Simulations Accounting for Uncertain Oil Prices





# Takeaway messages

## **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



## Issues still under consideration

**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?**